Phase I General Design Memorandum with Environmental Impact Statement

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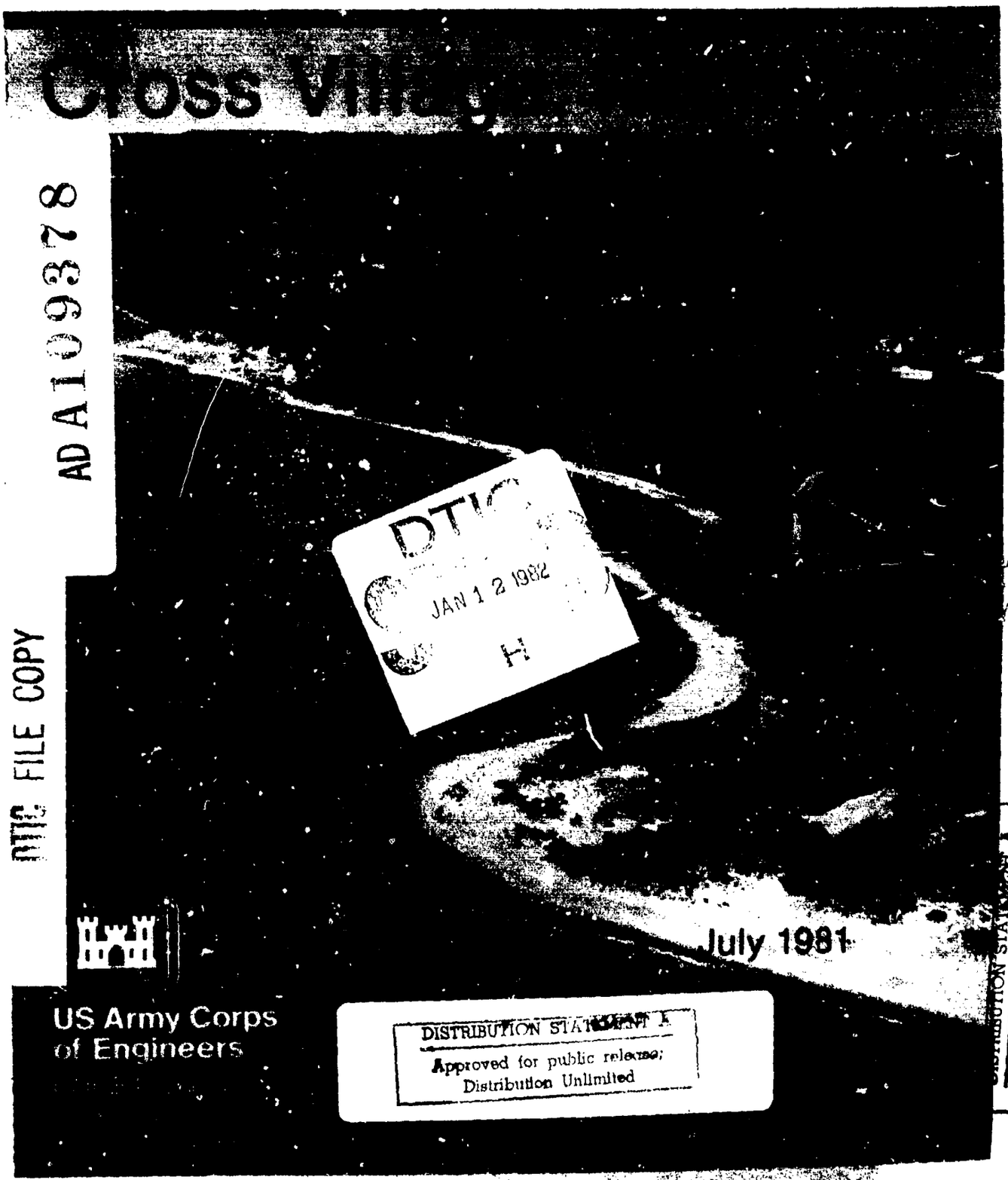
A Harbor for Light-Draft Vessels at

Cross Village



July 1981

US Army Corps of Engineers

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Rubblemound Breakwaters
Underwater Stone Reefs
Swimming Beach
Threatened Plant Species
Dredged Material Disposal
Benthic Organisms
Harbor of Refuge
River and Harbor Act

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A harbor for light-draft vessels is recommended for construction at Cross Village, Michigan, to facilitate the areas' recreational boating demand, provide docking for commercial fishing and transportation interests, and serve as a mainland harbor of refuge. Authorization for construction was granted on 7 November 1966, in the River and Harbor Act of 1966 (Public Law 89-789), in accordance with the plan presented in House Document

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

20. ABSTRACT (Continued)

490, 49th Congress, 2nd Session. The project would consist of (1) construction of two rubblemound breakwaters; (2) dredging of an entrance channel, inner access channel, and anchorage area; (3) removal of the deteriorated ~~Public Work Progress Administration's~~ 1939 breakwater; (4) construction of an underwater fish habitat; (5) swimming beach extension; and (6) shoreline dredged material disposal.

Construction operations would result in some minor degradation in noise, air, water, and aesthetic quality in the vicinity of the harbor. Representatives of three State of Michigan threatened plant species would be destroyed and some of their dune habitat eliminated. Additional habitat in the form of rock faced rubble-mound breakwaters and stone fish reefs would offer additional substrates for fish, algae, and benthic invertebrate production in the area.

A Harbor for Light-Draft Vessels
at Cross Village, Michigan

ERRATA SHEET

1. Page No. EIS-49 -- 5.06 Coordination will continue through circulation of the Final Environmental Impact Statement. The Preliminary 404 Evaluation has been coordinated with the appropriate agencies, organizations and public through distribution of the evaluation with the Draft Environmental Impact Statement. Comments relative to the 404 Evaluation were accepted during the 45 day DEIS review period and during a formal public meeting held at the Holy Cross Community Hall, Cross Village, Michigan, on 16 June 1981. The Corps will complete the 404 Evaluation Coordination procedure by obtaining a 401(a) Water Quality Certification from the State of Michigan.

2. Page III-12 -- 7. Conclusions and Determinations.

a. An ecological evaluation has been made following the guidance of 40 CFR 230.4 in conjunction with the evaluations and considerations in 40 CFR 230.5.

b. Appropriate measures have been identified and incorporated into the proposed plan to minimize adverse effects on the aquatic environment as a result of the discharge.

c. Consideration has been given to the need for the proposed activity, the availability of alternate sites and methods of disposal that are less damaging to the environment, and such water quality standards as are appropriate and applicable by law.

d. No wetlands would be adversely affected by the excavation or placement of any fill material.

8. Finding - The sites for the proposed rubblemound breakwaters, underwater reefs and dredged material disposal areas have been specified through the application of the Section 404(b)(1) guidelines of the Clean Water Act.

SYLLABUS

Cross Village is located in the northwestern part of Michigan's lower peninsula in Emmet County. It is situated on the south shore of Sturgeon Bay near the northeastern end of Lake Michigan.

A breakwater was constructed at Cross Village in 1939 by the Works Progress Administration as a harbor of refuge for local commercial fishing vessels. It has deteriorated to such an extent, that it is no longer useful for its intended purpose.

In recent years, recreational boating has greatly increased on the Great Lakes. The portion of Lake Michigan between Mackinaw City and Harbor Springs, a distance of 61 miles, is the last major stretch of Michigan's lower peninsula shoreline which does not have a readily accessible harbor. Development of a harbor at Cross Village would provide docking and mooring facilities to meet the existing demand for recreational boating activities in this region. In addition, this harbor would serve as a mainland port of refuge and serve as a base for commercial fishermen and the Beaver Island ferry which presently operate from the City of Charlevoix.

This report analyzes the needs for a light-draft vessel harbor in the Cross Village area, investigates alternative project locations, examines the economics and the environmental ramifications of various harbor plans, and recommends a project design for construction.

The principal features of the recommended plan are as follows: 2,590 lineal feet of rubblemound breakwaters, a flared entrance channel 140 feet wide at the breakwaters and 12 feet deep, and a maneuvering area and a two acre anchorage area both 10 feet deep. Breakwater crest surfacing and a safety rail for recreational fishermen are also included in the recommended project. A maximum wave height of 1.5 feet inside the harbor would be allowed under the recommended plan.

The estimated first cost of the recommended project is $5,395,500. This cost results in total annual charges in the amount of $262,905. The average annual benefits are computed to be $312,259, producing a benefit to cost ratio of 1.19, which indicates economic feasibility.

The District Engineer recommends that the construction of the above project be implemented subject to conformance to the Items of Local Cooperation by the sponsor. The estimated construction cost to the U.S. Government is $3,307,850 with annual maintenance costs estimated at $34,405.

PHASE I GENERAL DESIGN MEMORANDUM
STUDY FOR A HARBOR FOR LIGHT-DRAFT VESSELS AT
CROSS VILLAGE, MICHICAN

MAIN REPORT

WITH

ENVIRONMENTAL IMPACT STATEMENT

JULY 1981

DEPARTMENT OF THE ARMY

DETROIT DISTRICT, CORPS OF ENGINEERS

PHASE I GENERAL DESIGN MEMORANDUM
STUDY FOR A HARBOR FOR LIGHT-DRAFT VESSELS AT
CROSS VILLAGE, MICHIGAN

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FOLLOWS MAIN REPORT

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31 July 1981

PHASE I GENERAL DESIGN MEMORANDUM
STUDY FOR A HARBOR FOR LIGHT-DRAFT VESSELS AT
CROSS VILLAGE, MICHIGAN

Recreational harbors, for shallow draft vessels along the shoreline of the Great Lakes, fulfill several functions. Most obviously these harbors provide a base from which people can use the recreational resources of the Great Lakes. This utilization can serve to stimulate an area's economic growth as people use that area's recreational resources and purchase necessary related supplies. Also, recreational harbors provide refuge for small craft on the lakes during adverse weather conditions, potentially saving boats and lives. Harbors can be used as a base of operations for a variety of commercial activities, including charter fishing, commercial fishing, and passenger and car ferries which ply the waters between the mainland and the many inhabited islands of the Great Lakes. Such a harbor project was authorized in 1966 to be constructed at Cross Village, Michigan. This Phase I General Design Memorandum presents the results of the first step of pre-construction planning of the project.

AUTHORIZATION

A survey study was authorized by resolutions adopted by the Committee on Public Works, United States Senate, on 20 July 1959 and by the Committee on Public Works, House of Representatives, United States, on 14 August 1959. The Senate Committee resolution follows:

"Resolved by the Committee on Public Works of the United States, That the Board of Engineers for Rivers and Harbors, created under

Section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby requested to review the report of the Great Lakes-Harbors of Refuge for Light-Draft Vessels, published as House Document Numbered 446, Seventy-Eighth Congress, second session, with a view to determining whether any modification of the recommendations contained therein is advisable at the present time, with particular reference to provisions of a harbor of refuge in the Cross Village-Good Hart area, Michigan."

The House Committee resolution follows:

"Resolved by the Committee on Public Works of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the report, Coasts of Great Lakes, Harbors of Refuge for Light-Draft Vessels, published as House Document No. 446, 78th Congress, 2d Session, and other pertinent reports, with a view to determining the advisability of providing a harbor for light-draft vessels, on the shore of Lake Michigan, at or in the vicinity of Cross Village-Good Hart area, Emmet County, Michigan."

A survey report, prepared in response to these Congressional resolutions, recommended "that Cross Village Harbor, Michigan, be improved for light-draft craft by the construction of general navigation facilities consisting of two offshore breakwaters opening to the northeast, having an aggregate length of about 2,300 feet, an anchorage and maneuver area of about eight acres and ten feet deep, a flared entrance channel 12 feet deep decreasing in width to 100 feet through the breakwaters, and bituminous surfacing on the main breakwater to provide access for recreational fishermen; generally in accordance with the plan of the District Engineer and with such modifications as in the discretion of the Chief of Engineers may be advisable." The report was approved by the Secretary of the Army on 31 August 1966 and forwarded to the Congress for its consideration as House Document No. 490 dated 8 September 1966.

In Section 101 of the River and Harbor Act of 7 November 1966 (Public Law 89-789), the Congress authorized the construction of a harbor for light-draft vessels at Cross Village, Michigan, in accordance with the plan presented in House Document No. 490, 89th Congress, 2nd Session. This Phase I General Design Memorandum is prepared as part of the pre-construction planning under the authority of the 1966 River and Harbor Act.

HIGHLIGHTS OF THE AUTHORIZED PROJECT

A brief summary of the pertinent data relating to the authorized project is presented in the following paragraphs.

PROJECT DESCRIPTION

The authorized project (see Figure 1) provides for the establishment of Cross Village Harbor, Michigan, as a harbor of refuge for light-draft commercial and recreational craft and consists of the following improvements:

a. Breakwaters having a total length of about 2,300 feet, located in Lake Michigan, and opening to the northeast.

b. An entrance channel between the breakwaters 100 feet wide and 12 feet deep; and an anchorage and maneuver area within the breakwaters, about eight acres in extent and ten feet deep.

c. Bituminous breakwater surfacing to provide access for recreational fishing from the main breakwater.

d. The north section (500') of the existing breakwater is to be removed and the materials disposed of as necessary.

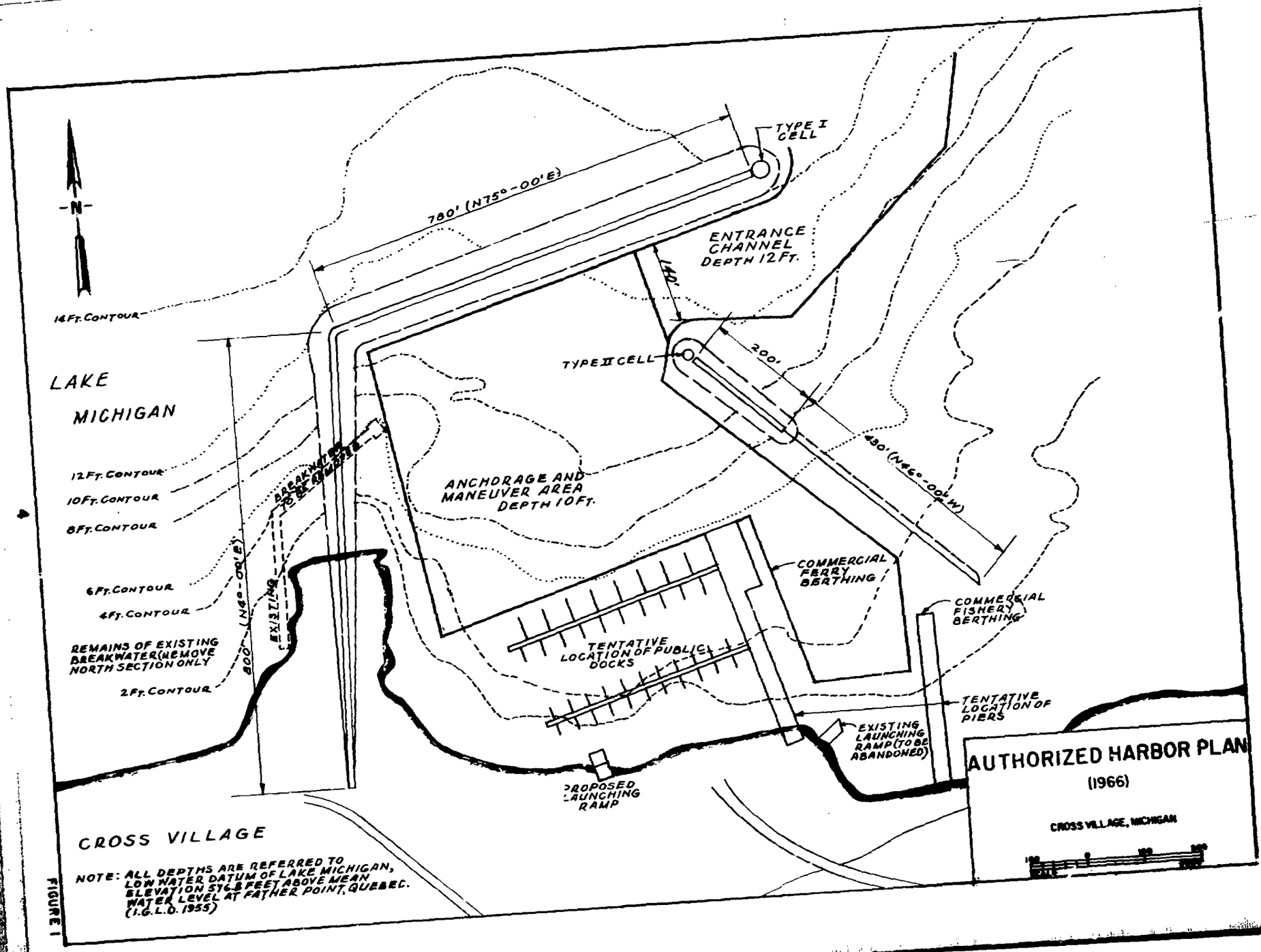
-N-
TYPE I CELL
780' (N75°-00'E)
ENTRANCE CHANNEL DEPTH 12Ft.
140'
14Ft. CONTOUR
LAKE MICHIGAN
TYPE II CELL
200'
12Ft. CONTOUR
10Ft. CONTOUR
8Ft. CONTOUR
ANCHORAGE AND MANEUVER AREA DEPTH 10Ft.
430' (N46°-00'W)
6Ft. CONTOUR
4Ft. CONTOUR
COMMERCIAL FERRY BERTHING
COMMERCIAL FISHERY BERTHING
REMAINS OF EXISTING BREAKWATER (REMOVE NORTH SECTION ONLY
800' (N46°-00'E)
EXISTING
TENTATIVE LOCATION OF PUBLIC DOCKS
2Ft. CONTOUR
TENTATIVE LOCATION OF PIERS
EXISTING LAUNCHING RAMP (TO BE ABANDONED)
PROPOSED LAUNCHING RAMP
CROSS VILLAGE
NOTE: ALL DEPTHS ARE REFERRED TO LOW WATER DATUM OF LAKE MICHIGAN, ELEVATION 576.8 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC. (I.G.L.D. 1955)
AUTHORIZED HARBOR PLAN
(1966)
CROSS VILLAGE, MICHIGAN

FIGURE 1

FIRST COSTS

The estimated first costs of the project authorized in 1966, based on prices and conditions existing in April 1965, are shown below. For comparison purposes October 1980 prices are also shown in parenthesis. The cost updates from April 1965 to October 1980 reflect the application of Construction Cost Index increases, the analysis of engineering and design and supervision and administration charges which reflect both current and past design expenses for similar project types, and the application of actual wage increases. This information is provided to enable comparison with the plan recommended in this Phase I General Design Memorandum.

	April 1965	(October 1980)
Federal	$ 728,100	($2,780,000)
Non-Federal	449,000	(1,730,000)
Total	$1,177,100	($4,510,000)

ANNUAL COSTS AND BENEFITS

Average annual costs and benefits for the project authorized in 1966, are computed on the basis of an economic life of 50 years and interest rates of 3-1/8 percent for both Federal and non-Federal expenditures. A 50-year economic life is used for the proposed harbor based on a number of economic and physical constraints such as physical depreciation of adjacent shore structures, shoaling, obsolescence, changing requirements for project services, and inaccuracies of overly lengthy projections. The 3-1/8 percent interest rate is that rate which was applicable at the time the project was authorized.

Average annual costs of the plan authorized in 1966 are as follows:

April 1965	Federal	Non-Federal	Total
Capital costs	$29,000	$17,800	$46,800
Maintenance	3,000	1,000	4,000
Total	$32,000	$18,800	$50,800
(October 1980)			
Capital costs	($112,000)	($70,000)	($182,000)
Maintenance	(14,000)	(4,000)	(18,000)
Total	($126,000)	($74,000)	($200,000)

Average annual benefits to be derived from the 1966 authorized plan are as follows:

	April 1965	(October 1980)
General	$34,235	($172,000)
Local	21,735	(118,000)
Total	$55,970	($290,000)
Area redevelopment	$ 6,300	($ 39,000)
Total	$62,270	($329,000)

Ratios of benefits to costs for the 1966 authorized plan are as follows:

	April 1965	(October 1980)
Without area redevelopment benefits	1.1 to 1	(1.5 to 1)
With area redevelopment benefits	1.2 to 1	(1.6 to 1)

The costs are based on prices and conditions existing in April 1965. These costs have been updated using October 1980 price levels and an interest rate of 3-1/4 percent (shown in parentheses) for comparison with the alternatives proposed in this document. The 3-1/4 percent is the

applicable rate for certain authorized projects provided the local sponsors indicated their willingness to provide the necessary items of local cooperation prior to 1969.

The authorized Federal improvements provided sufficient room within the protected basin for berthing up to 59 boats, including transient craft visiting during periods of heavy traffic. Boating traffic anticipated in the 1965 Report of the Chief of Engineers included 25 permanently based craft and 34 spaces for transient craft. Non-Federal work would include construction of a publicly operated pier with dock space for locally based and transient craft, and a commercial ferry landing, along with dredging of berthing areas to depths commensurate with the Federal project. A launching ramp and commercial fishing pier would also be a part of the non-Federal construction.

LOCAL COOPERATION

The items of local cooperation at the time of project authorization, as set forth in House Document No. 490, required that, prior to construction, local interests agree to:

"a. Contribute in cash 38 percent of the first cost of construction of the general navigation facilities and 50 percent of the first cost of facilities necessary to provide for recreational fishing on the main breakwater; such contributions presently estimated at $436,000 and $13,000, respectively, to be paid in a lump sum prior to initiation of construction, subject to final adjustment after actual costs have been determined;

b. Provide without cost to the United States all lands, easements, and rights-of-way required for the construction and maintenance of the project and aids to navigation upon the request of the Chief of Engineers, 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 therefor or the costs of such retaining works;

c. Hold and save the United States free from damages due to the construction works and subsequent use, operation, and maintenance of the project;

d. Provide and maintain without cost to the United States necessary mooring facilities and utilities, including an adequate public landing with provision for the sale of motor fuel, lubricants, and potable water, a parking lot with adequate sanitary facilities, and a launching ramp, open to all on equal terms; the dredging of berthing areas to be commensurate with the depth of the Federal channel improvements;

e. Establish a competent and properly constituted public body empowered to regulate the use, growth and development of the harbor, and recreation-oriented facilities with the understanding that said facilities shall be open to all on equal terms;

f. Reserve spaces within the anchorage and mooring facilities adequate for the accommodation of transient craft;

g. Provide and maintain without cost to the United States, for recreational fishing: access facilities, parking areas, and adequate sanitary facilities;

h. Establish regulations prohibiting discharge of untreated sewage, garbage, and other pollutants in the waters of the harbor by users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, State, and local authorities responsible for pollution prevention and control; and

i. Bear all costs of operation, maintenance, and replacement of the recreational fishing facilities, the amount involved currently being estimated at $1,000 on an average annual basis:

And provided further, that the improvement for navigation may be undertaken independently of the public recreational fishing facilities on the main breakwater whenever funds for that purpose are available and the required local cooperation has been furnished."

SCOPE OF THE PHASE I GENERAL DESIGN MEMORANDUM

THE SCOPE

The harbor for light-draft vessels recommended for Cross Village, Michigan, was authorized based on information presented in the July 1966 Report of the Chief of Engineers on Cross Village, Michigan. That study examined the lands, facilities, industries, and population, employed and resident, around the Cross Village area, as well as the effects such a harbor would have on the immediate area and surrounding regions. It was determined that a harbor for light-draft vessels in the vicinity of Cross Village was both engineeringly feasible and economically justified.

A significant amount of time has elapsed since a harbor was authorized to be constructed at Cross Village. During that time, changes have occurred in construction standards and techniques. Also, numerous laws and regulations have been enacted concerning the protection of the environment. In light of these developments, this Phase I General Design Memorandum (GDM) reassesses the factors considered in the 1966 Report of the Chief of Engineers to determine if that plan is still feasible. Part of that reassessment is an analysis of new information including: a current evaluation of the study area's needs and problems; an appraisal of current public attitudes; consideration of current water resources planning procedures, policies, criteria, and public laws including the National Environmental Policy Act; a review of alternative solutions considered in

the 1966 report and development of new alternatives based on present conditions; reevaluation of benefits and costs; updating of agency coordination; and a reaffirmation of the intent of local interests to provide the required items of cooperation.

The study focuses on the land and water areas near Cross Village, Michigan, extending along the Great Lakes shoreline from Cheboygan, Michigan, on Lake Huron to Charlevoix, Michigan, on Lake Michigan. Factors which are considered in defining the study area include the sizes and classes of boats expected to use the area, willingness of people to travel for boating and fishing, willingness of people to pay for seasonal docking privileges, and the interest in combining boating and fishing with other activities such as camping. The water area investigated is determined by the distance that larger classes of sport and commercial craft can be reasonably expected to travel in one boating day.

THE REPORT

This Phase I General Design Memorandum consists of a main report with an environmental impact statement and four appendixes. The main report provides a condensed review of the study scope, problems and needs of the study area, environmental, engineering, economic, and social data gathered during the study, alternative solutions considered, and the study conclusions and recommendations.

The environmental impact statement (EIS) is contained as an integral part of the report. There will be no separate reviews of the EIS as has been the case in the past. Included in the EIS as Supplement III is an evaluation of effects of construction on water quality as required under Section 404 of the Clean Water Act of 1977.

The four appendixes provide a more detailed analysis of their respective topics. The appendixes contained in this report are as follows:

Appendix A -- Design Analysis
Appendix B -- Economic Studies
Appendix C -- Human Resources
Appendix D -- Public Involvement and Coordination

PRIOR REPORTS

A previous report on Cross Village is contained in Senate Document No. 75, 48th Congress, 1st Session, which was transmitted to the Secretary of War on January 14, 1884. That report, compiled by the U.S. Engineer Office, Grand Rapids, Michigan, recommended construction of breakwaters to provide protection for local commerce. It contemplated an anchorage of approximately 20 acres. A subsequent report, House Executive Document No. 71, 48th Congress, 2nd Session, issued in November 1884, recommended that no improvement be made for a harbor at Cross Village.

House Document No. 446, 78th Congress, 2nd Session (The Coasts of the Great Lakes, Harbors of Refuge for Light-Draft Vessels) was submitted to the Chief of Engineers on 11 December 1943. The report considered constructing harbors of refuge for light-draft vessels at various locations 30-40 miles apart along the Great Lakes shoreline. St. James Harbor on Beaver Island was selected as the best location on northeast Lake Michigan. No harbor construction was recommended at Cross Village or at any adjacent location on the mainland. Some shelter was then available at Cross Village, provided by a breakwater constructed in 1939 by the Works Progress Administration.

A Report of the Chief of Engineers on Cross Village, Michigan, prepared by the U.S. Army Corps of Engineers, was published as House Document No. 490, 89th Congress, 2nd Session, on 8 September 1966. The report again looked at the feasibility of constructing a harbor to serve both light-draft commercial and recreational craft in the vicinity of Cross Village-Good Hart area, Michigan. Such a harbor was recommended to be constructed at Cross Village.

A Comprehensive Plan for Sewer and Water Facilities was prepared for the Emmet County Planning Commission and accepted and approved by a formal resolution of the Commission on 21 April 1971. The plan provides a general overview of the county's population, economic conditions, public utilities, resources, agriculture, land patterns, trends, and water systems. The information is limited in usefulness because it is derived from 1960 census data.

A report entitled, 1974 Michigan Recreational Boating Study, was completed in September 1975 by Recreation Resource Consultants under a contract with the Waterways Commission and the Law Enforcement Division of the Michigan Department of Natural Resources. The study surveyed the recreational behavior, and safety attitudes and experiences of Michigan registered boaters. The report indicates that boating activity in the study region, which included Emmet County, Michigan, increased during the period from 1971 to 1974. No site specific information can be drawn from the survey.

DESCRIPTION OF STUDY AREA

Lake Michigan offers an array of recreational opportunities. The lake is 307 miles long, 118 miles wide, 923 feet deep and occupies a surface area of 22,400 square miles. In addition to recreational boating and fishing, hundreds of thousands of tourists each year use nearshore areas for sightseeing, shore fishing, swimming, picnicking, camping, hiking, and other recreational activities.

GENERAL CONDITIONS

The study area is located in the northern part of Michigan's lower peninsula. It is in Emmet County on the northeastern shoreline of Lake Michigan (See Figure 2). The area is principally devoted to recreational activities because of its many lakes, rivers, parks, and forests.

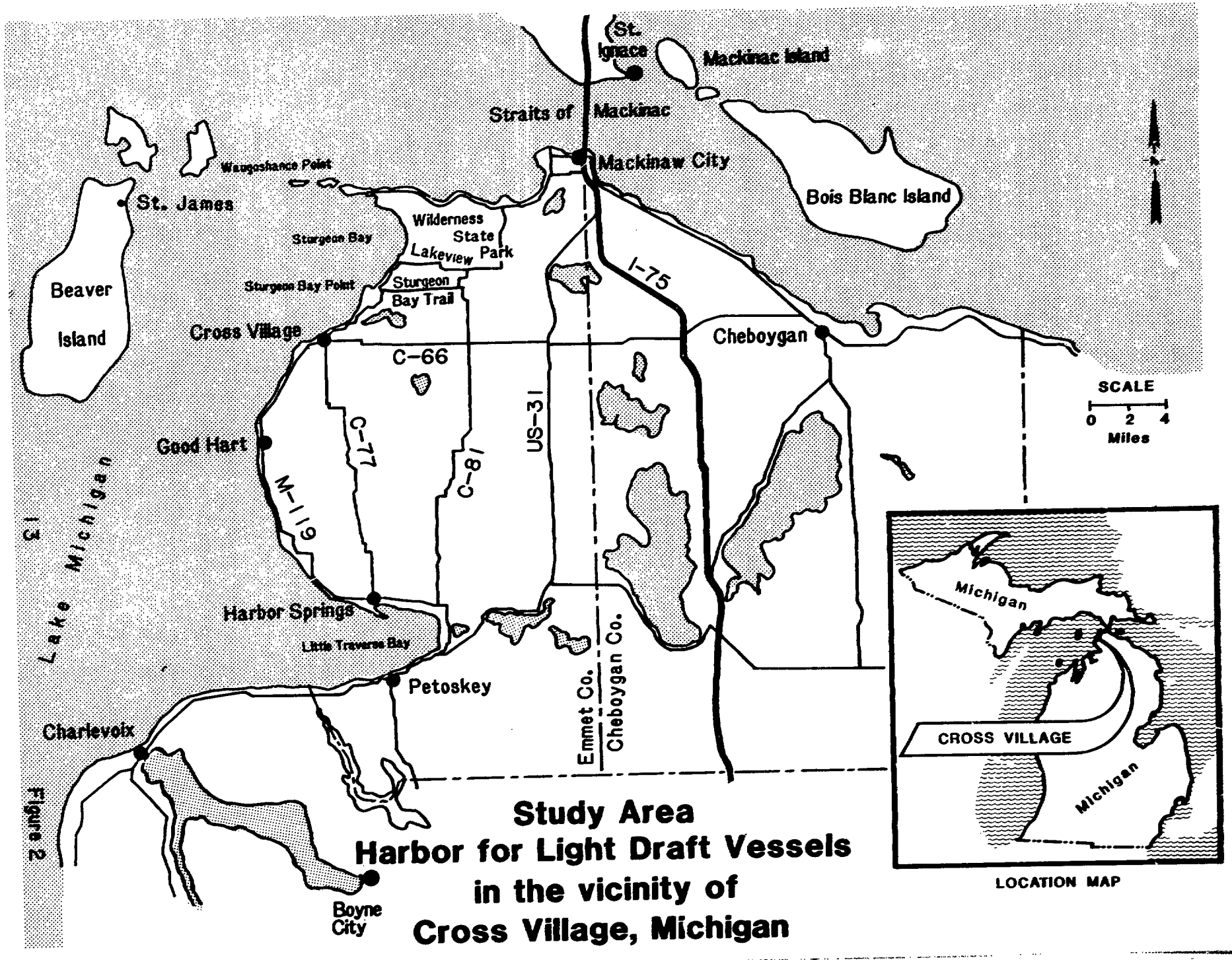

Figure 2

Study Area
Harbor for Light Draft Vessels in the vicinity of Cross Village, Michigan

Municipal harbors located in the vicinity of the study area which accommodate small boats are:

St. James Harbor	- on Beaver Island, Lake Michigan, about 23.5 miles west of the mainland with 25 slips.
Charlevoix Harbor	- on Lake Michigan in Charlevoix County with 48 slips.
Boyne City Harbor	- on the southeast end of Lake Charlevoix in Charlevoix county with 24 slips.
Petoskey Harbor	- on the south side of Little Traverse Bay, off of Lake Michigan with 70 slips.
Harbor Springs	- a natural harbor located on the north side of Little Traverse Bay with 54 slips.
Mackinaw City Harbor	- on the south shore of the Straits of Mackinac with 98 slips.
St. Ignace Harbor	- on the north shore of the Straits of Mackinac with 20 slips.
Mackinac Island	- east of the Mackinac Straits Bridge in Lake Huron with 79 slips.

The topography of the study area varies from a hilly region with elevations 300-400 feet above the lake level in the center of the county to a broad flat plain in the northern reaches rising to barely 20 feet above the lake over a distance of one to two miles inland. A sharp ridge 60-80 feet high (100 feet above lake level) parallels the shoreline from Good Hart to Cross Village leaving a beach area 100-500 feet in width. Along much of that beach is a smaller foredune 5-30 feet high, averaging 100 feet from the water. North of Cross Village in the area of Sturgeon Bay Point, the foredune continues but behind it is a hilly dune region ranging over a distance of a half mile inland before the elevation reaches that of the high bluff. Two to three miles north of Sturgeon Bay Point the land spreads out into a broad level lake plain sloping up to 20 feet above lake level over a distance of one to two miles. The land gradually slopes up to the 100 foot elevation over a distance of three to four miles to the southeast.

Rock indigenous to the area is characterized as part of the Bois Blanc formation and is composed of cherty dolomite, dolomite limestone, and limestone. Glacial action has scoured and molded the landscape, leaving behind moraine surface formations and surface deposits 200 to 400 feet thick.

Soil types in the study area vary, although for the most part they are deep (up to 60 inches), well drained and sandy, with low relief. Natural drainage is directly into Lake Michigan. The soils are of glacial origin and have some clay substratum.

The soils in the area surrounding a stretch from Good Hart to Cross Village have medium to low natural fertility, are somewhat droughty, are subject to wind erosion in areas where the soil is exposed, and have few limitations for most recreational uses. The soil in the area around Sturgeon Bay Point is shaped into active sand dune formations. The soils have low natural fertility and low water capacity. They are subject to severe erosion by wind action if the vegetation is removed. The soils throughout much of the Wilderness State Park are poorly drained and of an organic nature. The area occupies a broad, nearly level, lake border area of organic soils with low sand ridges scattered throughout. The soils have low natural fertility. The area is well suited for wetland wildlife.

The mean water surface elevation of Lake Michigan (1900-1977) is 578.49 feet International Great Lakes Datum - 1955 (IGLD-1955). Temporary, seasonal, and long term variations occur due to changing meteorological conditions and net water supply to the lake. The direction of surface currents along the northeast shore of Lake Michigan is from south to north. The direction and rate of flow results from the prevailing westerly winds coupled with the general flow of the outlet into Lake Huron.

General water quality problems such as eutrophication, soil erosion, combined sewer overflows and oil pollution, are not known to exist in the study area. Analysis of lake water samples taken in the area shows the water is of good quality and unpolluted (see Supplement I of the EIS, page I-1). While no ground water study has been performed in the study area, residents report that in general the availability of groundwater in Emmet County is adequate and of good quality (post-1965 wells average approximately 31 gallons per minute).

Because of its close proximity to Lake Michigan the study area experiences a moderate summer climate. In winter prevailing westerly winds blowing over the lake are responsible for the area's high annual snowfall. Severe wind storms normally occur during the winter-spring period but are not uncommon during the summer months.

The study area is covered by second growth forests of oak, maple, and pine, pine plantations, aspen-birch stands, and pole-sized hardwoods. In addition to large tracts of state and national forest, about 27 percent of the county is farmland. The major crops are wheat, oats, hay, and potatoes.

Four plant species, which are on the State of Michigan list of threatened species, are found in scattered groups along the low foredunes and beaches in the study area. These include: the Pitcher's thistle (Cirsium pitcheri), Lake Huron tansy (Tanacetum huronense), thickspike wheatgrass (Agropyron dasystachyum), and Pumpelly's bromegrass (Bromus pumpellianus). No animals on either the Federal or State of Michigan lists of threatened or endangered species are known to be in the study area.

A variety of terrestrial and aquatic fauna exist in the study area. In the Great Lakes Basin Framework Study Subarea 2.4, the following wildlife were found in medium to high densities: white tailed deer (Odocoileus virginianus), cottontail rabbit (Sylvilagus floridanus), ruffed grouse (Bonasa umbellus), gray squirrel (Sciurus carolinensus), fox squirrel (Sciurus niger), woodcock (Philohela minor), mourning dove

(Zenaidura macroura), muskrat (Ondatra zibethica), mink (Mustela vison), beaver (Castor canadensis), weasel (Mustela spp.), raccoon (Procyon lotor), skunk (Mephitis spp.), opossum (Didelphis marsupialis), woodchuck (Marmota monax), crow (Corvus brachyrhynchos) and raptors.[1] The area also lies on a migration corridor, and is a wintering place for blue geese (Chen caerulescens), snow geese (Chen hyperborea) and dabbling ducks.

The types of fish found in the waters off the study area reflect Lake Michigan's cold temperatures and excellent water quality. Lake trout (Salvelinus namaycush), brown trout (Salmo trutta), and rainbow trout (Salmo gairdneri), as well as some whitefish (Coregonus clupeaformis), form the major portion of the local fisheries. Other species include; northern pike (Esox lucius), walleye (Stizostedion vitreum), and small mouth bass (Micropterus dolomieui).

Inland, as of 1975, there were approximately 74 miles of trout streams, and one intensively managed trout lake. There were no intensively managed warm water fisheries in the area. No offshore spawning grounds have been identified in the area.

INDIVIDUAL SITE DESCRIPTIONS

Four locations within the study area were investigated as possible sites for a light-draft harbor. These are, Cross Village, Good Hart, Sturgeon Bay Point, and near Little Sucker Creek within the Wilderness State Park (see Figure 3). Because Cross Village was authorized as the site for the recommended harbor in the 1966 River and Harbor Act, the locations of the other sites will be referenced to it. The following site descriptions are to provide more detailed information on the individual sites.

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[1] Great Lakes Basin Commission, Great Lakes Basin Framework Study, Appendix 17, 1975.

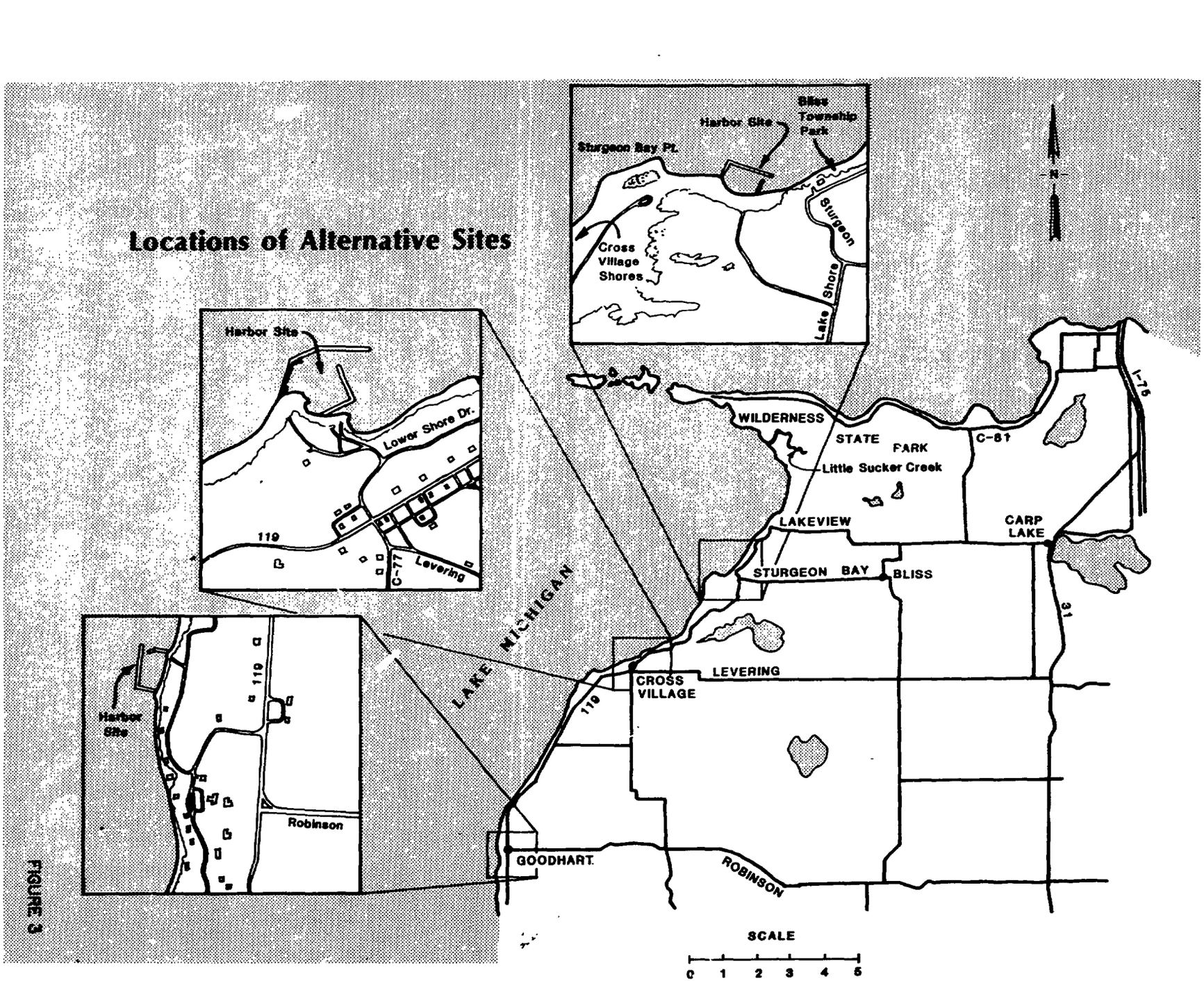

Locations of Alternative Sites
Harbor Site
Sturgeon Bay Pt.
Bliss Township Park
Sturgeon
Shore
Lake
Cross Village Shores
N
Harbor Site
Lower Shore Dr.
119
C-77
Levering
Harbor Site
119
Robinson
LAKE MICHIGAN
WILDERNESS
STATE PARK
Little Sucker Creek
C-81
I-75
LAKEVIEW
CARP LAKE
STURGEON BAY
BLISS
31
LEVERING
CROSS VILLAGE
119
GOODHART
ROBINSON
SCALE
0 1 2 3 4 5
Miles

FIGURE 3

Cross Village, Michigan

Cross Village is located on the south shore of Sturgeon Bay, a broad open bay near the northeastern end of Lake Michigan. It is at the junction of State Highway M-119 and county route 66, an east-west road which intersects U.S. Highway 31, 13 miles east of Cross Village, and Interstate 75, 6 miles farther east, providing a direct access to populated areas to the south.

Cross Village is primarily residential in character with several commercial enterprises that cater to local and summer transient needs, including a restaurant, gift shop, general store, and post office. These facilities are within walking distance of the recommended harbor site. The village is developed on a bluff overlooking Lake Michigan. Several secondary paved roads intersect in the village. Michigan Route 119 runs through the village parallel to the shoreline along a winding scenic route. The site for the authorized harbor is at the base of the bluff below the center of the village. A paved road runs from the center of the village to the site, and provides access to the Township owned lake frontage which is used as a swimming beach and boat launching area. The properties to either side of the Township land are privately owned.

Distances by water routes to harbors closest to Cross Village are 24 miles to St. James Harbor on Beaver Island, to the west; 22 miles to Harbor Springs, to the southwest; and about 34 miles to Mackinaw City Harbor, to the northeast.

A breakwater was constructed at Cross Village under a Works Progress Administration program in 1939 at a cost of $40,000. The breakwater has since deteriorated to a point where it no longer offers protection from rough lake conditions. The breakwater (see Figure 4) was of stone-filled, timber crib construction with piling, and extended from the shoreline about 250 feet north, thence 250 feet north-northeast. It was about

Township Park
Existing Conditions – Cross Village

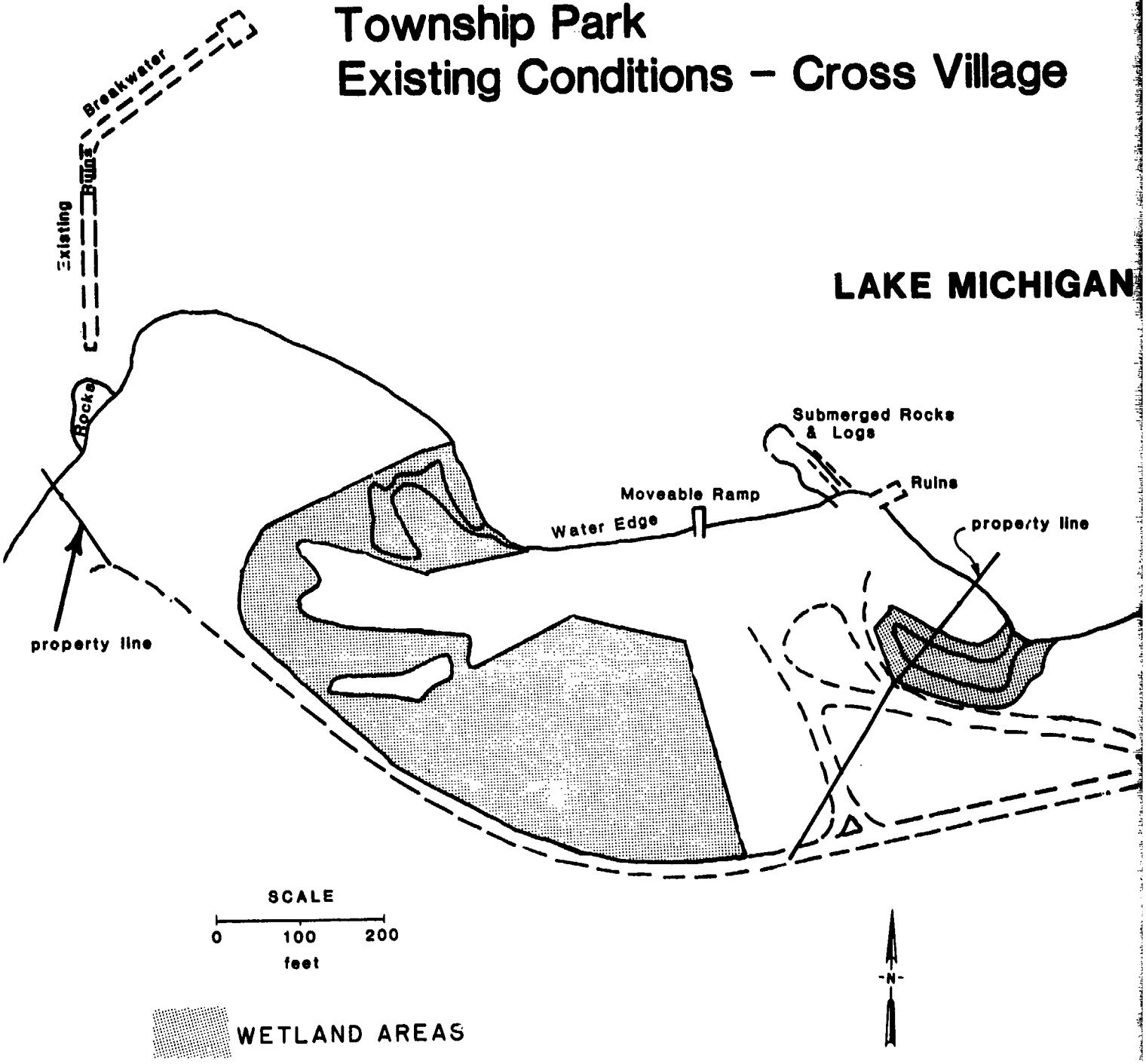


FIGURE 4

11 feet wide with a crest elevation approximately 6 feet above low water datum. Plans called for constructing a concrete cap and providing riprap protection along the lake side of the breakwater, with additional riprapping on both sides of the structure near its inner end and along the harbor basin shoreline near the breakwater. Neither the concrete cap nor the riprap protection was constructed. Lack of riprapping and the use of untreated timber probably aided the comparatively rapid deterioration of the breakwater.

The Northern Michigan Electric Cooperative, Inc. has an easement on the township park property allowing them access to Lake Michigan for their cable supplying electric power to Beaver Island. This is the main supply of electricity for island residents. A condition of the easement allows them to relocate the power line if requested by an agency of the Federal government. This would be coordinated during actual construction activities.

Sediment material located in the nearshore zone and on the beach consists primarily of a mixture of gravel and sand, with sand predominating. Analysis of sediment samples taken at the recommended harbor site in November 1979, indicates the material is unpolluted and suitable for beach nourishment or open water disposal (see Supplement I of the EIS, page I-6).

Littoral drift in the area of Cross Village is predominantly from southwest to northeast. Due to the deteriorated state of the existing harbor structure, littoral material has passed over or through the structure causing the material to settle out in its vicinity. Accretion has taken place southwest of the harbor and has promoted the formation of a well developed foredune which extends several thousand feet southwest of the harbor. Erosion from wave and wind action has removed much of the wind blown material that had accumulated nearshore, northeast of the harbor. There has been little replenishment of the material that has been lost.

Two wetland areas are located on the recommended site for the authorized harbor (see Figure 4). The larger area is located approximately in the center of the township park and occupies 2.4 of its 9 acres. The second, smaller area is only partially on township property, located on the eastern-most boundary of the park.

The National Register of Historic Places (Fed. Reg., Vol. 44, No. 26, 6 February 1979) lists no National Historical sites in the vicinity of Cross Village. There are also no known candidates from the area for inclusion in the Register.

The recreational focal points of the site are the sand beach, which is popular for swimming, and a small boat launching ramp. A launching ramp was built in 1960 by local interests at a cost of $800. It was of plank construction, 14 feet wide and 65 feet long. As the breakwater deteriorated, sand and rock were placed adjacent to the ramp as protection for boats being launched. Fluctuating lake levels often prohibited use of that ramp. The ramp was later abandoned and replaced with a portable version that can be adjusted as the lake levels change. However, this ramp is still not usable under conditions of rough weather.

Good Hart, Michigan

Good Hart is located approximately eight miles southwest of Cross Village along M-119. The area is accessible by an east-west gravel road (Robinson Road) which runs into U.S.-31 in Pellston, Michigan, or from the north or south along M-119. Designated as a Scenic Route, M-119 is a narrow twisting two lane black-top road which runs through a heavily wooded area.

The proposed harbor site encompasses the area within the township park, a single lot with about 150 feet of beach frontage surrounded on both sides by private residences of considerable value. The site is located approximately one mile off of M-119 and its approach is partially over a narrow gravel road.

The proposed harbor site, by water routes, is 38 miles from Mackinaw City Harbor, 23 miles from St. James Harbor, and 16 miles from Harbor Springs. Tne location is on a stretch of shoreline forming a convex curve into Lake Michigan and offering little natural protection.

There are no commercial facilities on the park site. Services available in the village, about one mile away, consist of a combination gas station-grocery store and two antique shops.

The township park has a flat sandy beach area 150 feet long and 50 feet deep. The beach runs into a low bluff 10-20 feet high which is backed by a foredune area 35-40 feet wide. Behind the foredune area is a small parking and picnic area. This area slopes gently upward over a distance of 700 feet until it reaches a steep bluff rising another 40-60 feet.

The lake bottom in the area is composed of gravel and has a shallow slope. During a site visit by Corps of Engineers' personnel, the water in the area was observed to be more turbid than at the Cross Village site.

Sturgeon Bay Point

The proposed harbor site is on the east shore of Sturgeon Bay Point, approximately five miles northeast of Cross Village. Access to the area is readily available along several county roads leading west from U.S.-31 and I-75. Access to the site is along a 1/2 mile gravel road off of Lake Shore Drive, 4 miles northeast of Cross Village, or a dirt road off of Sturgeon Bay Trail as it turns along the shoreline heading north.

Sturgeon Bay Point is a prominent feature near the south end of the bay. The proposed site is on an undeveloped beach backed by a low foredune and an undulating terrain where vegetation has trapped wind blown sand. High sand dunes provide a scenic backdrop to this region,

paralleling the general shoreline along most of the bay's southern shore. Many of these dunes reach over 100 feet in height. Large areas of blowouts have occured in the dunes where the stabilizing vegetation has been disturbed allowing the underlying sand to erode away by wind action.

The site is located on State land within the Mackinaw State Forest. The area is heavily posted against camping and motor vehicle use; however, the beaches are used for hiking, picnicking, and swimming. This area has been proposed for inclusion within the Wilderness State Park system.

To the southwest of the site beyond the point is an area of private residences called Cross Village Shores. Within a mile to the northeast of the site are additional private properties and the Bliss Township Park.

The proposed site, by water routes, is 34 miles from Mackinaw City Harbor, 26 miles from St. James Harbor and 27 miles from Harbor Springs. The Point forms part of a wide protected bay. Additional protection is provided to the area by islands to the west and Waugoshance Point to the north.

There are no services of any kind at the site. The nearest store or restaurant is located in Cross Village five miles away. The nearest shopping area is located in Mackinaw City approximately 20 miles east and north of the site.

The area is a wide natural bay with gravel lake bottom and sandy beach. The beach varies in width from 5 to 300 feet from the waters edge to a low bluff 5-15 feet high which roughly parallels the shoreline. There is sparse pioneer type vegetation found along the beach. On the eastern side of the site is a low poorly drained area with wetland type vegetation. The area behind the bluff is a hilly dune region extending east one-half mile to a high ridge and south one and one-half miles to a wetland area around Wycamp Lake.

Little Sucker Creek

Little Sucker Creek enters Sturgeon Bay on its northeast shore within the boundaries of the Michigan Department of Natural Resources' Wilderness State Park. The park, encompassing 7,505 acres, is located on the Straits of Mackinac at the extreme northern tip of Michigan's lower peninsula. The park is eleven miles west of Mackinaw City, along Wilderness Park Drive, where access can be made to U.S. Highway 31 and Interstate 75. There is no direct access to the proposed site which is approximately nine miles northeast of Cross Village along the shore. A narrow dirt road approaches within one-half mile of the site.

The proposed site is 34 miles from Mackinaw City Harbor, 28 miles from St. James Harbor, and 32 miles from Harbor Springs. This site is well outside of established cruising routes, and involves moving through shallow, shoal and rock strewn waters.

There are no facilities or services of any kind at this site. A small store is located four to five miles from the site on Wilderness Park Drive. For more extensive shopping people would need to go into Mackinaw City.

The area around the site is heavily wooded and has a very flat terrain. There is a narrow beach area averaging 50 feet in depth. Inland for about 1/4 mile is a fairly extensive wooded wetland area of about 320 acres. The lake bottom is shallow, rocky, and contains several extensive aquatic plant beds. The area is used for fishing and is a possible spawning site for several fish species, as well as a resting stop for migratory waterfowl.

RECREATION

Emmet County provides opportunities for many types of outdoor recreation activities. Three percent of the total county land is devoted

solely to recreation (campgrounds, tennis, golf, etc.). Forested areas within the county cover 62.0 percent of the total county land surface including large areas within Mackinaw State Forest and Wilderness State Park. These areas provide additional recreational opportunities for activities such as hiking, swimming, and hunting. Emmet County has 272 inland water bodies, of which 8 are larger than 200 acres. There are eleven public access sites on inland lakes in the county. Ninety-eight miles of streams and 68 miles of Great Lakes shoreline are found within the county borders. There are also three recreational boat harbors along the shoreline at Petoskey, Harbor Springs, and Mackinaw City.

The Mackinaw State Forest has a public campground located at Wycamp Lake which served an estimated 450 campers during 1979. The State has property available in Bliss Township at Sturgeon Bay for swimming and picnicking. Petoskey State Park, outside the City of Petoskey, has one campground with 90 campsites, which served approximately 260,000 campers in 1978. There is also a free public boat ramp to Lake Michigan at the campground. Wilderness State Park has a large campground of 210 campsites, four rustic trail cabins for use by the public, and designated picnicking areas and swimming beaches. Programs consisting of movies, talks, and slide shows are provided by the park naturalist. Also available are trails for hiking and viewing the diverse vegetation and animal life within the park. Hunting and fishing are also permitted within the park except inside a designated wildlife refuge. Over 150,000 people used the park's services in each of the years from 1976-79.

A summer outdoor recreation survey performed in 1977 by the Institute for Social Research of the University of Michigan, revealed residents of rural Emmet County preferred the following outdoor activities ranked in order; swimming, motorboating, fishing, bicycling, golf and sailing (tied), and tennis. Emmet County is well equipped to respond to residents golf and tennis needs with three public and five private golf courses, and 18 public and 29 private tennis courts. A majority of these are located near Harbor Springs and Petoskey.

Non-summer sports are also popular in Emmet County as they have an estimated 300 miles of snowmobile trails and 31 ski runs at four ski resorts. These are Boyne Highlands, Kiwanis Sports Park, Nub's Nob, and Petoskey Winter Sports. As of September 1978, Emmet County had 3,142 watercraft, 2,507 snowmobiles and 291 off road vehicles registered with the Secretary of State. Non-summer sports ranked by their popularity are hunting, snowmobiling, fishing, ice fishing, downhill skiing, and cross country skiing.

HUMAN RESOURCES

In general the populations of Emmet County and surrounding regions are increasing. Emmet County increased its population by 24.3 percent during the 10 year period between 1970 and 1980. Within the counties themselves, populations of the larger cities such as Petoskey and Harbor Springs have slowly decreased. This decrease is offset by the relatively large increase in populations of rural townships such as Cross Village, Readmond, Bliss, Center, and McKinley (17.3 percent, 55.7 percent, 24.6 percent, 15.0 percent, and 52.1 percent, respectively). A significant portion of this population increase is in the elderly, 60 years old or over group, which has increased at more than twice the rate of the State. Projections of population trends by the Northwest Michigan Regional Planning Commission indicate the population of Emmet County would increase by 30 percent between 1980 and 2000. Within the county large increases are expected in Cross Village and Center Townships and especially in the Harbor Springs area.

Seventy percent of Emmet County's housing units in 1970 were year-round dwellings; of these, 80 percent were occupied. The remaining housing units are classified either seasonal or migratory. Housing figures for 1975 indicate year-round housing units increased 5 percent and those units occupied increased by 15 percent. Preliminary 1980 census data indicate substantial increases in the number of housing units between 1970 and 1980 in Readmond and Cross Village Townships

(43 percent and 23.1 percent, respectively). Of the total units available in those townships the majority are vacant (61.6 percent in Readmond and 70.2 percent in Cross Village) indicating many of these are seasonal homes.

Projections indicate that public school enrollment for the Charlevoix-Emmet Intermediate School District will decline between the 1976-77 and 1981-82 school years. This trend is indicative of the increase of older families and retirees moving to the area and the loss of younger adult family members from the region due to limited employment opportunities.

Emmet County has experienced high unemployment rates during the last seven years; always at a higher rate than the State averages. The county's unemployment rate is the result of basically limited year-round employment and the extensive seasonal nature of existing employment opportunities. Retail services in Emmet County are dependent to a large part upon seasonal tourist trade using area recreational sites. Existing community services are oriented primarily toward rural residents; which gear up for sizable influxes of seasonal visitors.

Health care in Emmet County was rated very favorably by area residents. The county is served by one hospital, two nursing care facilities and one home for the aged. The number of medical care professionals per capita is significantly higher than the State average, which indicates gradual increases in population would not overly burden the available health care facilities of the county.

CONDITIONS IF NO FEDERAL ACTION IS TAKEN

Study Area

Population growth in the study area is expected to increase at a moderate rate, shifting away from population centers such as Petoskey

and Harbor Springs and concentrating in the more rural areas of townships like Cross Village and Center. The demand for second homes and vacation retreats is a contributing factor to the area's growth. However, the greatest pressure on the area will be the demand for more recreational facilities to satisfy the needs of not only Emmet County but large population centers throughout the State. If current fuel costs and economic conditions continue, this demand could increase as people seek recreation close to home.

An increase in population would stimulate a corresponding growth in support facilities such as access roads, waste disposal facilities, water systems, medical care, schools, police, and fire protection, needed to provide what many consider to be basic amenities.

This projected growth would not be expected to occur at a fast enough rate to cause significant damage to the areas physical environment. Localized disruptions and land use changes would occur in small areas as vacant farmland or forested areas are developed. Because the majority of the shoreline in the study area is built up with private dwellings or is in public ownership, mostly by the State, little new development would occur in those areas. Most development would occur along the major traffic arteries or inland in the more open farming areas.

Two recent events which could have a significant effect on future development in the study area are the passage of the Sand Dune Protection and Management Act of 1976 (Act No. 222, P.A. 1976) and the application of the Little Traverse Conservancy, Inc. to the Land Trust Fund for funds for the State of Michigan to use for the purchase of the Sturgeon Bay Dunes area. Under the 1976 Act the Michigan Department of Natural Resources may define the location of "sand dune" areas in the State to assure their wise use and protection. The shoreline from Waugoshance Point to Cross Village has been designated as a Series II Sand Dune Area, and thus commercial or industrial use of sand without a Department of

Natural Resources permit is prohibited. Public entities would be prohibited from extracting sand or minerals except in the interest of public safety and health in an emergency situation resulting from a natural disaster.

The land bid by Little Traverse Conservancy reflects the interest of many private and State groups to bring the remaining privately owned land between Wilderness State Park and the Mackinaw State Forest under the control of the Michigan Department of Natural Resources to preserve unique dune habitat from indiscriminate abuses by off-road vehicles and excessive hiking and camping. The area would be included in the Wilderness State Park.

With the area north of Cross Village reserved for recreational uses, the anticipated population growth would be confined to areas south of Cross Village and east of M-119. Thus the amount of land available for recreational purposes in those areas would be reduced.

Site Conditions

Conditions expected to occur which are specific to Cross Village and Good Hart are discussed below. No changes are expected at the Sturgeon Bay Point and Little Sucker Creek sites other than those discussed in general for the study area.

Cross Village

The existing ruins of the 1939 Works Progress Administration (W.P.A.) breakwater at Cross Village have been significant in the past in influencing the movement of littoral material and causing erosion of the shoreline to the northeast; however, at the present time the littoral environment has adjusted to the structure and is in an equilibrium state, so that the breakwater waves are of minor influence today. The wetlands on the Cross Village Township Park property would probably increase in size as windblown sand accumulates along the shore and alters the area's drainage patterns.

The park would continue to provide opportunities for swimming and picnicking. The boat ramp would be used as weather permits. As this is the only launching facility in the study area, pressure would increase to provide safer conditions as the area's population increases.

Good Hart

Demand for access to Lake Michigan could create pressure for upgrading the existing facilities at Good Hart. However, because the park area is limited in extent, and access is difficult to provide on a larger scale, there is little potential for development of the Good Hart property as a large recreational area.

PROBLEMS AND NEEDS

NEED FOR A LIGHT-DRAFT NAVIGATION HARBOR

A preliminary analysis of a 1977 mail survey of registered boaters in Michigan, performed by the Michigan Department of Natural Resources, Waterways Division, indicated an estimated demand of 378 boat slips in Region 10, a ten county area in the northwestern portion of Michigan's lower peninsula in which the study area is located. It was determined that 50 of these slips could be accommodated in the Cross Village area. A final analysis of the data, accomplished in 1979, indicated the Region 10 demand had increased to 518 boat slips. Accordingly, the number of slips to be provided in the Cross Village area was increased by approximately 50 percent to 104. The demand projections for the Cross Village area have been verified through further research by the U.S. Army Corps of Engineers. A more detailed explanation of the demand projections can be found in Appendix B, page B-14.

Representatives of the Michigan Department of Natural Resources, Waterways Division, have indicated no future development is planned for harbors under their jurisdiction within the study area. In addition,

checks of Corps of Engineers and state files of permit applications revealed no plans are under consideration in the private sector for marina construction or expansion. Thus if the projected demand in the Cross Village area is to be filled, a new harbor would be required.

A harbor in the vicinity of Cross Village would also provide a desirable base for the ferry operating to Beaver Island. A trip from a harbor at this location is both shorter and over a less exposed route than from Charlevoix Harbor. The shorter distance would permit scheduling additional trips to accommodate the anticipated increase in traffic to Beaver Island and would provide for savings in transportation costs.

A commercial fishing industry was at one time based at Cross Village. However, when the 1939 W.P.A. breakwater deteriorated, the operators moved to other harbors. Providing a harbor in the vicinity of Cross Village increases the potential for reestablishing a commercial fleet in the area. However, the success of any commercial fishing industry in the northern Lake Michigan area is dependent on the development of a self-sustaining fish population. The Michigan Department of Natural Resources (MDNR) is currently involved in litigation to determine their authority to manage these fish populations. If the court rules the MDNR cannot regulate all types of fishing in the area, it is their opinion that it would be unlikely that fish populations could be maintained at a level to support any type of commercial fishing enterprise.

DIFFICULTIES ATTENDING NAVIGATION

At public workshops and through correspondence, boating enthusiasts, who are familiar with conditions found on the upper area of Lake Michigan in the vicinity of Little Traverse Bay, Beaver Island, and the Straits of Mackinaw, have indicated a need for a harbor of refuge between the two closest mainland harbors of Mackinaw City and Harbor Springs (61 miles apart). Information provided describes the reach of Lake Michigan between Beaver Island and the Michigan mainland as one of the roughest, most treacherous sections of water on the Great Lakes. Of particular concern

to recreational boaters are summer storms which are often short and violent and occur with little warning.

To fill the need for a harbor of refuge in this area, a harbor was built at St. James on Beaver Island as recommended in the 1943 Corps of Engineers report, Coasts of the Great Lakes, Harbors of Refuge for Light-Draft Vessels. However, experience among boaters has shown that a harbor on the mainland would provide several advantages over the island location. Because a large number of storms in this area originate from a westerly direction, operators of many types of boats in the waters between Beaver Island and the mainland find it difficult to reach St. James Harbor, which requires traveling into the wind. In addition, there is a great psychological advantage to heading inland to a harbor under storm conditions rather than out into open water searching for an island harbor which is not visible from all shore locations even under good weather conditions.

PUBLIC CONCERNS

On 6 December 1978 a public workshop was held in the Cross Village Township Hall and was attended by 115 persons representing citizenry of Cross Village, the Corps of Engineers, Michigan State Waterways Commission, and Congressional and Michigan State legislative liaisons. The purpose of the workshop was to solicit public views on the proposed light-draft vessel harbor at Cross Village, Michigan. In general, opinion was in favor of a harbor of some type at Cross Village; however, there was much discussion as to what types of uses were to be allowed in the harbor and what size of harbor was needed. There was a consensus among those people present that the authorized harbor design be altered to preserve as much of the township swimming beach as possible. The disposition of the material left in the ruins of the W.P.A. breakwater at Cross Village was also questioned.

A second workshop was held on 27 August 1980 in the Holy Cross Community Hall at Cross Village. The workshop was attended by approximately 240 persons representing Federal, State, and local governments, local residents, and interested parties from adjacent communities. The majority of the concerns raised dealt with social and economic impacts on the area which might result from building a harbor at Cross Village. People were concerned over the amount and type of development which might occur and any effects the development might have on local taxes. Other concerns expressed were; that the harbor size be kept as small as possible, that plans be looked at for developing a harbor for refuge purposes only, that the swimming beach be expanded beyond 200 feet, and that plans for controlling oil spills within the harbor be available. It was decided another workshop would be held in the near future to present more details on the alternate plans at Cross Village, Good Hart and Sturgeon Bay Point.

On 13 November 1980 a third public workshop was held. The meeting was held primarily as a follow up to the 27 August meeting to present detailed plans of the three harbor locations still being considered. The sites include Cross Village, Good Hart, and Sturgeon Bay Point. Also presented were data on the benefits and costs associated with each harbor plan which had not been available at the previous workshop. Approximately 100 people attended. Most citizens in attendance appeared to favor the harbor at Cross Village, however, there were still concerns about the size and commercial aspects of the harbor, as well as the effects on the property owners adjacent to the harbor site.

A formal public meeting was held on 16 June 1981 at the Holy Cross Community Hall in Cross Village following the distribution of the draft Phase I General Design Memorandum with Environmental Impact Statement to the public. The meeting was attended by approximately 100 people. The District Engineer's proposed recommendations for a harbor for light-draft vessels at Cross Village as shown in the draft report were presented and formal public statements concerning the proposed project were accepted.

The concerns raised, again centered on support for the harbor or anticipated adverse effects on the local small town environment or tax base. A new concern highlighted at this meeting was the loss of use of the township park during construction. Although the audience was mixed in their reaction to the proposed harbor, the majority of the attendees appeared to favor a harbor at Cross Village. A digest of the meeting can be found in Appendix D, page D-62.

PROBLEMS, OPPORTUNITIES, AND CONCERNS

The previous sections have identified a need for a harbor for light-draft vessels in the study area. Four sites have been investigated as possible locations for a harbor. Each site demonstrates certain problems which would make it difficult to build a harbor at that site or opportunities that would appear to favor building the proposed harbor at that site. Also, local residents and interested agencies and groups have voiced certain concerns about the effects resulting from building a harbor at a particular site which need to be addressed. This section lists those problems, opportunities, or concerns that have been identified for each proposed site.

Cross Village

a. A 2.4 acre wetland area and part of a smaller wetland area are located on the site.

b. The Lake Huron tansy (Tanacetum huronense), Pitcher's thistle (Cirsium pitcheri), and thickspike wheatgrass (Agropyron dasystachyum) have been identified on the site. These plants are on the State of Michigan's list of threatened plant species.

c. The site is located near established commercial developments, and where there is adequate room for expanding such development.

d. The site is reportedly under public ownership.

e. There is good access to the site.

f. Some utility services are available and others may soon become available.

g. In a 26 September 1979 letter report the U.S. Fish and Wildlife Service requested that material from the existing breakwater be relocated to form new fish habitat.

h. If dredged materials are polluted they should not be placed in open water environments.

i. The power line to Beaver Island runs through the proposed site.

j. Area residents desire a swimming beach to be maintained on township property.

k. Local residents have expressed the desire to keep the narbor as small as possible.

l. Concerns expressed by local residents about the possible effects of the harbor on the town include:

(1) the cost of harbor operation to local taxpayers.
(2) whether the harbor would require increased police and fire protection.
(3) whether a harbor would affect property taxes in the area.
(4) township residents desire to retain control of the harbor growth and commercial functions within the harbor.
(5) what facilities would be made available for sewage disposal.
(6) whether the harbor would create excessive damage to roads due to increased traffic.
(7) control of population influx.
(8) control of commercial expansion in the village.

(9) the cost of insurance for the harbor.

(10) the impact of construction on community activities.

m. Local citizens also expressed a desire for the right of final approval or rejection of construction of the harbor.

Good Hart

a. Sufficient public land for the proposed harbor does not exist at this site. The purchase of additional private property by the State or local governments would be required to construct a harbor.

b. There is little natural protection from lake storms in the area.

c. Access to the project site is poor.

d. There are no commercial facilities (grocery stores, restaurants, etc.) at the site and no available land nearby for development of such facilities.

e. The shoreline terrain is not conducive to constructing large on-shore facilities.

f. A Michigan threatened plant species, the Lake Huron tansy (Tanacetum huronense), is found at the site.

Sturgeon Bay Point

a. The proposed site is on potentially unstable sand dune topography.

b. The area is highly scenic and largely unspoiled by human activity.

c. There are no commercial facilities in the immediate area.

d. Sufficient public land is available for the project.

e. There is a high degree of natural protection from wind and wave action provided by islands and other geographical features.

f. Three plant species on the Michigan threatened species list are found on the site: Lake Huron tansy, Pitcher's thistle, and thickspike wheatgrass.

Little Sucker Creek

a. This site is out of the normal cruising routes used by recreational boaters.

b. The area is located in shallow, shoaled and rock strewn waters.

c. Extensive marsh areas along the shoreline provide good spawning habitat and waterfowl resting areas.

d. Access to the site is poor.

e. There are no commercial facilities in the area.

MANAGEMENT MEASURES

Management measures as used in this section are alternative means, structural or nonstructural, which are capable of meeting the needs of the study area or answering concerns raised by interested parties as stated in the previous section. Various combinations of these measures will be made to form alternative plans during the plan formulation stage of the study.

The expressed need of the study area is for a harbor to provide berthing areas for permanent and transient recreational craft, to provide refuge under adverse weather conditions, and to provide a base of operations for commercial fishing enterprises and a ferry servicing Beaver Island. This can be accomplished through the provision of structural measures including the following items.

a. Breakwaters. To provide an area protected from wind and wave action, offshore breakwaters would be used. Breakwaters could be rubble-mound, steel sheet piling, or steel cell construction, or any combination of these types.

b. Channels. Access both to the harbor and to docking areas within the harbor would need to be dredged. The depths and widths of these channels would need to accommodate the largest craft anticipated to be using the harbor.

c. Anchorage. Temporary refuge from storms would be provided by an anchorage area to allow boats to moor in the calmer waters inside the breakwaters. The anchorage would be as small as possible to keep the harbor size to a minimum, would be separate from the channels to avoid blocking craft berthed at or trying to reach the dock facilities, and would need to accommodate the largest vessel anticipated to use the harbor.

d. Berthing Areas. Because all anticipated uses are not thought to be compatable, separate berthing areas would be required for recreational craft, commercial fishing vessels, and the Beaver Island ferry.

e. Launching Ramp. A small boat launching ramp would be provided to handle trailerable boats which make up a large part of the boating demand.

f. Shore Facilities. Support facilities would be required to facilitate boating activities. These would include adequate parking areas, availability of fuel supplies, sanitary facilities for people, and pumpout facilities for boats.

The harbor would be located on the Michigan mainland within a 30 to 40 mile cruising range from harbors located at either Harbor Springs, Michigan, or Mackinaw City, Michigan. Four potential sites located in that area are; Cross Village, Michigan; Good Hart, Michigan; Sturgeon Bay Point in the Mackinaw State Forest; and Little Sucker Creek in the Wilderness State Park.

Dredging activities would necessitate a means of disposing of the dredged material. Alternative measures to accomplish this include upland disposal, open water disposal, or the use of the material for beach nourishment.

The local residents have indicated they would like a swimming beach maintained on township property at Cross Village. To accomplish this, the harbor layout could be shifted to one side of the property, the breakwater alignment adjusted to leave as large an area as possible for a swimming beach, additional beach area could be built up through the use of dredged material, or some combination of these measures could be used.

A harbor located at Cross Village would necessitate the removal of the ruins of the 1939 Works Progress Administration breakwater. This would require disposal of the timber portions of the breakwater. The stone material could be disposed of in an offshore or upland disposal site or reused in one of two ways. First, it could be used as fill material for the proposed breakwater. Second, the material could be deposited in small reefs offshore to be used as fish habitat. This second measure would require the material to be deposited in such a manner that it would not be a hazard to navigation.

Local residents of the Cross Village area have repeatedly expressed concerns over local control of a harbor. They are concerned that they retain control of what commercial operations are allowed in the harbor and retain the final approval or denial of the construction of the harbor. The State of Michigan Department of Natural Resources would be the local sponsor of the project. Under the items of local cooperation it is the responsibility of the local sponsor to provide the necessary lands for the project. The land must first be obtained from the Cross Village Township, which is reportedly the present owner. It is up to these two groups to work out the arrangements for providing the items of local cooperation.

Several concerns of the local residents of the Cross Village area deal with sociological impacts of a harbor; what effect would the harbor have on

the growth and economy of the area. It is ultimately the responsibility of the local governments to plan for and manage their own progress. The Emmet County Zoning Ordinance, adopted on 24 August 1972 under Act 183, Public Acts of 1943 of the State of Michigan, gives the county government certain regulatory powers for those portions of Emmet County lying outside the limits of incorporated cities and villages. The requirements of the ordinance are administered by a County Zoning Administrator who sees to it that all new buildings and any changes in the use of existing structures conform to the ordinance. Residents have the opportunity for participation in the regulatory process by means of amendments to the ordinance or by appealing rulings of the Zoning Administrator to a Board of Appeals.

INVESTIGATIONS

INVESTIGATIONS USED FOR PHASE 1 GDM STUDIES

This Phase I General Design Memorandum reexamines the authorized project and looks at alternative sites for a proposed harbor. It investigated alternative harbor designs, wave studies, littoral movement, preliminary cost estimates, recreational demand, and an environmental analysis including the suitability of dredged material disposal sites. Also looked at were the impacts of the harbor on existing communities and on future development within the study area.

Field Surveys. Soundings were taken at 200-foot intervals for the proposed sites at Cross Village, Good Hart, and Sturgeon Bay Point. The soundings were used to determine the relative co s for harbor structures and to determine the amount of dredging which would be required (see Appendix A, Design Analysis).

Several trips were made to the study area by personnel of the Corps of Engineers, Michigan Department of Natural Resources, and U.S. Fish and Wildlife Service to investigate the environmental settings of the alternative locations. The information obtained on these trips is found in the

section titled "Description of the Study Area" and in the Environmental Impact Statement.

Technical Studies. The hydrography, wave action, and littoral movement of the proposed sites at Cross Village, Good Hart, and Sturgeon Bay Point were analyzed. This information was used to determine harbor breakwater layout and size. Quantities of material needed for construction of the breakwaters were estimated and a first cost estimate obtained. This information is presented in Appendix A -- Design Analysis.

Social Studies. An examination of the human resources of the study area including population, housing, employment, education, health care, and emergency services was performed. Also examined were area land use and recreational opportunities provided in the study area. This information is presented in detail in Appendix C -- Human Resources.

Economic Studies. Studies of recreational boating activity in the Cross Village area were updated in 1980. The boating data was tabulated by the number, length, and type of vessel expected to use a harbor at Cross Village. Personal contact with area residents and businessmen revealed information on navigation difficulties in the Cross Village area, vessel damage, and potential economic benefit to the Cross Village community. Potential benefits due to commercial and recreational fishing, and relocation of the Beaver Island Ferry to the study area were developed through contacts with key Federal, state, and local agencies, and commercial interests. The information was used in performing a benefit to cost analysis of the proposed sites. Detailed information can be found in Appendix B -- Economic Studies.

Water Quality and Sediment Sampling. Water quality and bottom sediment samples were taken at the authorized site on November 9, 1979. Samples were subsequently sent for laboratory testing and found to be uncontaminated (see Supplement 1 of the EIS, page I-1).

Cultural Resource Report. An archaeological and historical reconnaissance study was performed at the Cross Village site to identify any sites of historic or cultural importance. The study involved a walk-over survey, a record search for reported sites, a search for historical references and selected shovel testing. A draft report has been coordinated with the State of Michigan Historic Preservation Officer.

Soil Borings. Ten soil borings were taken in the vicinity of the authorized harbor site at Cross Village in July 1979. The results are shown in Supplement II of the Environmental Impact Statement.

Public Workshops and Meetings. As discussed earlier, three public workshops and a formal public meeting were held at Cross Village, Michigan, to obtain views and concerns of local residents, both permanent and seasonal, and input from governmental entities at all levels. The dates of the meetings were 6 December 1978, 27 August 1980, 13 November 1980, and 16 June 1981.

FUTURE INVESTIGATIONS

More detailed surveys and subsurface exploration will be required during subsequent steps in the post authorization planning process (Phase II General Design Memorandum, Plans & Specifications) to arrive at a final harbor design. Also, during these subsequent steps, a detailed real estate study will be required to accurately designate property boundaries required for the project. As a result of coordination with the State of Michigan Historic Preservation Officer, a detailed historical/architectural study is to be performed in the Cross Village area. Methods of wastewater treatment and the effects of area growth on water supplies will also be studied further.

PLAN FORMULATION AND EVALUATION

FORMULATING A PLAN

Plan formulation is a subjective process by which a plan is developed which provides the best uses or combination of uses of water and land resources to meet the identified needs of the project area, yet is consistent with the scope of investigations permitted under the study authority. This process involves identification and development of alternative plans, the evaluation and comparison of these plans and their impacts, and the selection of the plan that best satisfies the National objectives and planning objectives of the study.

PLANNING OBJECTIVES

Planning objectives are the National, state, and local water and related land resource management needs specific to a given study area which provide general guidelines for formulating project plans. The planning objectives are identified from an analysis of the problems, needs, concerns, and opportunities within the area.

The overall purpose or goal of water and land resource planning is to promote the quality of life through the attainment of two national objectives of enhancing National Economic Development (NED) and Environmental Quality (EQ).

National economic development is enhanced by increasing the value of the Nation's output of goods and services and improving National economic efficiency.

The quality of the environment is enhanced by the management conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources, and ecological systems.

In addition to the National objectives regarding National Economic Development (NED) and Environmental Quality (EQ), the following planning objectives have been identified:

a. To improve recreational boating opportunities on northeastern Lake Michigan in the vicinity of Cross Village, Michigan, during the 1985-2035 period of analysis.

b. Contribute to navigation safety of light-draft vessels on northeastern Lake Michigan in the vicinity of Cross Village, Michigan, during the 1985-2035 period of analysis.

c. To enhance light-draft commercial navigation on northeastern Lake Michigan in the vicinity of Cross Village, Michigan, during the 1985-2035 period of analysis.

d. To enhance recreational and commercial sport fishing opportunities on northeastern Lake Michigan in the vicinity of Cross Village, Michigan, during the 1985-2035 period of analysis.

e. To preserve wetlands at Cross Village Township Park for their beneficial effects on wildlife during the 1985-2035 period of analysis.

f. To preserve a swimming beach at Cross Village Township Park for use by local residents and vacationers during the 1985-2035 period of analysis.

PLANNING CONSTRAINTS

As plans are formulated to meet the needs and opportunities of the study area, certain constraints or limitations arise which narrow the range of alternatives which can be used. These limitations include:

a. The project location should comply with the spacing requirements recommended in the 1943 Corps of Engineers' report on Harbors of Refuge for the Great Lakes (30-40 miles distance between the harbors).

b. The annual maintenance dredging required by any selected plan should be minimized.

c. Adverse impacts on the area's ecosystem should be minimized.

d. Development at the Cross Village site is limited by the land presently available in public ownership.

FORMULATION AND EVALUATION CRITERIA

A standard set of criteria was adopted to permit a fair, objective appraisal of the merits and disadvantages of various alternatives. Such criteria come under the following headings: technical, economic, and environmental.

Technical criteria require that the dimensions of the selected plan be such as to accommodate safe access by expected users, safe traffic movements in both the harbor and the lake, and provide for continuing usage in the future. The selected plan must also permit unrestricted access to berthing and anchorage areas to fit the existing or expected fleet of recreational water craft normally using this area of the Great Lakes.

Economic criteria require that tangible benefits for the overall project should exceed project costs. The scope of development must be such that the benefits exceed project costs to the maximum extent possible (maximum net benefits). The costs of alternative plans of development are based on current prices, the adopted 50-year period of economic analysis, and an interest rate of 3-1/4 percent. An interest rate of 3-1/4 percent is in accordance with the provisions of Section 80(b) of the 1974 Water Resources Development Act since the Michigan Department of Natural Resources

certified its willingness to assure the requirements of local cooperation on 21 April 1969.

Environmental criteria involved require the identification of forms of aquatic life and wildlife which might be endangered by a plan's implementation, a minimal disruption of an area's natural resources, avoidance of plans with severe social impacts, and use of measures in the selected plan to protect or enhance existing environmental values.

PLANS CONSIDERED

Preliminary Evaluations and Conclusions

During the preparation of the preliminary Phase I General Design Memorandum (Stages 1 and 2) several alternative harbor configurations were evaluated for the area near the Cross Village site. The plans involved combinations of rubblemound or steel sheet pile cellular breakwaters, earth dikes with riprap protection, and excavated inland basins. The suggested plans are shown in Figures 5 thru 9.

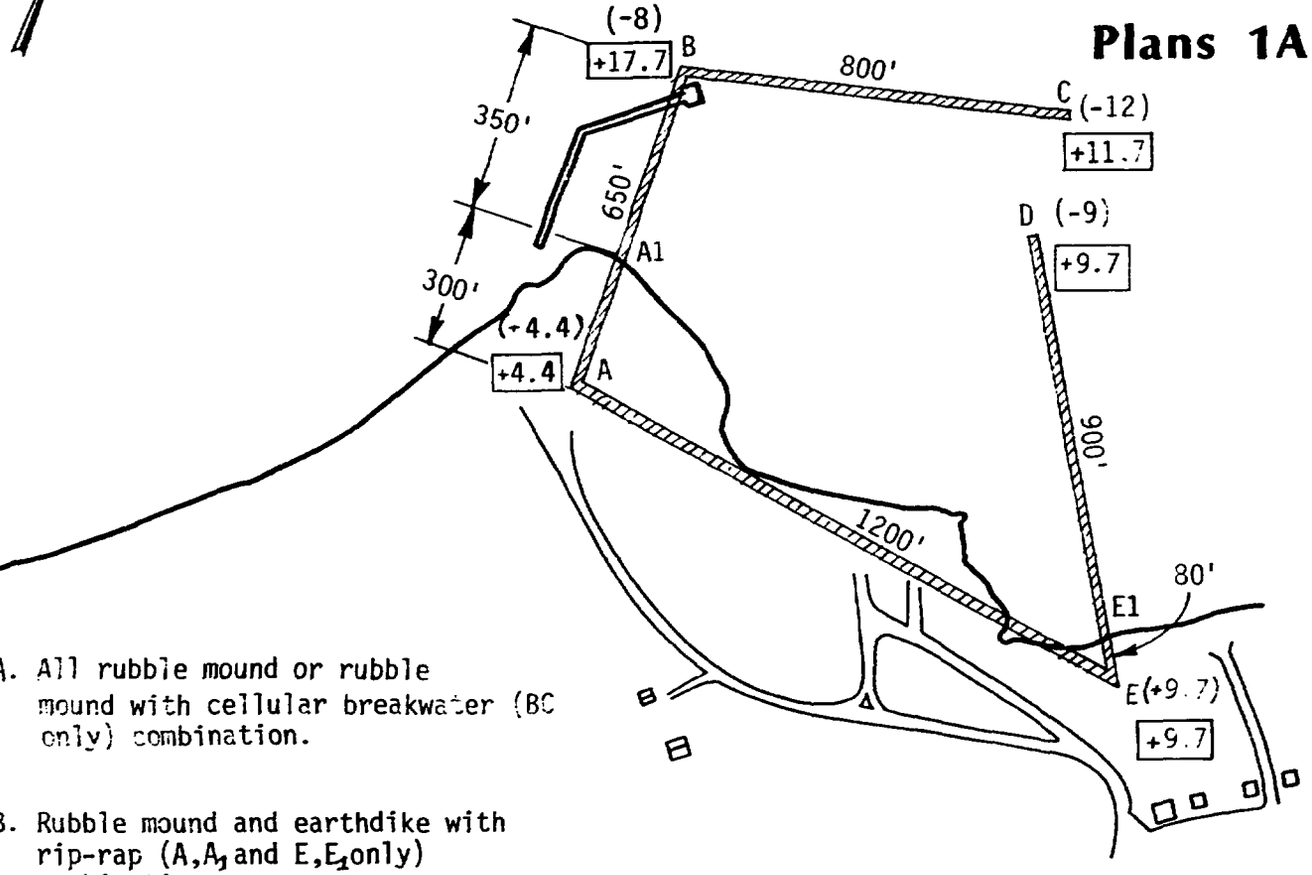
Further investigation during the more detailed planning studies (Stage 3) indicated that only Plans 1A and 1B, which are similar to the recommended and authorized plans, would merit further study. Plans 2A and 2B did not take into account the environmental resources of the study area and would have adversely disrupted the wetland areas at the site. Analysis of the cost data of Plans 3A, 3B, 4A, 4B, and 5 indicated that they were not economically viable plans. In addition, the local sponsor indicated funds were not available for purchase of additional lands beyond that which is available at the Cross Village Township Park.

In an effort to determine if Cross Village is still the best location for a harbor for light-draft vessels, four sites were evaluated during the Stage 3 planning process. After an initial investigation of the resources,

Cross Village Harbor

PRELIMINARY PHASE I GENERAL DESIGN MEMORANDUM

Plans 1A and 1B*



*1A. All rubble mound or rubble mound with cellular breakwater (BC only) combination.

1B. Rubble mound and earthdike with rip-rap (A,A_1 and E,E_1 only) combination.

ELEVATIONS :

( ) Existing

▭ Proposed

FIGURE 5

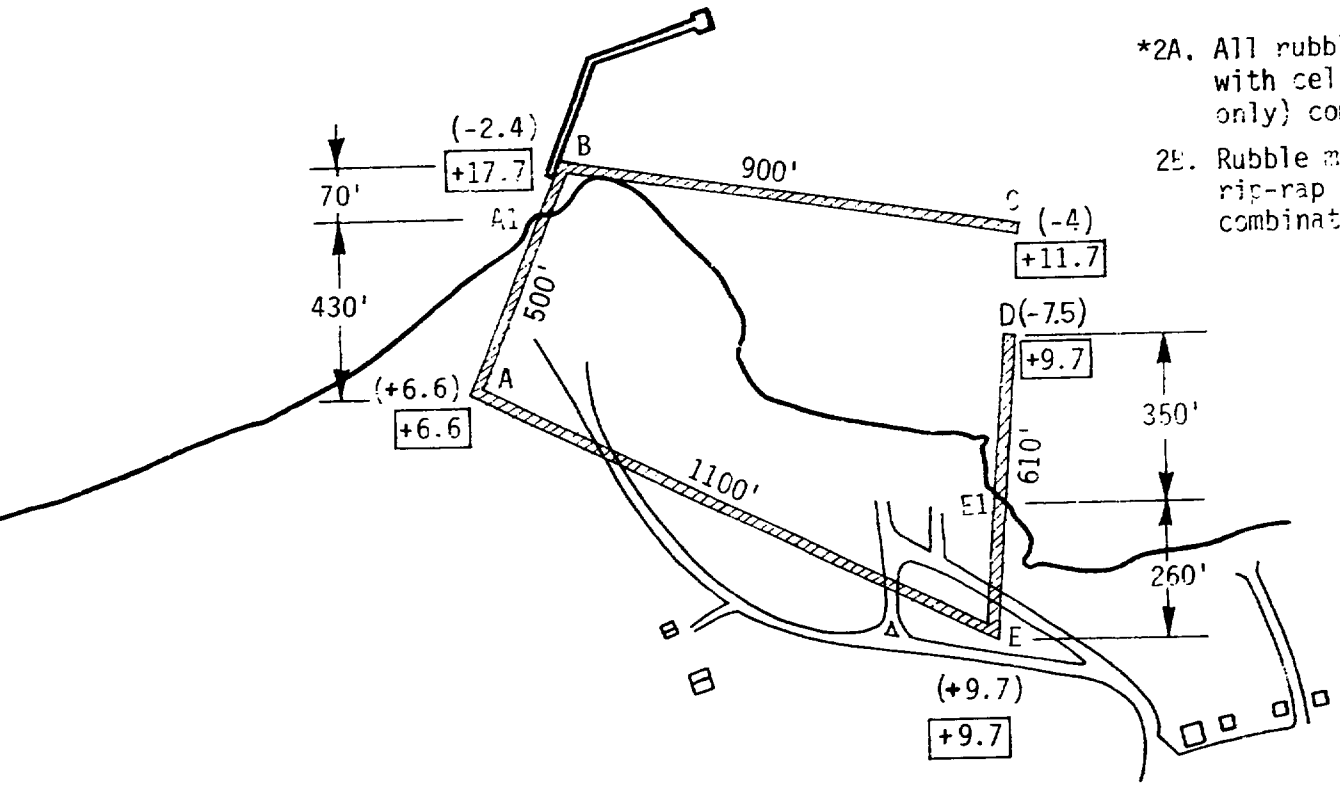
Cross Village Harbor

PRELIMINARY PHASE I GENERAL DESIGN MEMORANDUM

Plans 2A and 2B*

*2A. All rubble mound or rubble with cellular breakwater (BC only) combination.

2B. Rubble mound and earthdike with rip-rap (A,A1and E,E1only) combination.

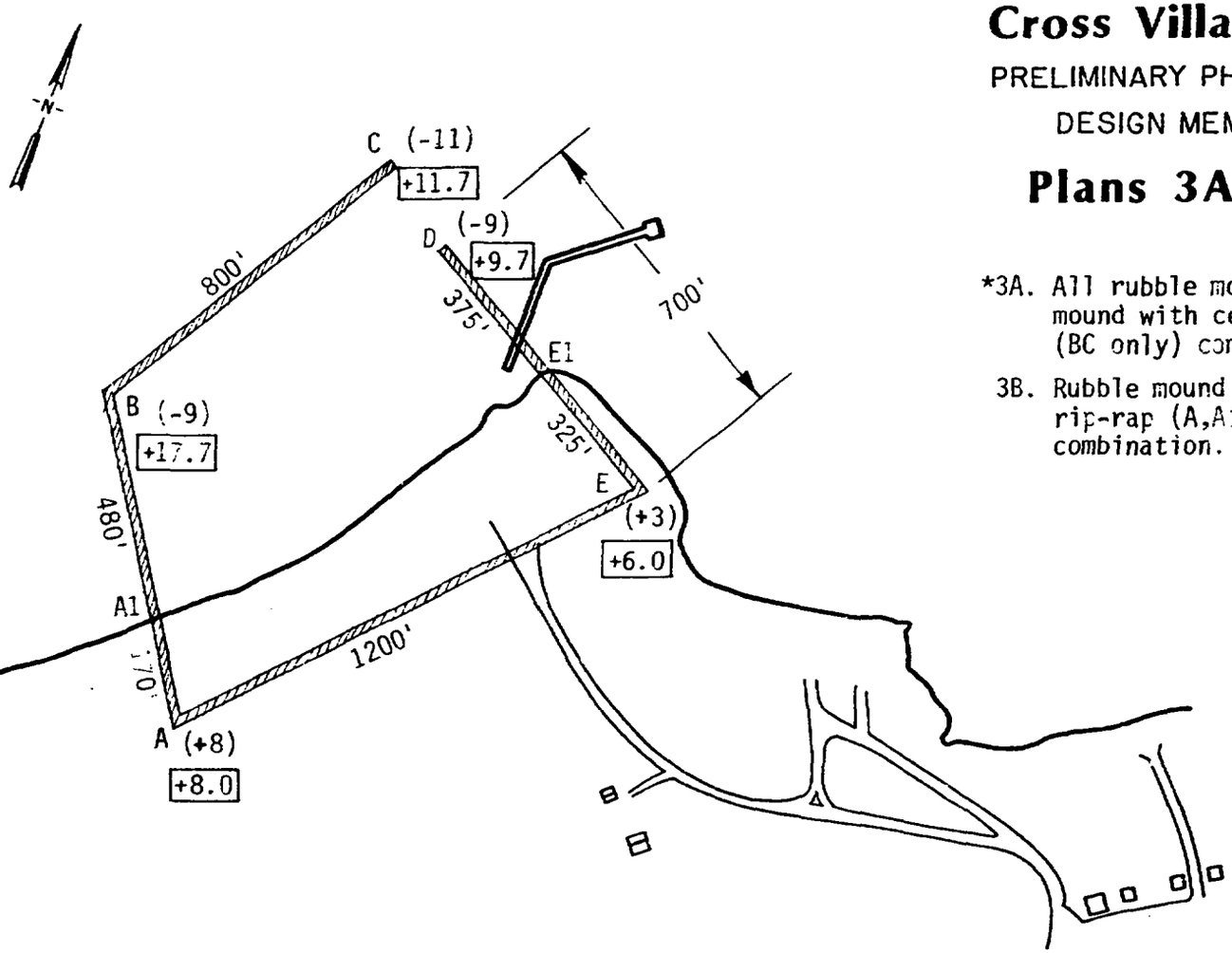


ELEVATIONS :

( ) Existing

▭ Proposed

FIGURE 6



Cross Village Harbor

PRELIMINARY PHASE I GENERAL DESIGN MEMORANDUM

Plans 3A and 3B*

*3A. All rubble mound or rubble mound with cellular breakwater (BC only) combination.

3B. Rubble mound and earthdike with rip-rap (A,A1and E,E1only) combination.

ELEVATIONS :

( ) Existing

▭ Proposed

FIGURE 7

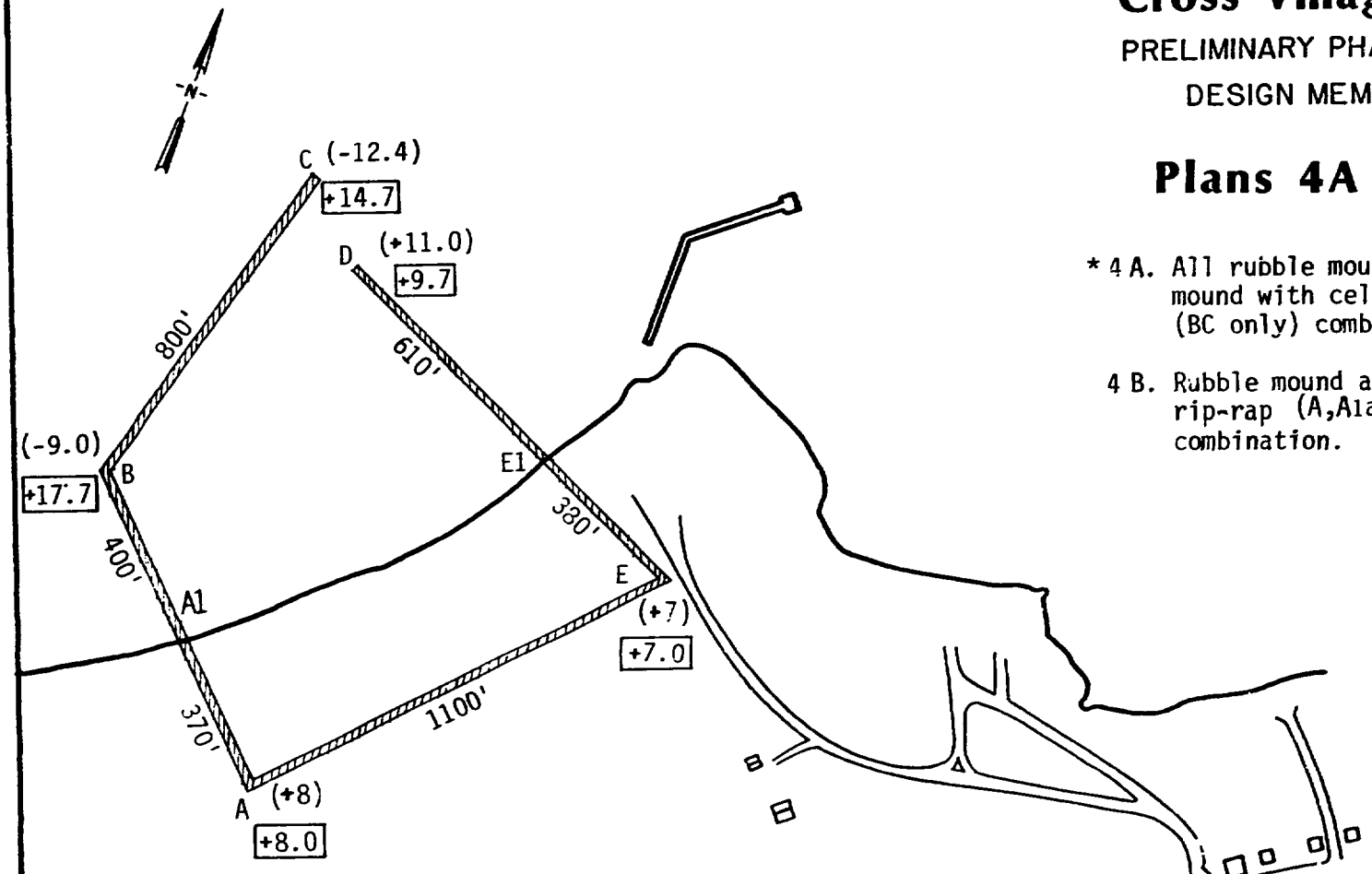
Cross Village Harbor

PRELIMINARY PHASE I GENERAL
DESIGN MEMORANDUM

Plans 4A and 4B*

* 4 A. All rubble mound or rubble mound with cellular breakwater (BC only) combination.

4 B. Rubble mound and earthdike with rip-rap (A,A1and E,E1only) combination.



ELEVATIONS :

( ) Existing

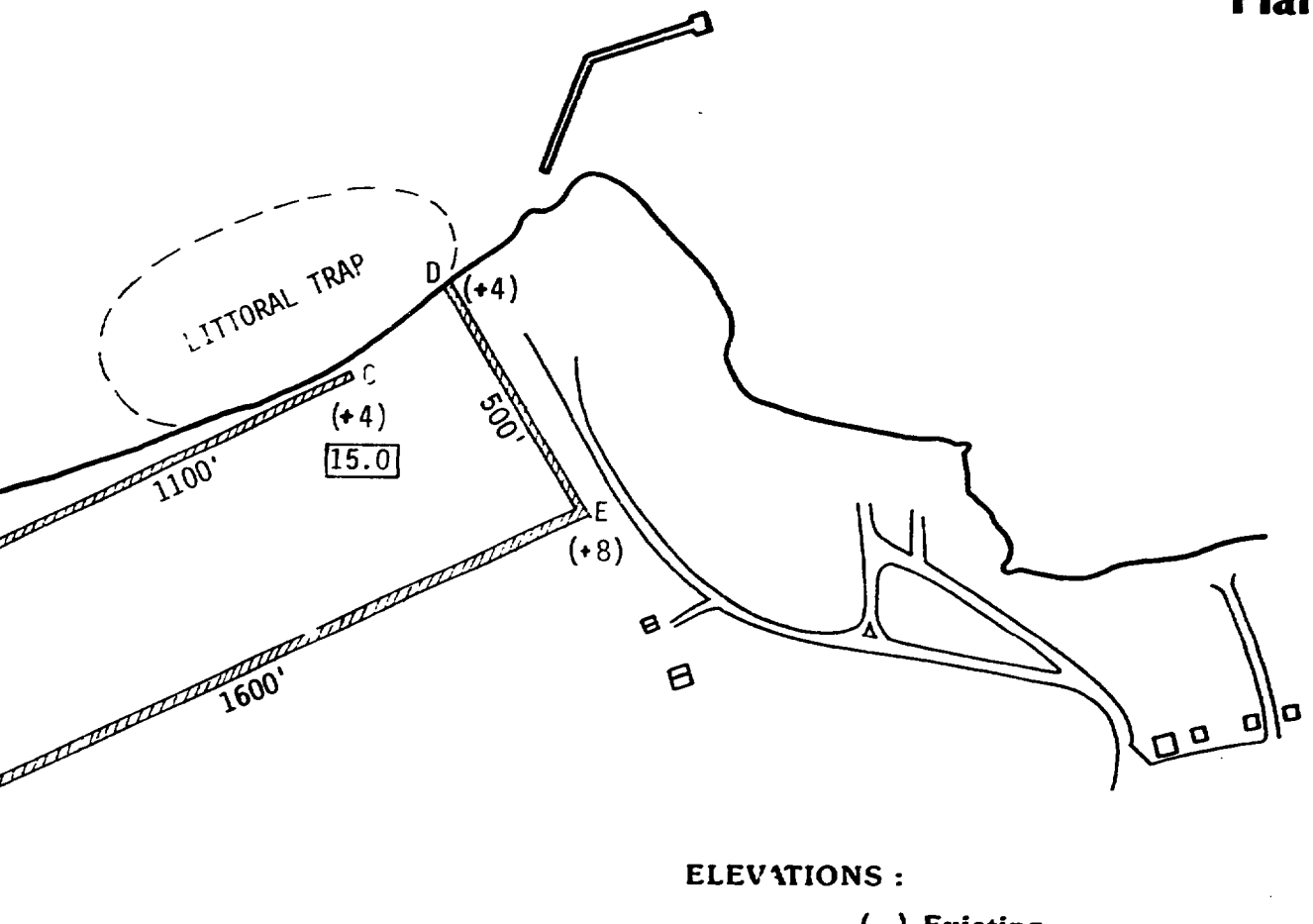
▭ Proposed

FIGURE 8

Cross Village Harbor

PRELIMINARY PHASE I GENERAL
DESIGN MEMORANDUM

Plan 5



ELEVATIONS :

( ) Existing

▭ Proposed

FIGURE 9

problems, and opportunities presented by each of the sites, it was determined the site near Little Sucker Creek in the Wilderness State Park was not feasible and did not warrant further study.

The Wilderness State Park is operated by the Michigan Department of Natural Resources. The park, as indicated by its name, has a limited number of developed facilities, providing instead a recreational experience based on enjoyment of the forest resources in a natural state. The proposed site on the southwest border of the park is well outside established cruising routes, requiring boaters to detour from their probable trip routes to replenish supplies, rest, or seek refuge. The shallow water in the vicinity is rocky and shoaled, and therefore not well suited for a harbor. Extensive marsh habitat providing spawning and resting areas for a wide variety of wildlife would be disrupted by development as would extensive forest areas as they were cleared for access and shore facilities. These factors considered, the proposed site is not suitable for the purpose of a light-draft vessel harbor.

The remaining three sites, Good Hart, Cross Village, and Sturgeon Bay Point exhibited enough potential for meeting the planning objectives to warrant additional study. Discussions with local residents, the Michigan Department of Natural Resources, and other state and Federal agencies resulted in a proposed harbor plan for each site.

Description of Detailed Plans

Three alternative plans of the layout of general navigation facilities (breakwaters, anchorage, and channels) necessary to accommodate the anticipated recreational and commercial boating demand of the area are analyzed in this report. The three plans are listed below.

Alternative 1: Cross Village, Michigan, modified plan (Figure 10)

Alternative 2: Good Hart, Michigan (Figure 11)

Alternative 3: Sturgeon Bay Point (Figure 12)

As shown in Figures 10-12, the structural alternatives consist of totally rubblemound breakwaters of lengths and orientations sufficient to enclose a two acre anchorage area, access channels, and a berthing area which can accommodate up to 104 small recreational craft, commercial fishing boats, and a passenger and car ferry operation. The breakwater dimensions and orientations have been designed to limit the wave height at the recreational boating docks to 1.5 feet. The access channel is a minimum of 140 feet wide and 12 feet deep outside the breakwaters and 10 feet deep within. The anchorage area is also 10 feet deep. Depths and widths of the proposed harbor channels and the depths of the anchorage area are based on guidelines presented in the Coastal Engineering Research Center (CERC) Special Report No. 2 of December 1974 using the dimensions of the vessels Beaver Islander and South Shore. These vessels, operated by the Beaver Island Boat Company, are the largest boats expected to use the harbor. A concrete walkway and a safety handrail would be placed along the crest of the breakwaters to facilitate recreational fishing.

Alternative 1 (Figure 10) is a modification of the Authorized Plan at Cross Village. The modifications reflect concerns expressed by local interests, changes in offshore topography caused by wind and wave actions, an increase in the number of boat slips required to meet existing demand in the area, changes in construction techniques, and attempts to preserve unique environmental characteristics of the area. These changes are described under the section titled, "Departures From Authorized Project".

In addition to the technical features listed above which pertain to all three alternatives, there are several aspects of Alternative 1 that are unique to that plan. A wetland area on the property has been defined and

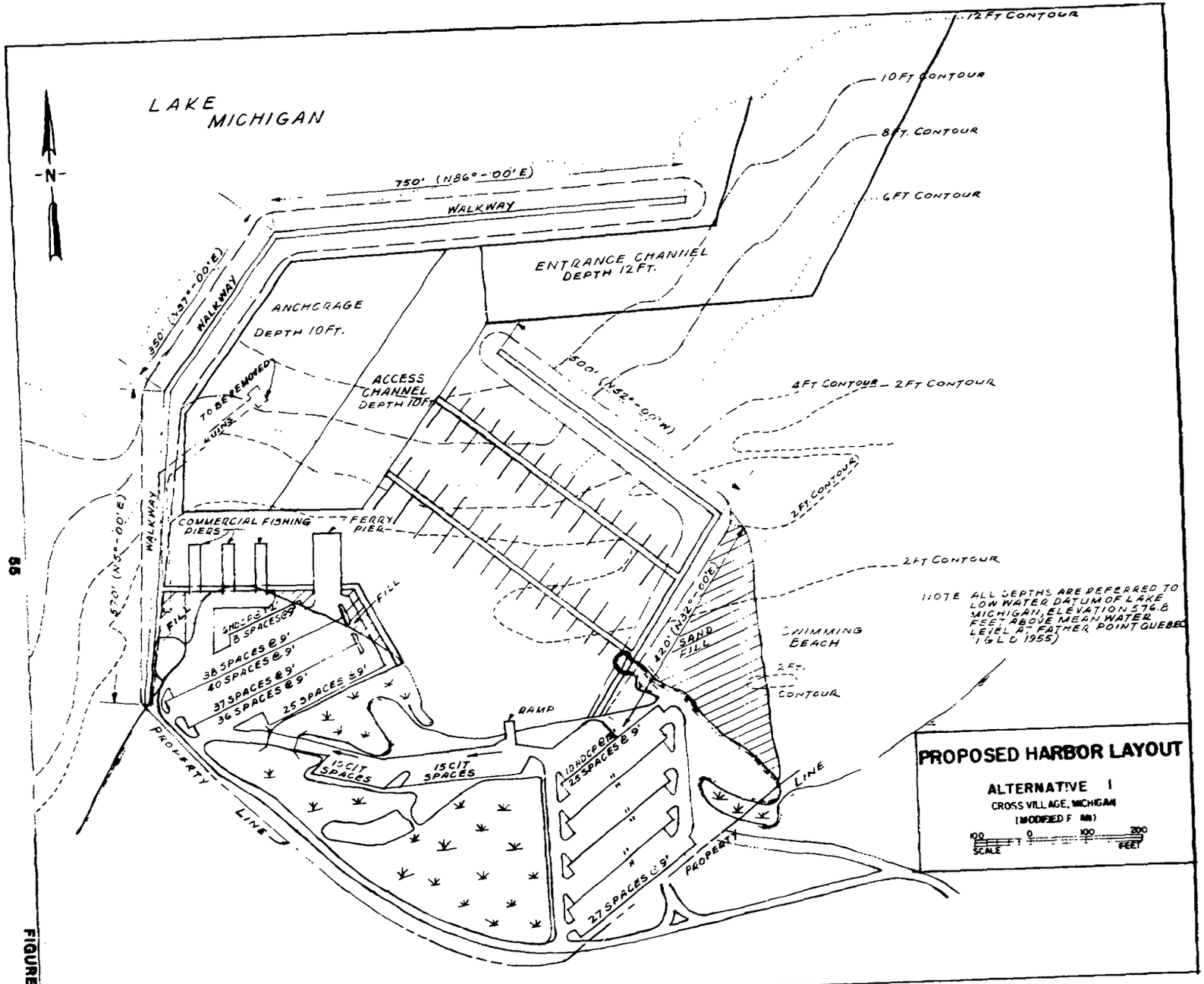

LAKE MICHIGAN
N
12 Ft CONTOUR
10 Ft CONTOUR
8 Ft. CONTOUR
6 FT CONTOUR
750' (N86°-00'E)
WALKWAY
ENTRANCE CHANNEL DEPTH 12 Ft.
ANCHORAGE DEPTH 10 Ft.
350' (N37°-00'E)
WALKWAY
500' (N52°-00'W)
4 Ft CONTOUR
2 Ft CONTOUR
ACCESS CHANNEL DEPTH 10 Ft.
TO BE REMOVED
RUINS
COMMERCIAL FISHING PIERS
FERRY PIER
WALKWAY
570' (N5°-00'E)
FILL
SAND FILL
8 SPACES @ 9'
38 SPACES @ 9'
40 SPACES @ 9'
37 SPACES @ 9'
36 SPACES @ 9'
25 SPACES @ 9'
RAMP
15 CIT SPACES
15 CIT SPACES
10 HANDICAP
25 SPACES @ 9'
27 SPACES @ 9'
PROPERTY LINE
PROPERTY LINE
420' (N32°-00'E)
SAND FILL
SWIMMING BEACH
2 FT. CONTOUR
NOTE ALL DEPTHS ARE REFERRED TO LOW WATER DATUM OF LAKE MICHIGAN, ELEVATION 576.8 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT QUEBEC (IGLD 1955)
PROPOSED HARBOR LAYOUT
ALTERNATIVE I
CROSS VILLAGE, MICHIGAN
(MODIFIED F MI)
100 0 100 200
SCALE
FEET

FIGURE 10

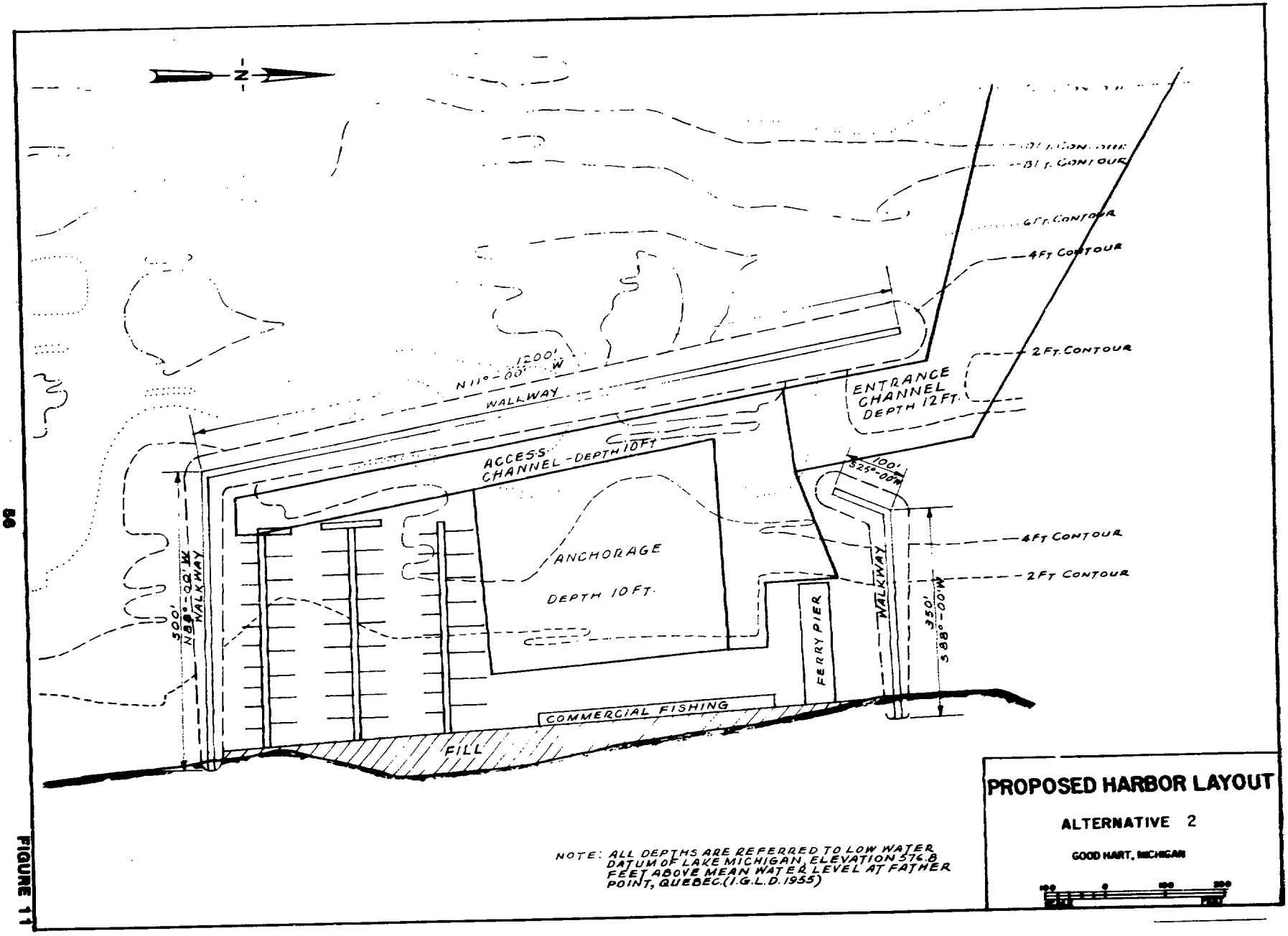

N
8 Ft. CONTOUR
6 Ft. CONTOUR
4 Ft CONTOUR
2 Ft. CONTOUR
ENTRANCE CHANNEL DEPTH 12 FT.
N 11°-00' W 1200'
WALLWAY
ACCESS CHANNEL - DEPTH 10 Ft
100'
S 25°-00' W
ANCHORAGE
DEPTH 10 FT.
4 Ft CONTOUR
2 Ft CONTOUR
WALKWAY
350'
S 88°-00' W
300'
N 88°-00' W
WALKWAY
FERRY PIER
COMMERCIAL FISHING
FILL
NOTE: ALL DEPTHS ARE REFERRED TO LOW WATER DATUM OF LAKE MICHIGAN, ELEVATION 576.8 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC. (I.G.L.D. 1955)
PROPOSED HARBOR LAYOUT
ALTERNATIVE 2
GOOD HART, MICHIGAN

FIGURE 11

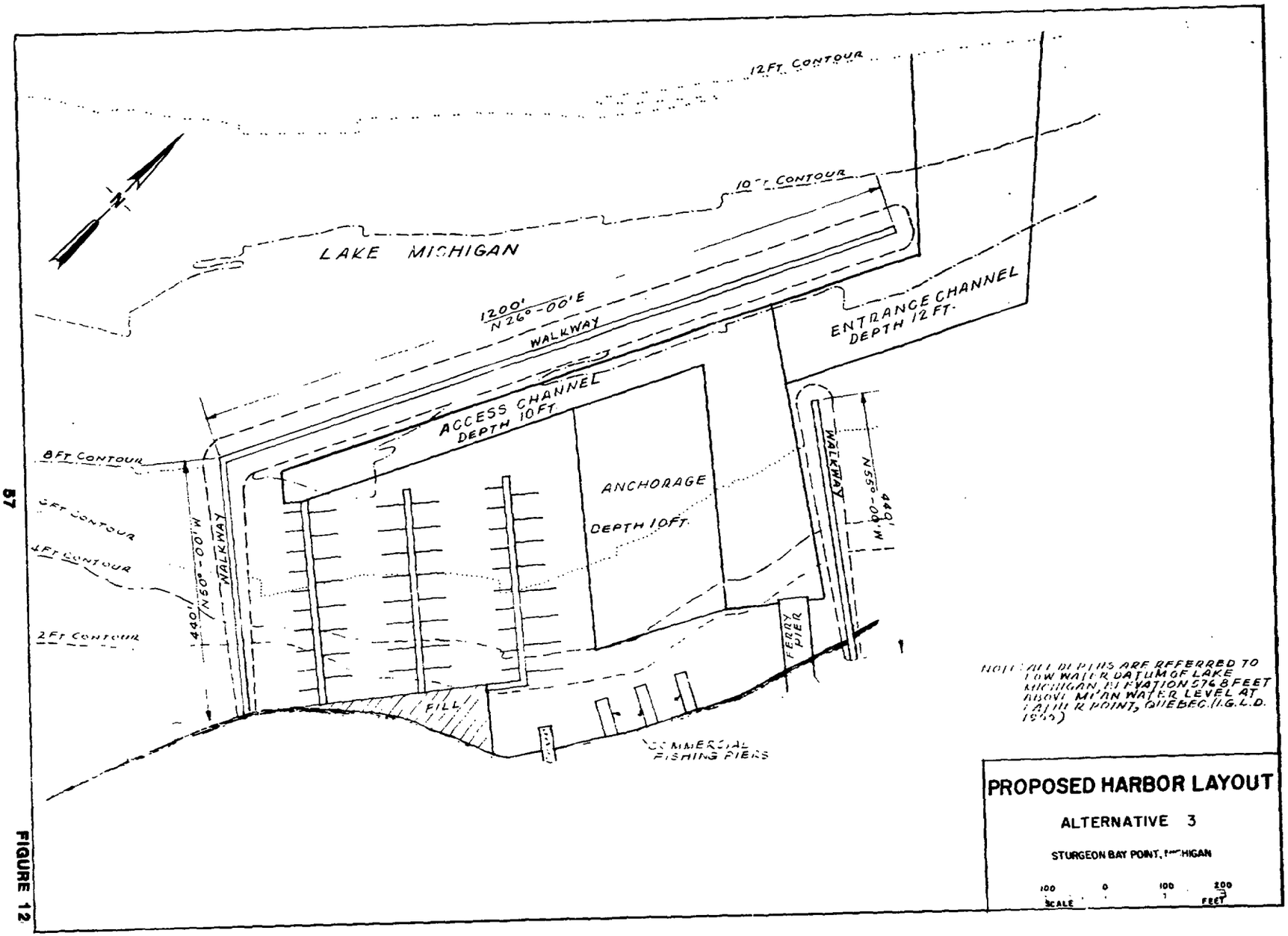

12Ft. CONTOUR
10Ft. CONTOUR
LAKE MICHIGAN
1200'
N 26°-00'E
WALKWAY
ENTRANCE CHANNEL
DEPTH 12 FT.
ACCESS CHANNEL
DEPTH 10FT.
8Ft CONTOUR
6Ft CONTOUR
4Ft CONTOUR
2Ft CONTOUR
440'
N 00°-00' W
WALKWAY
ANCHORAGE
DEPTH 10FT.
WALKWAY
N 55°-00' W
440'
FERRY PIER
FILL
COMMERCIAL FISHING PIERS
NOTE: ALL DEPTHS ARE REFERRED TO LOW WATER DATUM OF LAKE MICHIGAN, ELEVATION 576.8 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC. (I.G.L.D. 1955)
PROPOSED HARBOR LAYOUT
ALTERNATIVE 3
STURGEON BAY POINT, MICHIGAN
100 0 100 200
SCALE FEET

FIGURE 12

recommended plans for shore facilities designed around it to preserve wildlife and aesthetic values. To respond to the requests of the local residents it is recommended that the swimming area be expanded by moving the location of the east breakwater and built up with the use of clean dredged sand. The usable rock material from the existing Works Progress Administration breakwater would be disposed of in such a manner as to develop new fish habitat near the harbor to enhance recreational fishing.

IMPACT ASSESSMENT

Impact assessment is primarily an objective analysis conducted to identify, describe, and where possible, measure the likely economic, social, and environmental changes expected to result from implementation of each of the alternative plans. The changes are measured against the without condition as described earlier in the report. The beneficial and adverse impacts associated with each of the three alternatives are displayed in Table 1, System of Accounts.

DESIGNATION OF THE NED PLAN

As defined in the section on planning objectives, the National Economic Development objective is to increase the value of the Nation's output of goods and services and improve National economic efficiency. Accomplishment of this objective is measured by quantifying the contribution of net economic benefits of each alternative, that is, the dollars of benefits contributed annually to the National economy as a result of the Federal portion of the project in excess of those annual costs of building and maintaining the project. As seen in Table 1 -- System of Accounts, Alternative 2 -- Good hart, Michigan, provides the greatest number of net benefits ($144,199 as compared to Alternative 1 -- $49,354 and Alternative 3 -- $114,564). Therefore, Alternative 2, a harbor for light-draft vessels at Good Hart, Michigan, is the NED plan.

TABLE 1

SYSTEM OF ACCOUNTS

Accounts	Without Project Condition	(EQ PLAN) Alternative 1 Cross Village, MI (1.5')**	(NED PLAN) Alternative 2 Good Hart, MI (1.5')**	Alternative 3 Sturgeon Bay Point (1.5')**
1. National Economic Development (NED)				
a. Project Costs[1,6,9]				
(1) First Cost	No Costs			
Dredging of Channels and Anchorage		$ 335,000	$ 490,000	$ 335,000
Breakwaters		2,980,000	1,600,500	$ 1,966,500
Removal of Existing Stone/ Timber Piles		151,600	-	-
Walkway		392,450	505,250	488,800
Monitoring Plan - Initial Survey***		62,000	-	-
Est. Construction Cost		$ 3,921,050	$ 2,595,750	$ 2,730,300
Contingency (15%)		588,150	389,400	409,500
Subtotal		$ 4,509,200	$ 2,985,150	$ 3,139,800
Engineering & Design		470,000	470,000	470,000
Supervision & Administration		346,300	270,100	277,800
Gross Construction Cost		$ 5,325,500	$ 3,725,250	$ 3,887,600
Less Local Contribution		- 2,087,650	- 1,502,625	- 1,560,750
Net Federal Const. Cost		$ 3,237,850	$ 2,222,625	$ 2,326,850
Aid to Navigation		70,000	70,000	70,000
TOTAL FEDERAL FIRST COSTS		$ 3,307,850	$ 2,292,625	$ 2,396,850
TOTAL NON-FEDERAL FIRST COSTS		$ 2,087,650	$ 1,502,625	$ 1,560,750
TOTAL FEDERAL & NON-FEDERAL FIRST COSTS		$ 5,395,500	$ 3,795,250	$ 3,957,600
(2) Annual Charges	None			
Federal				
Interest		$ 107,500	$ 74,510	$ 77,900
Amortization		27,200	18,870	19,725
Monitoring Plan***		7,000	-	-
Maintenance		34,405	28,425	36,705
TOTAL		$ 176,105	$ 121,805	$ 134,330
Non-Federal				
Interest		$ 67,900	$ 48,835	$ 50,725
Amortization		17,200	12,365	12,845
Maintenance		1,700	2,200	2,100
TOTAL		$ 86,800	$ 63,400	$ 65,670
(3) Total NED Costs[1,6,9]	None	$ 262,905	$ 185,205	$ 200,000
b. Project Benefits[1,6,10] (Impacts, while occurring primarily in the study area, are held to be National in scope because of the contribution to the National economy.)	None			
(1) Value of Increased Output of Goods and Services				
(a) Recreational Boating		$ 179,140	$ 179,140	$ 179,140
(b) Harbor of Refuge		24,239	24,239	24,239
(c) Recreational Fishing		45,530	58,740	57,370
(d) Commercial Fishing		32,125	32,125	32,125
(e) Beaver Island Ferry		31,225	35,160	27,690
(2) Total NED Benefits		$ 312,259	$ 329,404	$ 320,564
c. Net NED Benefits	None	$ 49,354	$ 144,199	$ 120,564
d. Benefit - Cost (B/C) Ratio	N.A.	1.19	1.78	1.60

Timing

1. Impact is expected to occur prior to or during implementation of plan.

2. Impact is expected within 15 years following plan implementation.

3. Impact is expected in a longer time frame (15 or more years) following implementation.

Uncertainty

4. The uncertainty associated with the impact is 50% or more.

5. The uncertainty is between 10% and 50%.

6. The uncertainty is less than 10%.

Exclusivity

7. Overlapping entry; fully monetized in NED account.

8. Overlapping entry; not fully monetized in NED account.

Actuality

9. Impact will occur with implementation.

10. Impact will occur only when specific additional actions are carried out during implementation.

11. Impact will not occur because necessary additional actions are lacking.

*Items specifically required in Section 122 and ER 1105-2-240.

**Design wave height inside harbor.

***Costs for monitoring plan were not originally included in the economic analysis. They have been added to the Cross Village plan for consistency with the rest of the report.

TABLE 1

SYSTEM OF ACCOUNTS (Con. ed)

Accounts	Without Project Condition	(EQ PLAN) Alternative 1 Cross Village, MI (1.5')**	(NED PLAN) Alternative 2 Good Hart, MI (1.5')**	Alternative 3 Sturgeon Bay Point (1.5')**	Index of Footnotes
2. Environmental Quality (EQ) Impacts will occur at site locations.					Timing 1. Impact is expected to occur prior to or during implementation of plan. 2. Impact is expected within 15 years following plan implementation. 3. Impact is expected in a longer time frame (15 or more years) following implementation.
a. Lands Required for Project[1,2,3,9]					
Residential (Acres)	None	0.0	7.2	0.0	
Forest (Acres)	None	0.0	0.0	6.4	
Park (Acres)	None	6.6	1.0	0.0	
Wetlands (Acres)	None	2.4	0.0	0.5	
b. Archeological Sites Affected	No sites have been identified in the area.	No sites are known.	No sites are known.	No sites are known.	Uncertainty 4. The uncertainty associated with the impact is 50% or more.
c. Historical Sites Affected.	No plans are known to promote any specific sites in the area.	No sites would be affected by project construction.	No sites are known.	No sites are known.	5. The uncertainty is between 10% and 50%.
d. Effects on Biological Communities [1,6,8,9]	Established benthic communities would not be disturbed. Wetland areas of Cross Village and Sturgeon Bay Point will be undisturbed. Delicate dune areas are expected to receive protection.	Benthic communities would be destroyed due to dredging and placement of breakwaters. Breakwaters would provide a sheltered area conducive to growth of macrophytes and benthic organisms nourished by material flowing from wetland area. A 2.4 acre wetland will be preserved in its present state. Possibility for some damage to wetland during construction. Foredune areas would be leveled for onshore facilities.	Benthic communities would be destroyed due to dredging and placement of breakwaters. Some areas may eventually be recolonized. A segment of a low foredune would be leveled for onshore facilities.	Benthic communities would be destroyed due to dredging and placement of breakwaters, but some areas may eventually be recolonized. Part of a small wetland area would be destroyed. Shore facilities and access roads would disrupt the sand dune areas behind the proposed site. Additional erosion in the area would disrupt the delicate dune ecosystem of the Sturgeon Bay Dunes area northeast of the proposed site.	6. The uncertainty is less than 10%.
e. Vegetation[1,6,8,10]	No significant changes are expected; however, the continued growth of dune vegetation may further stabilize the dune ecosystem.	Some loss of grassland and a small wooded area to develop facilities. Submerged plant species could colonize harbor	Loss of fairly extensive wooded areas to develop shore facilities and widen access roads. Submerged plant species could colonize harbor.	Loss of fairly extensive wooded areas to develop shore facilities and widen access roads. Submerged plant species could colonize harbor.	Exclusivity 7. Overlapping entry; fully monetized in NED account. 8. Overlapping entry; not fully monetized in NED account.
f. Fish and Wildlife[1,5,8,9]	No adverse affects are anticipated on local fish and wildlife populations.	Breakwaters would provide improved habitat conducive to the production of algae, invertebrates, and small game fish. Additional habitat would be created by forming offshore reefs with rubble from existing WPA breakwater. Temporary disruption of animal populations due to construction.	Breakwaters would provide improved habitat conducive to production of algae, invertebrates, and small game fish. Temporary disruption of animal populations due to construction.	Breakwaters would provide improved habitat conducive to production of algae, invertebrates, and small game fish. Temporary disruption of animal population due to construction.	Actuality 9. Impact will occur with implementation. 10. Impact will occur only when specific additional actions are carried out during implementation. 11. Impact will not occur because necessary additional actions are lacking.
g. Threatened and Endangered Species	Four known Michigan threatened plant species would receive protection if Wilderness State Park expands its boundaries to Sturgeon Bay Point.	Stands of state threatened plant species, Lake Huron tansy, Pitcher's thistle, and thickspike wheatgrass, would be destroyed by construction of onshore facilities. No endangered or threatened animal species have been identified.	Stand of state threatened plant species Lake Huron tansy would be destroyed by construction of onshore facilities. No endangered or threatened animal species have been identified.	Stands of state threatened plant species Lake Huron tansy, Pitcher's thistle, and thickspike wheatgrass, would be destroyed by construction of onshore facilities. No endangered or threatened animal species have been identified.	*Items specifically required in Section 122 and ER 1105-2-240. **Design wave height inside harbor.
h. Aesthetics[2,5,8,9]	Extensive scenic beaches would continue to be used for recreational purposes. Some beach area would probably be lost to private development.	Addition of harbor below Cross Village would create a picturesque view from the bluff. Harbor would be complimentary to existing development.	Harbor in primarily residential area would not be out of place, however, would not be as acceptable as area with commercial support facilities.	Harbor at Sturgeon Bay Point would interrupt scenic view of relatively extensive, clean, undeveloped beaches. Harbor would seem out of place in undeveloped area. Removal of wooded area for access roads would also decrease the area's aesthetic value.	

TABLE 1

SYSTEM OF ACCOUNTS (Continued)

Accounts	Without Project Condition	(EQ PLAN) Alternative 1 Cross Village, MI (1.5')**	(NED PLAN) Alternative 2 Good Hart, MI (1.5')**	Alternative 3 Sturgeon Bay Point (1.5')**	Index of Footnotes
2. Environmental Quality (Cont.)					
i. Air Quality*[1,6,8,9]	No effects	Temporary insignificant increase in vehicle emissions and particulate matter due to construction. Increase in automobile and boat traffic should not cause significant effects.	Same as Alternative 1	Same as Alternative 1	**Timing** 1. Impact is expected to occur prior to or during implementation of plan. 2. Impact is expected within 15 years following plan implementation. 3. Impact is expected in a longer time frame (15 or more years) following implementation.
j. Water Quality*	No effects	Increased turbidity during construction. No resuspention of polluted matter 1,6,8,9 Some increase in pollutants from shore facilities and boats in harbor.3,5,8,9	Same as Alternative 1	Same as Alternative 1	
k. Erosion[2,5,8,9]	Continued erosion in vicinity of Cross Village due to existing W.P.A. breakwater.	Minimal erosion anticipated northeast of proposed harbor due to interruption of littoral drift by structure. Disposal of material from initial harbor dredging and maintenance dredging along shoreline would compensate for loss of littoral drift interrupted by proposed structures.	Same as Alternative 1	Same as Alternative 1	**Uncertainty** 4. The uncertainty associated with the impact is 50% or more. 5. The uncertainty is between 10% and 50%. 6. The uncertainty is less than 10%.
l. Man-made Resources[1,6,8,10]	No impacts	Would result in removal of existing breakwater ruins. Possible upgrading of access road required.	Require upgrading and widening of existing access roads. Several private homes would be removed.	Require upgrading and widening of existing access roads.	**Exclusivity** 7. Overlapping entry; fully monetized in NED account. 8. Overlapping entry; not fully monetized in NED account.
m. Irreversible Commitment of Resources to Future Use	None	Energy resources expended during construction. Materials for construction of support facilities and recreation facilities. Commitment of 940 feet of shoreline to new uses.	Energy resources expended during construction. Materials for construction of support facilities, recreation facilities, and access roads. Commitment of 1200 feet of shoreline to new uses.	Energy resources expended during construction. Materials for construction of support facilities, recreation facilities, and access roads. Commitment of 1120 feet of shoreline to new uses.	**Actuality** 9. Impact will occur with implementation. 10. Impact will occur only when specific additional actions are carried out during implementation. 11. Impact will not occur because necessary additional actions are lacking.
3. Social Well-Being Impacts would occur in study area or, if indicated, in local community near site.					
a. Community Cohesion*[2,4,8,9]	No Change	Support industries for recreational activities which locate at Cross Village would help create a more cohesive community commercial base.	Intrusion of harbor into residential area could serve to unite local residents against project.	Distance of harbor from developed community areas would negate any effects on community cohesion.	
b. Community Growth[2,5,8,9]	Gradual increase of area population growth with accompanying growth in related support facilities.	Some additional growth due to recreation related commercial activities.	Same as Alternative 1.	Same as Alternative 1.	*Items specifically required in Section 122 and ER 1105-2-240.
c. Leisure Opportunities[2,6,8,10]	Increase in public land for hiking, picnicking and swimming if Wilderness State Park expands its boundaries.	Increased opportunity for boating activities and recreational fishing. Loss of some of park swimming area. Partial loss of use of township park during construction.	Increased opportunity for boating activities and recreational fishing. Loss of some beach area.	Increased opportunity for boating activities and recreational fishing. Loss of some swimming beach.	•Design wave height inside harbor.
d. Public Services[1,5,8,10]	Gradual increase in extent of services as area population grows.	Adequate services available, would not put excessive demand on anticipated service growth. A power line supplying Beaver Island would need to be moved or modified to accommodate the harbor structures.	Existing utility services in residential area should be sufficient to handle requirements of harbor. Need to upgrade roads.	Need to extend existing utility services beyond expected normal growth to reach isolated site. Roads need to be upgraded.	
e. Public Safety[2,6,7,9]	No changes.	Harbor would provide refuge for commercial and recreational vessels during adverse weather conditions on Lake Michigan.	Same as Alternative 1.	Same as Alternative 1.	
f. Noise*[1,6,8,9]	No impacts.	Temporary increase in noise levels due to construction activities. Minimal long range increase due to increased traffic and use of recreational facilities.	Same As Alternative 1.	Same as Alternative 1, but with a lesser impact on local residents because of isolated site.	
g. Displacement of People[1,6,8,9]	None	None	Several residential properties would be required for development of harbor and owners displaced.	None.	

TABLE I

SYSTEM OF ACCOUNTS (Continued)

Accounts	Without Project Condition	(EQ PLAN) Alternative 1 Cross Village, MI (1.5')**	(NED PLAN) Alternative 2 Good Hart, MI (1.5')**	Alternative 3 Sturgeon Bay Point (1.5') **	Index of Footnotes
3. Social Well-Being (Cont.)					
h. Traffic Safety[2,5,8,10]	No change	Increased thru traffic by users of harbor would create pedestrian safety problems in Cross Village.	Same as Alternative 1, but would cause additional problems in Good Hart area.	Same as Alternative 1, but to a lesser extent due to additional access routes which do not go through Cross Village.	
i. Transportation[2,5,8,9]	No change	Provides more viable base of operations for Beaver Island Ferry service.	Due to lack of support facilities, harbor does not provide incentive for relocation of ferry although it would provide savings in operating expenses.	Same as Alternative 2.	
4. Regional Development (RD) Impacts occur in study area.					
a. Regional Income	No Contribution	Not quantified	Not quantified	Not quantified	
b. Regional Employment*[2,5,8,9]	As area population increases some opportunity for employment will increase in service industries.	Some additional opportunities due to ferry and harbor operations. Temporary jobs due to construction.	Same as Alternative 1.	Same as Alternative 1.	
c. Desirable Population Distribution[2,5,8,9]	Area population would grow in areas east of M-119 and south of Sturgeon Bay Point.	No change from without project condition anticipated due to harbor.	Same as Alternative 1.	Same as Alternative 1.	
d. Property Values*[2,5,8,9]	Property values would increase as demand rises for property due to increasing population.	Harbor could increase property values.	Same as alternative 1.	No effect (surrounded by state owned land).	
e. Business and Industrial Activity*[2,5,8,9]	Increased service related business to accomodate area population growth.	Some additional service industries related to harbor activities could be expected beyond those anticipated in the without project condition. These can be accommodated at Cross Village.	Some additional service industries related to harbor activities could be expected beyond those anticipated in the without project condition. These cannot be accommodated near the site.	Same as Alternative 2.	
f. Commercial Revenues*[2,5,8,9]	Total revenues increase as new businesses develop.	Same as without condition.	Same as without condition.	Same as without condition.	
g. Stability of Regional Economic Growth*[2,5,8,9]	Increased revenues from tourist and support services add to stability of regional economic growth.	Additional benefits from seasonal commercial activities related to harbor which compliment winter recreation activities in establishing a stable year-round economy.	Same as Alternative 1.	Same as Alternative 1.	
h. Income Lost	No lost income anticipated.	No lost income anticipated.	No lost income anticipated.	No lost income anticipated.	
i. Lost Employment	No loss of employment expected.	No loss of employment expected.	No loss of employment expected.	No loss of employment expected.	
j. Undesirable Growth[2,5,8,9]	Same as Alternative 1.	No undesirable growth expected except as defined by those who want no growth in area.	Same as Alternative 1.	Same as Alternative 1.	
k. Tax Revenues[2,5,8,10]	Moderate increase in property values would not be reflected in assessed values, therefore, no increase in revenues are expected from property taxes. Increased tax revenues to state from sales taxes resulting from increased number of service industries.	No increase in revenues anticipated from property tax as assessed value of property in area is not expected to be increased. Increased revenue to state from increased sales.	No increase in total revenue from property tax although individual taxes are expected to increase because of loss of private land from tax rolls. Increased revenue to state from increased sa.	No effect on revenues from property tax. Increased revenue to state from increased sales.	

Timing

1. Impact is expected to occur prior to or during implementation of plan.

2. Impact is expected within 15 years following plan implementation.

3. Impact is expected in a longer time frame (15 or more years) following implementation.

Uncertainty

4. The uncertainty associated with the impact is 50% or more.

5. The uncertainty is between 10% and 50%.

6. The uncertainty is less than 10%.

Exclusivity

7. Overlapping entry; fully monetized in NED account.

8. Overlapping entry; not fully monetized in NED account.

Actuality

9. Impact will occur with implementation.

10. Impact will occur only when specific additional actions are carried out during implementation.

11. Impact will not occur because necessary additional actions are lacking.

*Items specifically required in Section 122 and ER 1105-2-240.

**Design wave height inside harbor.

Additional costs would be incurred by the local sponsor and private interests to provide necessary lands, onshore facilities such as parking, sanitary facilities, launching ramp, and docking facilities including slips, and access to the harbor site. Sources of funds for the acquisition, construction, and maintenance of those facilities supplied by the local sponsor (Michigan Department of Natural Resources - Waterways Division) would come from state revenues derived from the state marine fuel tax and a portion of boat registration fees which are set aside for harbor construction and operation. If private interests such as the Beaver Island Ferry Company or commercial fishing interests construct their own docking facilities, they would pay for them out of their operating revenues. The same thing applies to fees paid by these interests to the state if they were to lease facilities built by the state. The costs for these on-shore and docking facilities are considered as self liquidating costs and are not included in the B/C ratio and do not affect the designation of the NED plan.

DESIGNATION OF THE EQ PLAN

The Environmental Quality objective was defined as enhancing the project area environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources, and ecological systems. Alternatives 2 and 3, Good Hart and Sturgeon Bay Point, respectively, do not meet this objective. A harbor facility at Good Hart would disrupt large areas of wooded lots and a well established foredune, as well as displace several homes. At Sturgeon Bay Point similar effects would occur in the forested and dune areas. Also, the development would have a negative impact on the nearby Sturgeon Bay Dune area. Development at Cross Village would have a far less negative impact on dunes, and would not affect any large wooded areas.

The use of rubblemound breakwaters would have an advantageous effect on the kinds and numbers of plants and animals that would inhabit the area by providing additional habitat conducive to the growth of algae, invertebrates, and small gamefish populations. These effects will be expanded at

Cross Village by using the ruins of the existing breakwater to form offshore reefs.

At Cross Village, support facilities would be designed to preserve an existing 2.4 acre wetland on the site. Movement of organic carbon and nutrients from these wetlands into the sheltered area of the breakwaters would provide conditions suitable for production of macrophytic, benthic, and algal communities.

Because the increased productivity and habitat diversity created by the breakwaters, offshore underwater reefs, and preserved wetland far outweigh the adverse environmental impact of removing representatives of three species of State of Michigan threatened plants and disruption of some dune habitat, a small wooded area, and grassland areas, Alternative 1, a harbor for light-draft vessels at Cross Village, Michigan, is designated as the EQ plan.

SELECTING A PLAN

During the plan formulation process three plans were identified which meet, to varying degrees, the established planning objectives. The economic, social, and environmental impacts of each of the plans were subsequently identified and displayed in Table 1. In selecting the best plan, the beneficial and adverse effects of each plan were compared against each other and against the future conditions which could be expected if no harbor was built. Table 2 shows the comparison of significant factors used in determining the selected plan. Few changes are expected to occur in the physical environment of the study area during the 50-year period that is used for projecting impacts. (50 years is considered to be the economic life of the project). Therefore, the without project condition indicated in the tables will be assumed to be the same as the base condition described in the section titled "STUDY AREA" unless there are significant changes which are noted.

TABLE 2

SUMMARY COMPARISON OF FINAL ALTERNATIVE PLANS

	Without Project Condition	Alternative 1 Cross Village, MI	Alternative 2 Good Hart, MI	Alternative 3 Sturgeon Bay Point
A. Plan Description	Do Nothing.	2,590 feet of rubblemound breakwater, 1,670 feet of which is surfaced for fisherman access, enclosing areas for docking for recreational craft, commercial fishing and Beaver Island Ferry, a 2 acre anchorage area, and a small boat launching ramp. Use of 15,000 c.y. of initial dredge material to develop swimming beach. Use of existing breakwater material for fish habitat. Disposal of remaining 52,000 c.y. of dredged material along 3000 feet of shoreline to the northeast of proposed harbor. Provision of aids to navigation. Provision of items of local cooperation by State of Michigan. 1.5 foot design wave height in harbor.	2,150 feet of rubblemound breakwater all surfaced for fishermen access, enclosing areas for docking for recreational craft, commercial fishing and Beaver Island ferry, a 2 acre anchorage area, and a small boat launching ramp. Provision of aids to navigation. Disposal of 98,000 c.y. of dredged material along beach to northeast of proposed harbor. Provision of items of local cooperation by State of Michigan. 1.5 foot design wave height in harbor.	2,080 feet of rubblemound breakwater all surfaced for fishermen access, enclosing areas for docking for recreational craft, commercial fishing and Beaver Island ferry, a 2 acre anchorage area, and a small boat launching ramp. Provision of aids to navigation. Disposal of 67,000 c.y. of dredged material along beach to northeast of proposed harbor. Provision of items of local cooperation by State of Michigan. 1.5 foot design wave height in harbor.
B. Impact Assessment*				
1. National Economic Development (NED) Objective				
a. First Cost	None	$5,395,500	$3,795,250	$3,957,600
b. NED Costs	None	262,905	185,205	200,000
c. NED Benefits	None	312,259	329,404	314,564
d. Net NED Benefits	None	49,354	144,199	114,564
e. Benefit/Cost	N.A.	1.19	1.78	1.57
2. Environmental Quality (EQ) Objective				
a. Lands Required for Project				
Residential (Acres)	None	0.0	7.2	0.0
Forest (Acres)	None	0.0	0.0	6.4
Park (Acres)	None	6.6	1.0	0.0
Wetlands (Acres)	None	2.4	0.0	0.5
b. Effects on Biological Communities	Possible increase in size of existing wetland at Cross Village.	Facilities will be designed to preserve existing 2.4 acre wetland on site. Loss of small foredune area.	Loss of existing foredune area.	Loss of part of a small .5 acre wetland area. Development of shore facilities and access roads would destroy a significant amount of dune area and would endanger nearby delicately balanced sand dune areas. Effects would be multiplied by additional development of support industries in area.
c. Effects on Vegetation	No significant changes.	Loss of small wooded area and open grass areas for shore facilities.	Loss of extensive wooded areas to develop access and shore facilities.	Loss of extensive wooded areas to upgrade access roads.
d. Effects on Fish and Wildlife	No significant changes.	Development of new fish habitat as offshore reefs are built from rock material in existing W.P.A. breakwater.	No significant effects.	No significant effects.
e. Aesthetics	Extensive scenic beaches would continue to be used for recreational purposes although some beach would probably be lost to private development.	Harbor is compatable with present development.	Harbor is compatable with present development.	Harbor would interrupt scenic view of extensive undeveloped beaches and would appear out of place. Removal of wooded area for access roads would also decrease area's aesthetic value.
f. Man-made Resources	No impacts.	Would result in removal of existing breakwater ruins.	Requires upgrading and widening of existing access roads. Several private homes would be removed.	Requires upgrading and widening of existing access roads.

*This section lists only those items from Table 1 - System of Accounts which show significant differences between the three sites and are important in determination of the selected plan. Those factors which are applicable to all three sites are not listed.

TABLE 2

SUMMARY COMPARISON OF FINAL ALTERNATIVE PLANS (Continued)

	Without Project *Condition*	*Alternative 1* Cross Village, MI	Alternative 2 Good Hart, MI	Alternative 3 Sturgeon Bay Point
B. Impact Assessment (Cont.)*				
3. Social Well Being (SWB) Account				
a. Displacement of People	No changes.	None.	Several properties will be required for development of harbor and owners displaced.	None.
b. Public Services	Gradual increase in extent of services as area population grows.	Adequate services available, would not put excessive demand on anticipated service growth. Need to relocate power line supplying Beaver Island.	Existing utility services in residential area should be sufficient to handle requirements of harbor. Need to upgrade access roads.	Need to extend existing utility services to reach proposed harbor site. Roads need to be upgraded.
c. Transportation	No changes.	Provides viable base of operations for Beaver Island ferry service.	Lack of support facilities provides less incentive for relocation of Beaver Island ferry service.	Same as Alternative 2.
4. Regional Development (RD) Account				
a. Property Values	Property values would increase as demand rises for property due to increasing population.	Harbor could increase property values.	Value of residential property taken for harbor could increase assessed value of surrounding properties.	No effect (surrounding land is state owned).
b. Tax Revenues	Moderate increase in property values would not be reflected in assessed values, therefore, no increase in revenues are expected from property taxes. Increased tax revenues to state from sales taxes resulting from increased number of service industries.	No increase in revenues anticipated from property tax as assessed value of property in area is not expected to be increased. Increased revenues to state from increased sales.	No increase in total revenue from property tax although individual taxes are expected to increase because of loss of private land from tax rolls. Increased revenue to state from increased sales.	No effect on revenues from property tax. Increased revenue to state from increased sales.
C. Plan Evaluation				
1. Contributions to Planning Objectives**				
a. Improve Recreational Boating Opportunities	No contribution	Area provided for development of 104 boat slips, launching ramp, and related shore facilities by the State of Michigan.	Same as Alternative 1.	Same as Alternative 1.
b. Contribute to Navigation Safety of Light-Draft Vessels	No contribution	Two acre refuge area within breakwaters provided for mooring of light-draft recreational and commercial vessels in rough weather.	Same as Alternative 1.	Same as Alternative 1.
c. Enhance Light-Draft Commercial Navigation	No contribution	Areas provided for development of docking and shore facilities for commercial fishermen and the Beaver Island Ferry by private interests.	Same as Alternative 1.	Same as Alternative 1.
d. Enhance Recreational and Commercial Sport Fishing Opportunities	No contribution	1,670 feet of walkway on breakwater provided for fishermen access. Rock material from existing breakwater used to provide additional fish habitat in form of off-shore reef. Area provided for development of docking for charter fishing boats.	2,150 feet of walkway on breakwater provided for fishermen access. Area provided for development of docking for charter fishing boats.	2,080 feet of walkway on breakwater provided for fishermen access. Provides docking for charter fishing boat.

*This section lists only those items from Table 1 - System of Accounts which show significant differences between the three sites and are important in determination of the selected plan. Those factors which are applicable to all three sites are not listed.

**Reference Section titled *PLANNING OBJECTIVES*, page 41.

TABLE 2

SUMMARY COMPARISON OF FINAL ALTERNATIVE PLANS (Continued)

	Without Project Condition	Alternative 1 Cross Village, MI	Alternative 2 Good Hart, MI	Alternative 3 Sturgeon Bay Point
C. Plan Evaluation (Cont.)				
1. Contributions to Planning Objectives (Cont.)**				
e. Preserve Wetlands at Cross Village Township Park	No change	Preserves 2.4 acres of wetlands.	Existing wetlands at Cross Village are not disturbed.	Same as Alternative 2.
f. Preserve Swimming Beach at Cross Village Township Park	No change	15,000 c.y. of initial dredged material used to build up swimming beach on east side of harbor.	Existing beach at Cross Village is not disturbed.	Same as Alternative 2.
2. Net (with vs. without) Beneficial and Adverse Effects				
a. Objectives				
(1) NED	N.A.	Net benefits of $49,354	Net benefits of $144,199	Net benefits of $114,564
(2) EQ	N.A.	Loss of 700 ft. of beach area. Minor loss of wooded areas. Loss of 900 ft. of foredune. Loss of stands of Lake Huron tansy, Pitcher's thistle, and thickspike wheatgrass. Provision of habitat for aquatic organisms by breakwaters and offshore reefs.	Loss of 1,200 ft. of beach and foredunes. Significant loss of wooded area for shore facilities and access roads. Provision of habitat for aquatic organisms by breakwaters.	Loss of 1,200 ft. of beach front and foredunes. Significant loss of wooded areas for access roads. Significant disruption of surrounding dune areas. Provision of habitat for aquatic organisms by breakwaters.
b. Accounts				
(1) SMB	Identified area need for recreation boating facilities will not be filled. Continued safety problems for reach of lake in northeastern Lake Michigan due to lack of refuge.	Increased recreational boating and fishing opportunities. Beneficial to ferry service. Provide harbor of refuge. Minor increase in noise levels. Increase in traffic hazards in town.	Increased recreational boating and fishing opportunities. Beneficial to ferry service. Provide harbor of refuge. Minor increase in noise levels. Increase in traffic hazards in residential area. Displacement of several home owners.	Increased recreational boating and fishing opportunities. Beneficial to ferry service. Provide harbor of refuge. Some increased traffic through residential areas.
(2) RD	Gradual increase in area population with related growth of service industries with inflow of retirees and people establishing second homes.	Some increases in population, business, and employment opportunities beyond that expected to occur without project. Increased growth can be accommodated in the village. Help to balance seasonal economy. May increase property values. Increased tax revenues from sales.	Some increase in population, businesses, and employment opportunities beyond that expected to occur without project. No nearby areas to accommodate growth of residents and businesses. Help to balance seasonal economy. Increased property values to make up lost revenues from property taken off the tax rolls. Increased tax revenues from sales.	Some increase in population, businesses, and employment opportunities beyond that expected to occur without project. Area is in public ownership and cannot accommodate growth near site. Help to balance seasonal economy. Increased tax revenues from sales.
3. Plan Response to Associated Evaluation Criteria	N.A.			
a. Acceptability		Strong local support by year round residents and some summer residents. Supported by Michigan Department of Natural Resources (MDNR), Beaver Island Boat Company, and commercial fishing interests. Small group of local and seasonal residents oppose.	Uncertainty expressed by local residents. Not supported by MDNR. No commitment on part of Beaver Island Boat Company.	Small groups opposed or in favor. Majority uncommitted. Not supported by MDNR. No commitment by Beaver Island Boat Company.
b. NED B/C Ratio		1.19	1.78	1.57
c. Reversibility		Irreversible commitment of energy expended during construction. Loss of materials used to construct shore facilities and recreation facilities. 940 feet of shoreline converted to a new use.	Irreversible commitment of energy expended during construction and materials used for shore and recreation facilities and access roads. 1,200 ft. of shoreline converted to a new use.	Irreversible commitment of energy expended during construction and materials used for shore and recreation facilities and access roads. 1,120 feet of shoreline converted to a new use.

TABLE 2

SUMMARY COMPARISON OF FINAL ALTERNATIVE PLANS (Continued)

	Without Project Condition	Alternative 1 Cross Village, MI	Alternative 2 Good Hart, MI	Alternative 3 Sturgeon Bay Point
C. Plan Evaluation (Cont.)				
4. Ranking of Plan***				
a. Objectives				
(1) NED	4	3	1	2
(2) EQ	2	1	3	4
b. Accounts				
(1) SWB	3	1	4	2
(2) RD	4	1	3	2
D. Implementation Responsibility				
1. Federal				
a. U.S. Army Corps of Engineers		Complete design, contract construction of general navigation facilities, beach and fish reefs. Maintain general navigation facilities.	Complete design, contract construction of and maintain general navigation facilities.	Complete design, contract construction of and maintain general navigation facilities.
b. U.S. Coast Guard		Aids to navigation (lights)	Aids to navigation (lights)	Aids to navigation (lights)
2. Non-Federal****				
a. State of Michigan		Ensure necessary items of local cooperation are provided, including: contribute 38% cost of general navigation facilities and 50% of recreation facilities. Construct berths, launching ramp, parking and shore facilities. Maintain recreation facilities.	Ensure necessary items of local cooperation are provided, including: contribute 38% cost of general navigation facilities and 50% of recreation facilities. Construct berths, launching ramp, parking, shore facilities, and access roads. Maintain recreation facilities.	Ensure necessary items of local cooperation are provided, including: contribute 38% cost of general navigation facilities and 50% of recreation facilities. Construct berths, launching ramp, parking, shore facilities and access roads. Provide land for on-shore facilities. Maintain recreation facilities.
b. Local		Provide land for onshore facilities.	Provide land for onshore facilities.	None.
c. Private		Construct commercial fishing and ferry piers and required on-shore facilities. Relocate Beaver Island power line.	Construct commercial fishing and ferry piers and required onshore facilities.	Construct commercial fishing and ferry piers and required onshore facilities.

***Indicates in increasing order how well [illegible] meets or [illegible] objective or [illegible] account as compared to the others, e.g. a ranking of 1 is the best and 4 the worst.
****While the State of Michigan as local sponsor [illegible] required under Section 221 of P.L. 91-611 to provide all non-Federal obligations, it is our understanding they will receive assistance from local government and private interests as shown above.

PUBLIC INVOLVEMENT AND COORDINATION

Efforts were made to encourage participation by Federal, state, and local interests in the plan formulation process. This participation provided the study manager with significant specialized information which was used to determine the most feasible and acceptable plan. To facilitate this information gathering process, a mailing list was established and maintained which incorporates all known interested parties at the local, state, regional, and Federal governmental levels as well as concerned private citizens. Liaison has been maintained with many of these parties throughout the plan form lating process. A list of participants can be found in Appendix D.

A public information fact sheet was distributed on 8 November 1978 announcing the appropriation of funds to begin the advanced engineering and design studies for a light-draft harbor at Cross Village, Michigan, after a 13 year gap since the project was first authorized in 1965. Those studies completed prior to authorization were to be updated to establish present engineering, environmental, social, economic, and institutional feasibility and acceptability.

Three public workshops and a formal public meeting were held during various stages of the study to inform concerned local groups and individuals of the study progress, to exchange ideas, and to solicit their desires and concerns about the project. The meeting dates were 6 December 1978, 27 August 1980, 13 November 1980, and 16 June 1981. Comments presented at the workshops and meeting are summarized in the "Improvements Desired" section of this report and in Appendix D.

SELECTED PLAN

An examination of the factors displayed in Table 1 confirms Alternative 1, a harbor for light-draft vessels at Cross Village, Michigan, (see Figure 10) is the best plan. Although this alternative has the largest

first costs and corresponding lowest net benefits of the three proposed plans, the intangible costs associated with the environmental and social effects of Alternatives 2 and 3 make Cross Village the more desirable plan. In addition, problems associated with secondary effects of building support facilities such as stores and restaurants multiply the negative effects at Good Hart and Sturgeon Bay Point. Cross Village has existing services and room for expansion without disrupting existing land uses.

The State of Michigan Department of Natural Resources (MDNR) stated at a number of meetings with personnel of the Detroit District, Corps of Engineers that, as a general guideline, the final harbor design should limit the maximum wave height inside the breakwater at the recreational boating docks to 0.5 foot. A cost comparison of structures designed to limit the maximum wave height inside the harbor to 0.5 foot and 1.5 feet was made. The cost of reducing the maximum interior wave height from 1.5 feet to 0.5 foot is approximately $900,000. A study of Leland Harbor, Michigan, 56 miles to the southwest, shows a number of similarities to Cross Village in harbor location and design requirements. Leland Harbor provides an interior wave height due to diffraction of 0.5 foot and due to overtopping of about 1.5 feet. Experience has shown Leland Harbor to be of an acceptable design. Because of the additional cost to reduce waves inside the harbor to 0.5 foot and the fact that waves of 1.5 feet would only occur occasionally during the navigation season, the MDNR agreed in a 17 February 1981 letter to a maximum interior wave height of 1.5 feet at the recreational boating docks (see Appendix D, page D-45).

PLAN DESCRIPTION

Channel Dimensions and Depths. The entrance channel would be 12 feet deep below low water datum and 140 feet wide through the breakwaters. The channel would extend about 1,100 feet and flare outward on the lakeward end. The inner harbor channel would be ten feet deep below low water datum and 140 feet wide, and extend about 500 feet.

Breakwaters. Two completely rubblemound breakwaters totalling 2,590 feet in length would enclose the harbor with an opening to the northeast. The breakwater crown would be 10-12 feet wide at elevations ranging from 4 to 8 feet above low water datum, depending upon the direction of wave attack. The side slopes are 1 foot vertical to 2.5 feet horizontal on the lake side and 1 foot vertical to 2 feet horizontal on the harbor interior. The breakwater heights and orientations were designed to limit the interior wave height at the recreational boat docks to 1.5 feet.

Anchorage. An anchorage area of approximately two acres would be provided for mooring of boats during periods of rough weather. It would be dredged to a depth of 10 feet below low water datum.

Facilities. Areas are provided within the breakwaters for the construction of docking facilities for recreational boats, commercial and charter fishing craft, and commercial ferry operations.

Disposal of Excavated Material. Dredged material to be removed from the recommended harbor for channels and anchorage area has been found to be uncontaminated in a 1979 analysis of bottom sediments. (See EIS Supplement I, page I-1). Initial dredging would remove 67,000 cubic yards of material. Fifteen thousand cubic yards would be used to build up a swimming beach on the east side of the harbor along the remaining township property and the first 420 feet of the east breakwater. The remaining material would be distributed along the shoreline for 1,500 to 3,000 feet northeast of the proposed harbor within the eight foot contour line but below the ordinary high water mark of 580.8 ICLD.

Recreational Facilities. A concrete walkway and safety handrail 1,670 feet long would be provided along the west breakwater for use by sport fishermen. To facilitate the development of a sport fishery near the harbor, the rock material from the existing breakwater ruins would be disposed of in such a way as to form offshore underwater reefs to encourage the buildup of fish populations in the area. The reefs would consist of

small piles of rocks deposited in three rows following a serpentine pattern to provide more cover and a greater variety of fish habitat. They would be placed between the 18 and 24 foot contours allowing a clearance of at least 12 feet for both recreational and commercial craft.

Support Facilities. On-shore support facilities would include a launching ramp for trailored boats, pump-out facilities for recreational boats, office and storage building, toilet and shower building, parking areas, and facilities for sale of fuel and lubricants.

Maintenance. It has been estimated that the channels and anchorage area would be dredged every three years. At each dredging approximately 15,000 cubic yards of accumulated sand material would be removed. This material would be disposed of along the swimming beach and shoreline to the northeast of the proposed harbor. Along with the disposal of the initial dredged material this maintenance dredging material is expected to compensate for that erosion attributable to the recommended harbor, which has been estimated as 15 percent of the total erosion occurring in the area (see Appendix A, page A-11).

Monitoring Plan. To verify our estimate of the effect of the harbor on the area's erosion and accretion processes, a monitoring plan would be implemented. The plan would also insure the maintenance dredging material from the harbor has not become contaminated. The plan would consist of topographic surveys, aerial photographs and testing of bottom sediments in the harbor. This would be accomplished once prior to construction and every three years prior to maintenance dredging activities for a period of twelve years. (Details of the proposed plan can be found in Appendix A, page A-13).

COST ESTIMATES

The estimated components of first costs and annual charges for the recommended harbor plan are shown in Tables 3 and 4, respectively, Costs are allocated to either navigation facilities or recreation facilities.

TABLE 3

ESTIMATED FIRST COSTS

HARBOR FOR LIGHT-DRAFT VESSELS

CROSS VILLAGE, MICHIGAN (1.5 feet)

Item	Navigation Facilities	Recreation Facilities	Total
Breakwaters	$2,980,000	---	$2,980,000
Dredging of Channels & Anchorage	335,000	---	335,000
Monitoring Plan-Initial Survey	62,000	---	62,000
Removal of Existing Stone/ Timber Piles	151,600	---	151,600
Walkway	---	392,450	392,450
Est. Construction Cost	$3,528,600	$392,450	$3,921,050
Contingency (15%)	529,300	58,850	588,150
Subtotal	$4,057,900	$451,300	$4,509,200
Engineering & Design	423,000	47,000	470,000
Supervision & Administration	311,700	34,600	346,300
Gross Construction Cost	$4,792,600	$532,900	$5,325,500
Less Local Contribution	$1,821,200	$266,450	$2,087,650
Net Federal First Cost	$2,971,400	$266,450	$3,237,850
Aids to Navigation	70,000	---	70,000
TOTAL FEDERAL FIRST COSTS	$3,041,400	$266,450	$3,307,850
TOTAL NON-FEDERAL FIRST COSTS	$1,821,200	$266,450	$2,087,650
TOTAL FEDERAL & NON-FEDERAL FIRST COSTS	$4,862,600	$532,900	$5,395,500

TABLE 4

ESTIMATED AVERAGE ANNUAL CHARGES

HARBOR FOR LIGHT-DRAFT VESSELS

CROSS VILLAGE, MICHIGAN (1.5 feet)

COMPUTED AT INTEREST RATE OF 3-1/4%

Investment Charges	Navigation Facilities	Recreation Facilities	Total
Federal First Costs	$3,041,400	$266,450	$3,307,850
Non-Federal First Costs	1,821,200	266,450	2,087,650
Total First Costs	$4,862,600	$532,900	$5,395,500
ANNUAL CHARGES			
Federal			
Interest (.0325)	$ 98,800	$ 8,700	$ 107,500
Amortization (.008230)	25,000	2,200	27,200
Monitoring Plan	7,000		7,000
Maintenance[1]			
Corps of Engineers	33,405	0	33,405
Coast Guard (Aids to Nav.)	1,000	0	1,000
Total	$ 165,205	$ 10,900	$ 176,105
Non-Federal			
Interest (.0325)	$ 59,200	$ 8,700	$ 67,900
Amortization (.008230)	15,000	2,200	17,200
Maintenance[2]	0	1,700	1,700
Total	$ 74,200	$ 12,600	$ 86,800
TOTAL ANNUAL CHARGES	$ 239,405	$ 23,500	$ 262,905

[1]Includes annual maintenance dredging and repairs to breakwaters.
[2]Includes annual maintenance of recreational walkway.

Costs are based on October 1980 price levels. Allowances for contingencies, engineering and design, and supervision and administration are as noted in the tabulation. The economic life of the project is considered to be 50 years. Interest costs during construction are not included since the time required for construction is expected to be less than two years. Accordingly, the investment cost equals the first cost. Interest and amortization charges are based on a project life of 50 years and an interest rate of 3-1/4 percent. The annual charges also include annual maintenance dredging, annual maintenance of navigation aids, and annual maintenance of fishing facilities.

Table 5 displays, for comparison purposes only, the annual charges computed at a 7-3/8 percent interest rate. This is the interest rate currently being used for Federal water resources projects. The 3-1/4 percent interest rate used for this project is applicable for certain authorized projects provided the local sponsor indicated its willingness to provide the necessary items of local cooperation prior to 1969.

BENEFITS

The construction of a harbor near Cross Village, Michigan, would provide benefits to recreational boaters in the region by providing docking spaces for the presently unmet demand for permanent and transient slips. These benefits are evaluated as the gain in annual return which owners of pleasure craft would receive as a result of the harbor, and if their boats were used as "for-hire" vessels.

Benefits would also accrue to the Beaver Island Ferry due to savings in operating expenses from using a shorter and safer route to St. James Harbor on Beaver Island.

Two other sources of benefits come from recreational and commercial fishing. Recreational fishing benefits are determined by the length of usable breakwater available to sport fishermen. Commercial fishing

TABLE 5*

ESTIMATED AVERAGE ANNUAL CHARGES

HARBOR FOR LIGHT-DRAFT VESSELS

CROSS VILLAGE, MICHIGAN (1.5 feet)

COMPUTED AT INTEREST RATE OF 7-3/8%

Investment Charges	Navigation Facilities	Recreation Facilities	Total
Federal First Costs	$3,041,300	$266,450	$3,307,850
Non-Federal First Costs	1,821,200	266,450	2,087,650
Total First Costs	$4,862,600	$532,900	$5,395,600
ANNUAL CHARGES			
Federal			
Interest (.07375)	$ 224,300	$ 19,650	$ 243,950
Amortization (.002163)	6,500	600	7,200
Monitoring Plan	9,900		9,900
Maintenance[1]			
Corps of Engineers	33,405	0	33,405
Coast Guard	1,000	0	1,000
Total	$ 275,205	$ 20,250	$ 295,455
Non-Federal			
Interest (.07375)	$ 134,300	$ 19,650	$ 153,950
Amortization (.002163)	3,900	600	4,500
Maintenance[2]	0	1,700	1,700
Total	$ 138,200	$ 21,950	$ 160,150
TOTAL ANNUAL CHARGES	$ 413,405	$ 42,200	$ 455,605

*This information is provided for information only. The applicable interest rate for this project is 3-1/4%.

[1]Includes annual maintenance dredging and repairs to breakwaters.
[2]Includes annual maintenance of recreational walkway.

benefits are derived from savings obtained by the closer location of the harbor to local markets which result in reduced operating costs.

Finally, the recommended harbor would benefit both recreational and commercial navigation along the northeastern shore of Lake Michigan. These activities are presently limited by the lack of safe refuge on the mainland along the 55 mile reach between Harbor Springs and Mackinaw City. Benefits from the harbor of refuge are determined from the probability that a certain number of severe weather days will occur on a given number of peak boating days. The presence of the harbor would allow boaters on the lake to seek refuge when severe weather hits, thus preventing damage or loss of the boats. Estimates of the damage prevented are used as harbor of refuge benefits.

The evaluated benefits from the project are summarized in Table 6. A detailed explanation of the estimated harbor benefits can be found in Appendix B starting on page B-14.

TABLE 6

SUMMARY OF ANNUAL BENEFITS
HARBOR FOR LIGHT-DRAFT VESSELS
CROSS VILLAGE, MICHIGAN

BENEFIT	VALUE
General Navigation	
Recreational Craft	
Seasonal	$ 52,190
Transient	125,320
Launched	1,630
Total	$179,140
Harbor of Refuge	$ 24,239
Beaver Island Ferry	31,225
Commercial Fishing	32,125
Total General Navigation Benefits	$266,729
Recreational Sport Fishing	$ 45,530
TOTAL BENEFITS	$312,259

CONSISTENCY WITH MICHIGAN COASTAL MANAGEMENT PROGRAM

The Federal Coastal Zone Management Act (P.L. 94-370) requires Federal agency actions to be consistent with approved State coastal management programs. The State of Michigan completed its Coastal Management Program in July 1978. Cross Village was nominated as a recreational area under Area of Particular Concern (APC) 10-49. The recommended harbor for light-draft vessels at Cross Village, Michigan, is consistent with Michigan's Coastal Management Program.

COMPLIANCE WITH EXECUTIVE ORDER 11988

Executive Order 11988, Floodplain Management, was issued by President Carter on 24 May 1977 for the purpose of "avoiding to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative." By its very nature, a recreational boat harbor is located within a floodplain. There is no practicable alternative available to building in the floodplain; however, such a project on the Great Lakes has no effect on the overall levels of the lakes themselves. In addition, on-shore facilities developed by the local sponsor will not be located in the floodplain, nor is the harbor expected to encourage further development in the floodplain. Also, measures are being taken to preserve the character of the wetlands in the vicinity of the harbor area.

ECONOMIC JUSTIFICATION

Through a comparison of estimated average annual costs and benefits, it is shown that the harbor at Cross Village is justified with a benefit to cost ratio of 1.19 and net benefits of $49,354. This ratio is based on 3-1/4 percent interest rate and a 50-year economic life.

SUMMARY OF IMPACTS OF THE RECOMMENDED HARBOR

Environmental Impacts

Three State of Michigan threatened plant species, Lake Huron tansy (Tanacetum huronense), Pitcher's thistle (Cirsium pitcheri), and thick-spike wheatgrass (Agropyron dasystachyum), are found on the harbor site. A permit has been obtained from the Endangered Species Coordinator of the MDNR's Wildlife Division to remove all these plants with the exception of one small colony of Tanacetum huronense (see page IV-29). A Corps of Engineers' field survey of the shoreline north and south of the project site found these species to be relatively abundant in the study area. It is therefore expected that the removal of the plants at the site would not adversely affect the species' survival.

Two small wetland areas are located on the harbor site. The design of the navigation structures and on-shore facilities was done to preserve these wetlands. Construction activities would also take care not to adversely affect the wetlands.

The Cross Village site is among those areas designated as Series II Sand Dune Areas on 17 March 1981 under the authority of Michigan's Sand Dune Protection and Management Act (SDPMA) (Act No. 222 of Public Acts of 1976). The intent of this act as interpreted by the Michigan Department of Natural Resources is to protect the integrity of sand dune formations from despoilation and conflicting land management practices. Projects planned within a designated sand dune area are evaluated individually to determine compatability and consistency with the provisions of the SDPMA. Representatives of the MDNR - Geological Survey Division have stated the removal of two small sand dune areas for development of on-shore facilities does not conflict with the provisions of the SDPMA. Additional information on the sand dunes can be found starting on pages EIS-15 and EIS-34 of the final environmental impact statement. Construction activities for development of on-shore facilities would also remove parts of wooded areas and grasslands as the facilities are phased in.

The harbor breakwater structures would affect the movement of littoral materials within a 5,000 foot zone around the harbor site (a 1,000 foot zone of accretion southwest of the harbor and a 4,000 foot erosion zone northeast of the harbor). It has been estimated that the presence of the harbor would be responsible for 15 percent of the total erosion occurring in the project area. The placement of over [illegible],000 cubic yards of dredged material from the initial harbor dredging and periodic nourishment from maintenance dredging would compensate for the impacts of the harbor structures. Additional information on littoral processes is presented in Appendix A starting on page A-8.

Construction activities would cause temporary increases in water turbidity and noise and air pollution. However, increased area traffic related to the harbor is not expected to affect the area's long term air quality. Minor fuel spills within the harbor would be dissipated by wave action inside the harbor. Sewage from vessels and harbor facilities would be treated according to laws and regulations existing at the time of construction and would not adversely affect lake, wetland, or groundwater quality.

Initial construction and dredging activities and the removal of the existing W.P.A. breakwater ruins would destroy or significantly disrupt existing benthic and aquatic communities. The new breakwaters, and fish reefs built from the rock material of the W.P.A. breakwater ruins, would provide a greater quantity of potential habitat for aquatic organisms including algae, invertebrates, and small game fish. The shelter provided by the breakwaters, and nutrients flowing into this area from the wetland would encourage colonization of aquatic plants and lake-bottom dwelling organisms. Both these factors would increase the area's productivity. However, it is possible measures would be required to control plant growth within the harbor.

Social Impacts

As was stated in the section titled "Conditions If No Federal Action Is Taken", the population in the study area is expected to increase. This increase would primarily occur due to the demand for retirement and vacation homes in scenic rural areas. As the area's population increases small service related industries such as grocery stores, gift shops, restaurants, and motels would also move into the area. The construction of a harbor at Cross Village would increase the rate which this development would occur but not to a significant extent. It would serve to define the types of businesses which would locate in the area as they provide water recreation oriented services. However, this development would be expected to occur gradually with or without the harbor.

The buildup of businesses in the area would serve to infuse money into the local community as residents, harbor users, and tourists all use these new services. These businesses, as well as operation of the harbor and island ferry would provide some employment opportunities for local residents.

The construction of a harbor at the Cross Village Township Park site would not be expected to increase taxes assessed to local residents. The construction itself would be paid for by Federal and state governments, the Federal share from Congressional appropriations and the state share from a fund derived from revenues obtained from the state marine fuel tax and a portion of boater registration fees. Operation of the harbor, whether by the MDNR - Waterways Division or by the township board, is done on a break-even basis with fees collected from rental of slips and sale of supplies paying for salaries of harbor employees, the purchase of supplies for sale, utilities including electricity, phone, and trash collection, as well as minor repairs such as painting of harbor facilities or replacement of dock fenders. Major repairs would be paid for on a cost sharing basis between the MDNR - Waterways Division and the local community based on its ability to pay the costs. If the community chose not to operate the harbor, it would bear no costs for operation or maintenance.

Because the harbor would be built on township property, there would be no direct increase in local property taxes to replace revenue lost if private property were purchased and taken off local tax rolls. There is, however, the possibility that as the area developes, property values would be increased by the demand for land in the area, thus increasing the assessed value of that land. It cannot be predicted to what extent this might occur.

The presence of the harbor at Cross Village would not obligate the township board to expend funds to provide police and fire protection. It is expected that attendants or citizens who notice a problem would report it to existing authorities.

Increased traffic in the vicinity of Cross Village relating to harbor users could present a hazard to area pedestrians.

Construction of the harbor is estimated to take most of two construction seasons (April through October). On-shore facilities and docks would be constructed the following season. Since this coincides with the peak season for use of the present township park, local residents would lose most if not all use of the park for three years.

DIVISION OF PLAN RESPONSIBILITIES

The Corps of Engineers has the responsibility to design and prepare detailed plans and specifications, construct breakwater structures and a walkway, dredge and maintain the access channels and anchorage area, and provide necessary maintenance to the breakwaters. The U.S. Coast Guard would provide and maintain necessary aids to navigation. These maintenance costs are currently estimated to be $34,405. The estimated Federal share of the total first project cost for the proposed harbor is $3,307,850. Total annual Federal costs would amount to $176,105.

The Michigan Department of Natural Resources certified its willingness to assure the requirements of local cooperation by letter dated

21 April 1969. This intent was reaffirmed in a letter dated 16 March 1981 (See Appendix D, page D-52). As local sponsor it is to provide the non-Federal share of the project first cost which is currently estimated at $2,087,650. This cost would include 38 percent of the cost of the channel works and breakwater structures and 50 percent of the recreational walkway. The local sponsor bears all costs of operation, maintenance, and replacement of the recreational walkway provided for breakwater fishing. This cost is currently estimated at $1,700. Total annual non-Federal costs are estimated at $86,800.

ITEMS OF LOCAL COOPERATION

Prior to construction of the harbor as recommended in this Phase I General Design Memorandum, non-Federal interests will be required to enter into a written agreement with the Secretary of the Army, pursuant to Section 221 of PL 91-611, that they will:

a. Contribute in cash 38 percent of the first cost of construction of the general navigation facilities and 50 percent of the first cost of facilities necessary to provide for recreational fishing on the main breakwater; such contributions presently estimated at $1,821,200 and $266,450, respectively, subject to final adjustment after actual costs have been determined; to be paid in a lump sum prior to initiation of construction, or in annual payments as construction proceeds as provided under the general authority of Section 40 of the 7 March 1974 Water Resources Development Act (P.L. 93-251);

b. Provide without cost to the United States all lands, easements, and rights-of-way required for the construction and maintenance of the project and aids to navigation upon the request of the Chief of Engineers, 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;

c. Hold and save the United States free from damages due to the construction works and subsequent use, operation, and maintenance of the project, not including damages due to the fault or negligence of the United States or its contractors;

d. Provide and maintain without cost to the United States necessary mooring facilities and utilities, including an adequate public landing with provision for the sale of motor fuel, lubricants, and potable water, a parking lot with adequate sanitary facilities, and a launching ramp, open to all on equal terms; the dredging of berthing areas to be commensurate with the depth of the Federal channel improvements;

e. Establish a competent and properly constituted public body empowered to regulate the use, growth and development of the harbor and recreation-oriented facilities, with the understanding that said facilities shall be open to all on equal terms;

f. Reserve spaces within the anchorage and mooring facilities adequate for the accommodation of transient craft;

g. Provide and maintain without cost to the United States, for recreational fishing: access facilities, parking areas, and adequate sanitary facilities;

h. Establish regulations prohibiting discharge of untreated sewage, garbage, and other pollutants in the water of the harbor by users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, State, and local authorities responsible for pollution prevention and control;

i. Bear all costs of operation, maintenance, and replacement of the recreational fishing facilities, the amount involved currently being estimated at $1,700 on an average annual basis; and

j. Comply with applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, approved 2 January 1971, in acquiring lands, easements, and rights-of-way for construction and maintenance of the project and inform affected persons of pertinent procedures, policies, and regulations:

And provided further, that the improvement for navigation may be undertaken independently of the public recreational fishing facilities on the main breakwater whenever funds for that purpose are available and the required local cooperation has been furnished.

DEPARTURES FROM THE AUTHORIZED PROJECT

Several changes from the authorized plan have been incorporated into the recommended plan for a harbor at Cross Village. These changes, discussed below, reflect an attempt to be responsive to the concerns expressed by the local citizens and to minimize the cost of the project (see Figures 1 and 10).

The breakwaters are to be of a totally rubblemound construction, eliminating the use of steel sheet pile cells and cantalevered walls. This is to maximize as much as possible the wave absorbing capacity of the structure and provide a calm interior to protect docked boats from damage resulting from contact with piers. The length and orientations of the west breakwater segments were changed somewhat to bring them into shallower water to reduce costs. The breakwater crest heights were reduced to heights of five to eight feet above low water datum as compared to six to ten feet in the authorized plan. The harbor plan was shifted slightly west to the township property boundary to provide a swimming beach on the eastern side of the property. The length of the east breakwater was altered and a segment added connecting it to shore to isolate the swimming beach from the harbor activities.

The authorized plan called for the removal and disposal of the north section (250 feet) of the existing deteriorated breakwater. In the

recommended plan the entire structure would be removed, the timbers discarded at an upland site, and the rock material formed into offshore underwater reefs consisting of small piles of rocks deposited in three rows following a serpentine pattern. This is done as an environmental enhancement measure to provide habitat for fish and benthic species. No cost savings would occur, however, as costs saved by the shorter distance to the reef locations than the open water disposal site are offset by the additional costs required in shaping the reef.

The walkway on the west breakwater would be of concrete construction as opposed to the authorized bituminous walkway. Construction experience has shown this type of construction would require less maintenance.

The configuration of the anchorage and maneuver area was changed and reduced in size reflecting a more efficient layout of docking facilities.

Public needs require that the present swimming beach (which will be supplanted by the proposed harbor) be replaced; therefore, the recommended project calls for providing for a swimming beach on the east side of the harbor. To accomplish this, part of the initial dredged material would be used to build up a beach area along the first 420 feet of the east breakwater and the existing shoreline up to the township property boundary.

Updating the construction costs and benefits for the recommended plan resulted in a change in the benefit to cost ratio from that presented in the project document. A summary of the benefit to cost comparison is shown in Table 7.

TABLE 7

BENEFIT TO COST COMPARISON

	Total Project First Costs	Average Annual Benefits	Average Annual Costs	Benefit to Cost Ratio	Net Benefits
Project Document (April 1965)	$1,177,100	$ 62,270	$ 50,800	1.2 to 1	+$ 11,470
Project Document (October 1980)	$4,510,000	$329,000	$200,000	1.6 to 1	+$129,000
Recommended Plan (3-1/4%)	$5,395,500	$312,259	$262,905	1.19 to 1	+$ 49,354
Recommended Plan (7-3/8%)	$5,395,500	$312,259	$455,605	0.69 to 1	-$143,346

PUBLIC ACCEPTANCE

Three public workshops and a formal public meeting were held on 6 December 1978, 27 August 1980, 13 November 1980, and 16 June 1981 to discuss the findings of the draft Phase I GDM. The workshops and meeting were attended by approximately 115, 240, 110, and 100 people, respectively. Some opposition and concerns were voiced pertaining to harbor size, commercial uses, possible increased property tax assessments and the social impacts of the harbor on the community. These concerns were addressed at the workshops and meeting, and the public's input used in formulating the proposed plans presented in this report. The recommended plan for a harbor at Cross Village is supported by the Cross Village Board of Supervisors and a majority of the year-round residents. A group of the area's seasonal and shoreline residents are concerned about the proposed harbors effect on the scenic character of the area.

RECOMMENDATIONS

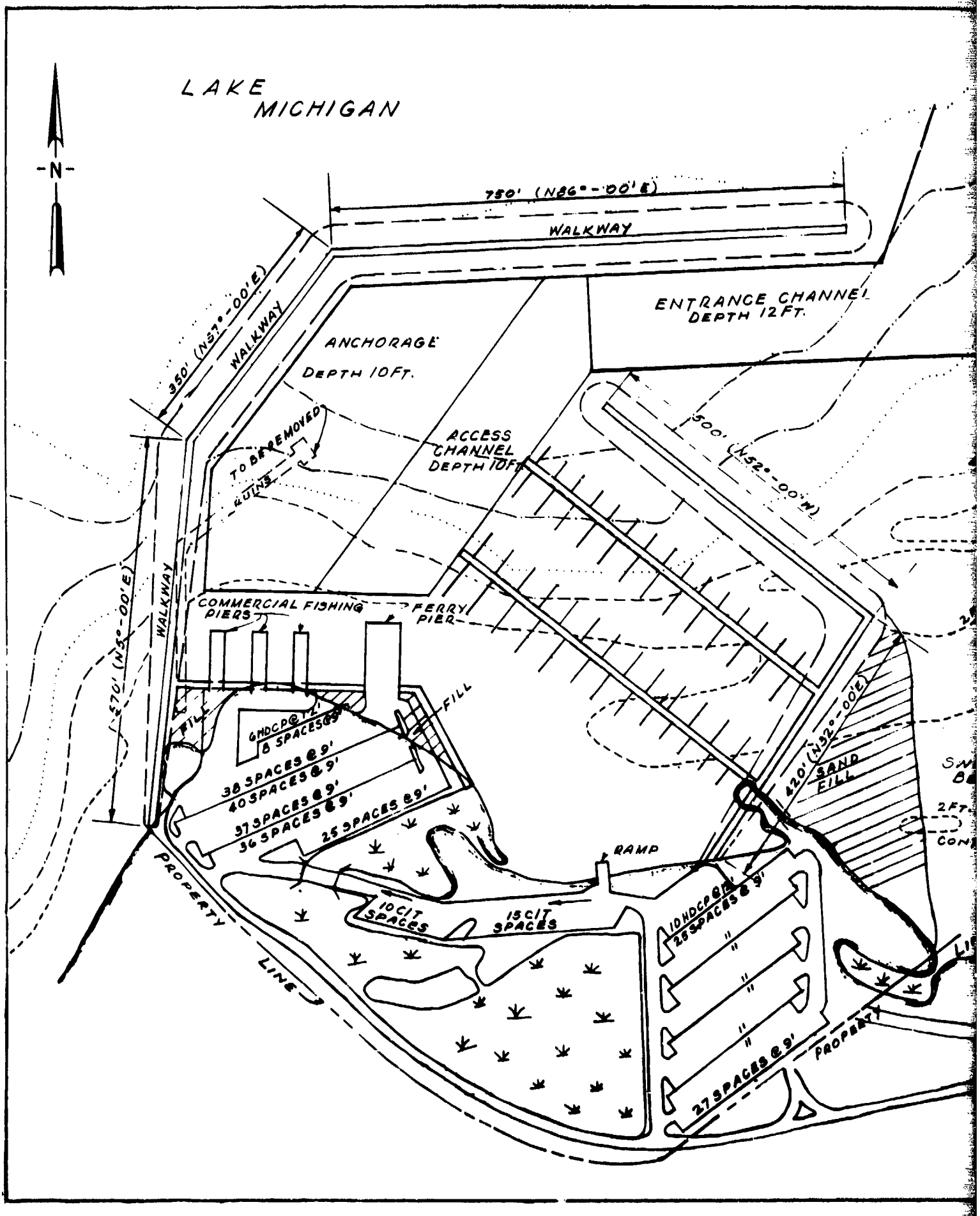
Federal participation in providing a harbor for light-draft vessels at Cross Village, Michigan, was authorized by Congress under the provisions

of the River and Harbor Act of 7 November 1966 (Public Law 89-789) in accordance with the plan presented in House Document No. 490, 89th Congress, 2nd Session.

It is recommended that a harbor for light-draft recreational and commercial vessels, as presented in this Phase I General Design Memorandum, be constructed at Cross Village, Michigan. The harbor would have general navigation facilities consisting of rubblemound breakwaters having an aggregate length of 2,590 lineal feet and an opening to the northeast, a two acre anchorage area ten feet in depth, a flared entrance channel 12 feet deep decreasing in width to 140 feet between the breakwaters, and an interior access channel 10 feet deep, 140 feet wide, and approximately 500 feet in length. A concrete recreational walkway with a safety handrail would be provided along the west breakwater crest providing access for recreational fishermen. Areas are provided for construction of docking facilities for recreational craft, commercial and charter fishing vessels, Beaver Island ferry operations, and on-shore support facilities. The recommended plan is shown in Figure 13 on page 89. Construction of the recommended improvements have an estimated total first cost of $5,395,500 and an annual maintenance cost of $36,105. The Federal share of these costs is $3,307,850 for construction and $34,405 for annual maintenance.

The foregoing recommendation is subject to the condition that non-Federal interests agree in writing to carry out the "Items of Local Cooperation" as required by Section 221 of P.L. 91-611.

ROBERT V. VERMILLION
Colonel, Corps of Engineers
Commander and District Engineer


LAKE
MICHIGAN
N
750' (N26°-00'E)
WALKWAY
350' (N37°-00'E)
WALKWAY
ENTRANCE CHANNEL
DEPTH 12FT.
ANCHORAGE
DEPTH 10FT.
TO BE REMOVED
ACCESS
CHANNEL
DEPTH 10FT.
500' (N52°-00'W)
570' (N5°-00'E)
WALKWAY
COMMERCIAL FISHING
PIERS
FERRY
PIER
FILL
FILL
6HDCP@12'
8 SPACES@9'
38 SPACES @ 9'
40 SPACES @ 9'
37 SPACES @ 9'
36 SPACES @ 9'
25 SPACES @ 9'
420' (N52°-00'E)
SAND
FILL
RAMP
10 CIT
SPACES
15 CIT
SPACES
10 HDCP @ 12'
25 SPACES @ 9'
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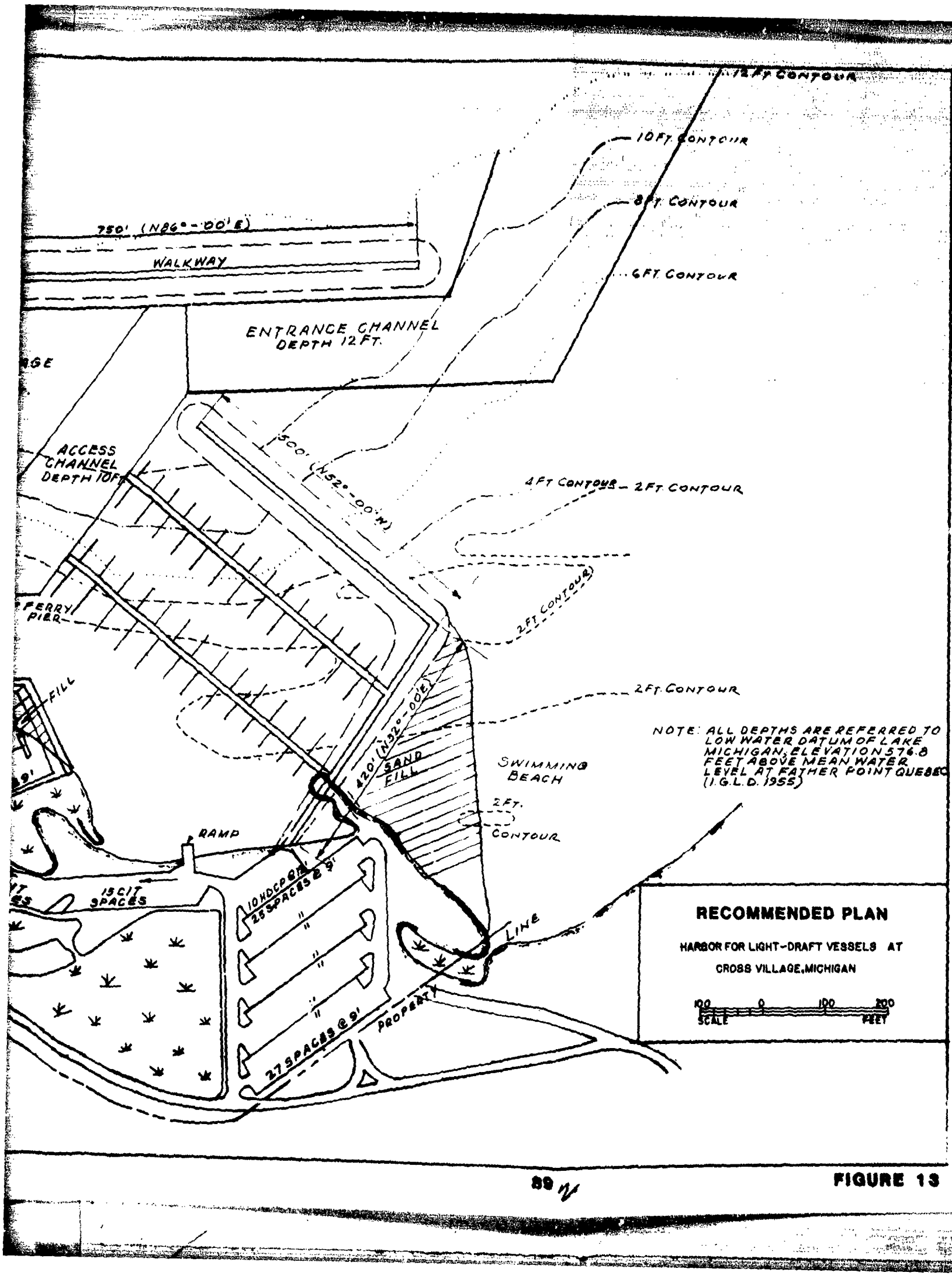

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FIGURE 13

PHASE I GENERAL DESIGN MEMORANDUM
STUDY FOR A HARBOR FOR LIGHT-DRAFT VESSELS
AT
CROSS VILLAGE, MICHIGAN

FINAL

ENVIRONMENTAL IMPACT STATEMENT

JULY 1981

DEPARTMENT OF THE ARMY

DETROIT DISTRICT, CORPS OF ENGINEERS

FINAL IMPACT STATEMENT
A HARBOR FOR LIGHT-DRAFT VESSELS AT
CROSS VILLAGE, MICHIGAN

The responsible lead agency is the U.S. Army Engineer District, Detroit. The responsible cooperating agency is the Michigan Department of Natural Resources, Waterways Division.

Abstract:

A light-draft recreational boat harbor is recommended for construction at Cross Village, Emmet County, Michigan. The project would consist of (1) construction of two new rubblemounds breakwater, (2) dredging of an entrance channel, inner channel and anchorage area, (3) removal of the deteriorated harbor breakwater, (4) construction of an underwater fish habitat, (5) swimming beach extension, and (6) shoreline dredged material disposal. Benefits to the community would consist of increased opportunities for sport fishing, boating, and provision of docking facilities for commercial fishing and ferry services. The proposed harbor would increase boating safety on northern Lake Michigan for both recreational and light-draft commercial vessels by providing a harbor of refuge for transient craft. Construction activities may have a temporary impact on air and water quality, but no significant long-term impacts are expected. A permanent moderate increase in noise would result, and some aesthetic degradation would occur. Representatives of three Michigan threatened plant species would be destroyed and 75 percent of their dune habitat within the project site eliminated. No major change in overall land use in the Cross Village area is foreseen, although an increase in water related activities would exert some additional demands on area resources.

Send any comments on this Statement to the District Engineer within 30 days after notice of availability in the Federal Register or approximately 30 days from date of transmittal. If you would like further information on this Statement, please contact:

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SUMMARY

Major Conclusions and Findings

The proposed construction, operation and maintenance of a recreational boat harbor at Cross Village, Michigan is environmentally sound; the project provides for appropriate environmental safeguards and mitigating measures.

The recommended project would create a variety of temporary negative environmental impacts from construction which would be mitigated. Long-term negative effects would occur from loss of vegetation, including small populations of three State of Michigan threatened plants. Long-term positive environmental impacts include recreational enhancements and additional aquatic habitat in the form of rubblemound breakwaters and stone fish reef.

Areas of Controversy and Unresolved Issues

There are currently no major areas of controversy on this project. However, one remaining unresolved issue, the mode of sewage disposal, would be resolved during Phase II design stage of the Cross Village Harbor project.

Relationship to Environmental Requirements

The project is being formulated to comply with Federal and state laws, and Federal Executive Orders. Compliance of alternatives with environmental regulations is shown in Table 1.

FINAL ENVIRONMENTAL IMPACT STATEMENT
A HARBOR FOR LIGHT-DRAFT VESSELS
AT CROSS VILLAGE, MICHIGAN

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TABLE 1

RELATIONSHIP OF PLANS TO ENVIRONMENTAL REQUIREMENTS

Federal Policies	Cross Village (Recommended Plan)	Sturgeon Bay Point	Good Hart	No Action
Fish and Wildlife Coordination Act, 16 U.S.C. 661 et seq.	F*	F	F	N/A****
Clean Water Act of 1977, 33 U.S.C. 1344	F	N***	N	N/A
National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470 et seq.	P**	N	N	N/A
National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321 et seq.	F	P	P	N/A
Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1451 et seq.	F	F	F	N/A
Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 et seq.	F	N	N	N/A

NOTES: The compliance categories used in this table were assigned based on the following definitions:

F* Full compliance -- All requirements of the policy and related regulations have been met.

P** Partial compliance -- Some requirements of the policy and related regulations remain to be met.

N*** Noncompliance -- None of the requirements of the policy and related regulations have been met.

N/A**** Not applicable.

TABLE 1 (Cont.)

RELATIONSHIP OF PLANS TO ENVIRONMENTAL REQUIREMENTS

State Policies	Cross Village (Recommended Plan)	Sturgeon Bay Point	Good Hart	No Action
Michigan Wetland Protection Act (Act No. 203, P.A. 1979)	F	P	N/A	N/A
Michigan Endangered Species Act of 1974 (Act No. 20, P.A. 1974)	F	N	N	N/A
Michigan Sand Dune Protection and Management Act (Act No. 222, P.A. 1976)	F	N	N/A	F
Executive Orders				
Floodplain Management (E.O. 11988)	F	F	F	N/A
Protection of Wetlands (E.O. 11990)	F	P	N/A	F
Analysis of Impacts on Prime and Unique Farmlands (CEQ Memorandum, 30 Aug 76)	F	F		F

NOTES: The compliance categories used in this table were assigned based on the following definitions:

F Full compliance -- All requirements of the policy and related regulations have been met.

P Partial compliance -- Some requirements of the policy and related regulations remain to be met.

N Noncompliance -- None of the requirements of the policy and related regulations have been met.

N/A Not applicable.

TABLE 2
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternative Plan Factors	(1) Cross Village *EQ Plan	(2) Sturgeon Bay Point	(3) Good Hart **NED Plan	(4) No Action
Natural Resources	Loss of bottom land from construction of breakwater; temporary destruction of aquatic habitat from dredging and deposition of dredged material; loss of energy used in construction; loss of some Series 2 Dune habitat; riprap breakwater, fish reef and protected harbor area would provide additional aquatic flora and fauna habitats.	Same as Alt. 1 but less bottomland displaced, less dredging necessary, and no fish reef.	Same as Alt. 2, however, dune area is not classified as Series 2 Dune habitat.	No impact
Flora	Loss of dune vegetation including several stands of the Michigan threatened species, Lake Huron tansy (Tanacetum huronense), Pitcher's thistle (Cirsium pitcheri), and thickspike wheatgrass (Agropyron dasystachyum); rotective breakwaters and wetland nutrient inputs should stimulate plant growth within the harbor.	Same as Alt. 1, plus: the probable destruction of a beach wetland area; loss of foredune vegetation; additional stress on the delicate Sturgeon Bay dunes.	Loss of terrestrial and foredune vegetation including several stands of the Michigan threateneed Species, the Lake Huron tansy (Tanacetum huronense).	No impact

*The EQ (Environmental Quality) Plan is that plan which makes the greatest positive contribution to the EQ Account.
**The NED (National Economic Development) Plan is that plan which provides the most net benefits to the National economy.

TABLE 2
COMPARATIVE IMPACTS OF ALTERNATIVES (Cont.)

Alternative Plan Factors	(1) Cross Village EQ Plan	(2) Sturgeon Bay Point	(3) Good Hart NED Plan	(4) No Action
Fauna	Some temporary destruction of benthic habitat as a result of dredging, dredged material disposal, and placement of riprap; new riprap and stone fish habitat. Terrestrial animal and waterfowl displacement during construction and operation, however no major long term affects anticipated.	Some temporary destruction of benthic habitat as a result of dredging and placement of riprap. Improved benthic and fish habitat from stone-faced breakwaters. Temporary displacement of terrestrial animals, with no major long term affects anticipated.	Some temporary destruction of benthic habitat as a result of dredging and placement of riprap; improved benthic and fish habitat from stone-faced dike breakwaters.	No impact.
Air Quality	Exhaust fumes would temporarily degrade air quality during construction.	Same as Alt. 1.	Same as Alt 1.	No effect.
Water Quality	Local elevation of turbidity levels during construction; slightly long term impact through increased boating usage.	Same as Alt 1.	Same as Alt 1.	No effect.

TABLE 2
COMPARATIVE IMPACTS OF ALTERNATIVES (Cont.)

Alternative Plan Factors	(1) Cross Village EQ Plan	(2) Sturgeon Bay Point	(3) Good Hart NED Plan	(4) No Action
Erosion	Erosion north of the harbor extending 4,000 feet would continue. However, the area would receive beach nourishment to replace that material lost due to the presence of the harbor.	Erosion north of harbor extending downdrift 3,000 feet. Beach nourishment would replace all erosion caused by the harbor.	Erosion north of the harbor extending downdrift 3,000 feet. Losses would be replaced by beach nourishment.	Continued erosion extending 2,200 feet north of the existing Cross Village breakwater.

Section I

Final Environmental Impact Statement
A Harbor for Light-Draft Vessels
at Cross Village, Michigan

Need For and Objectives of Action

1.01 The purpose of the project is to construct a harbor for transient and locally owned pleasure craft, and commercial fishing and ferry boats in the vicinity of Cross Village, Michigan. This area of northeastern Lake Michigan is one of the roughest sections of water in the Great Lakes. At present, the closest harbors are at Harbor Springs and Charlevoix about 25 miles south of Cross Village, Mackinaw City about 34 northeast around Waugoshance Point, and St. James Harbor on Beaver Island about 24 miles west. To transverse the 61 miles between Charlevoix and Mackinaw City without an intervening harbor of refuge is hazardous for both recreational and light-draft commercial vessels during periods of rough or unsettled weather.

1.02 The project would increase the general recreational use of Lake Michigan in the Cross Village Harbor area. The utilization of the offshore fishery would be increased as the improvements would provide safety and convenience for up to 104 recreational craft as well as commercial craft. Sailing, power boating, and water skiing would increase at Cross Village. Construction of an underwater fish reef in the area from old breakwater materials would enhance the local fishery, and a walkway on the proposed (west) rubblemound breakwater would provide access for shore fishermen (for additional discussions of benefits see page 75 of the Phase I General Design Memorandum (GDM)).

1.03 A timber and rock breakwater built at Cross Village prior to World War II is now deteriorated to the point where it no longer provides protection from wave action. Prior to the breakwater's deterioration, Cross Village provided a port of refuge for commerical and recreational craft. Currently the harbor is used only as a launching site for small

recreational boats during calm weather. Construction of the new facility would improve economic conditions in the Cross Village community resulting from the purchase of goods and services in the community by harbor users. Moderate employment opportunities would be provided from new businesses, harbor operations, and operation of the Beaver Island Ferry.

Public Concerns

1.04 Local public concerns over the Cross Village Harbor project include: 1) The potential impacts of the harbor on the local tax base; 2) the magnitude of commercial growth in response to the harbor; 3) environmental impacts on the wetland area and threatened state plant species located on the project site; and 4) the area of swimming beach to be preserved.

Planning Objectives

1.05 For a detailed analysis of planning objectives see page 44 of the Phase I GDM.

SECTION II

DESCRIPTION OF RECOMMENDED PROJECT AND ALTERNATIVES

Scope

2.01 A harbor for light draft vessels is recommended at Cross Village, Emmet County, Michigan (Figure 2, Phase I CDM pg. 13). The harbor would provide facilities for both commercial vessels and recreational craft using the Cross Village and northeastern Lake Michigan areas. The completed project would provide rubblemound breakwaters, commercial and recreational boat docks and slips, sport fishing access, (in the form of a boat launch and breakwater walkway), parking, restrooms, showers, and facilities for dispensing fuel and oil.

Authority

2.02 Authorization for construction was granted on 7 November 1966, in the River and Harbor Act of 1966 (Public Law 89-789) in accordance with the plan presented in House Document 490, 49th Congress, 2nd Session.

Recommended Project (Environmental Quality Plan)

2.03 The proposed breakwater configuration would provide a protected entrance channel into Lake Michigan and a sheltered anchorage area. The total breakwater length of 2,590 feet would enclose a 12 acre area. The main breakwater would extend 570 feet northerly from shore; angle to the northeast 350 feet, then extend 750 feet in an easterly direction. The east breakwater, 920 feet in length, would consist of a 420 foot northeasterly offshore section, and perpendicular northwest 500 foot extension.

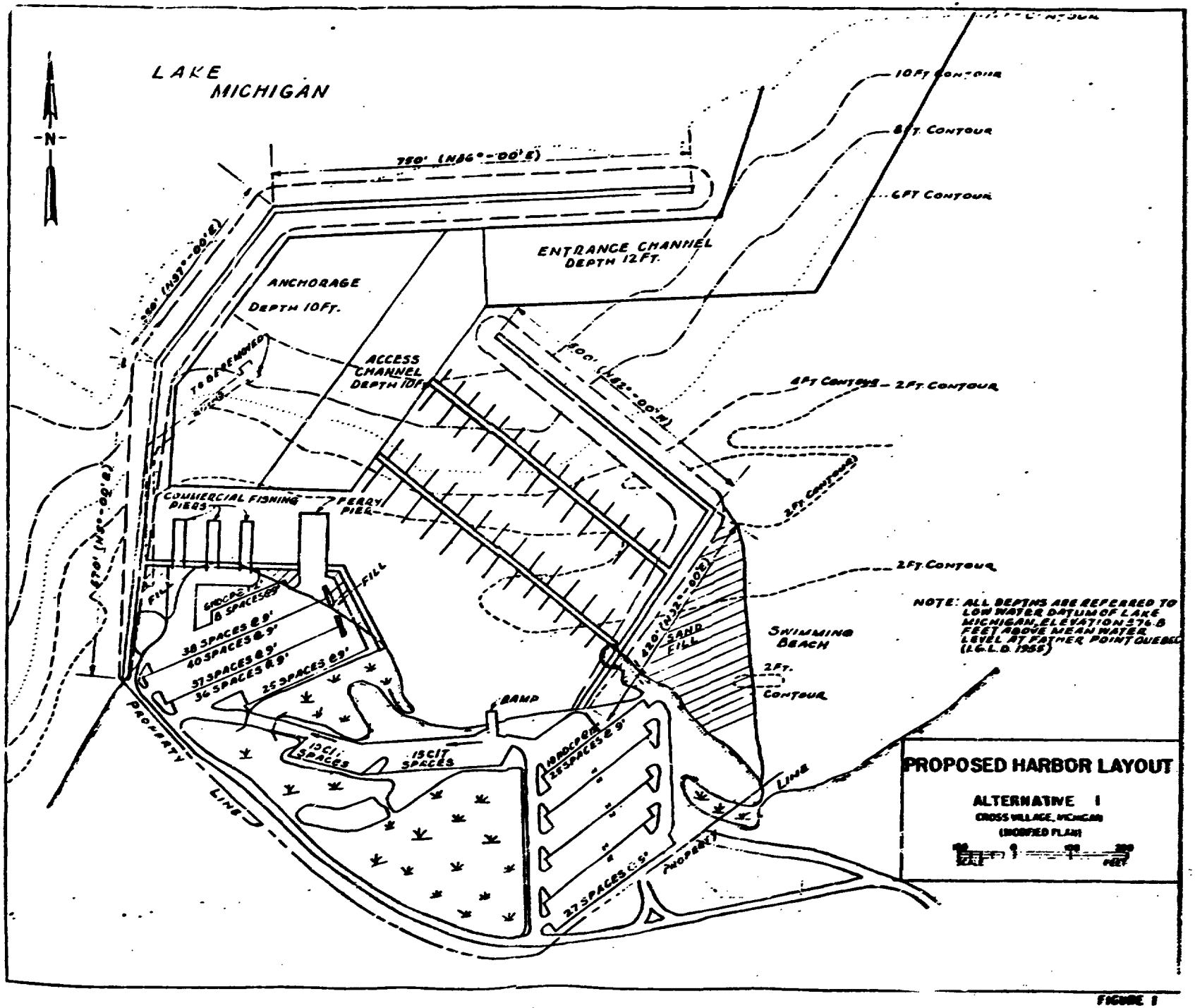
LAKE MICHIGAN
-N-
750' (N86°-00'E)
500' (N3°-00'E)
420' (N3°-00'E)
420' (N3°-00'E)
ENTRANCE CHANNEL DEPTH 12FT.
ANCHORAGE DEPTH 10Ft.
ACCESS CHANNEL DEPTH 10Ft.
TO BE REMOVED
COMMERCIAL FISHING PIERS
FERRY PIER
FILL
FILL
SAND FILL
SWIMMING BEACH
RAMP
38 SPACES @ 9'
40 SPACES @ 9'
37 SPACES @ 9'
36 SPACES @ 9'
25 SPACES @ 9'
15 CIT SPACES
15 CIT SPACES
25 SPACES @ 9'
27 SPACES @ 9'
PROPERTY LINE
PROPERTY LINE
10Ft CONTOUR
8Ft. CONTOUR
6FT CONTOUR
4Ft CONTOUR
2Ft. CONTOUR
2Ft. CONTOUR
2Ft. CONTOUR
2Ft. CONTOUR
NOTE: ALL DEPTHS ARE REFERRED TO LOW WATER DATUM OF LAKE MICHIGAN, ELEVATION 276.8 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT QUEBEC (I.G.L.D. 1955)
PROPOSED HARBOR LAYOUT
ALTERNATIVE I
CROSS VILLAGE, MICHIGAN
(MODIFIED PLAN)
FEET

FIGURE 1

2.04 The Coast Guard would provide battery-operated lights for the ends of the rubblemound breakwaters to serve as aids for identification of the harbor entrance. The entrance channel would be 140 feet wide with a depth of 12 feet. The 2-acre anchorage area and the connecting internal channel would be maintained at a 10 foot depth.

2.05 A walkway would be built on the west breakwater to provide access to the local fishery. The docking facilities would be constructed by the Michigan Department of Natural Resources (MDNR). They would be oriented perpendicular to the 420-foot segment of the east breakwater. Commercial firms are expected to supply materials and services to operate the facilities. Docking facilities for commercial carriers would be their responsibility.

2.06 The construction of the harbor's 1670-foot west breakwater would necessitate the removal of the deteriorated Works Progress Administration's 1936 breakwater. The estimated 926 cubic yards of clean stone would be used to construct three underwater reefs 6-feet in height and approximately 150-feet in length. The reefs would be located between the 18 to 24 foot contour (relative to the Lake Michigan low water datum of 576.8 feet), northwest of the harbor entrance. The three parallel reefs would be oriented in a northeast-southwest direction, with the northeast end of the center reef located 5,000-feet northwest (315°) of the existing breakwater-beach intersection (Figure 2). Individual reefs would be built in a serpentine pattern to provide optimal cover and habitat diversity.

2.07 To construct the entrance channel and basin, approximately 67,000 cubic yards of dredged material would initially be removed from the harbor site. This material is uncomtaminated sand and suitable for beach nouishment (EPA letter pg. IV-39). Fifteen thousand cubic yards of this sand material would be placed along the 420 foot portion of the east breakwater as fill, extending both the length and depth of the swimming beach (Figure 1). The remaining 52,000 cubic yards would be deposited along the shoreline erosion zone to the east of the harbor area extending

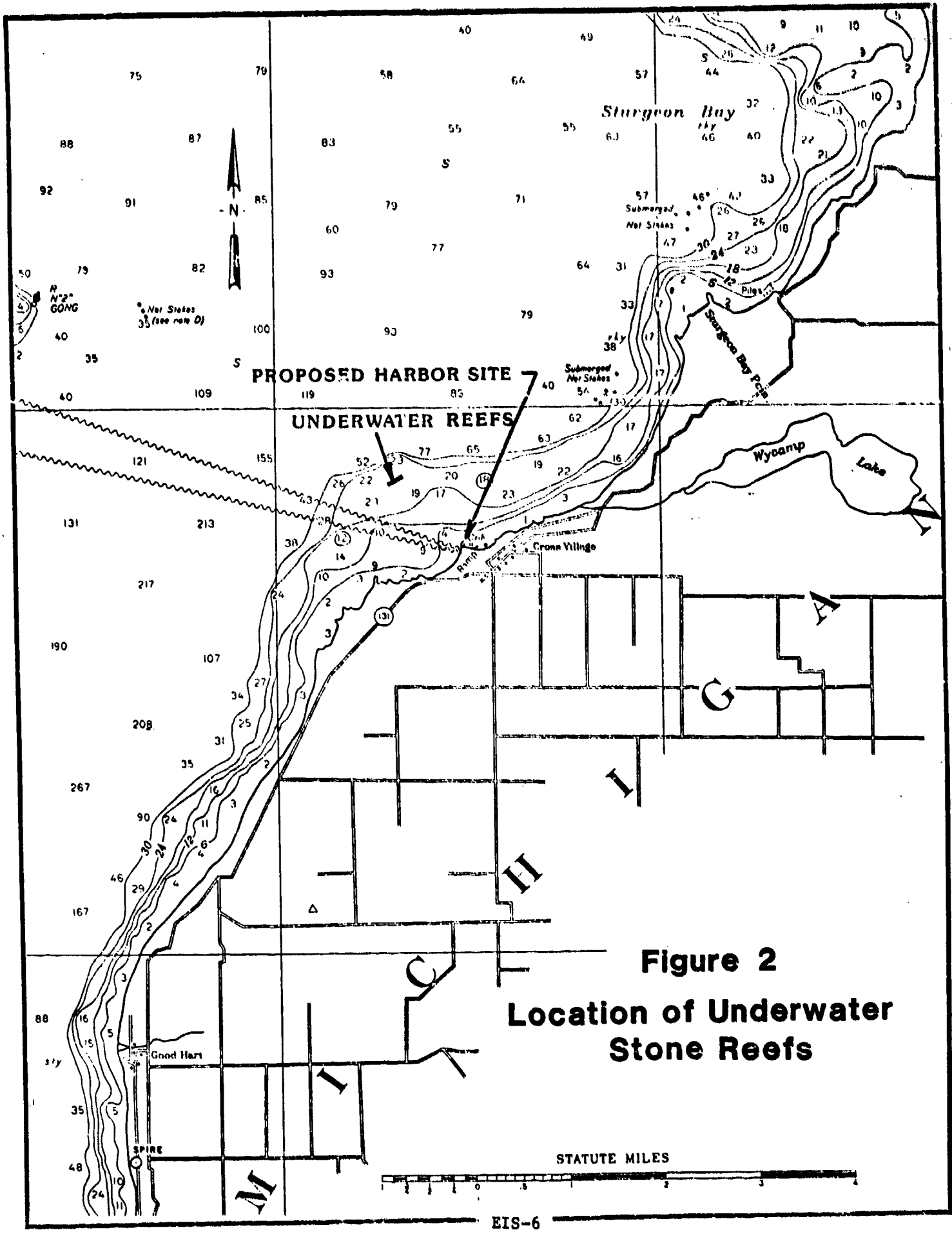

Figure 2

Location of Underwater Stone Reefs

approximately 4,000 feet (see Figure 8, page A-119). Following harbor construction, a shoreline monitoring program would be implemented to determine the volume of beach sand lost to erosion. Material from maintenance dredging would then be placed as beach nourishment in the erosion area, as long as the material remained uncontaminated. To determine if the dredged materials were uncontaminated, harbor sediments would be analyzed for pollutants just prior to maintenance dredging. If necessary, additional uncontaminated beach nourishment material, originating from an approved uncontaminated source, would make up the balance necessary to maintain the beaches in the erosion zone area. For further details on the Shoreline Monitoring Program see Appendix A (Page A-13), of the Phase I GDM.

2.08 In addition to the shoreline disposal site, an alternative deep open-water disposal site has been established. In the event that weather conditions would preclude shoreline disposal during either the initial harbor construction or maintenance dredging operations, the deep open-water site would be utilized. Because the volume of dredged material is low, a small open-water site, 1,500-feet by 2,600-feet, has been selected. The southwest corner of the site is located 8,200-feet NNE (25°) from the existing Cross Village breakwater pierhead (Figure 3).

2.09 The total first cost associated with this project is estimated at $5,395,500, of which $3,307,850 would be a Federal contribution. Annual costs include amortization of the first costs over a 50-year economic life, interest, and maintenance of the facility. The annual cost is estimated at $262,905, of which $176,105 would be the Federal contribution. Sport fishing, commercial fishing, the Beaver Island ferry, recreational docking facilities, and a harbor for refuge would be the primary benefits of the recommended harbor. The annual benefits to these activities have been estimated at $312,259. This annual benefit exceeds the annual cost by a factor of 1.19 (benefit-cost ratio). This indicates that the project is economically justified. For a detailed economic analysis see Page 71 of the Phase I GDM.

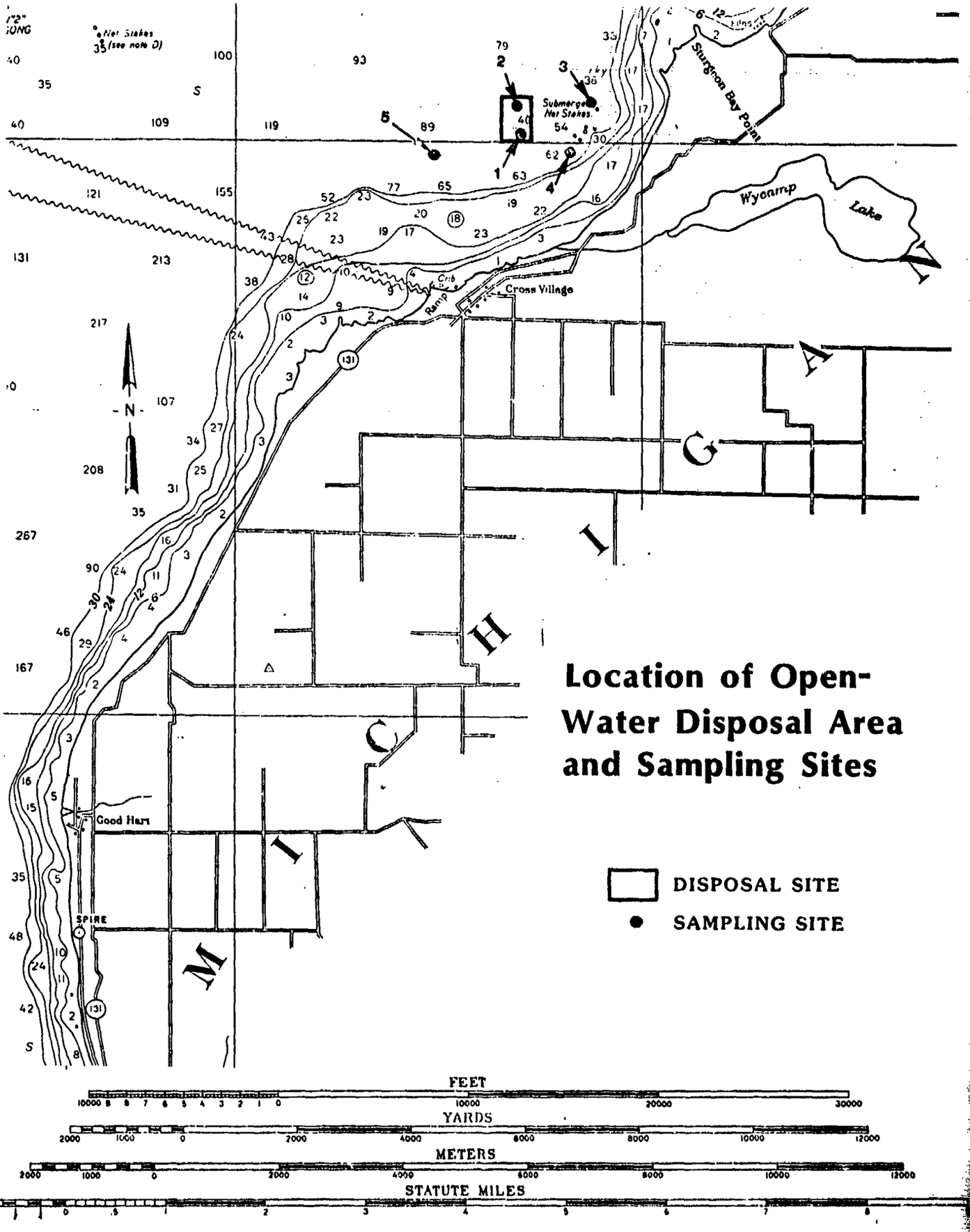
Net Stakes
(see note D)
Submerged Net Stakes.
Sturgeon Bay Point
Wyoamp Lake
Cross Village
Ramp
Crib
Good Harn
SPIRE
- N -
A
G
I
H
C
I
M
Location of Open-Water Disposal Area and Sampling Sites
DISPOSAL SITE
SAMPLING SITE
FEET
YARDS
METERS
STATUTE MILES

Figure 3

Alternatives

2.10 Sturgeon Bay Point and Good Hart, Michigan, are two alternative harbor sites that were also considered. The harbor layouts for these two alternative sites are basically the same, with a few minor variations in breakwater configurations.

2.11 The Sturgeon Bay Point Harbor configuration consists of two rubblemound breakwaters, a 12-foot entrance channel, 10-foot access channels, a two acre 10-foot anchorage area, and recreational and commercial docking facilities. The main breakwater would extend 400 feet northeasterly from shore, then northwesterly 1,200 feet. The smaller north breakwater, 440 feet in length, would protect the harbor against waves from the north (Figure 12, Phase I GDM, pg. 57).

2.12 The Good Hart Harbor configuration is almost identical to that of Sturgeon Bay Point. The only differences are: (1) the short segment of the main breakwater is 500'; and (2) the north breakwater would extend east offshore 350' then angle southeast 100' (Figure 11, Phase I GDM, pg. 56).

2.13 An additional alternative project site located near the Little Sucker Creek in Wilderness State Park is no longer considered a feasible alternative. Therefore, neither the Final Environmental Impact Statement or the Phase I General Design Memorandum address the site in detail.

Section III

The Affected Environment

Location (Cross Village)

3.01 Cross Village is located in Emmet County, Michigan, 25 miles northeast of Charlevoix, and 34 miles southwest of Mackinaw City on the south shore of Sturgeon Bay.

Climate

3.02 In general, the tempering effects of Lake Michigan are felt over all portions of the Lake Michigan basin, especially along the shoreline counties. The mean annual temperature and relative humidity in the northern portion of the basin average 41°F, and 75 percent respectively.

3.03 In the Cross Village area the daily average temperature in January is 18°F. The first frost occurs by 15 October followed by an average of 150 days when temperatures are below 32°F. Temperatures peak in July, with highs normally in the upper 70's. Snowfall totals about 90 inches per year. There is an average of 32 days with one inch or more snowfall. Total annual precipitation ranges from 16 to 32 inches (Baldwin, 1974).

3.04 Windstorms over the State of Michigan are normally caused by a frontal passage of a low-pressure center and with movement of extensive areas of high pressure. The more severe windstorms normally occur during the winter-spring period when these state-wide features coexist. Although the summer months are generally the calmest periods of the year, short-duration thunderstorm winds occur.

Topography

3.05 Although the nearshore slope is very gradual, the Cross Village area is hilly. Over the first 800 feet inland there is less than a 20 foot

increase in elevation (shoreline elevation is 578.5 feet). However, further west, along highway 119, elevations increase sharply, rising 62 feet over a horizontal distance of about 250 feet. The highway near Cross Village is at an elevation of 660 feet. Approximately two and one half miles further inland, to the southeast, elevations in the 900 foot range are common.

Geology

3.06 Rock indigenous to the area is part of the Bois Blanc formation, which runs from the south shore of the Straits of Mackinac, westward through Waugoshance Point and North Traverse Bay out to the Beaver Island area. Bois Blanc rock is composed of cherty dolomite, dolomite limestone, and limestone. This bedrock dates back to the lower Devonian period (about 300 million years ago). During the last million years, glaciers invaded the region several times and scoured and molded the landscape, leaving behind morainic surface formations and surface deposits 200 to 400 feet thick (Hough, 1958).

Soils

3.07 Soils in the vicinity of Cross Village are deep, well drained, and sandy. They are composed mostly of glacial till with some clay substratum. Natural drainage is directly into Lake Michigan, with 0 to 6% slopes. In the area of the recommended harbor and to the immediate northwest along Lake Michigan, the soil is mostly sand with some gravel and silt. Sandy soils also occur to the southwest along with poorly drained organic soils (U.S. Department of Agriculture, Soil Conservation Service, 1973).

Hydrology

3.08 The mean water surface level of Lake Michigan is 578.30 feet (1900-1979) IGLD. Temporary fluctuations can range several feet due to meteorological disturbances such as wind and changing barometric pressure. Long term variations, resulting from change in net supply to the lake, had

a range of about 4.82 feet during the period from 1900 to 1977. The long term (1900 to 1980) maximum instantaneous lake level was at 581.1 feet in 1974 with the long term instantaneous minimum of 575.4 occurring in 1964. Seasonal variations of about 1 foot result from changes in the rate of evaporation and precipitation, snowmelt, and freezing.

3.09 The direction of surface currents along the northeast shore of Lake Michigan is from south to north, their direction and flow rate result from the prevailing westerly winds. Net littoral drift patterns in the Cross Village harbor area run from the southwest to the northeast at an annual rate of approximately 3,800 cubic yards.

Water Quality

3.10 No ground water study has been performed in the project vicinity. In general ground water availability in Emmet County is adequate and of good quality. The only source of drinking water for homes and businesses in Cross Village is well water. Although the Emmet County Department of Health has no record of any water quality checks being performed on area wells, there has never been a water quality problem reported in the Cross Village area.

3.11 Post 1965 well logs provided by local Health Department Officials (Henne, 1981) provide the only information relative to the ground water supply at Cross Village. Average well depths and production rates vary from 120-feet and 31 gallons per minute (gpm) above the bluff, to 68-feet and 60 gpm below the bluff. The above mentioned bluff is oriented in a north-south direction parallel to and approximately 500-feet west of highway 119 (see Topography for further details, pg. EIS-10).

3.12 The Lake Michigan water quality in the area of the recommended harbor appears to be very good. Samples collected on 9 November 1979, were analyzed for a variety of chemical parameters (Attachments A and B). The reported values are characteristic of an uncontaminated fresh water

oligotrophic lake (International Joint Commission, Canada and the United States, 1978; Taylor et. al 1980). The locations of sampling sites (1, 2, and 3) are provided in Attachment C.

Wastewater Treatment Facilities

3.13 Peak sewage volume estimates for the Cross Village Harbor restroom facilities range from 6,000 to 10,000 gallons/day. At present there are no wastewater treatment facilities at Cross Village. When the harbor is built, the Michigan DNR would utilize a sewer system, if one existed at the time of construction. If one didn't exist, a system acceptable to the Michigan Department of Public Health would be designed by the State (see MDNR, Waterways Division correspondence pg. IV-35). The alternative modes of sewage disposal would include:

(a) Construction of a Cross Village wastewater treatment facility;

(b) Septic system with both a holding tank and tile field located at the project site;

(c) Septic system with a tile field located near the project site in more suitable soils;

(d) Holding tank and haul system; sewage would be trucked from holding tanks located at the harbor site to one or more neighboring sewage facilities for processing.

3.14 A septic system with the tile field located near the harbor, on an upland site, would probably be the best alternative to a sewage treatment facility based on economic and environmental criteria.

Sediments (Harbor Site)

3.15 Results of sediment sampling at the proposed project site show the bottom substrate to be light brown, odorless, medium to very fine grain

sands (Attachment D). The percent solids for all samples taken were high, exceeding 78%. Percent of volatile solds (dry weight) and percent oil and grease (dry weight) were very low, ranging from .19% to .26% and .02% to .04% respectively (Attachment E). These values are indicative of uncontaminated sediments (U.S. Environmental Protection Agency, Region V, 1977).

3.16 Pesticide analyses performed on the sediments are reported in Attachment F. Values for all of the chemical parameters tested are characteristic of uncontaminated sediments (International Joint Commission, Canada and the United States, 1978).

Sediments (Open-Water Disposal Area)

3.17 Five bottom samples collected from the deep open-water disposal area (Figure 2) on 11 June 1980 have been analyzed for particle size composition (Attachment G). Sediment composition within the disposal area (Figure 1, sample sites 1 and 2) appears to be quite uniform ranging from medium to very fine grain sand, at a depth of about 60-feet. Although, the open-water disposal area sediments are smaller in grain size than the sediments collected at Cross Village Harbor, more than 50% (dry weight) of the sediments collected from both the harbor and open-water disposal area are classified as fine to very fine sand.

Vegetation

3.18 The Cross Village area was once largely pine (northern xeric) forest on the outwash sands and maple-beech (southern mesic) forest on the moraines. Fires and clear-cut logging practices increased the acreage of large open areas within the early successional forest plant communities. The openings first revegetated with brush species such as viburnum (Viburnum sp.) and blueberry (Vaccinium sp.). However, the area is now covered by second growth forests of oak (Quercus spp.), maple (Acer sp.),

and pine (Pinus sp.), pine platations, aspen-birch stands (Populus - Betula), and pole-sized hardwoods.

3.19 Cross Village and the Sturgeon Bay Dunes found just to the northeast of the project site sustain several plant species which are on the State of Michigan's Threatened Species List. These species are: Lake Huron tansy (Tanacetum huronense); thickspike wheatgrass (Agropyron dasystachyum); Pumpelly's bromegrass (Bromus pumpellianus); and Pitcher's thistle (Cirsium pitcheri).

3.20 The Lake Huron tansy, thickspike wheatgrass, and the Pitcher's thistle have been found at the recommended harbor site. To accommodate harbor parking facilities a significant portion of these plants would be removed and their dune habitat eliminated. However, common to abundant stands of Lake Huron tansy and Pitcher's thistle are endemic to the Lake Michigan shoreline along both the north and south shores of Sturgeon Bay (Corps Survey conducted in 1980).

3.21 Additional plant species identified along the dunes at the harbor site include: wheatgrass (Agropyron trachycaulum); sagewort wormwood (Artemesia campestris); Canada wildrye (Elymus canadeis); prairie sandreed (Calamovilfa longifolia); silverweed cinquefoil (Potentilla anserina); common yarrow (Achillea millefolium); American searocket (Cakile edentula); sand cherry (Prunus pumila); teal lovegrass (Eragrostis hypnoides); American beachgrass (Ammophila breviligulata); and beach pea; or maritime peavine (Lathyrus maritimus).

SERIES II DUNES

3.22 On 17 March 1981 the Cross Village Harbor site was designated a Series II Dune Area by the Michigan Department of Natural Resources under the Sand Dune Protection and Management Act of 1976.

3.23 The Cross Village Harbor site contains two separate foredune areas (Figure 4). One small dune area (designated Dune Area I) about 100-feet west of Wetland I is circular in shape rising approximately 5-feet above the adjacent beach and measures about 95-feet in diameter. This dune is densely vegetated by dune grasses and the Michigan threatened Lake Huron tansy. Dune Area 2 is about 3 feet high, 350 feet long and 20 to 60 feet in width. The longitudinal axis of this dune area is oriented in a east-west direction 40 to 75-feet south of the normal high water mark between the beach and northeast border of Wetland I. The predominant forms of vegetation in Dune Area II are dune grasses, Lake Huron tansy, horsetails, and wheatgrass.

Wildlife

3.24 Mammals known to dwell near Cross Village include the white-tailed deer (Odocoileus virginianus) and black bear (Ursus americanus). Other small mammals thought to be present in medium to high densities through the area are listed in Table 3.

3.25 Emmet County lies on a migration corridor and is a wintering place for dabbling ducks, blue geese (Chen caerulescens) and snow geese (Chen hyperborea) (Great Lakes Basin Commission, 1975). Although not reported this winter at the Cross Village Harbor wetlands, mallard ducks (Anas platyrynchos) and heron (Ciconiiformes spp.) are known to frequent the area.

3.26 The U.S. Fish and Wildlife Services Red Book (1979) on threatened and endangered species was reviewed. One threatened bird, the Bald Eagle (Haliaeetus leucocephalus), may be found in the general project area. However, there is no record of any eagle nests in the area (see U.S. Fish and Wildlife correspondence pg. IV-15).

Figure 4

Cross Village Harbor Foredunes

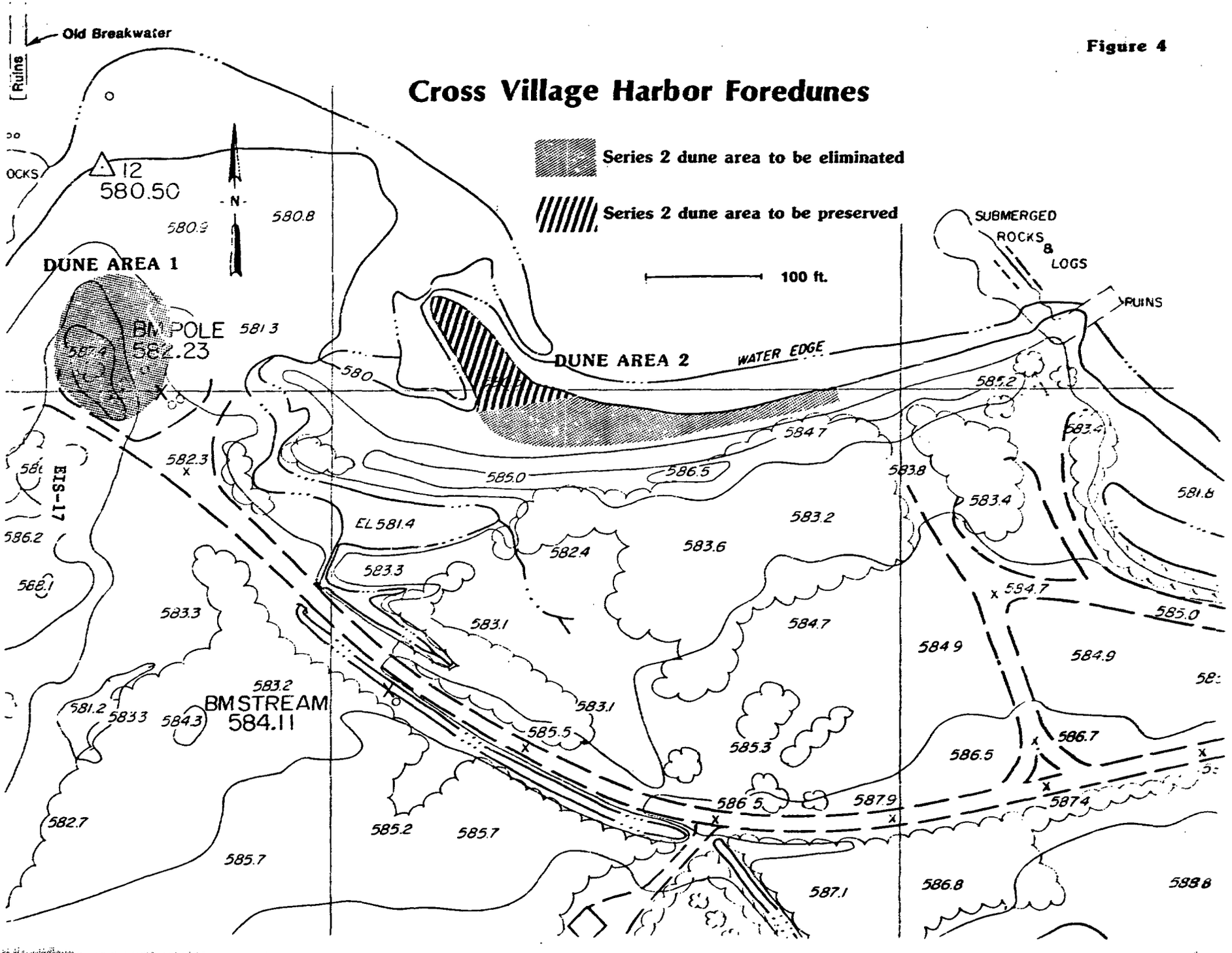

Table 3

Wildlife of Northwest Subarea of the Lower Peninsula (Great Lakes Basin Commission, 1975)

Common Name	Density	Trend	Scientific Name
BIG GAME			
White-tailed Deer	Medium	Decreasing	Odocoileus virginanus
Black Bear	Low	Decreasing	Ursus americanus
Moose	Low	Increasing	Alces alces
Turkey	Low	Increasing	Meleagris gallopavo
WATERFOWL			
Ducks	Medium	Stable	Anatidae spp.
Geese	Medium	Increasing	Anseeinae spp.
SMALL GAME			
Cottontail Rabbit	High	Stable	Sylvilagus floridanus
Ring-necked Pheasant	Low	Stable	Phasianus colchicus
Ruffed Grouse	High	Increasing	Bonasa umbellus
Gray Squirrel	Medium	Increasing	Sciurus carolinensis
Fox Squirrel	Medium	Increasing	Sciurus niger
Snowshoe Hare	Low	Decreasing	Lepus americanus
Woodcock	High	Increasing	Philohela minor
Mourning Dove	Medium	Stable	Zenaidura macroura
Bobwhite Quail	Low	Stable	Colinus virginianus
Sharp-tailed Grouse	Low	Decreasing	Pedioecetes phasianellus
FURBEARERS			
Muskrat	Medium	Decreasing	Ondatra zibethica
Mink	Medium	Stable	Mustela vison
Beaver	High	Stable	Castor canadensis
Weasel	Medium	Stable	Mustela spp.
Raccoon	High	Increasing	Procyon lotor
Otter	Low	Decreasing	Lutra anadensis
Skunk	High	Increasing	Mephitis spp.
Opossum	Medium	Increasing	Didelphis arsupialis
Badger	Low	Stable	Taxidea axus
NON-GAME			
Woodchuck	Medium	Stable	Marmota monax
Porcupine	Low	Decreasing	Erethizon dorsatum
Red Fox	Medium	Stable	Vulpes fulva
Bobcat	Low	Decreasing	Linx rufus
Crow	High	Increasing	Corvus brachyrhynchos
Raven	Low	Stable	Corvus orax
Red Squirrel	Medium	Increasing	Tamiasciurus hudsonicus
Coyote	Low	Stable	Canis latrans
Bald Eagle	Low	Decreasing	Haliaeetus leucocephalus

3.27 Several rare fish species, (Table 4) could be in the Cross Village region (Scott and Crossman, 1973), although none of these species have been found there to date.

TABLE 4

Unusual Fish Species of the Upper Lake Michigan Basin

Common Name	Scientific Name	Classification	
Longjaw cisco	*Coregonus alpenae*	Federal	Endangered
Deepwater cisco	*Coregonus johannae*	State	Endangered
Blackfin cisco	*Coregonus nigripinnis*	State	Endangered
Shortnose cisco	*Coregonus reighardi*	State	Endangered
Lake Sturgeon	*Acipenser fulvescens*	State	Threatened
Lake herring	*Coregonus artedii*	State	Threatened
Bloater	*Coregonus hoyi*	State	Threatened
Kiyi	*Coregonus kiyi*	State	Threatened

Wetlands

3.28 Within the project site are two wetland areas (Figure 1). Wetland I (2.4 acres) is a series of 4 open-water areas connected by a flow of water that enters Lake Michigan from its northeast end. Water depths range from 6 to 24 inches. The water source for wetland I is a combination of run-off and ground water.

3.29 Wetland II is a single pond (Figure 1), connected to Lake Michigan at its eastern end. This wetland is a spring feed, flooded, low-lying wooded area with water depths ranging from 12 to 24 inches. Most of this small wetland lies outside of the project site.

3.30 Both wetlands are possible spawning sites for northern pike (*Esox lucius*) (U.S. Department of the Interior, 1979). Table 5 lists the Wetland biota composition.

Table 5

Species Composition of Wetlands

(U.S. Dept. of Interior, 1979)

Wetland I	Wetland II
Cattail, Typha sp.	Cattail, Typha sp.
Bladderwort Utricularia sp.	Goldenrod Solidago sp.
Duckweed, Lemna sp.	Duckweed, Lemna sp.
Horsetail, Equisetum 2 spp.	Speedwell, Veronica anagallis-aquatica
Joe-pye weed, Eupatorium maculatum	Spikerush, Juncus sp.
Muskgrass, Chara sp.	Willow, Salix sp.
Pondweed, Potamogeton sp.	Midges, Dipera
Sedges, Carex sp.	Water striders, Gerridae
Spikerush, Juncus sp.	
Larval crayfish, Astacidae	
Midges, Diptera	
Snails, Pulmonata	
Water Striders, Gerridae	
Bullfrog, Rana catesbeiana	
Mallard, Anas platyrhynchos	

Benthos (Harbor Site)

3.31 On-site testing of the harbor area indicates that no well established benthic communities exist. The northeast section of the project, sample site 3 (Attachment C) apparently supports the densest benthic community. Benthos types collected at sample site 3 include amphipods (Pontoporeia hoyi), oligochaetes (Stylaria lacustris), and unidentifiable chironomid dipterans. At site 1 only small numbers of tubificids were collected, at sample site 2 only a small number of dipterans (Table 6). Sample sites 1 and 2 are higher energy environments than sample site 3. This is the most probable reason for sparse benthic populations at these sites.

TABLE 6

Results of Cross Village Harbor Benthic Macroinvertebrate Analysis.

Taxa	Site 1	Site 2	Site 3
Amphipoda			
Pontoporeia hoyi			19.1
Oligochaeta			
Tubificidae			
immature w/o capilliform chaetae	6.4		
Naididae			
Stylaria lacustris			6.4
Diptera			
Unidentifiable Chironomidae*		6.4	25.5
Total number/m^{2}**	6.4	6.4	51.0
Total taxa	1	1	3

*head capsule damaged or specimen too immature for identification beyond family level

**three grabs per site were taken

Benthos (Open-Water Disposal Area)

3.32 Results from the benthic macroinvertebrate analysis for dive samples collected in the vicinity of the open-water disposal area on 11 June 1980 are listed in Table 7. Both species diversity and total macroinvertebrate density are greatest in the near-shore sampling sites (Figure 2, sites 3 and 4). Macroinvertebrate diversity and density appear to decrease progressively with increased depth.

Fisheries

3.33 Inland spawning in relation to Lake Michigan around the Cross Village area is limited. The two small wetlands areas located on the project site

TABLE 7

Results from the Benthic Macroinvertebrate Analysis for Dive Samples Collected 1 1/4 Miles North of Cross Village, Michigan on 11 June 1980.

TAXA	SITE 1	2	3	4	5	POLLUTION TOLLERANCE
Oligocheata						
Tubificidae						
Immature w/out capilliform Chaetae	209	499	322	209	64	T
Immature with capilliform Chaetae	129	145	160			T
Audlodrilus americanus		16				
Limnodrilus spiralis			16	32		T
Peloscolex multisetosus		16				
Ephemeroptera						
Ephemeridae						
Hexagenia spp.		16	16			F,I
Ephemera spp.				48		
Chironomidae	32	16	129	435	81	
Tanypodinae			16		16	
Chironominae	64		306		16	
Orthocladinae				64		
Chironomus spp.	354	160	564	16	306	T,F
Procladius spp.	160	48	419	48	48	T,F
Endochironomus spp.			354		16	T,F,I
Larsia spp.	16				16	F
Tanytarsus spp.	386	338	1,030	160	81	F,I
Polypedilum spp.		64	1,175	113		F,I
Cryptocladopelma spp.	32	64				
Microteudipes spp.	16					I
Parametriocnemus spp.	16					
Cryptochironomus spp.			48	16		T,F,I
Pseudochironomus spp.				48		I
Dicrotendipes spp.				32		T,F,I

TABLE 7 (Cont.)

Results from the Benthic Macroinvertebrate Analysis for Dive Samples Collected 1 1/4 Miles North of Cross Village, Michigan on 11 June 1980.

TAXA	SITE 1	2	3	4	5	POLLUTION TOLLERANCE
Hydracarina			16			I
Nematoda			16	16		
Mollusca						
Pisidium spp.			16	32		F
Valvata spp.				16		
Total Number $1m^2$**	1,414	1,382	4,604	1,285	644	
Total taxa	11	11	16	15	9	

**One grab per site was collected.

are possible northern pike (Esox lucius) spawning grounds (U.S. Fish and Wildlife Service, 1979). Wycamp Creek, 1 mile to the north is the closest known inland spawning area within a 5 mile radius of Cross Village.

3.34 The offshore sport fishery is not well utilized by sportsmen even though northern pike, smallmouth bass (Micropterus salmoides), chinook salmon (Oncorhynchus tshawytscha), trout-perch (Percopsis omiscomaycus), and rainbow smelt (Osmerus mordax) frequent the harbor site. The proposed rubblemound breakwaters and on-shore facilities would provide a safe, convenient means of access to the local fisheries for both small and large recreational craft.

3.35 Commerical fishing at Cross Village ended in 1955 with deterioration of the breakwater. Lake trout (Salvelinus namaycush), whitefish (Coregonus culpeaformis), and suckers (Catostomus spp.) were the principal catches. Total catch peaked at 80,000 lbs. in 1948.

3.36 The Cross Village area is a desirable location to base a commerical fishery because it is adjacent to some of the areas best fishing grounds. However, the future of the entire northeastern Lake Michigan fishery is in question. If the Bay Mills and Sault Ste. Marie Indians win their fishing rights dispute against the State of Michigan, which is currently on appeal in the U.S. Sixth Circuit Court of Appeal in Cincinnati, the future outlook for the commercial fishery in the Cross Village vicinity is open to question. Without the authority to manage local fish stocks, the State of Michigan cannot accurately predict or regulate the future of the fish stocks and the fisheries in the area (Wright 1980). On the other hand, both Indian and non-Indian 1979 commercial whitefish catches were up 15.0 and 8.5 percent respectively over 1978 catches. It is not clear whether the increased catches were a result of increased fishing pressure or an increase in whitefish stocks. However, there is no evidence indicating that whitefish populations are currently being stressed by overharvest (Hatch, 1981).

Recreation

3.37 Local recreational resources in the immediate project area include the offshore fishery, a sand beach throughout the harbc area and a portable launching ramp located behind the remains of the existing breakwater structure. The ramp can only be used during calm weather conditions because the deteriorated breakwater no longer offers protection from wave action.

3.38 Although little sportfishing now occurs at the project site, it is a popular sport in the county, in both inland and Lake Michigan waters. In 1973, there were an estimated 50,000 trout and salmon angler days and 75,000 inland angler days (Sommers, 1977).

3.39 Wilderness State Park, about 6 miles north of the project area is an attraction of particular interest to tourists. Contained within the park are a wildlife refuge, a general store, and numerous rental cabins and camping facilities for both tents and recreational vehicles.

Man-made Facilities

3.40 The pre-World War II breakwater and portable launching ramp are located within the recommended project area. The portable launching ramp would not be utilized after the construction of a permanent boat launch. Stone breakwater material would be reused in the construction of underwater fish reefs.

Demography and and Social Characteristics

3.41 The population of Cross Village in 1980 was 217, an increase of 17.3% over the 1970 population of 185. Emmet County's population increased by 24.3% over the same time period. The 1980 population was 22,792.

3.42 Current population estimates for the time period 1980 to 1990 show project population increases of 20% for Cross Village and 9% for Emmet County. These figures do not take into account the construction of a harbor at Cross Village (for further details see Human Resources, page 27, GDM).

Cultural Resources

3.43 A preliminary cultural reconnaissance of the Cross Village area has been completed. There appears to be no significant sites present in the area of direct project impact. There are no sites listed on the National Register of Historic Places in the vicinity of the project. However, the Cross Village area is rich in pre-historical and historical resources. At the request of the State Historic Preservation Officer, a more detailed historical and architectural survey will be undertaken during the Phase II design stage to determine if development, which could take place indirectly in response to the presence of the harbor, could adversely affect any cultural resources at Cross Village.

Sturgeon Bay Point

3.44 The Sturgeon Bay Point site is located approximately 6 miles northeast of the Cross Village site, on the south shore of Sturgeon Bay. This site would utilize a 1500 foot stretch of scenic lakefront dune property which is now part of the Hardwood State Forest. The future expansion plans outlined in the Wilderness State Park Master Plan call for the eventual inclusion of this property (all of Section 13) within the Park boundries. All the dune formation located on and bordering the Sturgeon Bay Point site are designated Series II Dune Areas.

3.45 The north shore of Sturgeon Bay is divided into an upland region vegetated by white poplar (Populus alba) and white cedar (Chamaecyparis thyoides) and a foredune area dominated by beach grasses and sand cherries (Prunus pumila). An extensive sand and pebble beach measuring up to 100 feet in width follows the uneven shoreline of the bay. Directly behind the

proposed harbor site is a beach wetland area approximately 500 feet in length and 40 feet in width.

3.46 Three Michigan threatened plant species have been identified at the Sturgeon Bay site. (1) The Lake Huron tansy; (2) Pitcher's thistle; and (3) thickspike wheatgrass.

3.47 Sturgeon Bay Dunes, located less than one mile northwest of the Sturgeon Bay site is an area of special concern to environmentalists. This dune area is part of an 716-acre stretch of unique shoreline dune habitat (owned by Sand Products Corporation) currently being subjected to damage by recreational vehicles. In this fragile dune habitat a number of Michigan threatened plant species flourish. These include the Lake Huron tansy, thickspike wheatgrass, Pumpelly's bromegrass, and Pitcher's thistle (Voss, 1978).

Good Hart

3.48 The Good Hart site is located about 10 miles SSW of Cross Village. Most of the land at this site is wooded upland composed of aspen (Populus spp.), white cedar, and birch (Betula spp.). The upland slopes sharply downward to a small foredune which separates the beach and upland areas. The foredune, dominated by dune grasses, gradually diminishes into a gently sloping white sand beach, ranging from 20 to 30 feet in width. The Michigan threatened plant, Lake Huron tansy is common throughout the site's foredune area.

Wilderness State Park

3.49 The Wilderness State Park site is located in a marsh near Little Sucker Creek approximately 1 mile southwest of Waugoshance Point on the north shore of Sturgeon Bay. This site is part of a large State-owned wildlife refuge area located within the Wilderness State Park boundaries.

Along this portion of the Lake Michigan shore the Little Sucker meanders for 700 feet through a coastal wetland before flowing into the open waters of the lake. The 40 acres of marsh vegetation are dominated by sedges (Cyperus spp.); however, a number of Michigan protected plant species including the sundew (Drosera spp.) and the pitcher plant (Sarracenia purpurea), are common in the area.

SECTION IV

ENVIRONMENTAL CONSEQUENCES OF THE RECOMMENDED PROJECT AND ALTERNATIVES

Hydrology

4.01 Littoral drift and the deposition of sediments would be influenced by the construction. The proposed harbor structures would result in the accretion of fine to medium sand and drift material against the southwest side of the breakwater, and cause additional erosion along the shoreline extending to about 4,000 feet northeast of the harbor. The total amount of littoral drift expected to accrete southeast of the harbor structures, become trapped in the harbor entrance, or lost lakeward due to the effects of wave action, is estimated at 3,800 cubic yards.

4.02 The harbor would have its most significant impact on littoral drift the first few years after construction. Littoral material would accrete southwest of the harbor until a substantial build-up occurred facilitating the passage of littoral material around the harbor. Beach nourishment from the original harbor dredging and periodic maintenance dredging would compensate for the erosion attributable to the harbor structure which is estimated to be 15% of the total erosion occurring in the area.

4.03 A shoreline monitoring program would verify the estimated effect of the harbor on local accretion and erosion patterns along the 3 mile stretch of shoreline extending 4,350 feet west and 11,050 feet east of the harbor te. An initial shoreline survey would be performed prior to construction and periodically prior to maintenance dredging over a twelve year period after which the littoral regime would have adjusted to the harbor structures.

tlands

4.04 The recommended project would have no long-range impact on the two wetland areas located within the harbor site. However, there is a

potential for temporary damage to the large wetland area (Figure 1) during the construction of parking facilities due to its close proximity to this wetland. Any damage which occurred would be repaired by the contractor.

4.05 Parking lot drainage would be diverted away from the wetland areas, lakeward. This would minimize any wetland contamination potential from motor vehicles.

Water Quality

4.06 Water quality is not expected to be influenced by the project except temporarily during construction. Construction equipment would disturb the bottom materials during dredging and filling; however, the impact on water quality would be very local due to the coarseness and rapid settling of these materials. Some minor gasoline or oil spillage could occur during construction.

4.07 After the dredging and breakwater construction were completed, construction of docking facilities by the Michigan DNR would also cause a temporary water degradation due to turbidity. Although the area is currently used by recreational boats, an increase in boating use is expected. Due to this increased usage, a slight decrease in local water quality could be expected. Turbidity and levels of oil and grease would be elevated.

4.08 The cleaning of fish in the harbor by commercial or recreational fishermen would not be permitted. However, if recreational fishing usage were to become substantial, the State of Michigan may provide and maintain harbor cleaning facilities for recreational fishing use. Fish remains would be disposed of in garbage containers or ground into holding tanks. Under no circumstances will the cleaning of commerical fish catches be permitted at the facility. Thus, the deposition of fish remains should have little to no adverse impact on water quality within or around the harbor.

4.09 A 404(b)(1) evaluation has been prepared in reference to the dredge and fill operations associated with harbor construction and maintenance operations. As required under Section 404 of the Clean Water Act of 1977,

all dredge and fill operations associated with the Cross Village Harbor Project have been designed to conform with U.S. Environmental Protection Agency (U.S. EPA) Regulations (see 404 Evaluation, Supplement III).

4.10 Peak harbor water usage estimates range between 6,000 to 10,000 gallons per day. Based on the average post-1965 well production rate of 60 gallons per minute in the vicinity of the harbor, no adverse impact on the Cross Village aquifer from withdrawal of groundwater by the proposed facility is anticipated. Similarly, the consistent well depths and good production rates of post-1965 wells drilled in the business-residential district of the village (see Water Quality 3.11, pg. EIS-11), indicate that the Cross Village aquifer is sufficient to handle the projected increases in residential and business related activities.

4.11 Sewage generated from the Harbor's boat pump-out facilities would be stored in a holding tank(s) and trucked to a local water treatment facility. Lake, wetland, and ground water quality would not be affected.

4.12 The projected environmental impacts of the four alternative modes of restroom sewage disposal have been evaluated individually. Any sewage treatment facility or septic field would be required to meet all Michigan Department of Public Health (MDPH) specifications. Evaluation of the potential for ground water contamination would be based on a detailed hydrogeological study required by the MDPH. No significant adverse effects on ground water would occur. The USEPA approved State water quality standards would be met. The precise method of sewage disposal would be determined during the Phase II design stage of the Cross Village project. The MDNR would secure a permit from the Health Department for a sewage disposal system at the harbor. Coordination between the Corps and EPA would be established by the Corps to secure EPA concurrence with the proposed plan. The environmental impacts of the four potential modes of sewage disposal are described as follows:

(1) Cross Village Township Waste Water Facility

Cross Village Treatment Facility environmental impacts would be dependent on the geographical location of the system, method of treatment

and mode of discharge. Any adverse impacts would be in the form of increased bacterial, viral and nutrient loading of the environment. No significant adverse impacts on local drinking water would occur. EPA approved State water quality standards would be met.

(2) Harbor Septic Field System

Because of the wet sand beach soils, wetlands and high groundwater table at the Cross Village site, the construction of a septic field on harbor property may be impossible. A septic field on the harbor site would be a potential source of bacterial, viral and nutrient inputs to both Lake Michigan and the on-site wetlands. The suitability of this site will be determined by a Michigan State Public Health Department Study.

(3) Septic Field Adjacent to Harbor

This alternative would probably involve the pumping of effluent from harbor holding tanks to a septic field located near the harbor site. Without specific geographical information, or soils or groundwater data, the potential environmental impacts of such a system cannot be directly assessed. Although septic limitations in the Cross Village upland areas are classified as slight on 0 to 12% slopes by the U.S. Department of Agriculture Soil Conservation Service (1973), a thorough evaluation of the potential contamination of local groundwater supplies would be addressed on a site-to-site basis by the Michigan Department of Public Health.

Analysis of post-1965 Cross Village well logs obtained from local Health Department officials have provided some preliminary information regarding the hydrogeological make-up of the area. The post-1965 wells are relatively deep, averaging 120 feet and 68 feet above and below the bluff area, respectively. Throughout the above-bluff Cross Village area their appears to be a layer of surface to subsurface clay ranging from 5 to 65 feet in thickness. Based on the well log information, the near-site above

bluff septic field location appears to be a feasible method of sewage disposal. However, this position is not based on scientific data. Additional hydrogeological data is needed before a final review of the potential for groundwater contamination in the near-site harbor area can be made. Continued coordination between the Corps, MDNR's Waterways Division and EPA would continue during the Phase II design stage of the Cross Village project.

(4) Holding Tank and Haul System

Since the wastewater would be removed to a treatment plant, the lake, wetland, and ground water quality of Cross Village Harbor would not be affected.

Vegetation

4.13 Because there are no Lake Michigan submerged, floating, or emergent aquatic plant communities in the immediate vicinity of the project, little if any impact would be expected on existing aquatic vegetation. The presence of the breakwater could allow some plant growth to occur within the harbor after construction, however.

4.14 Some terrestrial dune vegetation would be eliminated within the project site. One abundant (more than 100 plants) stand of the Michigan threatened species, Lake Huron tansy (Tanecetum huronense), a few Pitcher's thistles (Cirsium pitcheri), and at least one small stand of thickspike wheatgrass (Agropyron dasystachyum), would be destroyed. A small colony of Lake Huron tansy, located in the Series II dune area that would be preserved, will remain unmolested by project construction activities (see Threatened Plant Collectors Permit, pg. IV-31).

4.15 Wetland vegetation would remain undisturbed. There would be no construction within the wetlands. Construction access roads would utilize existing roadways on the periphery of these wetlands (Figure 1).

Series II Dunes

4.16 Both Dune Areas I and II would be affected by the construction of onshore facilities. Dune Area I would be completely eliminated while approximately 50% of Dune Area II would be preserved (Figure 3). No conflicts with the proposed action and the provisions of Michigan's Sand Dune Protection and Management Act exist (see MDNR, Geological Survey Division Correspondence pg. IV-34).

Wildlife

4.17 Construction would temporarily displace some small mammals and waterfowl in the immediate project area. Greater human use of the surrounding area is expected after completion of the project. However, this activity (confined to the near shore and parking areas) should not interrupt critical reproductive stages of any mammals or waterfowl in the area.

4.18 Utilization of the on-site wetland by waterfowl would probably decrease during the summer boating season. However, because the open-water wetland habitat is less than 1 acre, regional waterfowl populations would not be affected.

4.19 No adverse impacts to any endangered wildlife species is expected. The Federal and State of Michigan lists have been checked and the U.S. Fish and Wildlife Service and Michigan Department of Natural Resources have been consulted and no endangered or threatened animals are known to exist in the project area.

Fisheries

4.20 Fish are expected to avoid the project area during dredging and breakwater construction due to locally high turbidity and noise levels. These effects would be temporary, and no long-range fish species or population changes could be anticipated. Schedules for dredging and

construction in the water would be coordinated with the Michigan DNR, the U.S. EPA and the Fish and Wildlife Service of the U.S. Department of the Interior to avoid adverse effects on fish spawning and migration.

4.21 The riprapped face of the breakwater would support additional benthic animals and algae and become a rich food source for fish. The breakwater walkway would facilitate greater utilization of the near shore fishery by providing an additional means of access to anglers.

4.22 The recommended harbor at Cross Village should not increase the commercial fishing pressure on local stocks. All the commercial fisheries that have expressed an interest in relocating at the proposed facility, currently fish off Cross Village waters.

Benthos (Harbor and Shoreline Dredged Material Disposal Site)

4.23 In the immediate project area, most of the bottom-dwelling organisms would be destroyed by dredging and breakwater construction. Some benthic habitat within the harbor would be permanently lost. Other areas would be periodically disturbed by dredging.

4.24 Natural benthic macroinvertebrate communities along the shoreline disposal area would be covered over by dredged materials and probably destroyed. These areas are, however, subject to constant sand movement. Under these conditions, the benthic populations are scant, so the adverse impacts from beach nourishment would be minor.

Benthos (Open-Water Disposal Site)

4.25 Utilization of the deep open-water disposal site would result in the destruction of those benthic organisms covered by the dredged material. Recolonization of the area should begin immediately after cessation of disposal with the appearance of "pioneer" species (Flint, 1979). Pioneer species density would probably peak within months giving way to species succession processes and the eventual return to an equilibrum benthic community (Rhoads et. al. 1978).

4.26 Preferably the deposition of dredged material at the open-water disposal site would occur between January and April, a period of low benthic recruitment and low bottom temperatures. Recolonization of the disposal area should be accomplished within 1-1/2 years (Schubel et. al., 1979).

4.27 The deposition of dredged material would cause a temporary increase in turbidity levels in the vicinity of the disposal site. However, impacts on local water quality and primary productivity should be minimal due to the coarseness of the harbor sediments.

Productivity

4.28 As previously mentioned, the Lake Michigan waters adjacent to the Cross Village Harbor area are low in dissolved nutrients, void of macrophytes and support a limited benthic community. The construction of the proposed rubblemound breakwaters should enhance the harbor's level of productivity in two ways.

4.29 First, the rubblemound breakwaters and underwater reef would have an advantageous effect on the kind and number of plants and animals that would inhabit the area. The stone structures would provide additional habitat conducive to algae, invertebrates and small gamefish production.

4.30 In addition, the breakwaters would provide a sheltered habitat conducive to colonization by macrophytes and benthic organisms. Particulate organic carbon and nutrients originating from the wetlands and emptying into the harbor would tend to accumulate within the protective confines of the harbor breakwaters. The accumulation of organic material in the harbor's sediments would provide a good substrate for both invertebrate and macrophyte colonization, while the influx of dissolved nutrients would tend to stimulate algal and macrophyte production within the harbor. The development of macrophyte and benthic communities within the harbor could occur rather rapidly and the level of benthic, macrophyte

and algal productivity could become substantial. It is possible that measures would have to be taken to remove macrophytes or inhibit their growth.

Oil and Gasoline Spills

4.31 At a facility of the size and type of the recommended harbor at Cross Village, an average of 2 to 3 minor fuel spills per year could be anticipated. The two most common origins of fuel spills in this type of facility are: (1) over-topped fuel tanks; and (2) hydrocarbon discharge from bilge pumps (De Mott, 1980).

4.32 The volume of oil or gasoline associated with these types of oil spills would usually be less than 10 gallons. Under normal conditions this volume would be dissipated rapidly by wave action inside the harbor. The lakeward flow of water through the wetland area contained within the project site would prevent any oil spilled inside the harbor from entering the wetlands. Although there is always the potential of a serious oil spill occurring at such a facility, under normal conditions oil spills should not adversely affect wildlife in the area.

4.33 If an oil spill clean-up operation would be necessary at Cross Village Harbor or the surrounding vicinity the operation would be coordinated by the U.S. Coast Guard, Captain of the Port, Sault Ste. Marie, Michigan.

Man Made Facilities and Services

4.34 The existing timber and rock breakwaters would be removed and the recovered rock material used to construct an underwater fish reef. Removal and relocation of these materials should cause no adverse impacts beyond the noise, movement and operation of heavy equipment.

4.35 A slight increase in service facilities may occur following construction of the harbor. As people make greater use of the area, one or

more additional eating establishments, motels, vehicle service centers, etc., could be needed. These services would probably be located along state Highway 119. They could exert some adverse impact on the natural resources in the area.

4.36 No change in the overall air quality would be expected from the increased automobile and boating traffic. With more boats utilizing the area there probably would be an increase in noise; however, no significant adverse impact on the area would be likely to occur.

Architectural and Archaeological Resources

4.37 A draft cultural resources reconnaissance report was prepared on Cross Village, Michigan, for the Detroit District Corps of Engineers in August of 1980. The report concluded that no significant archaeological sites, in the direct project impact area would be affected by project construction (Flanders, 1980). The report is being coordinated with the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation.

4.38 Informal coordination with SHPO representatives has taken place in conjunction with response to the reconnaissance study. In response to their requests, a more detailed architectural and historical survey of the Cross Village area will be undertaken during the Phase II design stage to assess the possibility of indirect effects on cultural resources in the village. These might occur from construction of service facilities (see paragraph 4.35).

Economic Activity

4.39 Construction of the recommended project would add to the economic base of the Cross Village Community. Increased use of the area's

recreational potential would also bring business into the area on a permanent basis.

4.40 At least 3 commercial fishing operations currently based at Charlevoix Harbor may relocate at Cross Village (for further information see page B-27, Appendix B).

Recreation

4.41 Recreational use of the area would increase following completion of the project. As people are drawn to the area for fishing and boating they would also discover other recreational opportunities in the area. Greater use of the area's hunting, snowmobiling, beach and camping facilities would probably follow.

4.42 Both the length and depth of the present beach at the Cross Village Harbor site would be substantially reduced. This could force some bathers to use the Bliss Township beach, located about 3 miles northeast of Cross Village along Lake Shore Drive. For further details see the description of the selected plan (page 69, Phase I GDM).

Affects of Recommended Project on Land Use Plans

4.43 No major changes are expected in the type of land use due to the project, but a slight increase in the number of businesses and residences is anticipated. Some increase in service-oriented development would probably take place along Highway 119. Any increase in residential development would probably be scattered throughout the Township. None of these uses are contrary to existing land use plans. The development of a marina and harbor facility at Cross Village have been recommended by Emmet County and the Emmet County Planning Commission to compliment the area's scenic Lake Michigan beaches (Emmet County's Civil Division, 1979, Emmet County Planning Commission, 1971). See Appendix C for detailed land use and zoning ordinance information.

Relationship Between Local Short-Term Use of the Environment and Long-Term Productivity

4.44 The long-term recreational productivity of the area would be enhanced by the recommended project. The availability and safety of the harbor would lead to greater boating and recreational use of the area. Pleasure boats would utilize the harbor as both a seasonal anchorage and as a temporary refuge for transient craft. Better use of the offshore sport fishery would follow construction of the project, and the efficiency of the commercial fishery would be improved as the boats would be able to use the harbor again rather than docking at existing facilities located in excess of 25 miles north or south of Cross Village.

4.45 Because of the increased use of the area, the local economy would benefit from the project. It is expected that the use would be somewhat seasonal but the long-term effect would be a more stable and dependable economy (for further economic details see Appendix B).

4.46 The short-term use of the area with the project would be the same as the mentioned long-term use except that it would take a number of seasons for people to learn of the improvements and utilize them. Long-term productivity of the natural resources of the area would be slightly enhanced by diversification of the aquatic habitat.

Irreversible and Irretrievable Commitment of Resources Involved in the Recommended Project.

4.47 Materials, energy, and labor would be the major resource commitments to the recommended project. The greatest activity would be during the initial construction, although periodic maintenance dredging would also be anticipated.

4.48 The rock rubble for the breakwater would probably be quarried from an approved quarry as near the site as possible. Energy would be largely in

the form of petroleum products necessary to run the heavy construction and dredging equipment. The majority of the labor involved in the construction of project would probably be contracted to private concerns.

Environmental Consequences of the Alternatives

4.49 Alternatives to the recommended Cross Village site include: (a) Sturgeon Bay Point site; (b) Good Hart site; and (c) no action.

(a) Sturgeon Bay Point

4.50 The Sturgeon Bay Point alternative site is an environmentally unacceptable location for the construction of a recreational boat harbor. Serious problems with land usage plans, erosion, threatened species and potential ground water contamination would probably be insurmountable.

4.51 Erosion problems at Sturgeon Bay Point would result directly from construction operations and indirectly through increased human activity in the area. The destruction of dune vegetation by the State during construction of support facilities and access roads, especially in the foredune areas, would probably result in numerous blowouts. These blowouts would destroy numerous representatives of the Michigan threatened plant species, Lake Huron tansy and Pitcher's thistle, and eliminate their dune habitat.

4.52 Those foredune areas not directly affected by harbor construction would be adversely impacted from increased foot traffic and recreational vehicle usage. Again, delicate dune vegetation would be destroyed resulting in erosion and habitat destruction. However, unlike direct construction induced erosion, the erosion potential related to increased human activity would extend north of the project site, endangering the very existence of the Sturgeon Bay Dunes.

4.53 The destruction of numerous representatives of the Michigan threatened species Lake Huron tansy, Pitcher's thistle, and thickspike wheatgrass, would probably be unavoidable during construction operations at Sturgeon Bay Point. However, the effects of human activity on these plant species would pose the most serious threat to their continued existence in the area.

4.54 The Sturgeon Bay Point site is part of the Deer Park-Dune Soil Association. In general the entire Sturgeon Bay Point area (Section 13) has a high ground water contamination potential from septic tank disposal fields. Residential development, especially along the beach, dune and hilly areas (slopes >18%) would be severely limited (U.S. Department of Agriculture Soil Conservation Service, 1973).

(b) Good Hart

4.55 The environmental impacts at the Good Hart site, would be similar to those outlined for the recommended Cross Village site. However, there are no wetlands, Pitcher's thistle, or thickspike wheatgrass, in the vicinity of the project. Several small stands (<25 plants) of Lake Huron tansy, in the foredune area would probably be destroyed to accommodate support facilities. In addition, a few acres of climax upland vegetation would be eliminated during the construction of support facilities.

(c) No Action Alternative

4.56 If the proposed harbor facility is not constructed, there would be no adverse effects on any life forms in the area. However, erosion to the north of the existing harbor breakwater would continue.

Wilderness State Park

4.57 Construction of a recreational boat harbor near the mouth of the Little Sucker Creek would be contrary to the land use plans of Wilderness

State Park. All or part of a highly productive Lake Michigan coastal wetland would be destroyed and numerous terrestrial and aquatic life forms would be adversely impacted.

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Section V
Coordination

Public Involvement Program

5.01 Three public workshops and a formal public meeting have been held by the Corps of Engineers at Cross Village, Michigan. Following an 8 November 1978 public notice, the first public workshop was held on 6 December 1978 in the Cross Village Township Hall. In attendence were 115 persons representing the citizens of Cross Village, Corps of Engineers, Michigan State Waterways Commission, and Congressional and Michigan State legislative liaison. In general, opinion was in the favor of a harbor at Cross Village, however, there was a lot of discussion relative to harbor size and usage. There was a concern among those present that the authorized harbor design be altered to preserve as much of the Township swimming beach as possible.

5.02 The second workshop was held in the Holy Cross Community Hall, Cross Village, Michigan on 27 August 1980. Approximately 240 people representing Federal, State, and local governments, local residents, and interested parties attended the workshop. The major areas of public concern were the potential social and economic impacts on the area as a result of the proposed action. Specific questions relative to the amount and type of development that might occur and any effects on local taxes were discussed. Other concerns regarding the size of the harbor and oil spill clean-up procedures were addressed. It was decided that another workshop would be held to present detailed plans of the Good Hart and Sturgeon Bay Point sites and to give additional economic information pertaining to project benefits vs. project costs.

5.03 On 13 November 1980 the third public workshop was held in the Holy Cross Community Hall at Cross Village. At this meeting the detailed Cross Village, Good Hart and Sturgeon Bay Point plans were presented. Discussions centered around the potential economic impacts on the community previously expressed at the 27 August meeting.

5.04 A formal public meeting was held at Holy Cross Community Hall, Cross Village, Michigan on 16 June 1981. A slide presentation detailing the updated harbor plans, environmental considerations and economic projections was presented by the Corps. Criteria that lead to the rejection of the alternative Sturgeon Bay Point and Good Hart sites were also discussed. Concerns relative to the potential effects of the harbor on the local tax base and social fabric of the community were expressed by Cross Village Township residents.

Required Coordination

5.05 There are three main areas of coordination that require further action.

(1) A permit to remove representatives of the three State of Michigan threatened plant species (Agropyron dasystachyum, Cirsium pitcheri and Tanacetum huronense) was issued by the State Endangered Species Coordinator to the MDNR's Waterways Division on 26 February 1981 (see page IV-31 of the FEIS). This permit expires on 31 December 1981. Prior to the expiration date it will be necessary for Waterways Division to secure a new permit. Although there is no guarantee that a permit will be approved at a later date, concurrence at this time is viewed as a reliable indicator of the Endangered Species Coordinator and Plant Technical Committee's future positions on the matter.

(2) Coordination between the Waterways Division and the Michigan Department of Public Health would be initiated during the Phase II design stage of the Cross Village project to facilitate the development of a sewage disposal system. When the MDNR secures a permit from the Health Department for a sewage disposal system at the harbor. Coordination between the Corps and U.S. EPA would be established by the Corps to secure EPA concurrence with the proposed plan.

(3) Coordination between the Corps, State Historical Preservation Officer and the Advisory Council on Historic Preservation, concerning the potential indirect effects of the harbor project on archaeological historical and architectural Cross Village resources will continue during the Phase II design stage of the Cross Village project.

5.06 Coordination will continue through circulation of the final Environmental Impact Statement and preliminary and final Section 404 Evaluations.

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Dept. of Health Educ. & Welfare
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COMMENTS AND RESPONSES ON THE
DRAFT ENVIRONMENTAL IMPACT STATEMENT

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COMMENTS AND RESPONSES ON THE
DRAFT ENVIRONMENTAL IMPACT STATEMENT

Table of Contents (Cont.)

Comments and Responses - The Draft Environmental Impact Statement was sent to government agencies (Federal, State and local) as well as interested groups and private citizens requesting their views and comments. Copies of the letters received can be found in Supplement IV.

Federal Agencies

A. United States Environmental Protection Agency

1. Comment: We have completed our review of the draft Environmental Impact Statement (EIS) for the proposed light-draft recreational boat harbor at Cross Village in Emmet County, Michigan. We understand that, as proposed, the project consists of new breakwaters, an entrance channel, an inner channel and anchorage area, removal of old harbor structures, construction of underwater fish habitat, beach extension, and shoreline disposal of clean, sandy dredged material.

Response: Your comment has been noted.

2. Comment: According to the EIS, the preferred alternative is designated Plan 1 - Alternative 1, as shown on page EIS-4 of the draft impact statement. The EIS concludes that only minor, temporary impacts to air and water quality will be experienced during construction and operation of the facility. Noise levels will increase over ambient conditions due to the increase in activity at the harbor, but the levels are not unacceptable. Assuming that sediment quality does not degrade over time, dredging and disposal of harbor sediments would also result in only minor, short-term environmental impacts. Overall, this alternative is not predicted to adversely impact air, noise, or water quality.

Response: Your comment has been noted.

3. Comment: We note that there are 3 unresolved issues on this project. These are: the location of the fish reef, the ultimate method of sewage disposal from harbor facilities, and mitigation for the destruction of 3

State of Michigan threatened plant species - the Lake Huron tansy (Tanacetum huronense), Pitcher's thistle (Cirsium pitcheri), and thickspike wheatgrass (Agropyron dasystachyum). These issues do not involve significant controversy and their resolution is expected to come rapidly. However, in the event that problems arise, please feel free to call upon this Agency if we may be of any assistance in helping to resolve them.

Response: Your comment has been noted.

4. Comment: Since the proposed project is not predicted to adversely affect the environment, we are classifying the project LO-2. This means we lack objections (LO) to the environmental impact of the project, and additional information (2) is needed to adequately assess the impact. The additional information needed is the resolution of the issues listed above. In accordance with our responsibility under Section 309 of the Clean Air Act to inform the public of our views on the environmental impact of Federal projects, this letter is written for public review and the classification will be published in the Federal Register.

Response: The FEIS has been expanded to include additional information concerning the location of the fish reef (paragraph 2.06), removal of three Michigan threatened plant species representatives (paragraph 4.14) and the ultimate method of harbor sewage disposal (paragraph 4.12).

B. Department of Health and Human Services -- Center for Disease Control

1. Comment: We have reviewed the Draft Environmental Impact Statement for a Harbor for Light-Draft Vessels at Cross Village, Emmet County, Michigan. We are responding on behalf of the U.S. Public Health Service and are offering the following comments for your consideration in preparing the final document.

Response: Your comment has been noted.

2. Comment: While we have no major objections to the proposed project, we have some concerns about the potential health effects upon local well water

users from any additional onsite sewage disposal facilities (i.e., both project and/or secondary development). Additional information is required in the EIS to indicate whether a potential health problem could occur. According to the EIS, well water is the only source of drinking water used by Cross Village residents and businesses. Please provide additional information on the depth of these wells, their quality and the suitability of the local hydrogeologic conditions to prevent contamination of ground waters from individual onsite sewage disposal systems or from other possible sources of contamination as a result of the proposed harbor. If local soils are not suitable for the construction of alternative (3) "Septic Field Adjacent to Harbor," we recommend that interior harbor facilities (i.e., fishing and ferry piers, parking spaces, marina boat slips, restrooms and other recreational facilities) not be constructed until a satisfactory municipal sewage treatment facility is available. Furthermore, if secondary development (i.e., increased residences, businesses, etc.) occurs in Cross Village as a result of this project and the construction of the associated onsite disposal facilities is expected to adversely affect groundwater resources, interior harbor facilities should not be constructed until a municipal sewage treatment facility is made available. Construction of interior harbor facilities could be concurrent with the construction of a municipal treatment facility provided the harbor facilities are not utilized until the municipal sewage treatment facility is available.

Response: Your comment is noted and the text of the FEIS has been revised to include additional groundwater information and alternative modes of sewage disposal (see paragraph 4.12).

3. Comment: The use of alternative (4) "Holding Tank and Haul System" is only practical if the distance to the "treatment plant" is reasonable and if secondary development doesn't cause any adverse impacts upon potable ground waters from the construction of additional onsite sewage disposal systems.

Response: Your comment has been noted.

4. Comment: The EIS should describe the potential long term impacts of the harbor upon the proposed beach and local water quality. Will another beach be permitted to form on the west side of the harbor or will any accreted material be used to replenish the proposed beach on the east side of the harbor?

Response: As only uncontaminated sand fill material would be placed in the erosion zone, the harbor should not adversely impact either the proposed beach, or local water quality. Material that accretes on the west side of the harbor would not be used to replenish the beach on the east side of the harbor.

4. Comment: Since shoreline erosion is expected to occur east of the harbor area as a result of the proposed project, has the long-term costs of the beach nourishment plan been considered in the project's cost-benefit analysis?

Response: The annual Federal charges listed in the report include costs for maintenance dredging and its disposal. Therefore, these costs have been figured into the projects benefit to cost (B/C) ratio.

6. Comment: It appears that facilities for a commercial fishing fleet will be provided in the proposed harbor. What measures will be taken to prevent fish cleaning and disposal of waste fish parts from both commercial and recreational fishermen inside the harbor?

Response: Your comment is noted and the text of the FEIS has been expanded to include fish cleaning and disposal information (see paragraph 4.08).

C. United States Department of the Interior - Regional Environmental Officer

1. Comment: The Department of Interior has reviewed the draft environmental statement and general design memorandum - Phase I - for a

harbor for light-draft vessels at Cross Village, Emmet County, Michigan. Our consolidated review comments follow:

The project would have negligible impact on mineral resources. The disposition of dredged material is adequately stated.

The draft material adequately addresses impacts on fish and wildlife resources.

Response: Your comment has been noted.

2. Comment: The recommended plan (Figure 13 of the Main Report) includes a sand fill swimming beach as part of the project at Cross Village. As "The local residents have indicated that they would like a swimming beach maintained on township property at Cross Village" (last paragraph of page 39), we urge that the swimming beach be included in the final project plan.

Response: The swimming beach is included in the recommended Corps final project plan.

3. Comment: The environmental statement should assess the direct impacts on the aquifer from withdrawal of groundwater for project-related uses and the indirect or secondary impacts on groundwater resources from increased visitation.

Response: Your comment is noted and the text of the FEIS has been expanded to include the appropriate information (see paragraph 4.10).

4. Comment: It is stated on page 25 of the draft environmental statement that, ". . . the Cross Village area is rich in pre-historical and historical resources". The preliminary cultural reconnaissance should be discussed in the final environmental statement, which should also contain evidence of consultation with the State Historic Preservation Officer.

Response: The preliminary cultural reconnaissance report discussed in the DEIS, concluded that no significant archaeological sites or architecture in the direct project impact area, would be affected by the proposed construction. The contractor neglected to consult with the State Historic Preservation Officer (SHPO) in preparation of the draft report. However, consultation between the contractor and SHPO would occur prior to the preparation of the final cultural reconnaissance report during the Phase II design stage of the project.

D. United States Department of Commerce -- National Oceanic and Atmospheric Administration

1. Comment: The subject DEIS prepared by the Corps of Engineers, Detroit District on proposed harbor at Cross Village, Lake Michigan has been reviewed and comments herewith submitted.

The overall long-term effects of the proposed harbor at Cross Village on Lake Michigan environment will remain minor. Locally the most pronounced effects appear to be the modification of the littoral drift currents and the associated changes in shoreline configuration. Some sediment deposition can be expected in front of the west breakwater. Protruding harbor structures will force larger amounts of littoral drift into deeper lake. On the east side of harbor, waves from northwest will produce a pronounced erosion. At the same time some accumulation of sand can be expected at the foot of east breakwater. This sand accumulation gradually will eliminate or isolate the nearby wetland area.

Response: Although sand would accumulate at the foot of the east breakwater, we do not anticipate either the isolation or elimination of the adjacent wetland area. Some minor variation in water level and flow direction, however, may occur. Any obstruction of the wetland outflow would result in an easterly migration of wetland flow into Lake Michigan.

2. Comment: Of the three sites investigated for the proposed harbor, the site at Good Hart shows the best benefit - cost ratio. While at this site benefits are only slightly higher over that for the selected site at Cross Village, the costs are much lower. Main reason for the difference in costs is the location of breakwaters. At the Cross Village site the breakwater facing lake is in twelve foot deep water (below Low Water Datum) and such breakwater at Good Hart site is in four foot water (pages A-93 and A-98). Construction of breakwaters at Cross Village site will cost twice as much as at the alternate site. It is suggested to investigate the placement of Cross Village harbor structures nearer to shore. This would reduce construction costs and also the adverse effects on shoreline.

Response: While it is agreed that looking at the three alternative plans from strictly an engineering design standpoint, it would appear the cost of a harbor at the Cross Village site could have been reduced by following a design similar to those at Good Hart and Sturgeon Bay Point. However, other factors enter into the selection of site locations and design of proposed harbors, such as social effects, institutional requirements, and environmental considerations as well as the physical layout of the proposed site. All must be considered when formulating the final design of structures. In the case of the Cross Village site we had to consider such things as the presence of State of Michigan threatened plant species and a wetland area, the desire of the local citizens for a swimming beach, and primarily, restrictions on the availability of land.

As part of the items of local cooperation entered to be furnished into by the local sponsor, which in this case is the State of Michigan Department of Natural Resources Waterways Division, the sponsor is to provide all necessary lands for the harbor. The proposed site for the harbor is presently owned by the Cross Village Township. In this case it is assumed the land would be provided to the state by the township. The township is financially unable to to purchase additional land for the harbor. Representatives of the Waterways Division have stated their office

similarly has no funds for the purchase of land. Therefore, the existing township property is the constraining factor in determining the layout of the proposed harbor.

Careful consideration was given to achieving the lowest cost for the proposed harbor based on the use of the available public land. Breakwaters were aligned to keep them within as shallow of water as possible and yet retain room within their confines for the required anchorage area, maneuvering areas, and docking areas for both recreational and commercial vessels. Further adjustments were made which would allow the construction of a swimming beach adjacent to the proposed harbor and still be on public property. Given these kinds of constraints, this harbor is the most economical design that will meet the needs of the study area.

b. United States Department of Agriculture -- Forest Service

Comment: The following comments are submitted on the Draft Environmental Impact Statement for A Harbor for Light Draft Vessels in the Vicinity of Cross Village, Michigan.

On page 16, in the fourth paragraph, the last sentence should be rewritten to read, "No animals either on the Federal or State of Michigan list of threatened or endangered species are known to be in the study area."

On page EIS-13, section 3.18, the first sentence needs to be rewritten to include the statement, "which are on the State of Michigan's Threatened Species List," and remove it from the second sentence.

We appreciate the opportunity to review this document and hope our comments will be helpful in the preparation of the Final Environmental Impact Statement.

Response: Your comments have been noted and the appropriate changes have been made in the Final GDM and EIS.

F. Advisory Council on Historic Preservation

1. Comment: We have reviewed the General Design Memorandum and Draft Environmental Impact Statement (DEIS) for the proposed new light vessel harbor at Cross Village, Emmet County, Michigan, under Section 102(2)(C) of the National Environmental Policy Act. It appears that survey investigations to identify historic and cultural properties which might be affected by the development are still underway, and results are not yet available for our review (e.g., pp. EIS-35, 36; also SHPO letters of October 7, 1980, and March 18, 1981). As you know, your compliance with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f, as amended, 90 Stat. 1320) and the Council's regulations for "Protection of Historic and Cultural" (36 CFR Part 800) is independent of NEPA requirements, but should be coordinated with NEPA to the maximum extent possible.

Response: Your comment has been noted.

2. Comment: Please let us know the status of identification and evaluation efforts planned or underway in the Cross Village area. You should continue to consult with the Michigan State Historic Preservation Officer in this regard, and in determining the potential effect (both direct and indirect) of the proposed harbor on any identified properties which may be eligible for inclusion in the National Register. For any significant properties that would be affected, you should carry out the remaining steps in 36 CFR Section 800.4 prior to the issuance of the final environmental impact statement.

Response: See paragraphs 3.43, 4.37 and 4.38. For additional information, refer to the State Historic Preservation Officer's comment letter response on page EIS-72.

State

A. State Historic Preservation Officer

Comment: Our staff has completed its review of the Draft Phase I General Design Memorandum and Draft E.I.S. for Light-Draft Vessels at Cross Village, Michigan and have the following questions.

As previously mentioned in our detailed critique of the cultural reconnaissance report of Cross Village in a letter dated March 18, 1981, we note that an architectural as well as archaeological survey still needs to be conducted within the village. What steps has the Corps taken to recontract these surveys?

Response: The Detroit District expects to obtain an adequate evaluation of the archeological resources within the village under our existing contract. The Corps will, of course, provide you the completed study results when we have them in hand. We expect them by the end of the summer. The architectural study of the village cannot be carried out this Fiscal Year because no funds are available. However, we intend to obtain a contractor for the architectural studies shortly after the beginning of the Fiscal Year. Studies could then begin in late October or November.

The architectural information you mention is not required for approval of the harbor construction, but rather to do adequate planning for the future development of onshore facilities; beginning with berthing and marina facilities.

You may be able to assist us in preparation of the scope of work for the architectural survey. We have discussed this with your staff, and a draft scope will be forwarded for your review.

B. Michigan Department of Natural Resources

1. Comment: The procedure used in estimating littoral transport rates contains assumptions which may be very inaccurate. The conclusion that

"additional erosion would amount to about 15% of the total erosion that would occur . . ." may be a low estimate. Examples of questionable assumptions include using bluff recession data from a location five to six miles from the proposed harbor site (page A-10) and assuming 20% of the littoral drift will be able to by-pass the harbor (page A-50).

Response: Whenever we (Detroit District) become involved in ascertaining littoral transport rates at project sites, we first attempt to draw upon applicable information that has been gathered previously at a nearby project site. Our reasoning is that littoral transport rates at a particular location would be similar to those developed at a nearby site, providing that the sites don't differ significantly with respect to sedimentology, physiography and wave climate. Unfortunately, we are unable to locate any littoral transport information in the vicinity of Cross Village.

Therefore, we have developed littoral transport rates based primarily on site specific data concerning the source area where sediment could be derived and on the apparent quantity of littoral drift that has accumulated on the existing navigation structures and shoreline at Cross Village. Accordingly, we found that the source area available for supplying littoral drift consists primarily of relatively low foredunes which are on the average of twenty-five to thirty feet high. We estimate that 90 percent of the sediment in the source area at the site is suitable to be incorporated into littoral drift. Furthermore, we felt that the proposed harbor may affect a shoreline reach extending approximately 5,000 feet (both accretion and erosion zone) and that the average recession rate based on a study conducted at a nearby site by the State of Michigan Resource Program Division would be about 1.2 feet per year along this reach. It is emphasized that we considered these the best estimates of the zone of erosion influence of the proposed harbor and average recession rates that would be expected to occur along this reach if the harbor were constructed. Based on this information, we estimated that the littoral transport in the Cross Village area is, on the average, 6,000 cubic yards annually.

In addition, we felt it relevant to draw comparisons between littoral transport and erosion effects at another Lake Michigan Harbor, namely Frankfort Harbor. This harbor exhibits the same effects we would expect to occur at the Cross Village site if the harbor is built. It was determined in the Section 111 Detailed Project Report prepared for the Frankfort Harbor structures, which extend over 1,500 feet from the shoreline, that the harbor has caused approximately 45 percent of the total erosion at the site. The proposed Cross Village Harbor structures will extend only about 650 feet from the shoreline and, therefore, we felt it reasonable that the overall effect of this harbor would be less than the effect of Frankfort Harbor. Accordingly, it was concluded that the proposed harbor structures would cause less shoreline erosion and interruption of littoral drift than the same effects caused by Frankfort Harbor and estimated that harbor erosion at Cross Village would be on the order of only about 15 percent of the total erosion that would occur at the site.

2. Comment: More important than the estimates of the adverse erosion impact of the harbor are the monitoring and mitigation plans for the project. Monitoring will quickly show the accuracy of the estimated impacts. Page A-14 only proposes to use periodic maintenance dredging for beach nourishment in the zone of adverse influence. While during initial stages of shoreline adjustment to the harbor structure very little dredging may be required since accretion occurs at locations other than the harbor mouth, the down drift erosion impacts during that period are usually most severe. Assurances must be provided that mitigation of the adverse erosion and other impacts of the project are fully and expeditiously undertaken.

Response: We (Detroit District) concur with your comment that a monitoring program including survey profiles, sediment sampling, and aerial photographs would be the best method of ascertaining effects of the proposed harbor structures at Cross Village. It is emphasized that we have developed such a monitoring program (see paragraph 2.07) which we plan to implement providing that the harbor is constructed as proposed. In addition, at the time of construction we plan to place a considerable quantity of dredged sand for beach nourishment, estimated to be over 50,000 cubic yards, in the erosion zone east of the harbor location. This

material will be obtained when the harbor basin and channels are dredged. We expect that this action will fully compensate for any littoral drift that may be interrupted by the harbor and the resulting erosion which may occur during the four to eight years it would take for the littoral regime to adjust to the new harbor structures. Furthermore, it is expected that on an average, 5,000 cubic yards of sediment will accumulate in the harbor annually. This material will also be placed in the erosion zone as part of our maintenance dredging program. It is expected that this material will compensate for any harbor induced erosion that may occur in the future.

3. Comment: Additionally, the cost of mitigation of shoreline damage should be included in the cost-benefit ratio for this project.

Response: The first costs for dredging of the harbor basin and channels includes the cost for disposal of that dredged material whether it be in the open water site or along the shoreline. The annual Federal charges listed in the report include costs for maintenance dredging and its disposal. Therefore, these costs are figured into the projects benefit to cost (B/C) ratio. No further shoreline mitigation costs are required. While the cost of the monitoring program was not figured into the B/C ratio shown in the draft report, this will be corrected in the final general design memorandum.

Public

A. Edwin Hulbert, Good Hart, Michigan

Comment: We have reviewed the Draft of the study for a harbor, in the vicinity of Cross Village Michigan, and wish to express our favorable reaction to the installation of such a facility.

I have been a seasonal resident and property owner in Readmond Township which adjoins Cross Village Township on the south and was under consideration as an alternate site for a harbor at Good Hart. We are now retired as permanent lakeshore residents and do not believe the harbor and accompanying traffic would harm the environmental charm which lead us to

choose Good Hart as our home after living in Wisconsin most of our working years.

Boating has been an active part of our recreation, including many sail yacht races on Lake Michigan and Huron. In the 30's I was engaged in yacht construction, sales, and operation out of Chicago, and spent many months headquartered out of Hessel in Les Cheneaux Islands. Therefore, I can appreciate the advantages offered by a Harbor of Refuge at Cross Village.

Since the days when we bought our whitefish from Indians who fished out of there in the 1920's to the present, we have been aware of the bounty Lake Michigan has offered sport fishermen and commercial fishermen alike. Hopefully good management will permit such fishing to continue, although the TONS of fish which have been harvested in the past few weeks by white and Indians alike from in front of our property must be taking its toll. Cross Village would offer the fishermen a far better base than Charlevoix or Beaver Island.

Although I would be approaching 70 at the time the harbor might be completed, we believe that it would entice us to base a small cruising sailboat there. We do not see major commercial or boating facilities as a danger in the forseeable future to the area we love and live in year around.

Response: Your comments have been noted.

B. William Golling, Petoskey, Michigan

Comments: Please be advised that my family and I have been boaters in this area of Michigan for many years and currently own a 44 foot Cruiser. Over the years we have taken many trips up through Waugoshance Point to the Straits of Mackinaw and then eastward to numerous ports. Upon our return at White Shoals Lighthouse when we make our turn, it has been an "all new

world". The seas have been frightening and many times comes as a complete surprise due to poor weather forecasting. Therefore, there is a dire need for a "Port of Refuge" at Cross Village for the safety of our boat and passengers.

As you are well aware, by far the majority of cruiser owners are older. We lived on our boat for two summers at Petoskey Marina and when these cruisers came in they were looking for places to eat, to buy food and beverage, etc. Being local and having the name Petoskey on the stern of our boat, we were fair game to many boaters unfamiliar with this area. Since these boaters are older, their conduct and spending of money does nothing but enhance the community and it's economy.

It boils down to:

a) Safety need for a Port of Refuge in Cross Village. Petoskey and Harbor Springs Ports are too distant.

b) It will help Cross Village and its economy.

Thank you in advance for your time in reading this letter. We are concerned boaters who wanted our opinions known.

Response: Your comments have been noted.

C. Ross Hume, Petoskey, Michigan

Comment: I have received and read your general design memorandum for the Harbor of Light-Draft Vessels at Cross Village, Michigan. Certainly all bases have been touched and the research appears to be exhaustive. The purpose and necessity of such a project is certainly constantly emphasized and repeated. However, there is in my opinion one very, very significant problem.

Cross township in itself is one of the poorest townships in the State of Michigan. More than half its population are either retired, on Social Security and Social Security Disability, ADC, public assistance or Welfare. The number of actual local paying taxpayers I understand is just a shade over 100. Many of these are taxpayers on second homes and uninvolved basically in community activities. In looking at your local cost proposals, while they seem equitable and fair, would impose a very, very significant additional burden on those that are already taking care of these many, many public tax charges. It might conceivably be said that those in the public basket, because of the nature of this endeavor find jobs and suitable employment for making them taxpayers, the very nature of the individuals themselves a basic shortness of any financially successful season I'm sure would preclude their becoming self-sustaining. I certainly, therefore, question whether this type of project is feasible in this type of society.

Response: Costs presented in the Phase I General Design Memorandum are first costs and the associated annual charges for general navigation facilities and recreational facilities. Items considered under general navigation facilities include the harbor breakwaters, dredging of harbor basin and channels, and the removal of the existing W.P.A. breakwater. Recreational facilities include a concrete walkway and safety handrails along the western harbor breakwater. The Federal government provides 62% of the cost of the general navigation facilities and 50% of the cost of the recreational facilities. Funds for the Federal portion ultimately come from the taxpayers by way of Congressional appropriation. Federal participation is justifiable because the project has a benefit to cost ratio of 1.19 to 1 which means that for every dollar the Federal government spends on the harbor over a dollar will be returned to the National economy, however, this return would be evidenced primarily in the Cross Village region. The remaining portion of the project's first cost would be provided by the project's local sponsor, which in the case of the Cross

Village Harbor, is the Waterways Division of the Michigan Department of Natural Resources (MDNR). Revenues for the Waterways Division recreational boat harbors are derived from the state marine fuel tax and a portion of boat registration fees. Out of these revenues the Waterways Division also constructs the recreational boat docks, small boat launching ramp, parking facilities, and other necessary on-shore facilities. There is no burden placed on local residents to cover the cost of construction of the harbor.

Once the harbor and on-shore facilities are completed the harbor would be operated by the Waterways Division, or if the Township officials prefer, the harbor operation could be handled by the township under guidelines established by the MDNR Waterways Division. It is the general policy of the MDNR that harbors under its jurisdiction are operated on a break even basis. Fees collected from rental of slips and sale of fuel, lubricants and other supplies would be used to pay for the salaries of dock attendants, the purchase of fuel and supplies for sale, and utility bills for the on-shore facility (electricity, phone, trash collection) as well as minor repairs such as painting of harbor facilities or replacement of dock fenders. In the case of major repairs the Waterways Division will on request handle the problem or work out a cost sharing arrangement with the township if it has elected to run the harbor.

D. Mr. and Mrs. William Cranmer, Cross Village, Michigan

Comment: As I said in the Public Meeting at the Holy Cross Community Hall in Cross Village June 16, my wife and I wish to be recorded as supporting Supervisor Harry Pintarelli in his continued efforts to secure a safe harbor for light draft vessels at Cross Village, Michigan.

We have been coming to Cross Village since 1951 and have been property owners since 1958. Our land is on Lake Michigan, approximately one half mile from the present township park and the proposed harbor. While the

ruins of the earlier attempts to develop a breakwater and safe harbor have a certain beauty, they are a mess and useful only to fishermen who may wish to fish in the area.

Certainly the park is a continuing eyesore because the village lacks resources to properly develop and police the area resulting in something none of the residents feel is an advantage to the residents nor the public generally. The village has been deteriorating since the fire about sixty years ago bringing about economic loss to the permanent residents.

On the positive side, such a development as proposed by the Corps of Engineers, the State of Michigan, and Mr. Pintarelli would provide a safe harbor for vessels in time of severe storms as they come around Waugashance Island (Wilderness Point) into Lake Michigan. Cross Village is the most logical site for such a safe refuge.

In addition, the three-way sponsorship and development by the Federal, State, and Village (Township) governments would start a development that could only speed the economic development of the area by providing for commercial marine development for boat owners, as well as pleasure boat owners who might wish to keep their vessels there.

Since this spot is the closest to Beaver Island, it is only natural that the Ferry might wish to berth and sail from here. This would restart a tourist development that could only benefit the community, the permanent residents, as well as develop resources for the summer residents as well.

The history elsewhere is that such development turns around the deterioration of a dying community. Such a result should reverse what we have seen in Cross Village the past thirty years. We believe that progress is inevitable. We believe it should come to Cross Village too.

For the above reasons we fully support the development of a harbor at Cross Village, Michigan.

Response: Your comments have been noted.

E. Robert Reemsnyder, Cross Village, Michigan

Comment: I was not aware that the meeting on June 16, 1981 at Cross Village was to be the last or I would have made a statement re-the reason for this letter.

I want to commend you on your presentation and patience in the meeting. I found it rather comical, but I'm sure disconcerting to your people, that in all the meetings even though questions were answered a dozen times, the same questions were posed by the same few repeatedly.

It would seem to me after attending and obseving all the meetings, that we have two small groups of decenters.

One, the third generation welfare group that just might have to go to work if Cross Village grows.

Two, about a dozen pseude intellectual summer families who think because they own a cabin on the beach, they own Lake Michigan.

As to the land, it is my understanding that it was donated (with a token payment) to the township for the development of the harbor as a condition of the bequest.

This area has wonderful potential for orderly development and I'm sure the state is aware of the value as a prime recreational area. I, myself, would appreciate not having to drive thirty miles to Petoskey every time I need a nut and bolt or have to do some laundry.

I have owned property here since 1954 and moved in 1972, however, I don't feel that I own Lake Michigan. I am very much in favor of the pier and the orderly growth of the Cross Village area.

At this point in time Cross Village (in it's quaint remoteness) is becoming a haven for the uncaring-destructive type persons, that prey on remote areas with no law enforcement and a few helpless residents. The shoreline north of Cross Village is fast becoming the dump of the north.

Again, I am in favor of the pier and the eventual benefits that would come with it including the services we now pay taxes for and fail to receive.

Response: Your comments have been noted.

F. Harry Pintarelli, Cross Village Township Supervisor

Comment: My letter to you is to express a few points about the harbor of refuge at Cross Village. I have been to all the meetings and have had much correspondence with the U.S. Corps of Engineers on this matter. The last hearing with the public is a copy of all the previous hearings, the same eight or ten people stating the same reasons. I can agree with everyone of the objectors but I won't mention any names. They are in the quite well off bracket and the other half are Welfare recipients. The latter, are the ones who have been here for sometime. In the well off group, some as recent as six months. They not only do not wish the harbor of refuge but are more or less anti-whatever even if it may benefit them. Believe me I am 64 years old and been in township office 37 years, supervisor since 1962 and lived here all my life, sailed the Great Lakes 6 years on Lake Carriers, and 23 years, a commercial fisherman on all the lakes but Ontario. Winter and summer.

I did not know that the last public meeting was to be the final hearing or I would have said it then in public and will do so if that time comes around again.

The silent majority do want this facility and pray that it becomes a reality and soon. I would say that better than 90% of the people favor it.

There is a strong feeling for it, the location, the design, and size all are quite well thought out. I have been in many harbors over the years and approve this layout.

Lets all work together and build this harbor soon.

Thanks for your effort and your time and patience.

Response: Your comments have been noted.

G. Edward Beard, Cross Village, Michigan

Comment: I am very sorry that I was unable to attend your meeting on June 16 regarding the safe harbor project for Cross Village area.

As I have been informed that this was your final meeting on the project, please be advised that I am very much in favor of the safe harbor project.

There are a very few local so called professional people that opposed this worthwhile project. This would be a sad world if all capital improvement for the benefit of the public was in the hands of these narrow-minded people.

Again, I would like to go on record in favor of the project.

Response: Your comments have been noted.

H. John Shepard, Moran, Michigan

Comment: Although no economical benefit would appear to come to we, the people of the Upper Peninsula, we can see a definite need for a harbor of

refuge in Cross Village. We have many people who come by boat to the Upper Peninsula and Mackinaw Island on vacation and at times get caught in bad seas up by the straits with their only choice being to reach port in St. Ignace or the Island. With a harbor at Cross Village, they could pull in and weather the storms there, thus protecting life and boat.

Also we have many commercial fishermen who fish in the Beaver Island to Cross Village waters that get caught in storms and have to fight their way back home. They are definitely in favor of such a port.

I have heard about the meetings on this harbor project and have discussed it with many people in the Upper Peninsula, and all that I have talked to are in favor of seeing this project develop. Cross Village is the most economical spot for this project in our opinion, since you already have a constructed access, stores, gas, etc.

This also is a personal matter since I have lost several good friends over the past few years who have gone down out in Lake Michigan. Yes, they were all commercial fishermen, but they aren't the only ones who drown out there. If the harbor saves one life, it is worth every penny.

Let's get the harbor built and quit quibbling over the matter.

Response: Your comments have been noted.

I. Buck LuHellier - Readmond Township Supervisor

Comment: I was unable to attend your last meeting but have attended all previous meetings. I have never spoke up in any of your previous meetings. I have just sit in and listened like most other people that want the harbor of refuge.

People with all the mouth are the ones that just blew in here from somewheres or the ones walking the streets or welfare recipients. This is

as close as I can describe your complainers without naming them. There isn't a great number of people objecting just a persistent handful. These same people have dominated every meeting that I have been to.

As you well know the harbor of refuge is badly needed in the Cross Village area. I'm not sure of how many miles between Mackinaw City and Harbor Springs, but it is a long distance and these waters get pretty treacherous in this area. Cross Village is the only logical site for the harbor of refuge. You have the best site in northern Michigan. You have good roads, stores and other services.

Thank you for the good work you have done. Let's not stop until you have the harbor built in Cross Village.

Response: Your comments have been noted.

J. David Munger, Cross Village, Michigan

Comment: I have learned today that this date is the deadline for Phase I comments relative to the proposed harbor at Cross Village.

Although I am a member of the Cross Village Township Board and am chairman of its Planning and Zoning Committee, I represent only myself in this letter.

I endorse the harbor concept as presented by your representatives and the Michigan Waterways Division during the past several years. The plan seems sound and very well conceived. Along with many other Cross Village residents (its Silent Majority?), I will continue to support efforts which will bring the concept to fruition. The harbor will be a positive benefit to Cross Village, a significant contribution to water safety on the upper Great Lakes, and a beneficial influence on the economy of this currently depressed area.

If I can be of help during the coming development stages, please contact me.

Response: Your comment has been noted.

K. Vincent McPharlin, Cross Village, Michigan

Comment: Our family has owned land in Cross Village for the past 50 years. We are in favor of the proposed harbor for the following reasons:

a. The safety factor is badly needed.

b. It will enhance the village economically.

c. It will improve the present condition of the harbor, visually and practically.

d. It will provide fishing opportunities.

e. It will provide a safe, policed recreation area.

f. It will not bring about a significant tax increase, nor will it necessarily inflate real estate values.

Response: Your comments have been noted.

L. Sarah McPharlin, Cross Village, Michigan

1. Comment: I am in favor of the plans to build a refuge harbor at Cross Village. This is an important safety measure for small boats.

It will also be a benefit to people who wish to moor boats at that location for convenience.

Response: Your comments have been noted.

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GLOSSARY

Accretion	- The increase of real estate by the addition of portions of soil, by gradual deposition through the operation of natural causes.
Algae	- General name for the chlorophyll - bearing primitive, chiefly aquatic, one cell or multicellular plants.
Aquatic Plants	- Plants rooted in the substrate that grow in water, either floating on the surface, growing up from the bottom of the body of water and emerging into the air, or growing under the surface of the water.
Benthic	- Having to do with the bottom of a stream, lake, or harbor.
Benthos	- Bottom dwelling organisms; uniformly applied to animals associated with substrates.
Breakwater	- A long narrow (rubble mound) pile of rock, concrete or wood; a structure in the water designed to break or moderate the effect of storm driven waves. Usually placed out into the water from shore at an entry channel to provide safer boat or ship navigation during stormy weather.
Conductivity (Specific Conductance)	- A measure of a solution's capacity to convey an electric current.
Copper (CU)	- Copper is a heavy metal which in trace quantities is essential to life, but which in greater amounts is toxic to life.

Cultural	- Produced by man or resulting from man's actions.
Total Dissolved Solids (TDS)	- The total amount of dissolved material, organic and inorganic, contained in water or wastes.
Dissolved Oxygen (DO)	- The oxygen freely available in water. Unpolluted water will contain more DO than polluted water.
Dredging	- A method for deepening and widening streams, swamps or coastal waters by scraping and removing solids from the bottom.
Environmental Impact Statement (EIS)	- A document prepared on the environmental impact of its proposals for legislation and other major actions significantly affecting the quantity of the human environment. Environmental impact statements are used as tools for decision making and are required by the National Environmental Policy Act (NEPA).
Endangered Species	- A series of plant or animal which is in danger of extinction through all or a significant part of its range.
Environmental Impacts	- A phrase used to express the extent or severity of an environmental effect; the effect itself.
Erosion	- The wearing away of the land by the action of wind, water, gravity or a combination thereof. Shoreland erosion on the Great Lakes is most often a result of a combination of wind driving waves beating upon the shore and forming littoral currents, and high water levels.

Fauna	- The animals, terrestrial or aquatic, of a region.
Fecal Coliform	- A group of bacterial organisms common to the intestinal track of man and of animals.
Flora	- The plants, terrestrial or aquatic, of a region.
Food Chain	- Energy transformation - Movement of food from one form of life to another; for example, algae to zooplankton to fish.
Groundwater	- Water that exists in a saturation zone of the earth's crust.
Impact	- The effect of one thing upon another. "Environmental" impacts may affect any one or combination of elements in the total environment and may be of positive or negative impact and of long or short duration.
Lead (Pb)	- A heavy metal which is toxic to life.
Littoral	- The shallow waters that extend along the shoreline of a lake or sea.
Littoral Drift	- The sediments moved in the littoral zone under the influence of waves and current. Direction of movement or "transport" of littoral materials depends upon wind and wave direction.
Low Water Datum (LWD)	- An approximation to the plan of mean low water that has been adopted as a standard reference plane. The Lake Michigan LWD is 578.8 feet mean water level at

Father Point, Quebec (International Great Lakes Datum, 1955).

Macrophyte	- A macroscopic aquatic plant.
Marsh	- A wetland dominated by herbaceous vegetation; primarily sedges, reeds, and grasses.
Mercury (Hg)	- A heavy metal, highly toxic if breathed or ingested. Mercury is residual in the environment, showing biological accumulation in all aquatic organisms, especially fish and shellfish.
mg/l	- Milligram per liter (10^{-3})
Nutrient	- Elements or compounds essential as raw materials for organism growth and development; for example, carbon, oxygen, nitrogen, and phosphorus.
Oligotrophic	- Of a lake lacking plant nutrients and usually containing plentiful amounts of dissolved oxygen without marked stratification.
Organic	- Material derived from organisms; leaves, sticks, animals, fish, etc.
Particulate Organic Carbon	- Organic carbon in the form of solid particles.
pH	- A measure of the relative acidic or alkaline state of water. pH is measured on a scale of 0 to 14. A pH of 7 is neutral, a pH below 7 is acidic, a pH above 7 alkaline. Rainwater is usually slightly acidic.

Phenols	- A group of organic compounds that in very low concentrations produce a taste and odor problem in water.
Phosphorus	- An element that, while essential to life, contributes to the eutrophication of lakes and other bodies of water.
Phytoplankton	- The algae of the open water of lakes, rivers, and streams.
Piers	- Permanent structures constructed of stone, steel, wood, cement or a combination of those materials, which are used to define and stabilize entry channels from the open lake into a harbor.
Pollution	- Any change in water quality that impairs it for the subsequent user. These changes result from contamination of the physical, chemical, or biological properties of water.
Productivity	- The yield of a given crop per unit of land, sediments and/or water.
Rare Species	- An extremely uncommon species limited in distribution.
Relief	- Elevations or inequalities of a land surface.
Sediments	- Clay, sand, gravel or stones which have been eroded from the land or from beneath the water, have been transported by river or lake currents, and re-deposited.

Silt	- Finely divided particles of soil or rock. Often carried in cloudy suspension in water and eventually deposited in sediment.
Species	- The smallest unit of classification normally used, based on overall resemblances. The species is always written along with the genus to designate the specific scientific name of the organism.
Substrate	- Any substance used as an attachment point by an organism.
Surface Water	- Atmospheric water that runs off to collect in streams, ponds, lakes, swamps, marshes, etc.
Threatened Species	- A species which is likely to become endangered because of low reproductive capacity, loss of suitable habitat or over-kill, now limited in numbers to few isolated populations.
Total Kjeldahl Nitrogen (TKN)	- Total Kjeldahl Nitrogen. A measure of the ammonia and organic nitrogen, but does not include nitrite and nitrate nitrogen.
Topography	- The configuration of the landscape including its relief, the position of its natural and man-made features.
Turbidity	- A cloudy condition in water due to the suspension of silt or finely divided organic matter.
Mg/l	- Micrograms per liter (10^{-6})

Total Volatile Solids - A measure of the organic material that could decompose and thus exert an oxygen demand on a body of water.

Wave - A ridge, deformation, or undulation of the surface of a liquid.

Wetland - Habitats characterized by aquatic or semiaquatic plants that are permanently wet, or intermittently water covered.

Water Quality Criteria - The level of pollutants, with respected to the chemical, physical, and biological characteristics that affect the suitability of water for a given use.

Wetland - Lowlands covered by shallow and sometimes temporary or intermittent waters. Important because they store floodwaters, provide flood and shelter for wildlife, and improve the quality of water entering lakes and streams.

Zinc (Zn) - A heavy metal which in trace quantities is essential to life, but which in greater quantities may be toxic to life.

I N D E X

SUPPLEMENT I

Sediment and Water Quality Attachments

ATTACHMENT A

Results of physical and chemical analyses performed at each sampling site while in the field at Cross Village, Michigan on 9 November 1979.

Parameter	Site 1	Site 2	Site 3
Core depth (inches)	Surface	Surface	Surface
Air temperature (°C)	0°	0°	0°
Water temperature (°C)	5.5°	6.5°	5.5°
Dissolved oxygen (mg/l)	16.6	16.2	16.6
pH (S.U.)	7.3	7.7	7.2
Water depth (m)	0.76	3.20	1.52
Secchi disc (m)	To bottom - 0.76	3.05	To bottom - 1.52
Redox potential	*	*	*
Sediments			
Color	Light brown	Light brown	Light brown
Odor	None	None	None
Texture	Fine sand	Fine sand	Fine sand

*meter not operating

ATTACHMENT B

Results of water chemical analyses (excluding chlorinated compounds) performed on samples collected on 9 November 1979, at the harbor at Cross Village, Michigan.

Site	Specific Conductance (umhos)	Dissolved Solids (mg/l)	Total Suspended Solids (mg/l)	Chemical Oxygen Demand (mg/l)	Ammonia-Nitrogen (mg/l)	Total Kjeldahl Nitrogen (mg/l)
1	191	180.0	<1.0	12.05	0.04	0.46
3	185	176.0	<1.0	12.05	<0.02	0.32
State Standards	250	500.0	N/A	None	5.0	None

Site	Total Cyanide (mg/l)	Oil and Grease (mg/l)	Total Phosphorus (mg/l)	Total Dissolved Phosphorus (mg/l)	Fecal Coliforms (counts/100 ml)
1	<0.030	0.2	0.018	0.008	<10
3	<0.030	<0.1	0.012	0.008	<10
State Standards	5.0	0.5	1.0	1.0	200

Site	pH (S.U.)	Total Arsenic (ug/l)	Total Cadmium (ug/l)	Total Chrominum (ug/l)	Total Copper (ug/l)	Total Iron (ug/l)
1	7.3	0.002	<0.0001	0.003	0.013	0.096
3	7.2	0.002	<0.0001	<0.002	0.004	0.026
State Standards	6.7 - 8.5	100.0	7.9	586.0	13.7	0.30

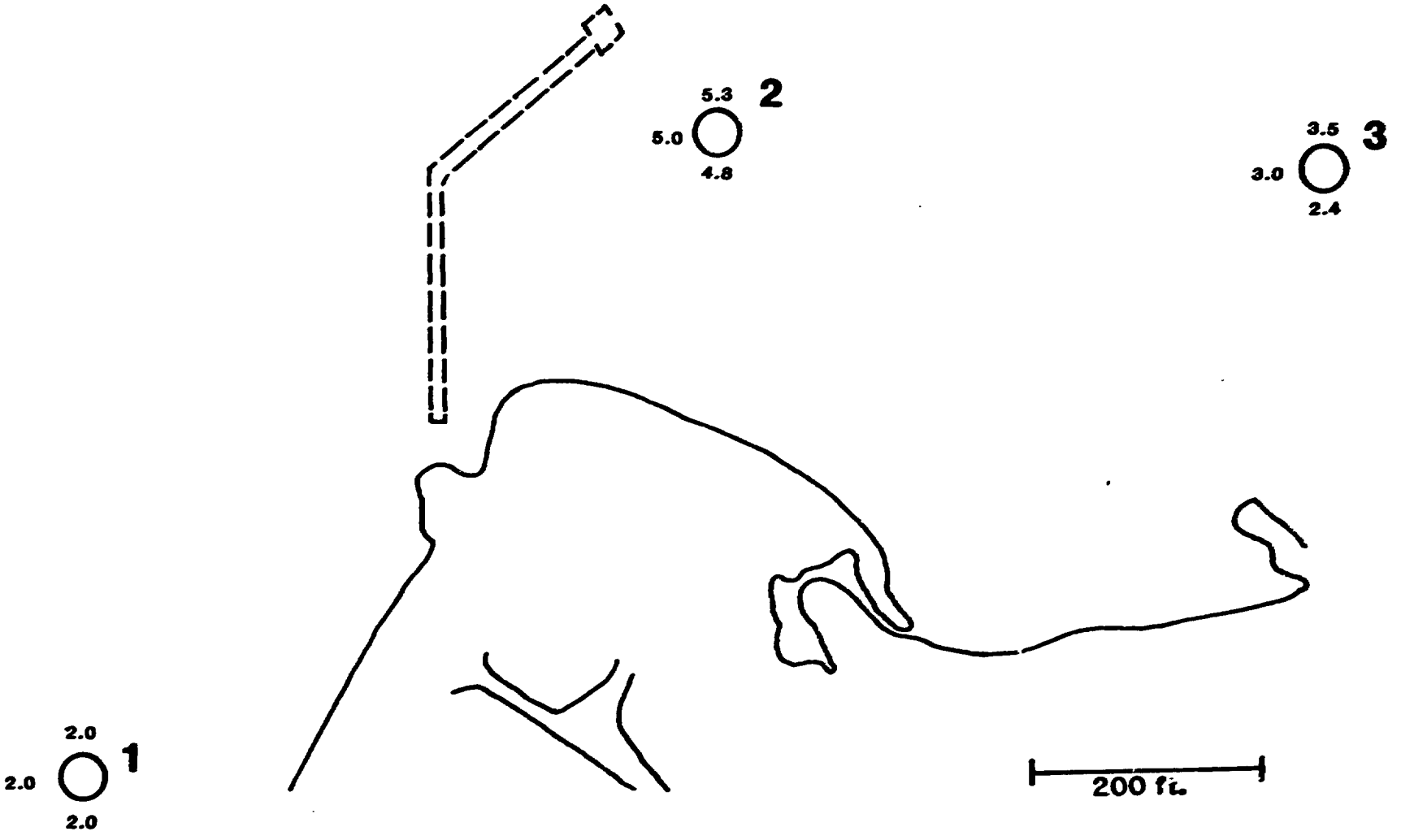
ATTACHMENT B (Continued)

Site	Total Mercury (ug/1)	Total Manganese (ug/1)	Total Nickel (ug/1)	Total Lead (ug/1)	Total Zinc (ug/1)	Phenols (mg/1)
1	<0.0002	0.107	0.165	0.018	<0.01	0.022
3	<0.0002	0.100	0.418	0.018	<0.01	0.006
State Standards	0.05	0.50	59.0	0.05	90.0	1.0

Site	Total Organic Carbon (mg/1)
1	3.30
3	1.88
State Standards	None

Attachment C

Location Of Benthos Sampling Sites At Cross Village Harbor



The Water Depths (in Feet) Of Sampling Sites Referred To The Low Water

ATTACHMENT D

Particle size composition of sediments collected from the harbor at Cross Village, Michigan on 9 November 1979. Tabular results are expressed as percent of dry weight retained per sieve.

	Sieve Opening (mm)*				
Site	2.000	0.850	0.250	0.075	Passed <0.075 (By Calculation)
1	0.05	0.28	59.74	35.68	4.25
2	0.37	1.12	50.05	49.21	<0.01
3	<0.01	<0.01	22.89	77.11	<0.01

*Corresponds to

Size (mm)	U.S. Standard Sieve No.	Classification
<2.0	Retained by 10	granule, pebble, cobble
.850 - 1.99	Retained by 20	very coarse sand
.250 - 0.849	Retained by 60	medium sand
.075 - 0.249	Retained by 200	fine and very fine sand
<0.075	Passed through 200	silt and clay

ATTACHMENT E

Results of sediment chemical analyses performed on samples collected at the harbor at Cross Village, Michigan on 9 November 1979.

Site	Parameter				
	Solids %	Total Volatile Solids (% Dry Solids)	Oil & Grease (% Dry Solids)	In Place Density	Total Organic Carbon (mg/g)
1	77.95	0.19	0.04	2.040	0.832
2	78.86	0.24	0.02	2.068	1.402
3	67.23	0.26	0.04	2.018	1.758

ATTACHMENT F

Results of the analyses of sediment from the harbor at Cross Village, Michigan for the pesticides Lindane, Heptachlor, and DDT. Sediment was collected on 9 November 1979.

Parameter	Site 1	Site 2	Site 3
Lindane (ug/kg)	<0.001	<0.001	0.053
Heptachlor (ug/kg)	<0.001	<0.001	<0.001
DDT (ug/kg)	0.220	0.122	<0.001

Results are reported on a dry weight basis.

ATTACHMENT G

Particle size composition of sediments collected from the open-water dredge disposal size at Cross Village, Michigan on 11 June 1980. Tabular results are expressed as percent of dry weight retained per sieve.

	Sieve Opening (mm)*				
Site	2.000	0.850	0.250	0.075	Passed <0.075
1	1.8	1.6	9.8	77.0	8.8
2	1.6	1.2	13.7	76.3	7.2
3	1.5	1.0	11.3	86.2	--
4	--	1.0	19.0	80.2	--
5	--	1.3	8.4	61.7	28.6

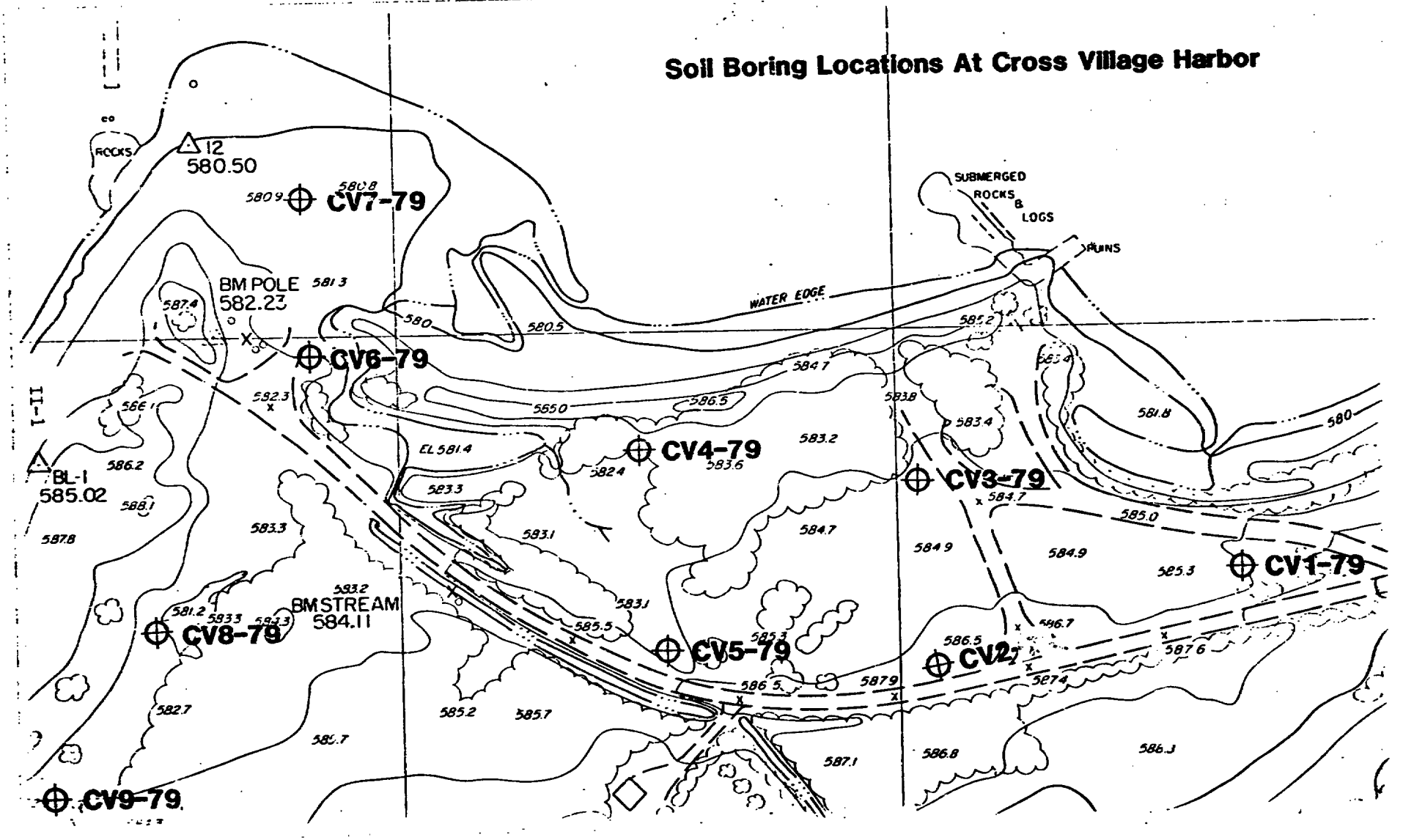
*Corresponds to

Size (mm)	U.S. Standard Sieve No.	Classification
>2.0	Retained by 10	granule, pebble, cobble
.850 - 1.99	Retained by 20	very coarse sand
.250 - 0.849	Retained by 60	medium sand
.075 - 0.249	Retained by 200	fine and very fine sand
<0.075	Passed through 200	silt and clay

SUPPLEMENT II

Soil Test Borings

Soil Boring Locations At Cross Village Harbor



Testing Engineers & Consultants, Inc.

1333 Rochester Road Phone 588-6200 Troy, Michigan 48099

P. O. BOX 249

soil borings soil evaluation foundation investigation instrumentation

BORING NO. CV -1 -79 JOB NO. 5709 PROJECT CROSS VILLAGE HARBOR

Ground Surface (Elev.) _____

Datum _____

CLIENT: U.S. Army District, Detroit
Corps of Engineers

Location: North of Harbor Springs, Michigan

Started 26 July 1979 Completed 26 July 1979

Driller J. King

Rec.	DEPTH IN FEET	SAMPLE TYPE	SAMPLE "N"	STRATA CHANGE	SOIL CLASSIFICATION	W. L.	W	γ_d	q_u
			3	1'	Firm Moist Brown Sandy LOAM	V	1' WATER LEVEL		
1.3		BS	4 7		Loose Wet Fine To Medium Brown SAND				
			6	3'					
1.5	5	BS	18 24		Dense Wet Coarse Brown SAND				
				8'					
			18						
0.7	10	BS	30 38						
			13						
1.0	15	BS	25 25		Very Dense Wet Brown SAND & GRAVEL				
			16						
1.5	20	BS	18 20						
			18						
1.0	25	BS	30 35						
			31						
1.5	30	BS	34 40	30'					
					END OF BORING				

"N" · Standard Penetration Resistance
S.S. · 2" O.D. Split Spoon Sample
L.S. · Sectional Liner Sample
S.T. · Shelby Tube Sample
B.S. · Bottle Sample
H.S. · Housel Sample

W · H_2O% of dry weight
γ_d · Natural Density-lbs. cu. ft.
q_u · Unconfined Compression lbs. sq. ft.
W.L. · Water Level

mk

Boring No. 1

Testing Engineers & Consultants, Inc.

1333 Rochester Road Phone 588-6200 Troy, Michigan 48099

P. O. BOX 249

MEMBER

soil borings soil evaluation foundation investigation instrumentation

BORING NO. CV- 2 -79 JOB NO. 5709 PROJECT CROSS VILLAGE HARBOR

Ground Surface (Elev.)

Datum

CLIENT: U.S. Army District, Detroit Corps of Engineers

Location: North of Harbor Springs, Michigan

Started 27 July 1979 Completed 27 July 1979

Driller J. King

Rec.	DEPTH IN FEET	SAMPLE TYPE	SAMPLE "N"	STRATA CHANGE	SOIL CLASSIFICATION	W. L.	W	γ_d	q_u
						V	10" WATER LEVEL		
.3		BS	1 2 1		Soft Moist Brown PEAT				
.9	5	BS	1 2 4	5'					
				8'	Loose Wet Medium To Fine Brown SAND				
1.2	10	BS	4 26 40	12½'	Very Dense Medium To Coarse Gravelly SAND				
1.0	15	BS	11 14 35		Dense Wet Medium To Coarse Wet Brown SAND With Layers of Gravel				
0.9	20	BS	13 16 20						
.7	25	BS	6 13 20						
1.4	30	BS	12 26 43	30'					
					END OF BORING				

"N" - Standard Penetration Resistance
S.S. - 2" O.D. Split Spoon Sample
L.S. - Sectional Liner Sample
S.T. - Shelby Tube Sample
B.S. - Bottle Sample
H.S. - Housel Sample

W - H_2O% of dry weight
γ_d - Natural Density-lbs. cu. ft.
q_u - Unconfined Compression lbs. sq. ft.
W.L. - Water Level

mk

TESTING ENGINEERS & CONSULTANTS, INC.

1333 Rochester Road Phone 588-6200 Troy, Michigan 48099

P. O. BOX 249

soil borings *soil evaluation* *foundation investigation* *instrumentation*

MEMBER

BORING NO. CV- 3-79 JOB NO. 5709 PROJECT CROSS VILLAGE HARBOR

Ground Surface (Elev.)

Datum

CLIENT: U.S. Army District, Detroit
Corps of Engineers

Location: North of Harbor Springs, Michigan

Started 24 July 1979 Completed 24 July 1979

Driller J. King

Rec.	DEPTH IN FEET	SAMPLE TYPE	SAMPLE "N"	STRATA CHANGE	SOIL CLASSIFICATION	W. L.	W	γ_d	q_u
			1	6"	Loose Moist Brown SAND	V			
		BS	1½				1' WATER LEVEL		
			1½	3½'	Soft Moist Brown PEAT				
.12	5	BS	1						
			3						
			4		Loose Wet Fine Brown SAND				
				8'					
			10						
.18	10	BS	15						
			18		Dense Wet Fine Brown SAND				
			12						
.12	15	BS	17						
			27						
				18'					
			14						
.11	20	BS	28						
			28		Very Dense Wet Fine Brown SAND				
			11						
.14	25	BS	30						
			40						
			11						
.15	30	BS	24	30'					
			40		END OF BORING				

"N" · Standard Penetration Resistance
S.S. · 2" O.D. Split Spoon Sample
L.S. · Sectional Liner Sample
S.T. · Shelby Tube Sample
B.S. · Bottle Sample
H.S. · Housel Sample

W · H_2O% of dry weight
γ_d · Natural Density-lbs. cu. ft.
q_u · Unconfined Compression lbs. sq. ft.
W.L. · Water Level

mk

Boring No. 3

Testing Engineers & Consultants, Inc.

1333 Rochester Road Phone 680-6200 Troy, Michigan 48099

P. O. BOX 249

soil borings *soil evaluation* *foundation investigation* *instrumentation*

BORING NO. CV- 4-79 JOB NO. 5709 PROJECT CROSS VILLAGE HARBOR

Ground Surface (Elev.)

Datum

CLIENT: U.S. Army District, Detroit
Corps of Engineers

Location: North of Harbor Springs, Michigan

Started 31 July 1979 Completed 31 July 1979

Driller J. King

Rec.	DEPTH IN FEET	SAMPLE TYPE	SAMPLE "N"	STRATA CHANGE	SOIL CLASSIFICATION	W. L.	W	γ_d	q_u
			2	1'	Loose Moist Sandy Brown PEAT	V			
.8		BS	3 2				1' WATER LEVEL		
				3½'	Loose Wet Fine To Medium Brown SAND				
			4						
1.5	5	BS	8 13		Medium Wet Fine To Coarse Brown SAND With Gravel				
				7½'					
.5	10	BS	49 68		Very Dense Wet Brown Coarse SAND & GRAVEL				
				12'					
.9	15	BS	12 17 21		Dense Wet Fine Brown SAND With Small Gravel				
				18'					
.4	20	BS	13 20 25		Very Dense Wet Medium Brown SAND & GRAVEL				
.6	25	BS	18 31 30						
				27'					
1.0	30	BS	14 24	30'	Dense Wet Coarse Brown SAND With Large Gravel				
			23		END OF BORING				

"N" - Standard Penetration Resistance
S.S. - 2" O.D. Split Spoon Sample
L.S. - Sectional Liner Sample
S.T. - Shelby Tube Sample
B.S. - Bottle Sample
H.S. - Housel Sample

W - H_2O% of dry weight
γ_d - Natural Density-lbs. cu. ft.
q_u - Unconfined Compression lbs. sq. ft.
W.L. - Water Level

mk

Testing Engineers & Consultants, Inc.

1333 Rochester Road Phone 1-00-6200 Troy, Michigan 48099

P. O. BOX 249

MEMBER

soil borings *soil evaluation* *foundation investigation* *instrumentation*

BORING NO. CV - 5 -79 JOB NO. 5709 PROJECT CROSS VILLAGE HARBOR

Ground Surface (Elev.) _____

Datum _____

CLIENT: U.S. Army District, Detroit
Corps of Engineers

Location: North of Harbor Springs, Michigan

Started 27 July 1979 Completed 27 July 1979

Driller J. King

Rec.	DEPTH IN FEET	SAMPLE TYPE	SAMPLE "N"	STRATA CHANGE	SOIL CLASSIFICATION	W. L.	W	γ_d	q_u
			1		Soft Very Moist Brown PEAT		NO WATER LEVEL		
.3		BS	1						
			2	3'					
			3						
.6	5	BS	4		Loose Wet Medium To Coarse Brown SAND				
			5	7½'					
			13						
1.2	10	BS	17		Dense Wet Brown SAND & GRAVEL				
			25						
			9						
.3	15	BS	13						
			23	17'					
			60						
.5	20	BS	50		Very Dense Wet Medium To Fine Brown SAND With Light Gravel Content				
			20						
.1	25	BS	33						
			37						
			44						
.9	30	BS	67	30'					
					END OF BORING				

"N" · Standard Penetration Resistance
S.S. · 2" O.D. Split Spoon Sample
L.S. · Sectional Liner Sample
S.T. · Shelby Tube Sample
B.S. · Bottle Sample
H.S. · Hosel Sample

W · H_2O% of dry weight
γ_d · Natural Density-lbs. cu. ft.
q_u · Unconfined Compression lbs. sq. ft.
W.L. · Water Level

mk

Boring No. 5

Testing Engineers & Consultants, Inc.

1333 Rochester Road Phone 588-6200 Troy, Michigan 48099

P. O. BOX 249

MEMBER

soil borings *soil evaluation* *foundation investigation* *instrumentation*

BORING NO. CV- 6 -79 JOB NO. 5709 PROJECT CROSS VILLAGE HARBOR

Ground Surface (Elev.)

Datum

CLIENT: U.S. Army District, Detroit Corps of Engineers

Location: North of Harbor Springs, Michigan

Started 27 July 1979 Completed 27 July 1979

Driller J. King

Rec.	DEPTH IN FEET	SAMPLE TYPE	SAMPLE "N"	STRATA CHANGE	SOIL CLASSIFICATION	W. L.	W	γ_d	q_u
						V	6" WATER LEVEL		
1.1		BS	2 2 4		Loose Wet Coarse Brown SAND				
			7	3½'					
1.5	5	BS	12 11		Medium Wet Fine To Medium Brown SAND				
			26						
1.5	10	BS	16 15	11'					
					Medium Wet Fine Brown SAND				
.6	15	BS	10 6	14½'					
			4	16½'	Firm Moist Sandy Brown CLAY				
			4						
1.2	20	BS	5 6		Firm Moist Silty Blue CLAY				
			7						
.9	25	BS	9 5	27'					
			12		Stiff Moist Silty Blue CLAY				
.4	30	BS	15 16	30'					
					END OF BORING				

"N" · Standard Penetration Resistance
S.S. · 2" O.D. Split Spoon Sample
L.S. · Sectional Liner Sample
S.T. · Shelby Tube Sample
B.S. · Bottle Sample
H.S. · Housel Sample

W · H_2O% of dry weight
γ_d · Natural Density-lbs. cu. ft.
q_u · Unconfined Compression lbs. sq. ft.
W.L. · Water Level

mk

Boring No. 6

Testing Engineers & Consultants, Inc.

1333 Rochester Road Phone 588-6200 Troy, Michigan 48099

P. O. BOX 249

soil borings soil evaluation foundation investigation instrumentation

BORING NO. CV- 7 -79 JOB NO. 5709 PROJECT CROSS VILLAGE HARBOR

Ground Surface (Elev.) _____

Datum _____

CLIENT: U.S. Army District, Detroit
Corps of Engineers

Location: North of Harbor Springs, Michigan

Started 30 July 1979 Completed 30 July 1979

Driller J. King

Rec.	DEPTH IN FEET	SAMPLE TYPE	SAMPLE "N"	STRATA CHANGE	SOIL CLASSIFICATION	W.L.	W	γ_d	q_u
			2	1'	Loose Moist Medium Brown SAND - With Gravel	▽			
1.1		BS	3				1½' WATER LEVEL		
			9						
			5						
1.3	5	BS	7		Medium Wet Coarse Brown SAND				
			12						
				8'					
			26						
1.4	10	BS	28		Very Dense Wet Brown SAND & GRAVEL				
			46						
				13'					
			15						
.7	15	BS	18		Dense Wet Brown SAND & GRAVEL				
			20						
				18'					
			4						
.8	20	BS	3		Loose Wet Fine Brown Clayey SAND				
			2						
				23'					
			6						
1.2	25	BS	8		Stiff Moist Sandy Brown CLAY				
			4						
				27½'					
			3		Medium Moist Silty Brown CLAY				
	30	BS	3	30'	With Sand & Gravel				
			3		END OF BORING				

"N" · Standard Penetration Resistance
S.S. · 2" O.D. Split Spoon Sample
L.S. · Sectional Liner Sample
S.T. · Shelby Tube Sample
B.S. · Bottle Sample
H.S. · Housel Sample

W · H_2O% of dry weight
γ_d · Natural Density-lbs. cu. ft.
q_u · Unconfined Compression lbs. sq. ft.
W.L. · Water Level

mk

Testing Engineers & Consultants, Inc.

1333 Rochester Road Phone 588-6200 Troy, Michigan 48099

P. O. BOX 249

soil borings *soil evaluation* *foundation investigation* *instrumentation*

MEMBER

BORING NO. CV- 8-79 JOB NO. 5709 PROJECT CROSS VILLAGE HARBOR

Ground Surface (Elev.)

Datum

CLIENT: U.S. Army District, Detroit
Corps of Engineers

Location: North of Harbor Springs, Michigan

Started 31 July 1979 Completed 31 July 1979

Driller J. King

Rec.	Depth in Feet	Sample Type	Sample "N"	Strata Change	Soil Classification	W. L.	W	γ_d	q_u
			2		Loose Moist Fine To Medium Brown SAND		2' WATER LEVEL		
1.1		BS	3	2'	With Gravel	V			
			4						
				3½'	Loose Wet Coarse Brown SAND				
		BS	5						
.9	5		7						
			13		Medium Wet Coarse Brown SAND				
			30						
	10	BS	16						
			14	11'					
			4		Stiff Moist Brown Sandy Silty CLAY With Traces of Gravel				
1.1	15	BS	5						
			6						
			3	17'					
1.5	20	BS	4						
			4		Medium Moist Brown Sandy Silty CLAY With Traces of Gravel				
			3						
.8	25	BS	4						
			7	28'					
			4		Stiff Moist Sandy Silty Brown CLAY				
1.2	30	BS	6	30'					
			13		END OF BORING				

"N" · Standard Penetration Resistance
S.S. · 2" O.D. Split Spoon Sample
L.S. · Sectional Liner Sample
S.T. · Shelby Tube Sample
B.S. · Bottle Sample
H.S. · Housel Sample

W · H_2O% of dry weight
γ_d · Natural Density-lbs. cu. ft.
q_u · Unconfined Compression lbs. sq. ft.
W.L. · Water Level

mk

Boring No. 8

Testing Engineers & Consultants, Inc.

1333 Rochester Road Phone 588-6200 Troy, Michigan 48099

P. O. BOX 249

soil borings *soil evaluation* *foundation investigation* *instrumentation*

BORING NO. CV- 9 -79 JOB NO. 5709 PROJECT CROSS VILLAGE HARBOR

Ground Surface (Elev.)

Datum

CLIENT: U.S. Army District, Detroit
Corps of Engineers

Location: North of Harbor Springs, Michigan

Started 30 July 1979 Completed 30 July 1979

Driller J. King

Rec.	DEPTH IN FEET	SAMPLE TYPE	SAMPLE "N"	STRATA CHANGE	SOIL CLASSIFICATION	W. L.	W	γ_d	q_u
1.0		BS	1 2 4	3'	Loose Moist Medium Brown SAND	V	2½' WATER LEVEL		
.7	5	BS	3 7 10	7'	Medium Wet Coarse To Medium Brown SAND				
1.2	10	BS	8 15 17	11½'	Dense Wet Fine To Medium Brown SAND				
1.1	15	BS	4 4 4	17'	Medium Moist Sandy Silty Brown CLAY With Gravel				
.6	20	BS	16 39 50	22½'	Hard Moist Sandy Brown CLAY With Layers of Wet Sand & Gravel				
1.0	25	BS	21 35 67		Hard Moist Sandy Blue CLAY With Thin Layers of Wet Gravel				
.7	30	BS	8 14 21	30'	END OF BORING				

"N" - Standard Penetration Resistance
S.S. - 2" O.D. Split Spoon Sample
L.S. - Sectional Liner Sample
S.T. - Shelby Tube Sample
B.S. - Bottle Sample
H.S. - Housel Sample

W - H_2O% of dry weight
γ_d - Natural Density-lbs. cu. ft.
q_u - Unconfined Compression lbs. sq. ft.
W.L. - Water Level

mk

SUPPLEMENT III

404 Evaluation

404 EVALUATION
SMALL BOAT HARBOR CONSTRUCTION
EMMET COUNTY
CROSS VILLAGE, MICHIGAN

1. PROJECT DESCRIPTION:

Construction of a small boat harbor is recommended at Cross Village, Emmet County, Michigan. The construction would involve the dredging of a 10 foot basin and a 12 foot entrance channel, placement of 2 rubblemound breakwaters and an underwater stone fish reef. A portion of the dredged material would be used for beach fill, and the balance deposited along the beach to the east of the harbor for a distance of approximately 4,000 feet.

a. Description of the proposed discharge of dredged or fill materials.

(1) General characteristics of material - Breakwaters of 1,670 and 920 feet, would be constructed of underlying mattress stone, core stone of 20# to 140#, and armor stone ranging in size from 1/2 ton to 3 tons. The dredged material requiring disposal would consist of approximately 97% medium and fine grain sands. Stone from the existing breakwater at Cross Village would be used for fish reef construction.

(2) Quantity of material proposed for discharge - The approximate volume of material required for breakwater construction would be 13,000 cubic yards of mattress stone, 32,000 cubic yards of core stone, and 55,000 cubic yards of armor stone. Dredged material would be approximately 67,000 cubic yards in volume. The quantity of stone available for fish reef construction is approximately 926 cubic yards.

b. Description of proposed disposal sites for dredged or fill material.

(1) Location - This project would require 3 discharge sites. The harbor site itself would be the location of the discharge of fill. Dredged material would be disposed of in Lake Michigan along the shoreline to the east of the harbor for a distance not to exceed 4,000 feet. The underwater fish reefs would be located approximately 5,000 feet northeast (315°) of the existing breakwater - beach intersection, between the 18 to 24 foot contour.

(2) Type of disposal sites - The beach and nearshore lake bottom material is glacial sediment belonging to a fine to medium sand category.

(3) Methods of discharge - The fill and dredged material would be discharged at the harbor site in construction of the harbor breakwaters.

(4) Time of disposal - Construction, disposal, and dredging activities would take place during the regular construction season, which runs from 15 April to 1 December depending on weather severity. Construction is scheduled for 1984.

(5) Projected life of project - The life of the project is 50 years.

(6) Bathymetry - The lake bottom at the harbor site is composed of fine to medium sand. It slopes nearly 13 feet from shore to the lakeward-most point of the breakwaters, a distance of 1,050 feet.

2. PHYSICAL EFFECTS (40 CFR 230.4-1(a))

a. Potential destruction of wetlands - effects on (40 CFR 230.4 - 1 (a)(1)(i-vi).

(1) Food chain production - There are two small wetland areas within the project area. These wetlands cover a combined area of approximately 2-1/2 acres. Vegetation of the western most wetland consists

primarily of cattails and sedges. The wetland to the east is mostly out of the project area and would not be affected by the project. Neither of these areas produce significantly large amounts of biomass and would only be able to support small wetland animal populations.

(2) General habitat - As previously stated, these wetlands total approximately 2-1/2 acres. They would provide good but very limited habitat for small birds and mammals. They would not provide sufficient cover or food for a quantity of game birds.

(3) Nesting, spawning, rearing and resting sites for aquatic or land species - Coordination with the Michigan Department of Natural Resources indicates that there is a small fishable population of Northern Pike which exist in the project area. It is possible that some Northern Pike use the wetlands for spawning.

(4) Those areas set aside for aquatic environment study or sanctuaries or refuges - No areas set aside for these activities are in the project area or will be affected by project activities.

(5) Natural drainage characteristics - Natural drainage patterns in the immediate project area will not be altered.

(6) Sedimentation patterns - Harbor construction would not effect sedimentation patterns within to the wetlands. However, the proposed harbor breakwaters would tend to facilitate the accumulation of wetland sediments within the harbor.

(7) Flushing characteristics - Placement of upland harbor facilities would not effect the flushing characteristics of the wetlands.

(8) Current patterns and wave action, erosion or storm damage protection - These wetland areas do not effect current patterns, wave action, erosion, or serve to protect the shore or shore structures from storm damage.

(9) Storage areas for storm and flood waters - Because the natural drainage patterns and wetlands would not be altered, wetland water storage capacity would not be affected.

(10) Prime natural recharge areas - The wetlands are not located in a prime natural recharge area.

b. Impact on the water column (40 CFR 230.4-1(a)(2)).

(1) Reduction in light transmission - There would be a temporary increase in turbidity during project construction. After construction is completed, turbidity should return to near ambient levels. As the material to be dredged is clean, fine to medium grained sand, turbidity along the disposal area should subside soon after dumping activities have been completed.

(2) Aesthetic values - There could be a temporary negligible adverse impact on the aesthetic value of the water volume during construction. It would be confined to the harbor area due to a small increase in turbidity. In the dumping area aesthetics would not be greatly affected, as few people would witness the short-term increase in turbidity.

(3) Direct destructive effects on nektonic and planktonic populations - Impact on these populations would be minor due to the nature of the dredged and fill material. Dredged material would consist of clean sand. Dredging operations would cause some nektonic species to temporarily relocate. These species would return after construction activities have ceased. The material for breakwater construction would be large size clean rock fill. Breakwater construction would cause nektonic populations to leave the area. They would have a limited adverse effect on planktonic populations and productivity due to the generation of small amounts of turbidity.

c. Covering of benthic communities (40 CFR 230.4-1(a)(3)).

(1) Actual covering of benthic communities - Most benthic organisms found in the area to be dredged would be destroyed. The benthic habitat at the proposed breakwater locations would be eliminated by the project. Most benthos in the dumping area would be smothered.

(2) Changes in community structure or function - The submerged rubblemound portion of the proposed breakwater and underwater fish reef would drastically alter the type of substrate that now exists on the lake bottom. Certain benefits would result from alteration. Stone structures in lake and harbor waters have an advantageous effect on the kinds and numbers of plants and animals. The rock structures projecting from the lake bottom would provide a microhabitat conducive to algae, invertebrate, and small gamefish production. This benefit would diminish somewhat as a certain portion of the submerged portion of the breakwater is filled with sediment from littoral drift. Most benthic inhabitants of the shoreline disposal site would be covered. Surrounding communities of benthos should recolonize the dumping site shortly after disposal has been completed; community structure would ultimately return to what it was before disposal.

d. Other effects (40 CFR 230.4-)(a))

(1) Changes in bottom geometry and substrate composition - Construction of the 2 breakwaters and dredging would alter both the geometry and substrate at the harbor site. All breakwaters would be construction with stone ranging in size from 20# to 1 1/2 tons. This would amount to a considerable change in substrate since sand is presently there. The main breakwater would project into Lake Michigan 1,670 feet and rise 6 to 11 feet above low water datum (LWD = 576.8). The smaller northeasterly breakwater would total 920 feet ranging from 6 to 11 feet above the LWD. The harbor basin and entrance channel areas would be dredged 10 and 12 feet below present lake bottom level respectively. The substrate would not be altered in these areas.

(2) Water circulation - Breakwater construction would deflect the long-shore current away from the shore at the westerly end of the project. Once 4,000 feet past the harbor, the current would resume a flow pattern similar to that which now exists.

(3) Exchange of constituents between sediments and overlying water with alterations of biological communities - Fill material would consist of large, clean rocks which would not release constituents into overlying water. Dredged material at the site is classified as clean sand, and would not release any substances which would cause alteration of biological communities.

3. CHEMICAL - BIOLOGICAL INTERACTIVE EFFECTS (40 CFR 230.4-1(b))

a. As specified by 40 CFR 230.4-1(b) the fill material may be excluded from evaluation for benthic and water column effects because the breakwater and fish reef material is composed of rock. Dredge material also meets criteria for exclusion. It is clean sand of medium grain size.

4. DESCRIPTION OF SITE COMPARISON (40 CFR 230.4-1(c))

a. Total sediment analysis (40 CFR 230.4-1(c)(1)) - Since the materials to be dredged consist of clean sand, a total analysis of sediments at the sites would not be helpful in assessing the impact of open water disposal.

b. Biological community structure analysis (40 CFR 230.4-1(c)(2)) - An analysis of the biological community structure at the proposed excavation and disposal sites would not be of value in addressing impacts and the disposal site since the dredged materials would consist of clean sand.

5. REVIEW APPLICABLE WATER QUALITY STANDARDS

a. Fill material would consist of clean quarried rock and stone from the existing breakwater. Dredge material would be clean sand. Neither

material would effect water quality. Disposal would be in accordance with applicable water quality stands.

6. SELECTION OF DISPOSAL SITES (40 CFR 230.5) FOR FILL AND DREDGED MATERIAL

a. Need for the proposed activity - No harbor of refuge exists in the Cross Village area. The harbor would provide for boater safety. The proposed project is also in the best interest of National Economic Development.

b. Objectives to be considered in discharge determination (40 CFR 230.5(a))

(1) Impacts of selected plan of chemical, physical, and biological integrity of the aquatic ecosystem (40 CFR 230.5(a)(1)) - Impacts on these parameters would not be significant because clean fill material would be used. The dredged material requiring disposal is clean sand.

(2) Impacts on food chain - There would be a beneficial effect on the food chain. After initial disruption, the increase in habitat area and diversity of the completed breakwaters and fish reef would have a positive long-term impact on production of algae and invertebrates. After initial disruption is completed, the open water disposal area should return to its pre-existing condition.

(3) Impacts on diversity of plant and animal species - Along the shore disposal area there would be a minor temporary impact on the diversity of animal species. Most animal species inhabiting the disposal area would be buried. However, surrounding benthos would quickly recolonize the area. In the project area, disturbance of the benthos and presence waste products could decrease species diversity in some benthic areas. However, the presence of the breakwaters and fish reef would increase the abundance and diversity of algae, invertebrates, and vertebrate species in the harbor area.

(4) Impact on movement into and out of feeding, spawning, breeding and nursery areas - No significant impact is expected on the movement into and out of these areas. It is not expected that the breakwaters would deny Northern Pike use of the two wetland areas for spawning, if in fact they do make use of these wetlands.

(5) Impact on wetland areas having significant functions of water quality maintenance - No wetlands which have a significant impact on water quality maintenance occur in the project area. However, two small isolated wetlands are found at the project site. Construction would not significantly affect these wetlands.

(6) Impact on areas that serve to retain natural high waters or flood waters - There are no natural areas that serve in the retention of high waters or flood waters in the project area.

(7) Methods to minimize turbidity - The use of clean rock material would minimize the impact from turbidity in the fill area. Materials to be disposed would consist mainly of clean sand, therefore, only slight amounts of turbidity would be associated with the disposal procedure.

(8) Methods to minimize degradation of aesthetic, recreational, and economic values - The harbor breakwaters will be of rubblemound construction. This will keep any negative aesthetic effects of the harbor to a minimum. Recreational opportunities would be augmented and economic values of the area should increase substantially. Disposal of dredged material would have no effects on recreation, aesthetics or economic values.

(9) Threatened and endangered species - The construction of parking lots, and other support structures, would impact State of Michigan threatened plant species, the Lake Huron tansy (Tanacetum huronense), Pitcher's thistle (Cirsium pitcheri), and thickspike wheatgrass (Agropyron dasystachyum), located within the project site.

d. Differential impacts of considered alternatives

(1) Alternatives considered - The following alternatives have been considered:

(a) Sturgeon Bay Point

This site is located approximately 500 feet northeast of Sturgeon Bay Point on the north shore of Sturgeon Bay. From an environmental standpoint Sturgeon Bay Point is a poor alternative. Numerous problems with land use plans, erosion, State of Michigan threatened plant species and high ground water contamination potentials are associated with this alternative. The dredging of 67,000 cubic yards of material from the harbor area and some shoreline filling would be necessary at this site.

(b) Good Hart (National Economic Development Plan)

The Good Hart site is located at a small lakeshore park area about 3 miles west of highway 119, Good Hart, Michigan. Construction of a boat harbor at this site would require the destruction of all or part of a 35 foot wide fore dune area that provides a habitat for a number of dune plant species including the Michigan threatened Lake Huron tansy (Tanacetum huronense). This site would require the dredging of 98,000 cubic yards and some shoreline filling.

(c) The effect of no action would cause no adverse impacts to benthic, planktonic, or necktonic inhabitants at the harbor or deep water disposal sites. There would also be no associated adverse secondary impacts to upland plants and wildlife. Without the project, algae, benthos and fish populations would not receive the beneficial impacts of increased and diversified habitat.

e. Impacts on water uses at proposed disposal sites (40 CFR 230.5(b)(1-10)

(1) Municipal water supply intakes - Neither the harbor or the disposal site is near any public water supply intake.

(2) Shellfish - Neither the harbor, fish reef or the disposal site is in an area of shellfish production.

(3) Fisheries - The fill sites would not disrupt fish spawning and nursery areas.

(4) Wildlife - During construction, equipment associated with the placement of fill and removal of dredged material would temporarily disturb some wildlife. No wildlife would be affected at the dumping site.

(5) Recreational activities - During construction recreation values at the construction and disposal sites would decline. But during the overall project life, the recreational impact would be overwhelmingly beneficial. The harbor will provide numerous fishing and boating opportunities.

(6) Threatened and endangered species - Five threatened or endangered plant species are known to exist in the Cross Village area. It has been determined that Tanacetum huronense, Cirsium pitcheri, and Agropyron dasystachyum, Michigan threatened species, are in the project area. Construction of parking and support facilities by the State of Michigan would destroy two abundant (> 100 plants) stands of Tanacetum huronense, at least two Cirsium pitcheri and one small stand of Agropyron dasystachyum. No threatened or endangered species would be affected at the deep water disposal site.

(7) Benthic life - Benthic organisms in the path of the breakwaters, fish reef, dredging area, and in the disposal area would be removed or destroyed. The net impact of the harbor construction should be positive since the breakwaters and fish reef would provide an expanded and diversified habitat for the benthic community.

(8) Wetlands - No wetlands would be affected at the deep water disposal site. The wetlands near the harbor area should not be altered as a direct impact of construction. Secondary effects of the construct may adversely impact upon these two small wetlands.

(9) Submerged vegetation - No significant beds of submerged vegetation exist in the project area. However, any vegetation existing in the fill, dredge or disposal sites would be destroyed.

(10) Size of disposal site - The perimeter of the breakwaters would enclose an area of approximately 12 acres. The shoreline disposal area would be 4,000 feet in length.

(11) Coastal zone management programs (40 CFR 230.3(e)) - The proposed project is consistent with the State of Michigan's Shorelands Protection and Management Act. Development of shoreline areas for recreational activities is part of Michigan's coastal zone management program.

f. Considerations to minimize harmful effects (40 CFR 230.5(c))

(1) Water quality criteria - Fill and disposal materials will be inert rock and clean sand. Leachate from these materials would be insignificant.

(2) Alternatives to open water fill - No alternative to shoreline fill are being considered. Because the dredged material is uncontaminated no inland disposal sites have been considered.

(3) Physical characteristics of alternative disposal - No alternative open water disposal sites were investigated because there is no apparent advantage to be gained over the selected site.

SUPPLEMENT IV

Correspondence

United States Department of the Interior

FISH AND WILDLIFE SERVICE
East Lansing Area Office
Manly Miles Building, Room 202
1405 South Harrison Road
East Lansing, Michigan 48823

IN REPLY REFER TO:

September 26, 1979

Colonel Robert V. Vermillion
U.S. Army Engineer
Detroit District
P.O. Box 1027
Detroit, Michigan 48231

Dear Colonel Vermillion:

This is our letter report concerning the proposed harbor of refuge to be located at Cross Village, Emmet County, Michigan. It is provided for inclusion in your draft Phase I General Design Memorandum and is based on information obtained from your staff prior to September 15, 1979. The project was authorized for construction by the November 7, 1966 River and Harbor Act as presented in House Document 490, 89th Congress, 2nd Session.

These comments have been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and in compliance with the intent of the National Environmental Policy Act of 1969. The letter report also complies with the obligations of the U.S. Fish and Wildlife Service to the Detroit District Corps of Engineers under Support Agreement No. NCE-IS-79-010-EH, effective November 15, 1978.

Cross Village is located in Emmet County, Michigan, on the south shore of Sturgeon Bay, a broad open bay near the northeastern end of Lake Michigan. The original breakwater at Cross Village, which was built prior to World War II by the Works Progress Administration and local interests, has deteriorated to the point where it no longer provides adequate harbor protection. Commercial fishing vessels have been the principal users of that breakwater.

The site for the authorized harbor works is at the base of the center of the Village. It provides access to the township-owned lake frontage which is used as a swimming beach and boat launching area. The general area is devoted principally to recreational activities and is noted for its many lakes, rivers, parks, and forests.

Currently, there is only one construction alternative being considered for the project. (see figure 1). Two breakwaters, measuring approximately 1,580 feet and 680 feet, respectively, will be constructed along the alignment indicated in figure 1. Portions of these breakwaters will either be steel cell, cantilever wall, or rubble mound. The entrance channel to the harbor of refuge will be 12 feet in depth, whereas the proposed anchorage and maneuver area will be 10 feet in depth. The north section only of the existing breakwater will be removed. Tentative locations for public docks, commercial fishing, and ferry berthings have been planned.

The construction and operation of the proposed harbor of refuge will not significantly affect fish and wildlife resources in the area. However, we do have concerns which should be included and addressed in the detailed project report.

Our first concern is the two wetland areas located on the east and west ends of the designated project area (see figure 2). A list of plant and animal species observed in these areas during a field investigation conducted August 28, 1979 is contained in Table 1. Wetland I contains a greater diversity of plant species than wetland II. It is a series of three wetlands connected by a flow of water entering Lake Michigan at its northeast end. Water depths range from six to twenty-four inches. The water sources for this wetland appear to be a combination of lake and spring water.

Wetland II is a single large pond area. The bottom contains a number of logs and stumps. This wetland appears to be a flooded low-lying wooded area. Water depths range between 12 to 24 inches. Water from wetland II enters Lake Michigan at its eastern end and moves much slower than in wetland I.

Both of these wetlands are probable spawning sites for northern pike (Esox lucius). Northern pike inhabit a variety of habitats, including lakes, reservoirs, and large streams (Pflieger, 1975). Pike avoid strong currents and seek waters with dense growths of aquatic vegetation. They spawn in early spring, with spawning preceded by movements into heavily vegetated flood plains of rivers, marshes, and bays of larger lakes (Scott and Crossman, 1973). Eggs are broadcast over submergent vegetation. The type of vegetation does not seem to be significant (Buss, 1961).

We recommend that wetlands I and II not be filled during construction of the proposed harbor of refuge. They provide good spawning habitat for fish and furnish feeding, resting, and nesting habitat for waterfowl. Development along the shoreline of the project area should also be curtailed in order that the outlets of the wetlands to Lake Michigan are maintained.

In order that the boundaries of the coastal wetlands be well defined, the 100-year storm or some other statistical flood plain should be designated in the draft General Design Memorandum. A 1-year flood mark is of particular relevance because it marks the upper edge of the coastal wetlands (Clark, 1977). The selection of a particular statistical flood plain will depend on the objective to maintain the existing wetlands according to maximum size, land slope, drainage characteristics, soil type, and other variables.

Our second area of concern is the excavation of material from the existing breakwater located at the west end of the project area. Timber and rock constitute the basis of the existing structure, and a good smallmouth bass fishery exists in this area, at least in part, because of these materials. Fish sampling with gill nets was conducted to estimate fish utilization of the area (see table 2). Because of the time of year when sampling took place, species diversity was not as high as expected. Other possible fish species inhabiting the project vicinity are contained in table 3.

We recommend that any materials removed from the existing breakwater be placed in another portion of the project area to enhance the fishing and recreational aspects of the project. A suitable location for possible reef construction using this material should be discussed with Mr. Ned E. Fogle, Fisheries Division Office, Michigan Department of Natural Resources. We have held preliminary discussion with Mr. Fogle on this idea, and it is his opinion that the Cross Village project would be a good site for this type of enhancement technique.

The third area of concern we have is the possible loss of beach area as a result of littoral drift change brought about by the construction of the breakwaters for the harbor of refuge. If the harbor is located at its proposed location, the beach area which will be available for public use, is at the east end of the project area. A determination must be made whether accretion or an erosive process will be acting on this area. The area should be maintained for recreational use consistant with PL 90-483 Sec. 111, Rivers and Harbors Act, 1968.

The location of the public and commercial docks inside the harbor area is another area of concern. We suggest that there be a change in orientation of the public docks to the shoreline in order to decrease the amount of proposed dredging for the area. Figure 2 depicts a proposed alternative location for the docks. This alternative utilizes more of the existing water depth for boat docking and thus results in less disruption to the existing shoreline from proposed dredging operations.

Figure 2 also shows a change in the location of the commercial fishery berth to the west of the harbor. If the commercial fishery berthing facility is placed at the east end of the harbor, it would be located adjacent to a public beach area. This location would be less desirable from a recreational viewpoint than if all boats were kept together in the harbor area. Also, the location of wetland II is adjacent to this berthing

area and portions of it would probably be filled to accommodate full use of the dock area. Thus, we recommend that these alternative dock locations be reviewed to attain maximum multiple use of the site with the least environmental impact.

A final concern we have in relation to the project is the possibility of dredging to maintain the harbor area. All potential dredge materials must be tested to determine whether they are polluted and then handled accordingly. Any polluted materials should not be sidecasted into open water. Coordination with our agency should be initiated to cooperatively find suitable disposal sites.

We assume the solicitation of these comments includes a request for an endangered species list under the Endangered Species Act of 1973, as amended. Accordingly, comments regarding endangered species will be forwarded under separate cover from our Twin Cities, Minnesota, Regional Office. For information regarding possible species on the State of Michigan's endangered lists, please contact the State's Department of Natural Resources.

We appreciate the opportunity to review this project. Please notify us of any changes or refinements in project plans so that we may revise or supplement this report as necessary.

Sincerely yours,

Richard O. Hunter

Area Manager

Attachment

Literature Cited

Buss, Keen, "The Northern Pike," Pennsylvania Fish Commission, Benner Springs Fish Research Station, Special Purpose Report 1961.

Clark, John R., Coastal Ecosystem Management, John Wiley and Sons, New York, 1977.

Pflieger, William L., The Fishes of Missouri, Missouri Department of Conservation, 1975.

Scott, W.B. and E.J. Crossman, Freshwater Fishes of Canada, Fisheries Research Board of Canada, Bulletin 184, Ottawa 1973.

Table 1

Species Composition of Wetlands I and II

Wetland I

Cattail, Typha spp.
Coontail, Ceratophyllum demersum
Duckweed, Lemna spp.
Muskgrass, Chara spp.
Sedges, Carex spp.

Larval crayfish, Astacidae
Midges, Diptera
Snails, Pulmonata
Water striders, Gerridae

Bullfrog, Rana catesbeiana
Mallard, Anas platyrhynchos

Wetland II

Cattail, Typha spp.
Coontail, Ceratophyllum demersum
Duckweed, Lemna spp.

Midges, Diptera
Water striders, Gerridae

Fish and Invertebrate Species Sampled At Proposed Harbor Site*

By East Lansing Area Office, USF&WS on 28 August 1979*

Alewife, Alosa pseudoharengus
Blacknose dace, Rhinichthys atratulus
Carp, Cyprinus carpio
Chinook salmon, Oncorhynchus tshawytscha
Crayfish, Astacidae
Northern pike, Esox lucius
Smallmouth bass, Micropterus dolomieui
Smelt, Osmerus spp.
Spottail shiner, Notropis hudsonius
Trout-perch, Percopsis omiscomaycus
White sucker, Catostomus commersoni

*Gill nets with mesh sizes from 3/4 to 6 inches were utilized.

Table 3

ECOLOGICAL SUMMARIES FOR SOME IMPORTANT LAKE MICHIGAN FISHES*

Species	Life Stage	Fall	Winter	Spring	Summer	Known Food Source
Alewife	Adult	Deep water and mid-depths	Deep water	Shallow water and mid-depths. Migrating inshore in April and May.	Widely distributed. Spawn at 60°-82°F in streams and unprotected lake shores. May return to cooler waters after spawning.	Zooplankton, benthic crustaceans, fish eggs and larvae, insects.
	Juvenile	Mid-depths				
Whitefish	Adult	Move to shallow water. Spawn in 8'-15' depths on current swept gravels and sands at 42°F and below.	Deep water	Deep water. May migrate. inshore.	Deep water	Benthic invertebrates, insect nymphs, and larvae.
	Juvenile				School at 8'-10' depths	
Cisco	Adult	Deep water. Spawn in November and December in inshore depths out to 90' (below 39°F).	Deep water	Deep water and mid-depths	Deep water and mid-depths	Copepods Cladocera Rotifers Benthic invertebrates

Table 3 (Continued)

Species	Life Stage	Fall	Winter	Spring	Summer	Known Food Source
	Juvenile		Hatch at ∿ 45°F		School in 8'-10' depths at 58°-65°F	Zooplankton
Yellow Perch	Adult	Shallow water and mid-depths	Deep water	Shallow water less than 40' deep. Spawn in weeds, rocky shallows, and rivers (May and June).	Shallow water and mid-depths	Insect larvae and nymphs Cladocerans Copepods Snails Sphaeridae Amphipods Ostracods small fish
	Juvenile				Shallow water, 3'-18' depths	Similar to adult fish
Bloater	Adult	Mid-depths (60' or more)	Mid-depths. Spawn in 120'-180' depths (March).	Shallow water	Mid-depths at 46°-50°F. Some insnore migration.	Pontoporeia Mysis insect larvae molluscs fish eggs
	Juvenile				Mid-depths at 50°F	Zooplankton

Table 3 (Continued)

Species	Life Stage	Fall	Winter	Spring	Summer	Known Food Source
Smelt	Adult	Mid-depths (50'-120')	Mid-depths	Spawn in shallow water and streams	Deep water and mid-depths at 43°-57°F	Aquatic insects Copepods Cladocerans Mysis Pontoporeia
	Juvenile			8'-10' depths		Rofifers Cladocerans Copepods small eggs
Lake Trout	Adult	Spawning in streams, along shore, and on shoals.	Deep water, 120'-300' depths near 39°F.	Widely distributed (39°-53°F).	Widely distributed (39°-53°F).	Fish of all sizes, primarily alewives
	Juvenile					Crustaceans (Mysis) insects small fish (Sculpin)

* United States Atomic Engery Commission
Donald C. Cook: Nuclear Plant Units 1 and 2

Figure 1

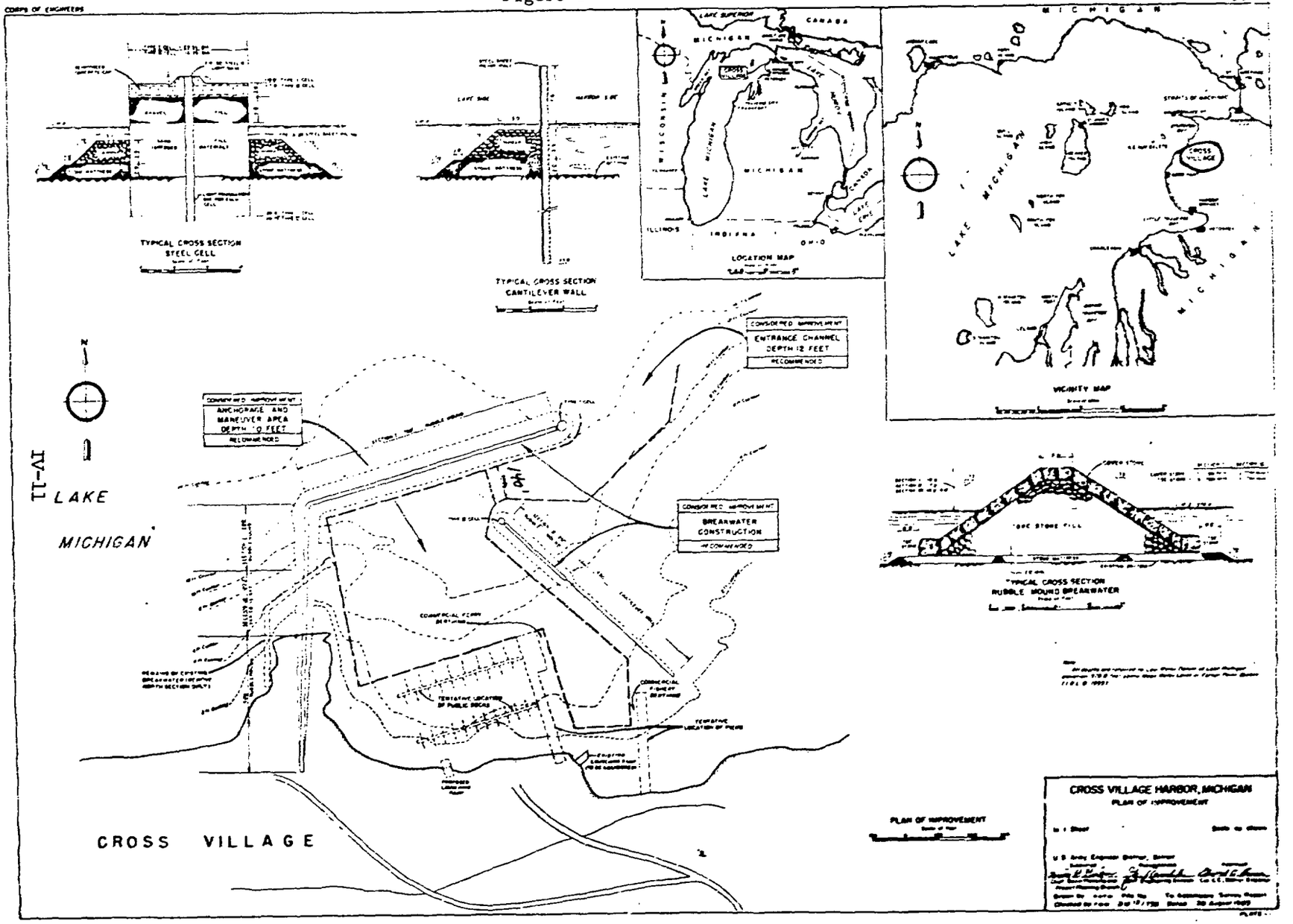
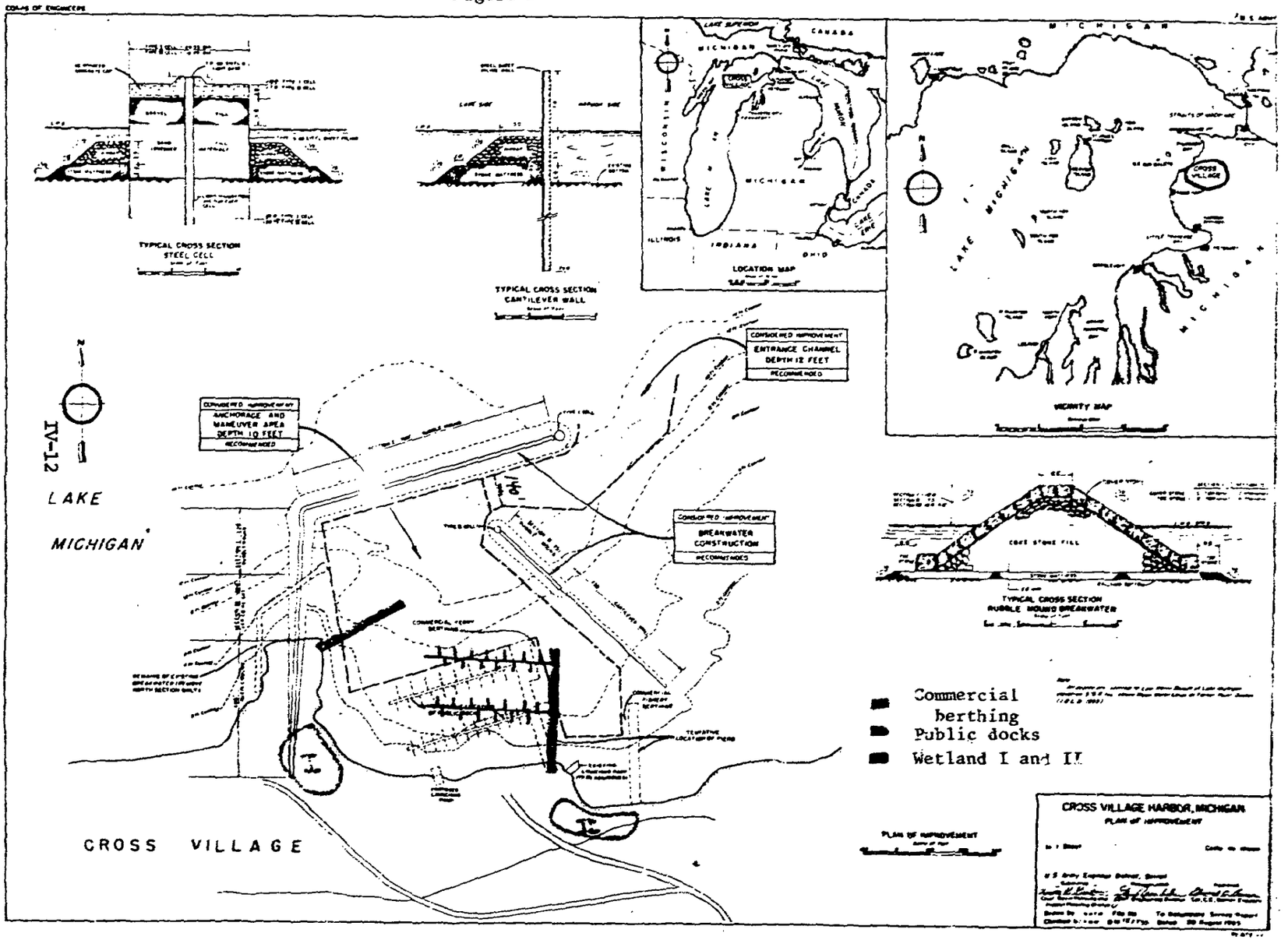

CORPS OF ENGINEERS
TYPICAL CROSS SECTION
STEEL CELL
TYPICAL CROSS SECTION
CANTILEVER WALL
LOCATION MAP
VICINITY MAP
ENTRANCE CHANNEL
DEPTH 12 FEET
RECOMMENDED
ANCHORAGE AND
MANEUVER AREA
DEPTH 10 FEET
RECOMMENDED
BREAKWATER
CONSTRUCTION
RECOMMENDED
TYPICAL CROSS SECTION
RUBBLE MOUND BREAKWATER
IV-11
LAKE
MICHIGAN
CROSS VILLAGE
PLAN OF IMPROVEMENT
CROSS VILLAGE HARBOR, MICHIGAN
PLAN OF IMPROVEMENT

Figure 2


TYPICAL CROSS SECTION
STEEL CELL
TYPICAL CROSS SECTION
CANTILEVER WALL
LOCATION MAP
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ENTRANCE CHANNEL
DEPTH 12 FEET
RECOMMENDED
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DEPTH 10 FEET
RECOMMENDED
BREAKWATER
CONSTRUCTION
RECOMMENDED
TV-12
LAKE
MICHIGAN
CROSS VILLAGE
TYPICAL CROSS SECTION
RUBBLE MOUND BREAKWATER
Commercial
berthing
Public docks
Wetland I and II
PLAN OF IMPROVEMENT
CROSS VILLAGE HARBOR, MICHIGAN
PLAN OF IMPROVEMENT

MICHIGAN DEPARTMENT OF STATE
RICHARD H. AUSTIN SECRETARY OF STATE

LANSING
MICHIGAN 48918

MICHIGAN HISTORY DIVISION
ADMINISTRATION, ARCHIVES
HISTORIC SITES, AND PUBLICATIONS
3423 N Logan Street
517-373-0510
STATE MUSEUM
505 N Washington Avenue
517-373-0515

February 22, 1979

Mr. Philip McCallister, Chief
Engineering Section
Detroit District, Corps of Engineers
Box 1027
Detroit, Michigan 48231

REF: ER-2556 (MHD)

Dear Mr. McCallister:

Our staff has reviewed the Reformulation Phase I General Design Memorandum for the Harbor of Refuge at Cross Village, Michigan and would like to offer these comments. We do believe that an archaeological survey of the Cross Village area will be necessary. Furthermore, we believe that there are numerous properties of architectural and historical significance which may be eligible for the National Register of Historic Places and that an intensive study of the historical and architectural resources should be conducted in the project area. Both studies should concern themselves not only with possible or probable direct impacts, but also with the potential impacts of a secondary nature which would be engendered by economic growth in the village, increased property values, etc.

Any questions on this project should be addressed to Dr. John R. Halsey, Environmental Review Coordinator for the Michigan History Division. Thank you for this opportunity to comment on this project.

Sincerely,

Martha M. Bigelow
Director, Michigan History Division
and
State Historic Preservation Officer

BY: Michael J. Washo
Deputy State Historic Preservation Officer

MJW/JRH/cw

MICHIGAN DEPARTMENT OF STATE
RICHARD H. AUSTIN SECRETARY OF STATE

LANSING
MICHIGAN 48918

MICHIGAN HISTORY DIVISION
ADMINISTRATION, ARCHIVES, HISTORIC SITES, AND PUBLICATIONS
3423 N. Logan Street
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STATE MUSEUM
505 N. Washington Avenue
517-373-0515

October 7, 1980

Mr. Philip McCallister, Chief
Engineering Section
Detroit District
U. S. Army Corps of Engineers
Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

Our staff has reviewed the "Cultural Reconnaissance Cross Village, Emmet County, Michigan" Report prepared by R. E. Flanders of the Department of Anthropology and Sociology, Grand Valley State College and would like to offer the following comments.

The report's information is insufficient and inadequate for the purpose of determining the direct and indirect effects of the project on cultural resources of Cross Village. As stated in our earlier letter of February 22, 1979, we believe the Village contains sites eligible for listing in the National Register. The Corps of Engineers should conduct an intensive, rather than a reconnaissance inventory of historic and architectural resources, by someone other than an archaeologist, in and adjacent to the project area to determine if any might be affected by the primary and secondary impacts of the proposed harbor refuge. (See federal regulation 36 CFR Part 66, Appendix B, I 1(4)c and I 4.).

If you have any questions, please call Mr. Donald E. Weston, Environmental Review Coordinator for the Michigan History Division.

Sincerely,

Martha M. Bigelow

Martha M. Bigelow
Director, Michigan History Division
and
State Historic Preservation Officer

MMB/DW:tj
Enc.

MH-69

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

IN REPLY REFER TO: AFES-SE

FEB 11 1980

Colonel Robert V. Vermillion
District Engineer
U. S. Army Engineer District
Detroit
P. O. Box 1027
Detroit, MI 48231

Dear Colonel Vermillion:

This is in response to your letter of January 31, 1980 (NCEED-ER) regarding the proposed boat harbor at Cross Village, Emmet County, Michigan.

The Bald Eagle (Haliaeetus leucocephalus) and the Longjaw Cisco (Coregonus alpenae) are the only two species that are presently listed for the project area. We have no record of any eagle nests in the area and there is no evidence that the Longjaw Cisco occurs in the project area. It is unlikely that either of these species will be adversely affected by this project.

This letter provides comment only on the endangered species aspect of the project. Comments on other aspects of the project under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et. seq.) may be sent under separate cover.

Sincerely yours,

Charles A. Hughlett

Charles A. Hughlett
Acting Regional Director

STATE OF MICHIGAN
WILLIAM G. MILLIKEN, Governor
DEPARTMENT OF NATURAL RESOURCES
STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909
HOWARD A. TANNER, Director

September 17, 1980

Mr. P. McCallister, Chief
Engineering Division
Department of the Army
Detroit District, Corps of Engineers
Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

I have reviewed the report of the distribution of Tanacetum huronense (Lake Huron tansy) in the vicinity of Cross Village prepared by your staff. The photographs show a pattern of local abundance which is not surprising since these beaches are near the center of the range of the species.

Enclosed is a map of Emmet County showing the places state-listed plants have been found in the past. The majority of the records are of plants which grow nowhere on earth except the northern shores of Lakes Michigan and Huron. Also enclosed is a leaflet which explains the importance of these species.

I think you will agree that it would be difficult to locate a harbor of refuge anywhere in northern Emmet County without encountering one or more threatened species. The need is not to avoid taking these plants at all costs but rather to conserve them within a framework of orderly development.

One of the most serious current adverse impacts to the Lake Huron tansy is the abuse of shoreline vegetation on the Sturgeon Bay dunes by off-road vehicles. I am concerned that a large parking facility at Cross Village might attract even more of these destructive vehicles to the area. A large parking facility would also require the taking of a considerable number of tansy plants at the harbor site. I ask, therefore, that you consider planning for slow, stepwise parking development rather than building a large lot in anticipation of future needs.

Enclosed is an application for a permit to take threatened plants. Please wait until final harbor designs are completed and approved

before submitting the application to this office. At that time you will know specific taking needs.

Thank you for conducting the field investigation. It provides important documentation for permit approval.

Sincerely,

WILDLIFE DIVISION

Sylvia M. Taylor, Coordinator
Endangered Species Program

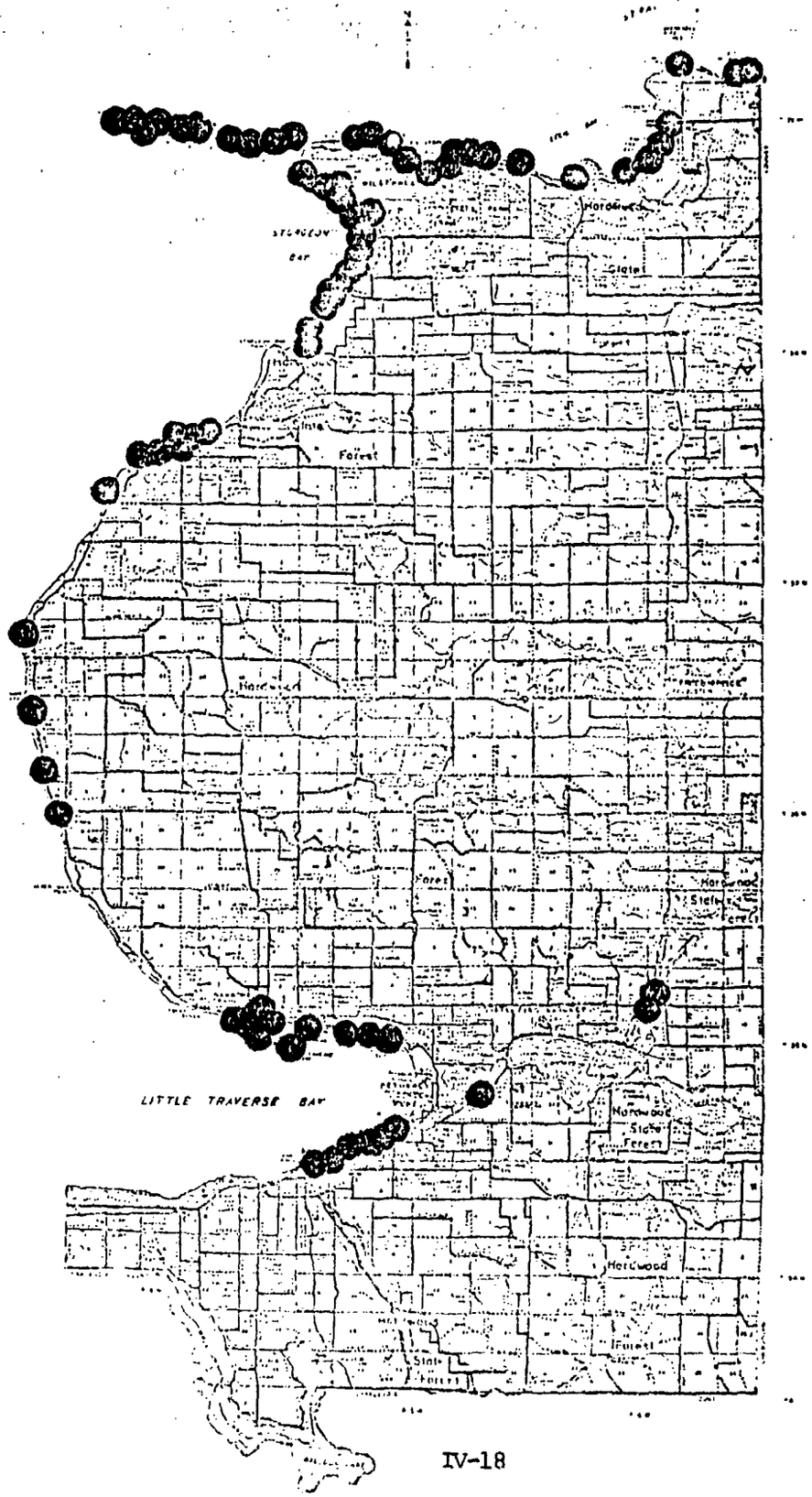
SMT:mh

cc Carolyn Bohan, USFWS, East Lansing
Ray Lawrence, Waterways Division, MDNR
L. N. Witte, Water Management Division, MDNR
Nels Johnson, Wildlife Division, MDNR
Virginia Pierce, Environmental Enforcement, MDNR
Edward Voss, Plant Technical Committee

Enclosures

EMMET COUNTY

Records of threatened and endangered plants (no endangered plants recorded from this county).



STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

P. O. Box 30028
Lansing, Michigan 48909
322-1311
Area Code 517

September 30, 1980

Serial No. 2799-80
File No. EMT CV

Mr. P. McCallister
Chief, Engineering Division
Department of the Army
Detroit District, Corps of Engineers
Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

Your letter to the Chief of the Waterways Division dated September 23, 1980, has been assigned to me for reply.

I believe that my letter to your assistant dated September 2, 1980, regarding the design of shoreside facilities at Cross Village addresses itself to the area in which the parking lot will be located.

With respect to drainage, every reasonable effort will be made to direct runoff from pavements away from the wetlands.

Sincerely yours,

Raymond G. Lawrence
Assistant Chief
Waterways Division

RGL:pas
cc: L. Witte

R1026-5 1/80

STATE OF MICHIGAN

WILLIAM G MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

Refer to:
9000.

STEVENS T MASON BUILDING
BOX 30028
LANSING MI 48909

September 22, 1980

Mr. P. McCallister
Chief, Engineering Division
Detroit District
Corps of Engineers
Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

I am writing you in response to your letter of August 15, 1980 to Mr. Scott, Chief of Fisheries Division, requesting information concerning the native American commercial fisheries in the vicinity of Cross Village. In answer to your questions, the following information is provided.

1. What is the present situation?

Answer: The United States of America, the Bay Mills Indian Community and the Sault Ste. Marie Indian Communities (maybe the Grand Traverse Indian Community also - their status in the suit is questionable) have sued the State of Michigan to obtain treaty fishing rights for descendents of Indians who ceded the Michigan territory in 7 Stat 491 (Map I.). Presently these Indians are fishing and the state has been precluded from regulating their fisheries by order of Federal District Judge Noel P. Fox. The case is on appeal in the U.S. Sixth Circuit Court of Appeals in Cincinnati. The appeal will most likely be continued to the U.S. Supreme Court, regardless of the decision of the appellate court.

2. Who is being affected by the court rulings?

Answer: Persons being affected by the decision are all the citizens of the United States.

3. What geographical area is encompassed by this controversy?

Answer: All the ceded portion of Michigan referred to in 7 U.S. Stat 491, minus a few small areas ceded prior to 1836. (See Map I.)

4. What species of fish are involved and what is their value and annual catch in tons?

Answer: The Indian fishery that developed in the 1836 treaty area (7 Stat 491) took in excess of the pounds of fish listed on Table I in 1979. The poundage figures given are for those fish sold in the wholesale fish trade within Michigan only (no record is available for the total Indian catch which would also include

MICHIGAN
THE GREAT LAKE STATE

fish sold locally to restaurants, sold in the retail trade, consumed for subsistance, etc., as well as those sold in the wholesale trade out of state). These figures are for fish caught throughout the Michigan waters of the Great Lakes within the 7 Stat 491 treaty area.

The pounds of fish caught by licensed Michigan commercial fishermen in the same area are listed in Table II. These figures represent the total catch as reported by the nontreaty fishers.

5. What is the projected future of the fishing industry in this area?

Answer: The cost of managing and maintaining stocks of fish in the Great Lakes appears to be rising at a faster rate than the value of the commercial product. Consequently, the future for the commercial fisheries does not look very bright unless we can turn the declines in stocks around. This will take the full cooperation of the fishers and a considerably larger amount of money than is presently available. As it is most uncertain at this time whether or not the state will be in a position to manage the fish stocks in the Great Lakes area ceded in 7 Stat 491, we cannot with any degree of accuracy predict what may be the future of the fish stocks and fisheries in the Cross Village area. However, we can say with certainty that the fish stocks in northern Lake Michigan are again showing severe stress and decline due to overharvest. Further, the populations of lake trout, which had been rebuilt through 10 years of stocking and on which we had high hopes for developing self-sustaining populations, have been nearly harvested out. The chances for rehabilitation of the trout populations are most slim if possible at all under present conditions.

I apologize for not being more specific on the future of commercial fishing in the Cross Village area. However, until we can determine whether or not the state will have the authority to manage its Great Lakes fishing opportunities in this area, a projection of what may happen in the future is not possible with any degree of confidence.

If I can provide you any further information, please do not hesitate to contact me.

Sincerely,

Asa T. Wright
Great Lakes Program Manager
FISHERIES DIVISION

ATW:bm

Enclosures

United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

East Lansing Area Office
Manly Miles Building, Room 202
1405 South Harrison Road
East Lansing, Michigan 48823

December 22, 1980

Colonel Robert V. Vermillion
U.S. Army Engineer
Detroit District
P.O. Box 1027
Detroit, Michigan 48231

Dear Colonel Vermillion:

This is our draft fish and wildlife coordination report concerning the proposed harbor of refuge at Cross Village, Emmet County, Michigan. It is provided for inclusion in your draft report.

These comments have been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq) and in compliance with the intent of the National Environmental Policy Act of 1969. This report complies with the obligations of the U.S. Fish and Wildlife Service to the Detroit District Corps of Engineers under Support Agreement No. NCE - IS-81-003-EH, effective October 1, 1980.

Two alternate sites being considered for the harbor of refuge are Sturgeon Bay and Good Hart. The proposed harbor is to include rubble-mound breakwaters, a 140-foot wide and 12-foot deep entrance channel, and a 2-acre anchorage and maneuvering area both ten feet deep. This same facility is also planned for the Cross Village site.

The Sturgeon Bay site is under consideration for designation by the Michigan Department of Natural Resources (MDNR) as a series II dune area (Figure 1). It is also located south of Wilderness State Park and is proposed to become part of the park system (figure 2). Michigan State University has classified the Sturgeon Bay area as a Big Sable Dunes Shoretype and made a general botanical and soil profile of the shore (figure 3). Our field investigations have provided a more site-specific identification of wet and dry beach vegetation. The following species are present:

Beach grass, Ammophila breviligulata
Wormwood, Artemisia sp.
Paper birch, Betula-papyrifera
Sand reed, Calamovilfa-gigantia
Pitcher's thistle, Cirsium Pitcheri
Canada wild rye, Elymus canadensis

A series of wetlands, located east of the pine upland area, are not connected to the lake system, but are promulgated by ground water. Resident aquatic plant species include cattails, rushes, and sedges. The Lake Huron tansy is characteristically found more abundant in the wet seeps than in the more open dry sands at this site.

The primary negative environmental impact on the dune areas is caused by human use of off-road recreational vehicles. Loss of vegetation allows the sand to be eroded by winds, thus destroying the dunes (Clark, 1977).

The development of a harbor of refuge at the Sturgeon Bay site seems inconsistent with MDNR planning activities. Construction activities and uncontrolled access to the dunes could result in the destruction of habitat. We suggest that the Cross Village site be investigated thoroughly before Sturgeon Bay receives further consideration.

The Good Hart site has been impacted to a greater extent than the Sturgeon Bay site by housing development. The beach area is confined to a width of approximately 300-feet. Plant species present in the project area include:

Balsam fir, Abies balsamea
Bearberry, Arctostaphylos uva-ursi
Paper birch, Betula papyrifera
Red Osier dogwood, Cornus stolonifera
Juniper, Juniperius communis
White pine, Pinus strobus
Lake Huron tansy, Tanacetum huronense
White cedar, Thuja occidentalis

The topographic relief east of the beach area would present a difficulty for use as parking facilities. The area would need to be purchased from private landowners and leveled to provide access. Presently, the Cross Village site contains parking areas which can be enlarged for necessary capacity. We recommend that this site be considered if the Cross Village site is not used.

Since providing our September 26, 1979 letter report, we have coordinated with biologists from your Environmental Division concerning parking facilities at the Cross Village site. We have refined the preliminary wetland boundaries as stated in our letter, and agree with the proposed parking facility plans as stated in a copy of your September 24, 1980 letter to the MDNR's Waterways Division.

We wish to make another comment with regard to the Cross Village site which concerns the change in plans for dredge spoils in the harbor. Instead of open-water disposal, the spoils will be utilized for beach nourishment on the north end of the project. We have no objection to this decision, provided the spoils are placed on the existing beach and spread out into

open water. We oppose open-water deposition of spoils at a designated lake contour where wave action carries sand to the beach area.

We appreciate the opportunity to review this phase of the proposed project. We look forward to continued coordination on the draft report which is scheduled for our review by May 1981.

Sincerely yours,

Area Manager

Attachment

cc: Director, MDNR, Lansing, MI

References

Clark, John R., Coastal Ecosystem Management, John Wiley and Sons, New York, 1977

Michigan Department of Natural Resources, "Wildnerness State Park Master Plan", Parks Division

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909
HOWARD A. TANNER, Director

February 9, 1981

Mr. Philip A. McCallister, Chief
Engineering Division
U. S. Corps of Engineers
P. O. Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

We have reviewed your proposal to change disposal sites for unpolluted spoils at Cross Village Harbor in Michigan.

The Department of Natural Resources has always supported and encouraged the use of clean dredge spoils for beach nourishment. We therefore have no objections to the use of clean dredged material for beach disposal at Cross Village Harbor.

It is our understanding that disposal would occur between the normal high water mark and the eight (8) foot contour, and would therefore not cover or destroy any of the threatened plant species growing in the area.

Sincerely,

L. N. Witte, P.E., Chief
Water Management Division

LNW/ELW:cjs

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909
HOWARD A. TANNER, Director

February 19, 1981

Mr. P. McCallister, Chief
Engineering Division
Corps of Engineers
Detroit District
P. O. Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

Reference is made to a meeting held in Lansing on February 12, 1981 involving members of your planning staff and various representatives of the department pertinent to a proposed small craft harbor at Cross Village, Michigan.

At this meeting, the relevance of the Sand Dune Protection and Management Act (SDPMA) (Act No. 222 of the Public Acts of 1976) to portions of the proposed project was discussed. It is the purpose of this letter to inform you that the provisions of the SDPMA may affect those on-land support facilities contemplated for this project inasmuch as the project is located within a designated (pending formal designation as of this date) sand dune area. Those legal procedures accomplishing the designation process shall be completed on, or about, March 17, 1981.

The SDPMA does provide the department with the authority to regulate specific types of land use activities--sand dune mining--within designated sand dune areas. Sand dune mining is defined as:

> "The removal of sand from sand dune areas for commercial, or industrial purposes, or both."

In addition, the following language is also included in the statute:

> "The state or an instrumentality of the state shall not engage in the extraction of sand or other minerals from a sand dune area, except as required in the interest of public health and safety in an emergency situation resulting from a natural disaster. . . ." (emphasis supplied).

The department has consistently maintained the position that the intent of this act, where applicable, is that of protecting the integrity (structure and function) of sand dune formations from despoilation and conflicting land management practices.

R1026 1/80

There are numerous instances where public agencies (state, county, or local) plan to undertake development projects within portions of a designated sand dune area. Prior to the initiation of the development phase of the project the porposed plan is reviewed to determine its compatability with the physical characteristics of the environment on a site-specific basis. Each project is evaluated individually to determine compatability and consistency with the provisions of the SDPMA.

As of this date, we have not been provided with a plan of the proposed on-shore facilities relative to the Cross Village project. Therefore, it is virtually impossible to forecast or predict any potential problems which may be associated with this effort. We wish to inform you that a critique shall be formulated upon receipt of the proposed plan and relevant construction techniques.

Sincerely,

Jon W. Roethele

Jon W. Roethele, Environmental Specialist
Reclamation and Mining Control
Geological Survey Division

JWR:ljc

cc: Ms. Ellen Watson, Water Management Division
Dr. S. Taylor, Wildlife Division
Mr. R. Lawrence, Waterways Division
Mrs. V. Pierce, Environmental Enforcement Division

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

February 26, 1981

TO: Raymond Lawrence, Assistant Chief, Waterways Division

FROM: Sylvia Taylor, Endangered Species Coordinator, Wildlife Division

SUBJECT: Threatened Plant Collector's Permit

In response to your application, we have prepared a permit to take Agropyron dasystachyum, Cirsium pitcheri, and Tanacetum huronense for construction of a harbor of refuge at Section 33, Cross Village Township, Emmet County. These state-listed threatened plants are locally abundant along the Lake Michigan coast in the vicinity of Cross Village. There will be no immediate effect on the status of the species as a result of the project.

Secondary impacts to the species will occur if the presence of the new facility promotes intensive development of private lake frontage near the harbor. I suggest, therefore, that the Waterways Commission seek to acquire additional land adjacent to the facility to serve the dual use of adequate open space for the public and as a local refuge for the coastal plant community. This community, containing some threatened species, is found nowhere else on earth except along the northern Great Lakes shores. Land acquisition would satisfy a procedure that has been followed for Great Lakes shoreline projects wherein refuge space is provided within each site plan for threatened species if individuals of the species must be removed for the project.

The only on-site accommodation for threatened species possible under the present harbor design is preservation of a small colony of Tanacetum huronense near the boat ramp (see map attached to unsigned permit). It is a condition of your permit that this colony remain unmolested.

The private Lake Michigan frontage in the vicinity of the project is zoned R-1, Recreational Residential District. This designation has the following intent:

> The Recreation Residential District is designed to accommodate cottage and seasonal home developments. It is intended that the seasonal home areas be reasonably homogeneous by discouraging the mixing of recreation home areas with commercial resorts, business services and major institutional or community services.

If the R-1 designation remains in force, property owners will likely find that they practice reasonable species conservation within the scope of allowable site development. Under these conditions, the local status of species will not suffer important change even if no additional public land is acquired adjacent to the harbor.

It is, however, regretable that we depend on the conservation efforts of neighboring private citizens to justify our own inability to conserve a resource. I hope the DNR will be able to enlarge the present land base for this project.

The permit will be signed in 30 days unless serious objection is raised during the public review period. It is eligible for annual renewal if project delays are encountered.

SMT:mh

cc Cross Village Township Planning Commission
Plant Technical Committee Members
Mr. P. McCallister, Corps of Engineers
Ms. Ellen Watson, Water Management Division

State of Michigan
Department of Natural Resources
Box 30028
Lansing, Michigan 48909

THREATENED PLANT COLLECTOR'S PERMIT

Permit Number: 1981-11 Date: 02/26/81

Under the provisions of Section 6, Subsections 5, 6, and 7, Act 203, P.A. 197[illegible], and the rules and regulations established thereunder, and authorized by Natural Resources Commission action, permission is hereby granted to:

Raymond G. Lawrence, Assistant Chief
Dept. of Natural Resources, Waterways Division
General Offices Building, Secondary Complex
P. O. Box 30028
Lansing, Michigan 48909

To take, possess, or transplant for scientific purposes, the following threatened plant species subject to the limitations on the back and the special conditions listed below:

Agropyron dasystachyum, Cirsium pitcheri, and Tanacetum huronense

Collecting shall take place on the following lands:

Emmet County, Cross Village Township, Section 33, Cross Village Harbor of Refuge (9.6 acres, more or less).

This document paid for with State funds.

Special conditions:

A small colony of Tanacetum huronense, located as marked on the attached map, will remain unmolested by project construction activities.

Unless revoked sooner, this permit expires on December 31, 1981.

The Director of Natural Resources

By: _____

Sylvia M. Taylor
Endangered Species Coordinator
Wildlife Division

SEE REVERSE SIDE FOR LIMITATIONS

R 2013-3
9/79

Endangered plants may not be taken under this permit.

None of the specimens collected shall become part of a private collection.

This permit is not valid for collecting on state game areas, state parks, or recreation areas unless specifically authorized herein.

This permit is not valid for collecting on state and national forests without an additional special use permit obtained from the local forestry office.

Collecting shall not take place on any private lands without written permission or bill of sale from the owner or lessee of such lands.

Written permission must be received from local units of government before collecting on lands administered by them.

All specimens shall be deposited in the collection of a public educational or research institution prior to expiration of this permit unless provided otherwise.

The holder is required to carry his identification card with him at all times when collecting specimens as provided for under this permit.

Not later than 30 days after expiration of this permit, the holder is required to file with the Wildlife Division, Department of Natural Resources, Box 30028, Lansing, Michigan 48909, a detailed report that includes specimens collected, number and disposition.

THE ACTIVITIES COVERED UNDER THIS PERMIT ARE NOT TRANSFERABLE TO ANOTHER PERSON UNLESS SPECIFICALLY AUTHORIZED HEREIN.

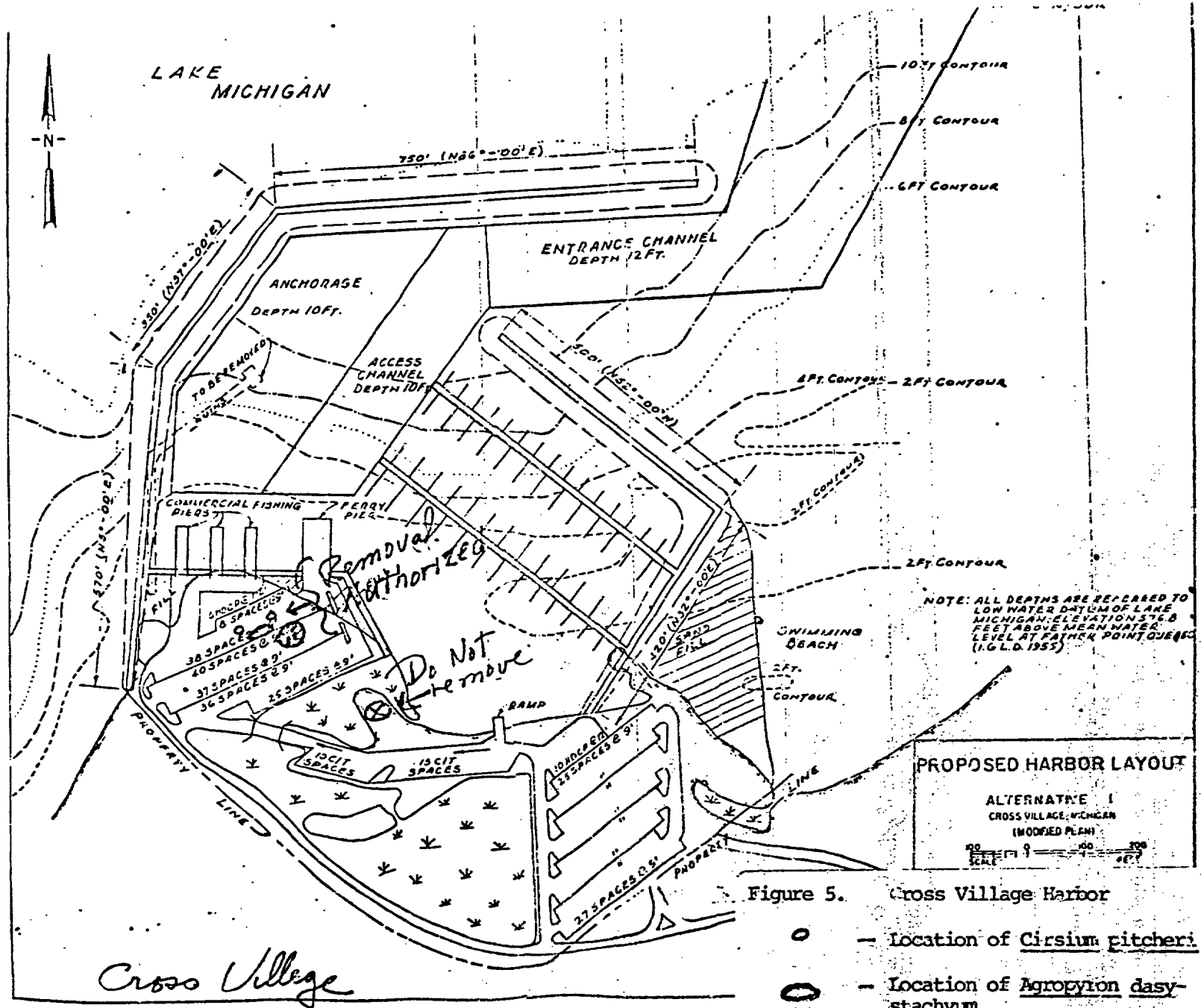


Figure 5. Cross Village Harbor

- — Location of Cirsium pitcheri
- — Location of Agropyron dasystachyum
- Tanacetum huronense

This document paid for with State funds

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909
HOWARD A. TANNER, Director

March 11, 1981

Mr. P. McCallister, Chief
Engineering Division
Corps of Engineers
Detroit District
P. O. Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

Please make reference to my letter of February 19, 1981 pertaining to a proposed small craft harbor at Cross Village, Michigan.

The Waterway Division of the Department of Natural Resources has provided us with relevant information concerning proposed on-shore facilities for this project. We have reviewed this information toward the determination as to whether or not potential problems exist with this development and the provisions of Michigan's Sand Dune Protection and Management Act (SDPMA). Similarly, a field evaluation has been conducted by a representative of the Geological Survey Division on this particular site.

We do not find any conflicts with this project and the provisions of the SDPMA as far as its proposed scope is presently envisioned. However, if the project should be expanded to include additional acreage in a landward direction, impacts to geomorphic features, including the barrier dune formation, are envisioned.

If additional information is needed please advise.

Sincerely,

Jon W. Roethele, Environmental Specialist
Reclamation and Mining Control
Geological Survey Division

JWR:ljc

cc: Ms. Watson
Dr. Taylor
R. Lawrence
V. Pierce

February 17, 1981

Serial No. 273-81
File No. EMT-CV

Mr. P. McCallister, Chief
Engineering Division
Corps of Engineers
Detroit District
P.O. Box 1027
Detroit, MI 48231

Dear Mr. McCallister:

Reference is made to the proposed plan for developing a small craft harbor at Cross Village, and more particularly, to a meeting between representatives of various divisions of the Michigan Department of Natural Resources and members of your planning staff which was held in Lansing on February 12, 1981.

At that meeting, Mr. Lou Marchinda, project engineer, brought up four items of concern to the Detroit District. They are as follows:

1. Attitude of the Waterways Division to the proposed breakwater design which would permit development of a maximum 1 1/2 foot wave within the basin.

2. Method of handling the wastewater from the proposed toilet-shower building and sewage pump-out facility.

3. Impact of the proposed development on any threatened plant species.

4. Impact of recently passed legislation regarding sand dune mining on the proposed plan.

The Waterways Division is prepared to accept a maximum 1 1/2 foot high wave within the basin. The decision is based primarily upon economics and the feeling that such waves will only very occasionally occur during the navigation season.

When the time comes for developing the mooring and launching facilities, this agency will construct wastewater facilities in full compliance with the then applicable rules of the Michigan Department of Health.

Regarding items 3 and 4 above, I expect you will hear directly from Dr. Taylor of Wildlife Division and Mr. Roethele of Geological Survey Division. If I can be of any further assistance, please contact me.

Sincerely,

Raymond G. Lawrence
Assistant Chief
Waterways Division

RGL:db
cc: Ms. Watson
Dr. Taylor
Mr. Roethele

MICHIGAN DEPARTMENT OF STATE

RICHARD H. AUSTIN SECRETARY OF STATE

LANSING
MICHIGAN 48918

MICHIGAN HISTORY DIVISION

ADMINISTRATION, PUBLICATIONS, RESEARCH, AND HISTORIC SITES
208 N. Capitol Avenue

STATE ARCHIVES
3405 N. Logan Street

STATE MUSEUM
208 N. Capitol Avenue

March 18, 1981

Mr. P. McCallister, Chief
Engineering Division
Department of the Army
Detroit District, Corps of Engineers
Box 1027
Detroit, MI. 48231

Re: ER-2556

Dear Mr. McCallister:

Mr. Don Williams of your staff has asked for a detailed critique of "Cultural Reconnaissance, Cross Village, Emmet County, Michigan" by Richard E. Flanders. It is our opinion that this report does not fulfill the contractual obligations set forth in the scope of work under which the work was done. None of the objectives of the study set forth in the scope of work were met with the possible exception of the fieldwork done to locate cultural resources which may have been located in the area of direct construction for the small boat harbor. No cultural resources were identified which could be indirectly affected by the growth and development induced by the construction, operation or maintenance of the project. Given the above, no alternatives or measures were identified which would avoid direct damage to cultural resources in the project area or indirect damage to resources in Cross Village.

In regard to the detailed statement of work, while Dr. Flanders has assembled an impressive list of references relating to the history of the Cross Village area, what use he may have made of them is not apparent and not a single one is referenced in the text. There are at least two more references which should be added to this list:

Wright, J. C.
1895 The Ottowan: A Short History of the Village and Resorts Surrounding Little Traverse Bay, and the Indian Legends Connected Therewith. Robert Smith & Co., Publishers and Printers, Lansing.

Bedford-Jones, H.
1917 L'Arbre Croche Mission. Privately published, Santa Barbara, California.

Surely there were some sites and structures described in these references which deserved searching out and examination. At no time did Dr. Flanders consult with the Michigan History Division concerning the full range of cultural resources which might be encountered in the Cross Village area, possible sources of information or the utility of references he had discovered or was considering using. The prehistory of the area is not mentioned at all and the history of

the area is inadequately developed to allow for the evaluation of what kinds of resources might be or should have been present.

There is no evidence that site examination took place anywhere but at the site of proposed direct impact although work elsewhere within the village limits was called for in the scope of work nor were any of the alternative plans considered by the Corps of Engineers and referenced in the scope discussed. While we do not believe that the potential for underwater cultural resources in the project area is high, the possibility should have at least been considered.

The result is that the final report is so brief and sketchy that it does not begin to approach the specifications set forth in Section 4(c)(1-3) of the scope of work, of 36 CFR 66 or the specifications publicized by the Michigan History Division for contract survey reports (copy of this enclosed).

We believe that the scope of work could have been strengthened by inserting the word "architectural" after "historical" in Section 1 and by inserting another paragraph between the existing 4(a) and 4(b) which would read

> "conduct a survey to inventory those districts sites, buildings, objects and structures existing and identified through literature search or observation as possessing interest or importance in architecture, history or prehistory within the study area including the village of Cross Village. Record on field forms, map and photograph every building or structure within the survey boundaries including the village of Cross Village. Complete survey field forms according to instructions in the Michigan History Division publication Surveying Michigan's Historic and Architectural Resources: A How-To-Do Guide.

In sum, we have no doubt in our minds that the existing survey report is inadequate in addressing the existence of and documenting the cultural resources present in the Cross Village area. We also believe that it will be extremely difficult to "salvage" this report without the input of an historian and architectural historian. Dr. Flanders, in our opinion, does not have this expertise. It maybe necessary to recontract the entire project.

Any questions you may have should be addressed to Ms. Kathryn B. Eckert, Deputy State Historic Preservation Officer or Dr. John R. Halsey, State Archaeologist at (517) 373-0510.

Sincerely

Martha M. Bigelow

Martha M. Bigelow
Director, Michigan History Division
and
State Historic Preservation Officer

MMB/JRH/sl

enc.

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

REPLY TO ATTENTION OF:

25 MAR 1981

Mr. P. McCallister
Chief, Engineering Division
U.S. Army Engineer District, Detroit
P.O. Box 1027
Detroit, Michigan 48231

RE: Cross Village Harbor

Dear Mr. McCallister:

I was asked by your office to review and comment on dredged material disposal plans at the proposed Cross Village Harbor, Emmett County, Michigan.

Based on my review of the November 9, 1979 physical and chemical analyses of the sediments from the area, I concur with your assessment that the dredged material is predominantly medium to fine - grained, uncontaminated sand and is suitable for either placement along the shoreline or open-water disposal.

Sincerely yours,

James Hooper

James Hooper
Biologist
Environmental Impact Review Staff
Office of Environmental Review

United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

East Lansing Area Office
Manly Miles Building, Room 202
1405 South Harrison Road
East Lansing, Michigan 48823

June 10, 1981

Colonel Robert V. Vermillion
U. S. Army Engineer
Detroit District
P.O. Box 1027
Detroit, Michigan 48231

Dear Colonel Vermillion:

This is our final fish and wildlife coordination report concerning the proposed harbor of refuge at Cross Village, Emmet County, Michigan. It is provided for inclusion in the final Phase I General Design Memorandum and Environmental Impact Statement.

These comments have been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et. seq) and in compliance with the intent of the National Environmental Policy Act of 1969. This report complies with the obligations of the U.S. Fish and Wildlife Service to the Detroit District Corps of Engineers under Support Agreement No. NCE-IS-81-003-MI, effective October 1, 1980.

We have received supplemental site information from your agency concerning the construction of an offshore underwater reef and disposal of dredged material at the Cross Village location. These plans are consistent with previous preliminary coordination efforts between our agencies and have adequately addressed our concerns.

This report concludes our scheduled fish and wildlife input on the proposed harbor of refuge at Cross Village for fiscal year 1981. We appreciate the opportunity to review this phase of the project.

Should you have questions or need additional information, please contact our East Lansing Ecological Services Field Office.

Sincerely yours,

John Popovich
Area Manager

cc: Director, Michigan DNR, Lansing, MI

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909
HOWARD A. TANNER, Director

June 12, 1981

Mr. Philip A. McCallister, Chief
Engineering Division
U. S. Corps of Engineers
P. O. Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

In response to your May 11, 1981 letter regarding reef construction from the old breakwater at Cross Village Harbor, we endorse the reef concept and believe that the rubble from the old breakwater would be very suitable. We would, however, suggest as an alternative to one large pile of rocks that a basic design pattern of the Muskegon reef be followed.

In this design, the reef was made up of small piles of rocks deposited in three rows, each with a more or less serpentine pattern (see enclosed diagram). This design will provide more cover and a greater variety of fish habitat than does one large pile.

It is our assumption that the Corps would provide buoy markers so fishermen can locate the reef. We also hope that the Corps will provide for replacement buoys and reef maintenance as necessary.

Thank you for the opportunity to comment on this proposal.

Sincerely,

L. N. Witte

L. N. Witte, P.E., Chief
Water Management Division

LNW/ELW:cjs

Enclosure

R1026 1/80

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

REPLY TO ATTENTION OF:

5 JUN 1981

Colonel Robert V. Vermillion
District Engineer
U.S. Army Engineer District, Detroit
P.O. Box 1027
Detroit, Michigan 48231

RE: 81-COE-MI-045
D-COE-F32066-MI

Dear Colonel Vermillion:

We have completed our review of the draft Environmental Impact Statement (EIS) for the proposed light-draft recreational boat harbor at Cross Village in Emmet County, Michigan. We understand that, as proposed, the project consists of new breakwaters, an entrance channel, an inner channel and anchorage area, removal of old harbor structures, construction of underwater fish habitat, beach extension, and shoreline disposal of clean, sandy dredged material.

According to the EIS, the preferred alternative is designated Plan 1 - Alternative 1, as shown on page EIS-4 of the draft impact statement. The EIS concludes that only minor, temporary impacts to air and water quality will be experienced during construction and operation of the facility. Noise levels will increase over ambient conditions due to the increase in activity at the harbor, but the levels are not unacceptable. Assuming that sediment quality does not degrade over time, dredging and disposal of harbor sediments would also result in only minor, short-term environmental impacts. Overall, this alternative is not predicted to adversely impact air, noise, or water quality.

We note that there are 3 unresolved issues on this project. These are: the location of the fish reef, the ultimate method of sewage disposal from harbor facilities, and mitigation for the destruction of 3 State of Michigan threatened plant species - the Lake Huron tansy (Tanacetum huronense), Pitcher's thistle (Cirsium pitcheri), and thickspike wheatgrass (Agropyron dasystachyum). These issues do not involve significant controversy and their resolution is expected to come rapidly. However, in the event that problems arise, please feel free to call upon this Agency if we may be of any assistance in helping to resolve them.

Since the proposed project is not predicted to adversely affect the environment, we are classifying the project LO-2. This means we lack objections (LO) to the environmental impact of the project, and additional information (2) is needed to adequately assess the impact. The additional information needed is the resolution of the issues listed above. In accordance with our responsibility under Section 309 of the Clean Air Act to inform the public of our views on the environmental impact of Federal projects, this letter is written for public review and the classification will be published in the Federal Register.

Please call Mr. James Hooper of my staff at 312/886-6694 if we may be of any further assistance on this project.

Sincerely yours,

Barbara Taylor Backley

Barbara Taylor Backley, Chief
Environmental Impact Review Staff
Office of Environmental Review

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
Atlanta, Georgia 30333
(404) 262-6649

May 15, 1981

Mr. P. McCallister
Chief, Engineering Division
U.S. Army Engineer District, Detroit
ATTN: NCEED-ER
P.O. Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

We have reviewed the Draft Environmental Impact Statement for a Harbor for Light-Draft Vessels at Cross Village, Emmet County, Michigan. We are responding on behalf of the U.S. Public Health Service and are offering the following comments for your consideration in preparing the final document.

While we have no major objections to the proposed project, we have some concerns about the potential health effects upon local well water users from any additional onsite sewage disposal facilities (i.e., both project and/or secondary development). Additional information is required in the EIS to indicate whether a potential health problem could occur.

According to the EIS, well water is the only source of drinking water used by Cross Village residents and businesses. Please provide additional information on the depth of these wells, their quality and the suitability of the local hydrogeologic conditions to prevent contamination of ground waters from individual onsite sewage disposal systems or from other possible sources of contamination as a result of the proposed harbor. If local soils are not suitable for the construction of alternative "(3) Septic Field Adjacent to Harbor," we recommend that interior harbor facilities (i.e., fishing and ferry piers, parking spaces, marina boat slips, restrooms and other recreational facilities) not be constructed until a satisfactory municipal sewage treatment facility is available. Furthermore, if secondary development (i.e., increased residences, businesses, etc.) occurs in Cross Village as a result of this project and the construction of the associated onsite disposal facilities is expected to adversely affect ground water resources, interior harbor facilities should not be constructed until a municipal sewage treatment facility is made available. Construction of interior harbor facilities could be concurrent with the construction of a municipal treatment facility provided the harbor facilities are not utilized until the municipal sewage treatment facility is available.

The use of "alternative (4) Holding Tank and Haul System" is only practical if the distance to the "treatment plant" is reasonable and if secondary development doesn't cause any adverse impacts upon potable ground waters from the construction of additional onsite sewage disposal systems.

The EIS should describe the potential long term impacts of the harbor upon the proposed beach and local water quality. Will another beach be permitted to form on the west side of the harbor or will any accreted material be used to replenish the proposed beach on the east side of the harbor? Since shoreline erosion is expected to occur east of the harbor area as a result of the proposed project, has the long-term costs of the beach nourishment plan been considered in the project's cost-benefit analysis?

It appears that facilities for a commercial fishing fleet will be provided in the proposed harbor. What measures will be taken to prevent fish cleaning and disposal of waste fish parts from both commercial and recreational fishermen inside the harbor?

We appreciate the opportunity to review this Draft EIS. Please send us one copy of the final document when it becomes available. Should you have any questions regarding the comments above, please contact Robert Kay of my staff at FTS 236-6649.

Sincerely yours,

Frank S. Lisella

Frank S. Lisella, Ph.D.
Chief, Environmental Affairs Group
Environmental Health Services Division
Center for Environmental Health

United States Department of the Interior

OFFICE OF THE SECRETARY
NORTH CENTRAL REGION
175 WEST JACKSON BOULEVARD
CHICAGO, ILLINOIS 60604

ER 81/670

June 1, 1981

Colonel Robert V. Vermillion
District Engineer
Detroit District, Corps of Engineers
Box 1027
Detroit, Michigan 48231

Dear Colonel Vermillion:

The Department of Interior has reviewed the draft environmental statement and general design memorandum - Phase 1 - for a harbor for light-draft vessels at Cross Village, Emmet County, Michigan. Our consolidated review comments follow:

The project would have negligible impact on mineral resources. The disposition of dredged material is adequately stated.

The environmental statement should assess the direct impacts on the aquifer from withdrawal of groundwater for project-related uses and the indirect or secondary impacts on groundwater resources from increased visitation.

The draft material adequately addresses impacts on fish and wildlife resources.

The recommended plan (Figure 13 of the Main Report) includes a sand fill swimming beach as part of the project at Cross Village. As "The local residents have indicated that they would like a swimming beach maintained on township property at Cross Village" (last paragraph of page 39), we urge that the swimming beach be included in the final project plan.

It is stated on page 25 of the draft environmental statement that, ". . . the Cross Village area is rich in pre-historical and historical resources". The preliminary cultural reconnaissance should be discussed in the final environmental statement, which should also contain evidence of consultation with the State Historic Preservation Officer.

Sincerely yours,

Sheila D. Minor
Regional Environmental Officer

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ENVIRONMENTAL RESEARCH LABORATORIES
Great Lakes Environmental Research Laboratory
2300 Washtenaw Avenue
Ann Arbor, MI 48104

May 14, 1981

TO: PP/EC - Joyce Wood

FROM: RF/RF24 - Eugene J. Aubert

SUBJECT: DEIS 8104.13 - A Harbor for Light Draft Vessels in the Vicinity of Cross Village, Michigan

The subject DEIS prepared by the Corps of Engineers, Detroit District on proposed harbor at Cross Village, Lake Michigan has been reviewed and comments herewith submitted.

The overall long-term effects of the proposed harbor at Cross Village on Lake Michigan environment will remain minor. Locally the most pronounced effects appear to be the modification of the littoral drift currents and the associated changes in shoreline configuration. Some sediment deposition can be expected in front of the west breakwater. Protruding harbor structures will force larger amounts of littoral drift into deeper lake. On the east side of harbor, waves from northwest will produce a pronounced erosion. At the same time some accumulation of sand can be expected at the foot of east breakwater. This sand accumulation gradually will eliminate or isolate the nearby wetland area.

Of the three sites investigated for the proposed harbor, the site at Good Hart shows the best benefit - cost ratio. While at this site benefits are only slightly higher over that for the selected site at Cross Village, the costs are much lower. Main reason for the difference in costs is the location of breakwaters. At the Cross Village site the breakwater facing lake is in twelve foot deep water (below Low Water Datum) and such breakwater at Good Hart site is in four foot water (pages A-93 and A-98). Construction of breakwaters at Cross Village site will cost twice as much as at the alternate site. It is suggested to investigate the placement of Cross Village harbor structures nearer to shore. This would reduce construction costs and also the adverse effects on shoreline.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
NORTHEASTERN AREA STATE AND PRIVATE FORESTRY
370 REED ROAD — BROOMALL, PA. 19008

1950
May 28, 1981

Mr. P. McCallister
Chief, Engineering Division
U. S. Army Engineer District, Detroit
ATTN: NCEED-ER
P. O. Box 1027
Detroit, MI 48231

Dear Mr. McCallister:

The following comments are submitted on the Draft Environmental Impact Statement for A Harbor for Light Draft Vessels in the Vicinity of Cross Village, Michigan.

On page 16, in the fourth paragraph, the last sentence should be rewritten to read, "No animals either on the Federal or State of Michigan list of threatened or endangered species are known to be in the study area."

On page EIS-13, section 3.18, the first sentence needs to be rewritten to include the statement, "which are on the State of Michigar's Threatened Species List," and remove it from the second sentence.

We appreciate the opportunity to review this document and hope our comments will be helpful in the preparation of the Final Environmental Impact Statement.

Sincerely,

A. J. Schacht

ALLEN J. SCHACHT
Area Director

Advisory Council On Historic Preservation

1522 K Street, NW
Washington, DC 20005

May 5, 1981

Mr. P. McCallister
Chief, Engineering Division
U.S. Army Corps of Engineers
Detroit District
Attn: NCEED-ER
P. O. Box 1027
Detroit, MI 48231

Dear Mr. McCallister:

We have reviewed the General Design Memorandum and draft environmental impact statement (DEIS) for the proposed new light vessel harbor at Cross Village, Emmett County, Michigan, under Section 102(2)(C) of the National Environmental Policy Act. It appears that survey investigations to identify historic and cultural properties which might be affected by the development are still underway, and results are not yet available for our review (e.g., pp. EIS-35, 36; also SHPO letters of October 7, 1980, and March 18, 1981). As you know, your compliance with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f, as amended, 90 Stat. 1320) and the Council's regulations for "Protection of Historic and Cultural Properties" (36 CFR Part 800) is independent of NEPA requirements, but should be coordinated with NEPA to the maximum extent possible.

Please let us know the status of identification and evaluation efforts planned or underway in the Cross Village area. You should continue to consult with the Michigan State Historic Preservation Officer in this regard, and in determining the potential effect (both direct and indirect) of the proposed harbor on any identified properties which may be eligible for inclusion in the National Register. For any significant properties that would be affected, you should carry out the remaining steps in 36 CFR Section 800.4 prior to the issuance of the final environmental impact statement.

Thank you very much. If you have any questions or would like assistance, please contact Ronald Anzalone of our staff at FTS-254-3495.

Sincerely,

Jordan E. Tannenbaum

Jordan E. Tannenbaum
Chief, Eastern Division
of Project Review

MICHIGAN DEPARTMENT OF STATE

RICHARD H. AUSTIN SECRETARY OF STATE

LANSING
MICHIGAN 48918

MICHIGAN HISTORY DIVISION

ADMINISTRATION, PUBLICATIONS
RESEARCH, AND HISTORIC SITES
208 N. Capitol Avenue

STATE ARCHIVES
3405 N. Logan Street

STATE MUSEUM
208 N. Capitol Avenue

April 17, 1981

Mr. P. McCallister
Chief, Engineering Division
U.S. Army Engineer District-Detroit
Corps of Engineers
Attn: NCEED-ER
P.O. Box 1027
Detroit, MI. 48231

Re: ER-2556
NCEED-PB

Dear Mr. McCallister:

Our staff has completed its review of the Draft Phase I General Design Memorandum and Draft E.I.S. for a Harbor for Light-Draft Vessels at Cross Village, Michigan and have the following questions.

As previously mentioned in our detailed critique of the cultural reconnaissance report of Cross Village in a letter dated March 18, 1981, we note that an architectural as well as archaeological survey still needs to be conducted within the Village. What steps has the Corps taken to recontract these surveys?

Please let us know if we can be of any assistance.

Sincerely,

Martha M. Bigelow
Director, Michigan History Division
and
State Historic Preservation Officer

Kathryn B. Eckert

BY: Kathryn B. Eckert
Deputy State Historic Preservation Officer

MMB/KBE/DEW/sl

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909
HOWARD A. TANNER, Director

May 14, 1981

Mr. Phillip McCallister
Chief, Engineering Division
U.S. Army Corps of Engineers
P.O. Box 1027
Detroit, Michigan 48231

Re: General Design Memorandum
EIS Cross Village Harbor
Proposal

Dear Mr. McCallister:

The Department of Natural Resources has reviewed the cited document and supports the Cross Village site as the best location for the harbor of the four sites proposed. The following additional comments are provided.

The procedure used in estimating littoral transport rates contains assumptions which may be very inaccurate. The conclusion that "additional erosion would amount to about 15% of the total erosion that would occur . . ." may be a low estimate. Examples of questionable assumptions include using bluff recession data from a location five to six miles from the proposed harbor site (page A-10) and assuming 20% of the littoral drift will be able to by-pass the harbor (page A-50).

More important than the estimates of the adverse erosion impact of the harbor are the monitoring and mitigation plans for the project. Monitoring will quickly show the accuracy of the estimated impacts. Page A-14 only proposes to use periodic maintenance dredging for beach nourishment in the zone of adverse influence. While during initial stages of shoreline adjustment to the harbor structure very little dredging may be required since accretion occurs at locations other than the harbor mouth, the down drift erosion impacts during that period are usually most severe. Assurances must be provided that mitigation of the adverse erosion and other impacts of the project are fully and expeditiously undertaken.

Additionally, the cost of mitigation of shoreline damage should be included in the cost-benefit ratio for this project.

The opportunity to review this document is appreciated. If you have any questions concerning these comments, please contact Jack Bails of the Environmental Enforcement Division at 517/373-3503.

Sincerely,

Howard A. Tanner
Director

June 2, 1981

U. S. Army Engineer District, Detroit
Att'n: NCEED-ER
P. O. Box #1027
DETROIT, MI., 48231

Gentlemen:

We have reviewed the Draft of the study for a Harbor in the vicinity of Cross Village Michigan, and wish to express our FAVORABLE reaction to the installation of such a facility.

I have been a seasonal resident and property owner in Readmond Twp. which adjoins Cross Village Twp. on the south and was under consideration as an alternate site for a harbor at Good Hart. We are now retired as permanent lakeshore residents and do not believe the harbor and accompanying traffic would harm the environmental charm which lead us to choose Good Hart as our home after living in Wisconsin most of our working years.

Boating has been an active part of our recreation, including many sail yacht races on Lakes Michigan and Huron. In the 30's I was engaged in yacht construction, sales, and operation out of Chicago, and spent many months headquartered out of Hessel in Les Cheneaux Islands. Therefor I can appreciate the advantages offered by a Harbor of Refuge at Cross Village.

Since the days when we bought our whitefish from indians who fished out of there in the 1920's to the present, we have been aware of the bounty Lake Michigan has offered sport fishermen and commercial fishermen alike. Hopefully good management will permit such fishing to continue, although the TONS of fish which have been harvested in the past few weeks by white and Indians alike from in front of our property must be taking its toll. Cross Village would offer the fishermen a far better base than Charlevoix or Beaver Island.

Although I would be approaching 70 at the time the harbor might be completed, we believe that it would entice us to base a small cruising sailboat there. We do not see major commercial or boating facilities as a danger in the forseeable future to the area we love and live in year around.

Sincerely yours,

Edwin F. Hulbert

Box #44,
2266 No. Lake Shore Drive,
GOOD HART, MICHIGAN, 49737

A. William Golling
856 Surrey Lane
Petoskey, Mich. 49770

U. S. Army Eng. Dist.
Attention: NCEED-ER
Detroit, Mich. 48231

To Whom This May Concern:

Please be advised that my family and I have been boaters in this area of Michigan for many years and currently own a 44 foot Cruiser. Over the years we have taken many trips up thru Waugoshance Point to the Straits of Mackinaw and then Eastward to numerous ports. Upon our return at White Shoals Lighthouse when we make our turn, it has been an "all new world". The seas have been frightening and many times comes as a complete surprise due to poor weather forecasting. Therefore, there is a dire need for a "Port of Refuge" at Cross Village for the safety of our boat and passengers.

As you are well aware, by far the majority of cruiser owners are older. We lived on our boat for two summers at Petoskey Marina and when these cruisers came in they were looking for places to eat, to buy food and beverage, etc. Being local and having the name Petoskey on the stern of our boat, we were fair game to many boaters unfamiliar with this area. Since these boaters are older, their conduct and spending of money does nothing but enhance the community and it's economy.

It boils down to:

A) Safety need for a Port of Refuge in Cross Village. Petoskey and Harbor Springs Ports are too distant.
B) It will help Cross Village and its economy.

Thank you in advance for your time in reading this letter. We are concerned boaters who wanted our opinions known.

Yours truly,

A. W. Golling

H. ROSS HUME, M.D., P.C.
ORTHOPAEDIC SURGERY

426 BAY STREET
PETOSKEY, MICHIGAN 49770
TEL. 347 5155

May 6, 1981

Mr. P. McCallister
Chief, Engineering Division
U.S. Army Engineer District, Detroit
Attn: NCEED-ER
P.O. Box 1027
Detroit, Michigan 48231

Dear Phil:

I have received and read your general design memorandum for the Harbor for Light-Draft Vessels at Cross Village, Michigan. Certainly all bases have been touched and the research appears to be exhaustive. The purpose and necessity of such a project is certainly constantly emphasized and repeated. However, there is in my opinion one very, very significant problem.

Cross township in itself is one of the poorest townships in the State of Michigan. More than half its population are either retired, on social security and social security disability, ADC, public assistance or Welfare. The number of actual local paying taxpayers I understand is just a shade over 100. Many of these are taxpayers on second homes and uninvolved basically in community activities. In looking at your local cost proposals, while they seem equitable and fair, would impose a very, very significant additional burden on those that are already taking care of these many, many public tax charges. It might conceivably be said that those in the public basket, because of the nature of this endeavor find jobs and suitable employment for making them taxpayers, the very nature of the individuals themselves a basic shortness of any financially successful season I'm sure would preclude their becoming self-sustaining. I certainly, therefore, question whether this type of project is feasible in this type of society.

Sincerely,

H. Ross Hume, M.D.

HRH:sm

Cross Village, Michigan 49723
June 23, 1981

U.S. Army Engineer District, Detroit
Attention: NCEED-T
P.O. Box 1027
Detroit, Michigan 48231

Gentlemen:

RE: Public Meeting--Cross Village, Mich.
June 16, 1981

As I said in the Public Meeting at the Holy Cross Community Hall in Cross Village June 16, my wife and I wish to be recorded as supporting Supervisor Harry Pintarelli in his continued efforts to secure a Safe Harbor for light draft vessells at Cross Village, Michigan.

We have been coming to Cross Village since 1951 and have been property owners since 1958. Our land is on Lake Michigan, approximately one half mile from the present township park and the proposed harbor. While the ruins of the earlier attempts to develop a breakwater and safe habbor have a certain beauty, they are a mess and useful only to fishermen who may wish to fish in the area.

Certainly the park is a continuing eyesore because the Village lacks resources to properly develop and police the area, resulting in something none of the residents feel is an advantage to the residents nor the public generally. The Village has been deteriorating since the fire about sixty years ago, bringing about economic loss to the permanent residents.

On the positive side, such a development as proposed by the Corps of Engineers, the State of Michigan, and Mr. Pintarelli would provide a safe harbor for vessells in time of severe storms as they come around Waugashance Island(Wilderness Point) into Lake Michigan. Cross Village is the most logical site for such a safe refuge.

In addition, the three-way sponsorship and development by the Federal, State, and Village(Township)governments would start a development that could only speed the economic development of the area by providing for commercial marine development for boat-owners, as well as pleasure boat owners who might wish to keep their vessels there.

Since this spot is the closest to Beaver Island, it is only natural that the Ferry might wish to berth and sail from here. This would re-start a tourist development that could only benefit the community, the permanent residents, as well as develop resources for the summer residents as well.

The history elsewhere is that such development turns around the deterioration of a dying community. Such a result should reverse what we have seen in Cross Village the past thirty years. We believe that progress is inevitable. We believe it should come to Cross Village too.

For the above reasons we fully support the development of a harbor at Cross Village, Michigan.

Very truly yours,

(Mrs.) William H. Cranmer

William H. Cranmer

Telephone 616-526-2791

On Lake Michigan

CAMPGROUNDS

Box 606
Cross Village
Michigan 49723

June 18, 1981

DEPARTMENT OF THE ARMY
Detroit District,
Corps of Engineers
Detroit, Michigan 48231

Dear Sir,

I was not aware that the meeting on June 16, 1981 at Cross Village was to be the last or I would have made a statement re-the reason for this letter.

I want to commend you on your presentation and patience in the meeting. I found it rather comical, but I'm sure disconcerting to your people, that in all the meetings even though questions were answered a dozen times, the same questions were posed by the same few repeatedly.

It would seem to me after attending and observing all the meetings, that we have two small groups of decenters.

ONE- the third generation welfare group that just might have to go to work if Cross Village grows.

TWO- about a dozen pseudo intellectual summer families who think because they own a cabin on the beach, they own Lake Michigan.

As to the land, it is my understanding that it was donated (with a token payment) to the township for the developement of the harbor as a condition of the bequest.

This area has wonderful potential for orderly developement and I'm sure the, state is aware of the value as a prime recreational area. I myself would appreciate not having to drive thirty miles to Petoskey every time I need a nut and bolt or have to do some laundry.

I have owned property here since 1954 and moved here in 1972, however I don't feel that I own Lake Michigan. Iam very much in favor of the pier and the orderly growth of the Cross Village area.

Telephone 616-526-2791

On Lake Michigan

CAMPGROUNDS

Box 606
Cross Village
Michigan 49723

June 18, 1981

At this point in time Cross Village (in it's quaint remoteness) is becoming a haven for the uncareing-distructive type persons, that prey on remote areas with no law enforcement and a few helpless residents. The shoreline north of Cross Village is fast becoming the dump of the north.

Again- I am in favor of the pier and the eventual benefits that would come with it including the services we now pay taxes for and fail to receive.

Sincerely,

Robert H. Reemsnyder

June 19 - 1981
Cross Village Michigan

Col. Robert Vermillion
District Engineer
U.S. Army Corps of Engineers
P.O. box 1027
Detroit, Mi. 48231

Dear Col. Vermillion

My letter to you is to express a few points about the Harbor of Refuge at Cross Village. I have been to all the meeting and have had much correspondence with the U.S. Corps of Engineers on this matter. The last hearing with the public is a copy of all the previous hearings, the same eight or ten people stating the same reasons. I can degree every one of the objections but I wont mention any names. They are in the quite well off bracket and the other halves are Welfare Receiptents. The latter are the ones who have been here for some time. The well off groups well some as recent as 6 months. They not only do not wish The Harbor of Refuge, but are more or less anti what ever, even if it may benefit them. Believe me I am 64 years old and been in township office 37 years. Supervisor since 1962 and lived here all my life, sailed the Great Lakes 6 years on Lake Carriers, and 23 years a commercial fisherman on all Lakes but Ontario. Winter and summer.

I did not know that the last public meet was to be the final Hearing or I would have said it then in Public and will do so if that time comes around again.

The silent majority do want this facility and pray that it becomes a reality and soon. I would say that better than 90% of the people favor it.

There is a strong feeling for it and the location the design, size all are quite well thought out. I have been in many Harbors over the years and approve this layout.

Lets all unite together and build this Harbor soon,

Thanks for your effort and your time and patience.

Sincerely

Gary Pintarelli

Cross Village Twp. Supervisor

Telephone 616-526-2791

[illegible] SHORE CAMPGROUNDS

On Lake Michigan

Box [redacted] 120
Cross Village
Michigan 49723

Department of the Army
Detroit District
Corps of Engineers

Dear Sir:

I am very sorry that I was unable to attend your meeting on June 16 regarding the safe Harbour Project for Cross Village Area.

As I have been informed that this was your final meeting on the project. Please be advised that I am very much in favor of the safe harbour project.

There are a very few localed so called professional people that opposed this worth while project. This would be a sad world if all capital expen[illegible] for the benefit of the public was in the hands of these narrow minded people.

Again I would like to go on record in favor of the project.

Sincerely yours
Gerald [illegible] Reed

Col. Robert Vermillion
District Engineers
U.S. Army Corp. of Engineers
P1O. Box 1027
Detroit, Mich. 48231

To Whom it may concern;

Although no economical benifit would appear to come to we the people of the Upper Peninsula, we can see a definite need for a harbor of refuge in Cross Village. We have many people who come by boat to the Upper Peninsula and Mackinaw Island on vacation and at times get caught in bad seas up by the straits with their only choice being to reach port in St Ignace or the Island. With a harbor at Cross Village they could pull in and weather the storms there, thus protecting life and boat.

Also we have many commercial fishermen who fish in the Beaver Island to Cross Village waters that get caught in storms and have to fight their way back home. They are definitely in favor of such a port.

I have heard about the meetings on this harbor project and have discussed it with many people in the Upper Peninsula, and all that I have talked to are in favor of seeing this project develope. Cross Village is the most ecnimical spot for this project in our opinion, since you already have a constructed access, stores, gas, etc.

This also is a personal matter since I have lost several good friends over the past few years who have gone down out in Lake Michigan. Yes, they were all commercial fishermen, but they aren't the only ones who drown out there. If the harbor saves one life, it is worth every penny.

Let's get the harbor built and quit quibbling over the matter.

Sincerely,

John P. Shepard

John P. Shepard
Register Forester &
Commercial Fisheries

READMOND TOWNSHIP

Emmet County, Michigan

Col. Robert Vermillion
District Engineers
U. S. Army Corp. of Engineers
P.O. Box 1027
Detroit, Mich. 48231

To whom it may concern in regard to harbor of refuge in Cross Village.

I was unable to attend your last meeting but have attended all previous meetings. I have never spoke up in any of your previous meetings. I have just sit in and listened like most other people that want the harbor of refuge.

People with all the mouth are the ones that just blew in here from somwheres or the ones walking the streets or welfare recipients. This is as close as I can describe your complainers with out naming them. There isn't a great number of people objecting just a persistent handful. These same people have dominated every meeting that I have been to.

As you well know the Harbor of refuge is badly needed in the Cross Village area. I'm not sure of how many miles between Mackinaw City and Harbor Springs, but it is a long distance and these waters get pretty treacherous in this area. Cross Village is the only logical site for the Harbor of refuge. You have the best site in northern Michigan. You have good roads, stores and other services.

Thank you for the good work you have done. Let's not stop until you have the harbor built in Cross Village.

Sincerely,

Buck LeHallier
Readmond Township
Supervisor

6607 Lakeshore Drive
P.O. Box 180
Cross Village, Michigan 49723
June 23, 1981

Col. Robert Vermillion
District Corps of Engineers
P.O. Box 1027
Detroit, Michigan 48231

Dear Colonel Vermillion:

I have learned today that this date is the deadline for Phase I comments relative to the proposed harbor at Cross Village.

Although I am a member of the Cross Village Township Board and am chairman of its Planning and Zoning Committee, I represent only myself in this letter.

I endorse the harbor concept as presented by your representatives and the Michigan Waterways Division during the past several years. The plan seems sound and very well conceived. Along with many other Cross Village residents (its Silent Majority?), I will continue to support efforts which will bring the concept to fruition. The harbor will be a positive benefit to Cross Village, a significant contribution to water safety on the upper Great Lakes, and a beneficial influence on the economy of this currently depressed area.

If I can be of help during the coming development stages, please contact me.

Sincerely,

David Munger

cc: Senator Carl Levin
Senator Donald Riegle
Representative Bob Davis
Senator Mitch Irwin
Representative Charles Varnum

June 21 '81

Army Corps of Engineers
Col Robert Vermillion

Dear Sir:

Our family has owned land in Cross Village for the past 50 years

We are in favor of the proposed harbor for the following reasons:

1 - The safety factor is badly needed.
2 - It will enhance the village economically
3 - It will improve the present condition of the shore, visually and practically.
4 - It will provide fishing opportunities
5 - It will provide a safe, protected recreation area.
6 - It will not bring about a significant tax increase, nor will it necessarily inflate real estate prices.

Sincerely

Vincent Alice Pardini
833 Court St
Port Huron Mich
or Box 54
Cross Village Mich

June 21, 1981

Army Corps of Engineers
Col Robert Vermillion

Dear Sir.

I am in favor of the plans to build a refuge harbor at Cross Village. This is an important safety measure for small boats.

It will also be a benefit to people who wish to moor boats at that location for convenience.

Sincerely

Samuel Wojahn
633 Court Street
Petoskey, Mich
and
Cross Village, Mich

APPENDIX A

PHASE I GENERAL DESIGN MEMORANDUM
STUDY FOR A HARBOR FOR LIGHT-DRAFT VESSELS AT
CROSS VILLAGE, MICHIGAN

DESIGN ANALYSIS

Department of the Army
Detroit District, Corps of Engineers

APPENDIX A

DESIGN ANALYSIS

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APPENDIX A
DESIGN ANALYSIS

INTRODUCTION

This appendix presents an analysis of the physical factors pertinent to the design of each of the proposed harbor configurations at Cross Village (Alternative 1), Good Hart (Alternative 2), and Sturgeon Bay Point (Alternative 3). Rubblemound breakwater designs are utilized because of their energy dissipating characteristics and on the basis of environmental and aesthetic factors. The analysis provided recommendations for various combinations of breakwater crest heights and side slopes to achieve a wave height of 1.5 feet in the berthing area of each harbor. Each harbor was evaluated for the 1.5 feet factor to provide a means of comparing the costs of the various proposed harbor plans. To provide for a determination of the comparative costs of limiting the wave height in the berthing area to 0.5 foot, a second analysis was performed at the Cross Village site.

CROSS VILLAGE SITE

Location

Cross Village is located on the northeastern shore of Lake Michigan near the tip of Michigan's Lower Peninsula. The recommended harbor (see Figure 1, page A-112) would be on the southern rim of Sturgeon Bay, a broad bay opening to the west and bounded by Waugoshance Point on the north as shown in Figure 2 on page A-113.

Lake Michigan, one of the Great Lakes, is roughly oriented in a north-south direction and has a length of about 307 miles, a width of about 118 miles, and a maximum recorded depth of 923 feet. The surface level of Lake Michigan varies from year to year. During the course of each year the water surface elevation is subject to a consistent seasonal

fluctuation, the lowest stages prevailing during the winter months and the highest during the summer months. During the period between 1900 and 1978, the difference between the highest monthly mean lake stage (elevation 581.04, recorded July 1974) and the lowest monthly mean lake stage (elevation 575.35, recorded March 1964) has been 5.69 feet. The mean lake stage of Lake Michigan over 79 years (1900-1978) was elevation 578.20. The low-water datum established for Lake Michigan is elevation 576.80. All elevations in this report are referred to International Great Lakes Datum (IGLD), as measured above mean water level at Father Point, Quebec (IGLD, 1955).

Harbor Site Hydrography

The general pattern of the offshore contours of Lake Michigan at Cross Village follows the configuration of the shoreline as shown in Figure 3 on page A-114. The lake bottom slope from shore to the 30-foot depth is fairly uniform with an offshore slope of about 1 on 160. In depths below 30 feet, the gradient of the lake bottom increases to about 1 on 50. Depths north of the harbor site are generally less than 90 feet. Depths west and southwest of the proposed site reach an average depth of approximately 200 feet about 3 miles offshore. The lake bottom consists primarily of sand interspersed with a small amount of gravel and traces of clayey material.

Actual photographs taken in 1973 and 1977 indicate that the Cross Village area has been subject to a small amount of littoral material movement. Some erosion has occurred easterly from the breakwater. This fact indicates a small net littoral movement from west to east, a direction that is in accord with information contained in the 1966 Corps of Engineers Survey Report on Cross Village Harbor.

The earliest known survey of the coast of Lake Michigan, at and in the vicinity of Cross Village, was made by personnel of the former U.S. Lake Survey in 1853. This survey was confined to the area between the shoreline and a strip one-half to one mile lakeward. This data was supplemented by surveys of 1903 and 1925-26. These latter surveys

extended lake bottom mapping to the deeper waters of Lake Michigan. Soundings were also made in 1961. The soundings used for this study were the official soundings from National Oceanic and Atmospheric Administration (NOAA) chart No. 14911 released November 8, 1975.

Actual photographs of Cross Village and vicinity were taken in October 1973, April 1977, and May 1980.

Existing Harbor

In the late 1930's, local interests and the Works Progress Administration constructed a stone-filled, L-shaped, wooden-pile breakwater extending 400 feet due north from shore. The lake arm of the breakwater was about 250 feet long. This breakwater formed a small craft harbor about 500 feet by 500 feet in size, with depths of about 10 feet at the entrance and 3 feet within the harbor. This breakwater has not been maintained and has largely deteriorated.

Wave Refraction

Wave refraction calculations are shown on pages A-31 and A-32 and are summarized in Table 1 below. Wave directions which would have the most impact on the proposed harbor were selected, and a computer-drawn refraction diagram was obtained. (See Figure 4 on page A-115.) Deep water wave heights were selected from the Corps of Engineer's Waterways Experiment Station (WES) Technical Report H-76-1, Sturgeon Bay and Harbor Springs grid points.

TABLE 1

WAVE REFRACTION - CROSS VILLAGE

Wave Direction	Deep Water Height(Ft.)	Deep Water Length(Ft.)	Period(Sec.)	Refracted Height	Refracted Length
NNE	4.6	154.9	5.5	3.8	104.1
NNWXW (N30W)	9.8	319.5	7.9	9.6	173.8
WSW (S20W)	14.8	433.5	9.2	14.2	205.0

Design Wave Heights

Design wave heights are significant wave heights as determined from Goda's 1975 chart h/H_o' vs. H_s/H_o, for a .01 lakebed slope. The design wave heights derived are shown in Table 2. Calculations showing how the design waves were derived are shown on pages A-33 and A-34.

Wave Runup

Coastal Engineering Research Center's (CERC) publication, Civil Engineering Technical Article (CETA) 79-6 guidelines were utilized to determine runup for the various breakwater sections. Wave runup calculations for the subject harbor plan are shown on pages A-35 and A-36. A summary of wave runup values is shown in Table 3.

Design Crest Heights

Design crest heights were determined by using the CERC (CETA) publication 79-6 equation:

$$K_T = \frac{H_T}{H_I} = (.51 - \frac{.11B}{h})\ (1 - \frac{h - d}{R})$$

where H_T is the height of the transmitted wave, H_I is the height of the incident wave, B is the crest width, d is the design depth at the toe of the structure, R is runup, and h is the height of the structure from lake bed to crest. Crest heights were established to limit the interior waves in the harbor to 0.5 and 1.5 feet. Diffraction of the transmitted wave will occur with a corresponding slight reduction in wave height; therefore, diffraction effects were considered in crest height determination where applicable. Crest height calculations are shown on pages A-37 through A-42, and crest heights are presented in Table 3.

TABLE 2
DESIGN WAVE HEIGHTS - CROSS VILLAGE

Location*	Significant Wave Height (Ft.)	Direction
Sections AB, BC	8.8	NNWXW
Section CD at C	10.4	WSW
Section CD at D	4.0	WSW
Section EF	3.7	NNE
Section FG	3.0	NNE

TABLE 3
RUNUP AND CREST HEIGHTS - CROSS VILLAGE

Location*	Slope	Runup (Ft)	Crest Ht. Above LWD .5' Interior Wave	Crest Ht. Above LWD 1.5' Interior Wave
Sections AB, BC	1:1.5	8.1	+11.2	+7.8
	1:3	6.1	+ 9.6	+7.0
Sections CD at C	1:1.5	9.8	+12.0	+6.7
	1:3	7.4	+10.2	+6.2
Sections CD at D	1:1.5	4.3	+ 7.6	+5.0
	1:3	3.5	+ 7.0	+5.0
Sections EF	1:1.5	3.5	+ 7.2	+5.0
	1:3	2.6	+ 6.6	+5.0
Sections FG	1:1.5	2.9	+ 6.2	+5.0
	1:3	2.3	+ 5.9	+5.0

*Reference Figure 1, page A-112.

Wave Diffraction

Diffraction diagrams were constructed using Goda's (1978) charts for S=10 (Wind waves). To apply the Goda diagrams, which are for normal wave incidence, the charts were rotated to the desired angle. Relative to the 9.6 foot high incident wave that approaches the harbor from a N30°W direction (Figure 5, page A-116), the largest waves that could impact on the boat berthing areas would be about 0.6' high (at point Y). Figure 6 on page A-117 shows diffraction due to overtopping.

Armor Stone

For the purpose of sizing armor stone for the recommended harbor plan 20-year deep water waves for the winter period as given in the Waterways Experiment Station (WES) Technical Report H-76-1 Lake Michigan were analyzed. Table 4 shows armor stone sizes for the breakwater sections. Armor stone size calculations are shown on pages A-46 and A-47.

A comparison is made between the Cross Village site design crest heights and armor stone sizes, and existing crest heights and stone sizes at Leland Harbor. Leland Harbor has been stable since the latest renovation in the early 1960's. The hydrologic and geologic parameters involved in wave analysis are similar at Leland and Cross Village; therefore, it is expected that Cross Village Harbor would be somewhat similar to Leland Harbor in crest height and armor stone size. The highest breakwater crest elevation at Leland is +10.0 ft. on a 1:1.75 slope. The largest armor stone sizes are 5 ton cover stone and 7 ton toe stone. Table 5 shows differences in design procedure for Cross Village and Leland Harbors. These differences result in different crest heights and armor stone sizes at the two sites.

TABLE 4

ARMOR STONE SIZES - CROSS VILLAGE

Location*	Slope	Weight of Stone (lbs.)
Sections AB, BC, CD (trunk)	1:1.5	9156
	1:3	4578
at A,B,C (head)	1:1.5	11051
	1:3	8011
at D	1:1.5	487
	1:3	243
Section EF (trunk)	1:1.5	524
	1:3	262
at E and F (head)	1:1.5	632
	1:3	458
Section FG	1:1.5	210
	1:3	105

*Reference Figure 1, page A-112.

TABLE 5

COMPARISON OF DESIGN PROCEDURES FOR CROSS VILLAGE AND LELAND HARBORS

	Leland	Cross Village
Design still water level	580.6 (+3.8)	581.5 (+4.7)
Method of selecting design wave height	SPM charts	WES T.R. H-76-1 $H_{1/3}$ calculated using Goda diagrams
Waves used in armor stone sizing	Design waves from SPM charts	Winter 20 yr. deep water waves from WES T.R., find $H_{1/3}$ as for above summer waves.
Runup procedure	SPM	Combination of Goda charts to find $H_{1/3}$ and CERC CETA 79-6 equation
Wave height inside harbor	Limit to 2 cfs/ft overtopping.	.5' and 1.5' wave in berthing areas.

Shoreline Sediments & Geomorphology

The existing L shaped, stone filled wood pile harbor structure was built in 1930. Therefore, it has existed and has influenced the littoral zone in the Cross Village area for about 50 years. The structure extends for about 450 feet into Lake Michigan from the shoreline proper. Sediment material located in the nearshore zone and on the beach consists primarily of a mixture of gravel and sand with sand predominating. In general, a low sand bluff which is likely a foredune extends along the shore at the site. This low bluff reaches a height of about 30 feet in places although its height does vary in the vicinity of Cross Village. For the purpose of this study, however, we will assume that the nearshore bluff for the most part is 30 feet high in order that an estimate of littoral transport rates can be made. The low 30-foot high bluff is backed by a higher bluff which reaches a height of 90 feet in some places and consists of gravel, sand and clay with clay predominating. The high bluff has, in general, remained stable in the vicinity of Cross Village and, therefore, has not been significantly affected by wave action and has not contributed much material to the littoral zone.

Analysis of Aerial Photographs

A more detailed study of available aerial photographs (1973, 1977) which cover the Cross Village area was performed to estimate what effects the existing harbor structure at Cross Village has had on littoral drift, and to what extent this structure has effected shoreline erosion and accretion in the vicinity of Cross Village. This information, used in conjunction with available information concerning the similar effects of other harbors located near Cross Village on littoral drift and shoreline accretion and erosion trends, would be used to estimate the effects the recommended harbor structures at Cross Village (see Figure 1) would have on littoral transport and on shoreline accretion and erosion. Lower water level conditions prevailed when the 1977 photographs were taken as compared to the 1973 photographs. Therefore, more shoreline and offshore

features are apparent on the 1977 photographs. The fillet which has accreted southwest of the harbor extends for a distance of about 2,800 feet. This indicates that the harbor structures have impacted on littoral drift. The fillet is also shown on the 1973 photographs although it is less discernible due to higher lake levels. The 1977 photographs also clearly show that due to the deteriorated state of the existing harbor structure, littoral drift has passed over or through the structure. Thus, the material that has moved over or through the structure has, to a degree, helped to nourish the shoreline northeast of the harbor structure. However, it appears that the existing harbor structure has interrupted a portion of the littoral drift that would have nourished the shoreline extending northeast of the harbor. More specifically, the accretion that has taken place southwest of the harbor has promoted the formation of a well-developed foredune which extends several thousand feet southwest of the harbor. This well-developed foredune is lacking for the most part northeast of the harbor since less littoral sand is moving and accreting in this area as compared to the littoral sand that is accreting southwest of the harbor. Furthermore, there is evidence that erosion from wave and wind action has removed much of the wind blown material that has accumulated nearshore northeast of the harbor, and that there has been little replenishment of the material that has been lost. Available aerial photographs indicate that the shoreline extending about 2,200 feet northeast of the harbor has been affected by the harbor structure. The shoreline is recessed in this area and the quantity of littoral material moving and accumulating along the shoreline in this area is relatively low. At about 2,200 feet northeast of the harbor, the beach widens and it appears that the harbor structure has caused no significant increase in erosion beyond this point even though the higher bluffs located in this area and further northeast have received extensive erosion from natural wave and wind action. It is reasonable to believe, however, that during the formation of the fillet southeast of the harbor, and because of the formation of the well developed foredune southwest of the harbor and further loss of accreted littoral material blown inland, that the harbor structures have interrupted a portion of littoral drift moving in the area

and have contributed to the overall erosion that has occurred in the zone of influence northeast of the harbor structure.

Shoreline Recession

A shoreline recession analysis conducted by the State of Michigan Department of Natural Resources revealed that in the area located about 5 to 6 miles southwest of Cross Village, the bluff has receded at an average rate (most severe) of about 1.2 feet per year. The shoreline at this location is considered a relatively critical erosion area and the shoretype at this location is similar to the shoretype located at Cross Village. It is expected that the bluff recession rates occurring in these two areas would be similar. Therefore, for the purpose of this study, we will consider that the most severe average nearshore bluff (one contributing sand to the littoral zone) recession rate in the Cross Village area is about 1.2 feet per year.

Estimate of Littoral Transport Rates

Considering that the bluff in the Cross Village area is eroding at an average rate of about 1.2 feet per year, knowing the height (30 feet) of the nearshore bluff that is contributing sediment to littoral zone, knowing the approximate length of zone of influence of the harbor (both accretion and erosion zone--about 5,000 feet) and estimating that approximately 90 percent of material in the bluff is suitable to be incorporated into littoral drift, an estimate of littoral transport rates in the Cross Village area can be determined. Accordingly, it is estimated that the average gross littoral transport rate in the Cross Village area is about 6,000 cubic yards annually. Since a substantial quantity of littoral material has accreted on the southwest side of the harbor and little to no material has accumulated northeast of the harbor, it is concluded that littoral drift moves predominantly southwest to northeast in the Cross Village area. It is further estimated that approximately 80 percent (about 4,800 cubic yards) of littoral drift moves from the southwest

direction and that the remainder (about 1,200 cubic yards) of the gross littoral drift moves from the northeast direction. These estimated rates were based partially on measurements and partially on judgment of the littoral drift distribution and quantities which appeared to be accumulating on both sides of the harbor on the aerial photographs studied. Figure 7 on page A-118 shows the estimated zone of erosion northeast of the harbor created by the existing harbor structure. Furthermore, since fetch distances in the north and northeast direction are relatively short, waves impacting on the shoreline from these directions would be relatively small. This factor further supports the conclusion that littoral drift in the Cross Village area moves predominately from southwest to northeast. It follows that there is a net littoral drift of approximately 3,600 cubic yards of material moving from southwest to northeast in the study area. Calculations concerning how the estimates of littoral transport rates in the Cross Village area were derived are shown on pages A-48 through A-50.

Possible Estimated Effects of Recommended Breakwaters on Shoreline Erosion and Littoral Transport

To estimate what effects the recommended harbor structures at Cross Village could have on shoreline erosion and accretion, the effects the existing harbor structures have had at Cross Village were compared to similar effects caused by the harbor structures located at Frankfort, Michigan. Frankfort Harbor was selected because it is the harbor closest to Cross Village where detailed littoral transport rates and harbor induced shoreline erosion effects have been determined. Furthermore, the harbor structures at Frankfort have impacted on the littoral zone for a considerable period which allowed for a detailed study of the effects the harbor has had on littoral drift and shoreline erosion through time. A similar study could not be accomplished at Cross Village since the recommended harbor has not yet been constructed and the effects of the deteriorated existing structure are not fully representative of the effects the recommended harbor could be expected to have on the littoral zone. It is realized that the shoreline characteristics and sediment in the bluffs are

not exactly the same. However, there are enough similarities at the two sites so that an estimate of possible harbor induced erosion can be determined relative to the existing and recommended harbor structures at Cross Village.

In the Section 111 Detailed Project Report prepared in 1976 for Frankfort Harbor by the U.S. Army Corps of Engineers, it was established that the zone of influence (erosion effect) of the harbor extended for about 10,000 feet north of the harbor. It was further established that the shoreline erosion damage caused by Frankfort Harbor has amounted to about 45 percent of the total erosion that has occurred in the zone of influence of the harbor. However, the existing harbor structure at Cross Village extends only about 450 feet into Lake Michigan. Furthermore, since only one structure exists at Cross Village instead of two breakwaters, such as is the case at Frankfort, there is no inner harbor area at Cross Village which could trap substantial quantities of littoral drift that are moving in the area. Therefore, it follows that the existing structures at Cross Village would have less overall impact on littoral drift and shoreline erosion when compared to the same effects caused by Frankfort Harbor.

It was established previously that the nearshore bluff at the site is approximately 30 feet high and consists of about 90 percent sand which can be incorporated into littoral drift. It has also been determined that the bluff in the Cross Village area is eroding at an average annual rate of about 1.2 feet per year and that the existing structure at Cross Village extends only about 25 percent as far into Lake Michigan as the harbor structures at Frankfort, Michigan. Therefore, the existing structure at Cross Village would be expected to affect a shoreline reach (erosion area) extending for about 2,500 feet northeast of the harbor. This zone of influence agrees well with the length of shoreline shown on the aerial photographs that appears to have received additional erosion due to the existing structure.

The harbor structures (Figure 1) recommended for Cross Village would extend about 650 feet into the lake from the shoreline proper. An inner

harbor area would be formed by the construction of the northeast and southwest breakwater structures. Therefore, it is expected that the recommended harbor structures could have a greater effect at interrupting littoral drift and contributing to the erosion problem northeast of the harbor than the existing structure. It is estimated that the recommended breakwaters could cause additional erosion along the shoreline extending to about 4,000 feet northeast of the harbor. It is further estimated that the recommended harbor structures could interrupt a larger quantity of the littoral drift which moves predominantly in southwest to northeast direction than the existing structure. The additional erosion would amount to about 15 percent of the total erosion that would occur in that reach. The amount of littoral drift which could be expected to be accreted south of the harbor structures, trapped in the harbor entrance, or lost inland due to action of wind on the accreted material, is estimated to total about 3,800 cubic yards per year. The above estimates of the possible zone of influence of the recommended harbor, possible harbor induced erosion percentage, and average annual quantity of littoral drift which could be expected to be interrupted or trapped by the proposed harbor were based on the actual observed effects of the existing structure and on judgement of the estimated effects of the recommended harbor. Figure 8 on page A-119 shows the estimated shoreline reach where additional erosion due to the recommended harbor may occur.

Shoreline Monitoring Plan

To verify the estimated effects of the recommended harbor structures on the erosion and accretion processes of the surrounding shoreline, a monitoring plan has been recommended to be used in connection with disposal of dredged material from the initial construction and periodic maintenance dredging. The plan will be finalized during the plans and specifications stage of preconstruction planning.

Fifteen thousand cubic yards of initial dredged material would be used to construct a swimming beach east of the recommended harbor and the

remaining dredged material would be placed along the shoreline northeast of the recommended harbor along the entire 4,000 foot zone that has been identified as a possible zone of erosion. Material resulting from periodic maintenance dredging would be placed in a zone extending from about 1,500 to 3,000 feet northeast of the recommended harbor, where any harbor induced erosion would be most serious.

The elements of the recommended monitoring plan, and their estimated costs, are shown below.

a.	Perform hydrographic survey of lake bottom and shoreline and obtain sediment samples.	
	(1) Initial Survey	$35,000
	(2) Periodic Survey	$20,000
b.	Perform sieve analysis, test for pollutants, and tabulate resulting data	$ 5,000
c.	Aerial photography	$ 2,000
d.	Topographic mapping (Optional--funds permitting)	$10,000
e.	Analysis and reporting of data	$10,000

Twenty survey lines would be located as shown on Figure 9 on page A-120. The survey lines should extend from a permanent baseline located far enough landward of the bluff crest so as not to be affected by erosion. Permanent horizontal and vertical controls would be established so that the baseline and survey lines can be accurately relocated in the same location for future surveys. Elevations to the nearest 0.1 foot would be established for the top and toe of bluff and shoreline. A continuous trace of the lake bottom would be obtained from the shoreline out to the 20-foot contour depth below low water datum (1GLD, 1955). The survey would be performed prior to initial dredging and prior to periodic maintenance dredging (approximately every three years) for a period of approximately twelve

years, after which the littoral regime is expected to have adjusted to the recommended structures.

Sediment samples for sieve analysis would be obtained along survey lines 2, 4, 7, 10, 12, 14, 16, 18, and 20. A sample should be obtained at or near the toe of the bluff, representative of the sediment comprising the bluff at the shoreline, and at the 0, 5, 10, 15, and 20 foot contour depth locations in Lake Michigan. About a liter of sediment should be obtained at each sample location.

Three years after completion of the harbor and every year maintenance dredging is anticipated, four additional sediment samples would be taken within the harbor as shown in Figure 9. Tests to be run on these samples include those for macrobenthos, nutrients, heavy metals, and oil and grease.

Color aerial photographs would be taken of the shoreline extending about one mile southwest and about three miles northeast of the harbor site. The photographs would have a scale not to exceed one to 6,000 and would have a 60 to 70 percent overlap. The aerial photographs would be taken at about the same time the survey is conducted (within 30 days).

Topographic maps showing the location and elevation of the top and toe of the bluff, the shoreline, and several prominent cultural and natural landmarks landward of the bluff edge, would be developed from the aerial photographs. The topographic mapping would have a two-foot contour interval and cover the shoreline up to 5,000 feet northeast of the recommended harbor.

GOOD HART SITE

The Good Hart harbor site is located north of the Village of Good Hart along Lake Michigan in an area where offshore slopes are about 1:50 (.02). Figure 10, page A-121, shows the layout of the proposed harbor.

Design Water Level

A 20-year design still water level of 581.5 feet IGLD (1955) was selected combining levels and rise frequency data from Standardized Frequency Curves for Design Water Level Determination on the Great Lakes. A 10-year level of 580.1 feet and a 2 year rise of 1.4 feet (interpolation between Pt. Inland and Mackinaw City 2 year values) were chosen to give a 20-year level of 581.5 feet.

Wave Refraction

Wave directions which would have the most impact on the proposed harbor were selected and a computer-drawn refraction diagram was obtained for WSW, W, NNW, and N waves (see Figure 11, page A-122). Refraction coefficients were determined by measuring the distance between adjacent rays at the lakeward and shoreward ends of the rays and taking the square root of the quotient. Since each wave was represented by 6 rays, the refraction coefficient was determined to be the average of the values obtained for each pair of adjacent rays.

Summertime 20-year frequency deep water wave heights were selected from the Waterways Experiment Station Technical Report H-76-1, Harbor Springs and Sturgeon Bay grid points. Wave refraction calculations are shown on pages A-52 and A-53 and are summarized in Table 6.

TABLE 6

WAVE REFRACTION - GOOD HART

Wave Direction	Deep Water Height(Ft)	Deep Water Length(Ft)	Deep Water Period(Sec)	Refracted Height	Refracted Length
N	5.6	216.3	6.5	3.8	109.4
NNW	9.8	319.5	7.9	10.8	135.1
W	14.8	433.4	9.2	14.1	194.1
WSW	14.8	433.4	9.2	12.6	194.1

Design Wave Heights

Significant wave heights for the refracted deepwater waves were determined using Goda's 1975 chart h/H_o' vs. H_S/H_o' for a .02 lakebed slope. Calculations showing the determination of significant wave height are shown on page A-56 and summarized in Table 7.

TABLE 7

DESIGN WAVE HEIGHTS - GOOD HART

Location*	Significant Wave Height(Ft.)	Direction
Section AB	10.0	W
Section BC at B	6.3	WSW
Section BC at C	4.2	WSW
Section DE, EF at E	6.7	NNW
Section EF at F	3.9	NNW

*Reference Figure 10, page A-121.

Wave Runup

Coastal Engineering Research Center (CERC) publication Civil Engineering Technical Article (CETA) 79-6 equation 4 was used to determine runup on the breakwater sections. The equation has the form

$$R = H_{\frac{1}{3}} \frac{.692}{.504 + \sqrt{H_{\frac{1}{3}} / L_o}} \cot \alpha$$

where R is runup, H_s is the incident significant wave height, L_o is the deepwater wavelength, and α is the angle of the seaward face of the breakwater. Wave runup calculations are on pages A-55 and A-56. Wave runup values are shown in Table 8.

TABLE 8

RUNUP AND CREST HEIGHTS - GOOD HART

Location*	Slope	Runup(Ft.)	Crest Ht. Above LWD 1.5 ft. Interior Wave
Section AB	1:1.5	9.5	+11.2
	1:2	8.6	+10.5
	1:3	7.2	+ 9.6
Section BC at B	1:1.5	6.4	+ 7.5
	1:2	5.9	+ 7.2
	1:3	5.0	+ 6.8
Section BC at C	1:1.5	4.6	+ 7.8
	1:2	4.1	+ 7.3
	1:3	3.6	+ 6.8
Section DE and EF at E	1:1.5	6.4	+ 7.8
	1:2	5.8	+ 7.5
	1:3	4.9	+ 7.1
Section EF at F	1:1.5	4.0	+ 7.2
	1:2	3.7	+ 6.9
	1:3	3.2	+ 6.4

*Reference Figure 9, page A-120.

Design Crest Heights

Design crest heights were determined using CERC publication CETA 79-6 equation 2:

$$K_T = \frac{H_T}{H_I} = \left(.51 - \frac{.11B}{h}\right)\left(1 - \frac{h - d}{R}\right)$$

where H_T is the height of the transmitted wave, H_I is the height of the incident wave, taken to be the significant wave height, B is the crest width, taken to be 10 feet, d is the design depth at the toe of the structure, R is runup, and h is the height of the structure from lake bottom to crest. The crest height was established to limit waves in the berthing areas to 1.5 feet. Crest height calculations are shown on pages A-57 through A-59 and are presented in Table 8.

Wave Diffraction

Diffraction diagrams were constructed using Goda's 1978 charts for S=10 (wind waves). To apply Goda's charts, which are for normal incidence, the charts were rotated to the desired angle. Relative to the 10.8 foot incident wave from N 22° W (Figure 12, page A-123), the largest waves that could be experienced in the berthing areas would be about 3.1 feet at point Y. To limit the waves to 1.5 feet at point Y, breakwater section AB would need to be extended 300 to 400 feet to the north, or another section would need to be added to block more of the north-northwest (NNW) wave. The present design limits the diffracted west (W) wave to 1.5 feet in the berthing areas (Figure 13, page A-124).

Armor Stone

For the purpose of sizing armor stone, 20-year deep water winter waves were selected from the Waterways Experiment Station Technical Report H-76-1, Harbor Springs grid point. To determine the weight of the armor stone in pounds, Shore Protection Manual equation 7-110 was used:

$$W = \frac{W_r H^3}{K_D (S_r - 1)^3 \cot \alpha}$$

W = weight of armor stone, lbs.

W_r = specific weight of armor stone unit, lbs./Ft.^{3}
= 165 lbs/ft^3 at Sturgeon Bay.

H = wave height, Ft., taken as significant wave height

S_r = specific gravity of armor stone relative to the water
(S_r = 165/62.4)

α = angle of breakwater slope

K_D = coefficient depending on shape, roughness, sharpness, and degree of interlock of the armor stone.

Armor stone size calculations are shown on pages A-64 and A-65 and summarized in Table 9.

Physical Factors Affecting Littoral Transport

The shoreline near Good Hart is classified as Good Hart Bluff shoretype in "Shoretype Classification of Emmet County, Michigan", by Michigan State University. Analysis of 1973 and 1980 air photos and United States Geologic Survey topographic maps indicates that the bluff is lower and farth inland in the area of the harbor site than areas to the south or north. Much of the bluff material is gravelly sand, so that most eroded bluff material is transportable in the littoral zone. Littoral drift calculations are shown on pages A-66 and A-67.

Possible Zone of Influence

Comparison to Cross Village and Frankfort and analysis of effects of existing structures in the area determined the possible zone of influence of the proposed harbor at Good Hart to be about 3,000 feet downdrift and 2,000 feet updrift, for a total reach of 5,000 feet (see Figure 14, page A-125).

Littoral Transport Rate

Considering the physical factors above, a gross transport rate of about 4000 yd^3/yr was estimated assuming that a certain percentage of

TABLE 9

ARMOR STONE SIZES - GOOD HART

Location*	Slope	Weight of Stone (Lbs.)
Section AB (trunk)	1:1.5	8421
	1:2	6316
	1:3	4211
at A (head)	1:1.5	3600
	1:2	3132
	1:3	2610
at B (head)	1:1.5	3054
	1:2	2657
	1:3	2214
Section BC (trunk)	1:1.5	2323
	1:2	1742
	1:3	1161
Section DE and EF (trunk)	1:1.5	2865
	1:2	2149
	1:3	1433
at D and E (head)	1:1.5	3458
	1:2	3008
	1:3	2507

*Reference Figure 9, page A-120.

bluff material was transportable and that transport of material into the reach equalled transport out of the reach. About 70% (2800 yd^3/yr) of the transport is south to north, and the remaining 30% (1200 yd^3/yr) is north to south. A monitoring plan similar to that discussed for Cross Village would be instituted to verify the estimated effects of the proposed harbor on erosion processes in the area.

STURGEON BAY POINT SITE

The Sturgeon Bay Point harbor site is located toward the south end of Sturgeon Bay in a shallow protected area with offshore slopes around 1:150 (.0067). Figure 15 on page A-126 shows the layout of the proposed harbor.

Design Water Level

A 20-year design still water level of 581.5 feet International Great Lakes Datum (IGLD, 1955) was selected combining levels and rise frequency data from Standardized Frequency Curves for Design Water Level Determination on the Great Lakes. A 10-year level of 580.1 feet and a 2 year rise of 1.4 feet (interpolation between Pt. Inland and Mackinaw City 2 year values) were chosen to give a 20-year level of 581.5 feet.

Wave Refraction

Wave directions which would have the most impact on the proposed harbor were selected and a computer-drawn refraction diagram was obtained for W, NW, NXW, and NNE waves (see Figure 16, page A-127). Refraction coefficients were determined by measuring the distance between adjacent rays and taking the square root of the quotient. Since each wave was represented by 6 rays, the refraction coefficient was determined to be the average of the values obtained for each pair of adjacent rays.

Summertime 20-year frequency deepwater wave heights were selected from the Waterways Experiment Station Technical Report H-76-1, Harbor Springs grid point, and the Shore Protection Manual Fig. 3-29 for the NNE wave to accomplish the design crest height analysis. Wave refraction calculations are shown on pages A-70 and A-71 and are summarized in Table 10.

TABLE 10

WAVE REFRACTION - STURGEON BAY POINT

Wave Direction	Deep Water Height(Ft.)	Deep Water Length(Ft.)	Deep Water Period(Sec.)	Refracted Height	Refracted Length
NNE (N 10°E)	3.2	69.9	3.6	2.6	69.9
NW (N 45°W)	9.8	319.5	7.9	7.2	160.4
W	5.2	178.2	5.9	2.4	111.7

Design Wave Heights

Significant wave heights for the refracted deepwater waves were determined using Goda's 1975 chart h/H_o' vs. H_S'/H_o' for a .008 lake bed slope. Calculations showing the determination of significant wave height are shown on page A-73, and summarized in Table 11.

TABLE 11

DESIGN WAVE HEIGHTS - STURGEON BAY POINT

Location*	Significant Wave Height(Ft.)	Direction
Section AB	7.1	NW
Section BC	2.4	W
Section DE	2.4	NNE

*Reference Figure 15, page A-126.

Wave Runup

Coastal Engineering Research Center (CERC) publication Civil Engineering Technical Article (CETA) 79-6 equation 4 was used to determine runup on the breakwater section. The equation has the form

$$R = H_{\frac{1}{3}} \frac{.692}{.504 + \sqrt{\frac{H_{\frac{1}{3}}}{L_o}}} \cot \alpha$$

where R is runup, H_S is the incident significant wave height, L_o is the deepwater wavelength, and α is the angle of the seaward face of the breakwater. Wave runup calculations are shown on page A-74. Wave runup values are shown in Table 12.

Design Crest Heights

Design crest heights were determined using CERC publication CETA 79-6 equation 2:

$$K_T = \frac{H_T}{H_I} = \left(.51 - \frac{.11B}{h}\right)\left(1 - \frac{h - d}{R}\right)$$

where H_T is the height of the transmitted wave, H_I is the height of the incident wave, taken to be the significant wave height, B is the crest width, taken to be 10 feet, d is the design depth at the toe of the structure, R is runup, and h is the height of the structure from lake bottom to crest. The crest height was established to limit waves in the berthing areas to 1.5 feet. Crest height calculations are shown on page A-75 and A-76 and presented in Table 12.

TABLE 12

RUNUP AND CREST HEIGHTS - STURGEON BAY POINT

Location*	Slope	Runup(Ft.)	Crest Ht. Above Low Water Datum 1.5' Interior Wave
Section AB	1:1.5	6.8	+8.3
	1:2	6.1	+8.0
	1:3	5.2	+7.5
Section BC	1:1.5	2.5	+5.7
	1:2	2.3	+5.5
	1:3	1.9	+5.1
Section DE	1:1.5	2.1	+5.3
	1:2	1.9	+5.1
	1:3	1.6	+4.8

*Reference Figure 14, page A-125.

Wave Diffraction

Diffraction diagrams were constructed using Goda's 1978 charts for S=10 (wind waves). To apply Goda's charts, which are for normal incidence, the charts were rotated to the desired angle. Relative to the 4.7 foot high incident wave that approaches the harbor from a N 5° W direction (Figure 17, page A-128), the largest waves that could be experienced in the berthing areas would be about 1.5 ft. high at point Y.

Armor Stone

For the purpose of sizing armor stone, 20-year deep water winter waves were selected from the Waterways Experiment Station Technical Report H-76-1, Harbor Springs grid point. To determine the weight of the armor stone in pounds, Shore Protection Manual equation 7-110 was used:

$$W = \frac{W_r H^3}{K_D (S_r - 1)^3 \cot \alpha}$$

w = weight of armor stone, lbs.

W_r = specific weight of armor stone unit, 165/Ft.^{3}
= 165 lbs/ft^3 at Sturgeon Bay

H = wave height, Ft., taken as significant wave height

S_r = specific gravity of armor stone relativ to the water (S_r = 165/62.4)

α = angle of breakwater slope

K_D = coefficient depending on shape, roughness, sharpness, and degree of interlock of the armor stone.

Armor stone size calculations are shown on pages A-81 and A-82 and summarized in Table 13.

TABLE 13

ARMOR STONE SIZES - STURGEON BAY POINT

Location*	Slope	Weight of Stone(pounds)
Section AB (trunk)	1:1.5	5506
	1:2	4129
	1:3	2753
at A (head)	1:1.5	6645
	1:2	5781
	1:3	4817
at B (head)	1:1.5	5240
	1:2	4559
	1:3	3799
Section BC (trunk)	1:1.5	203
	1:2	152
	1:3	101
Section DE (trunk)	1:1.5	2323
	1:2	1742
	1:3	1161
at D (head)	1:1.5	2803
	1:2	2439
	1:3	2032

*Reference Figure 15, page A-126.

Physical Factors Affecting Littoral Transport

The Sturgeon Bay area is classified as Big Sable Dunes shoretype in "Shoretype Classification of Emmet Co., Michigan" by Michigan State University. Analysis of 1973 and 1980 air photos also shows a high foredune along the beach in the area. The height of the foredune bluff is 6 to 30 feet, averaging about 25 feet. Since most of the bluff is dune material, the composition of the bluff is for the most part fine sand. Wind erosion is significant in the area. Measurements from the 1973 and 1980 photos indicate an average bluff recession rate of 1.7 ft/yr. Table 14

summarizes the measurements and Figure 19 on page A-130 shows the locations of the measurements. It should be understood that the measured recession rates are approximate since it was not possible to correct for scale error in the photographs. Littoral drift calculations are shown on pages A-83 to A-86.

Possible Zone of Influence

Comparisons to Cross Village and Frankfort and analysis of 1973 and 1980 air photos determined the possible zone of influence for the proposed harbor at Sturgeon Bay to be a total of 4,500 feet, 3,000 feet downdrift and 1,500 feet updrift (see figure 20, page A-131).

TABLE 14

BLUFF RECESSION MEASUREMENTS - STURGEON BAY POINT

Location	1973 Measurements (Ft)			Avg.	1980 Measurements (Ft)			Avg.	Rate (Ft/yr) (1973-1980)/7
1	445	442	445	444	435	428	428	430	2.0
2	70	71	70	70	68	65	65	66	0.6
3	65	60	62	62	56	56	51	54	1.1
4	221	221	223	222	215	217	215	216	0.9
5	88	86	87	87	68	68	67	68	2.9
6	141	143	146	143	133	125	131	130	1.9
7	780	780	780	780	760	760	760	760	2.9
8	55	60	55	57	50	50	45	48	1.3
								Sum =	13.6
								Avg. =	1.7

Littoral Transport Rates

Using the physical factors above, a gross transport rate can be calculated assuming a certain percentage of the eroded bluff material is transportable. As a check on the above logic, the accreted beach east and northeast of Sturgeon Bay Point was measured from the 1973 and 1980

photos. The accretion rate indicates a net drift rate and accounts for losses, but it is difficult to know precisely what volume of sand accreted. The area accreted can be measured and with that, a reasonable estimate of accreted volume can be made. Pages A-85 and A-86 show the rate calculations and show that the two methods compare reasonably well. A gross rate of about 6650 yd^3/yr is estimated, of which about 80% (5320 yd^3/yr) moves SW to NE and 20% (1330 yd^3/yr) moves NE to SW. A monitoring plan similar to that discussed for Cross Village would be instituted to verify the estimated effects of the proposed harbor on the erosion processes in the area.

TABLE 15

*WIND DATA FROM PELLSTON 1948-1954

Direction	NO. OF DAYS PER YEAR WIND SPEED 0-12 mph	13-24 mph	25+ mph
WSW	16	14	2
W	19	7	1
WNW	22	13	2
NW	16	7	1
NNW	12	4	1
N	7	1	0
NNE	9	2	0

*Used in Littoral Transport Analysis page A-85.

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CROSS VILLAGE HARBOR

Design Conditions

offshore slope: 1:100 = .01

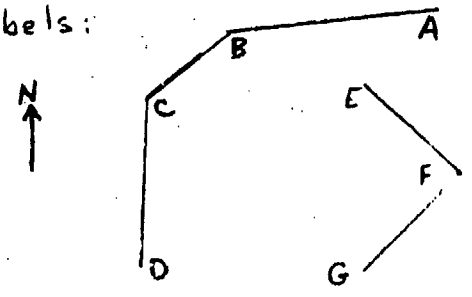
design water level: A 20 year design still water level of 581.5 feet IGLD (1955) was selected combining levels and rise frequency data from Standardized Frequency Curves for Design Water Level Determination on the Great Lakes

10yr level = 580.1 + 2yr rise 1.4 = 581.5

(rise between Pt. Inland and Mackinaw City 2yr values)

depths at structure toe for breakwater sections: the maximum depth along each outer section is used in the following wave analysis. The sections which have landward extensions will be considered for the maximum and minimum depths at the structure toe.

Breakwater Section Labels:



Not to Scale

Section	Depths (below LWD)	Depth (below design water level)
AB	12.2	16.9
BC	12.0	16.7
CD	11.7 at C	16.4
	0.0 at D	4.7
EF	11.0 at E	15.7
	3.0 at F	7.7
FG	3.0 at F	7.7
	0.0 at G	4.7

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WAVE DATA

Design Waves were selected from the WES report: Design Wave Information for the Great Lakes - Lake Michigan.

For Runup and Crest Height Determination, 20 year summer waves were used, combining Sturgeon Bay and Harbor Springs grid points.

Direction	Wave Height (Ft)	Period (Sec)
NNE*	4.6	5.5
N	5.6	6.5
NNWxW (N30W)	9.8	7.9
WSW (S 20 W)	14.8	9.2

* Angle Class 3, Sturgeon Bay, SSE wave. Since Cross Village is on the opposite side of the bay, we consider the fetches similar but in the opposite direction

Section	Attacking Wave Direction, Height, Period		
AB and BC	NNWxW	9.8 ft.	7.9 sec
CD	WSW	14.8 ft.	9.2 sec
EF and FG	NNE	4.6 ft.	5.5 sec

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COMPUTATION SHEET

PROJECT CROSS VILLAGE

ITEM REFRACTION

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COEFFICIENTS AS PREVIOUSLY COMPUTED

WAVE: NNE

$d_{at\,E} = 15.7$ $H_o = 4.6'$ $T = 5.5$ sec $K_R = .82$

$L_o = 5.12\,T^2 = 5.12\,(5.5)^2 = 154.9$ ft.

$\frac{d}{L_o} = \frac{15.7}{154.9} = .1014$

From SPM Appendix, Table C-1

$K_s = \frac{H}{H_o'} = .9316$

$H = K_s K_R H_o = .9316\,(.82)(4.6) = 3.5$

$H_o' = \frac{H}{K_s} = \frac{3.5}{.9316} = 3.8'$

$\frac{d}{L} = .1508$ $L = 104.1'$

WAVE: NNW x W

$d_{at\,AB} = 16.9$ $H_o = 9.8$ $T = 7.9$ $K_R = .98$

$L_o = 5.12\,T^2 = 5.12\,(7.9)^2 = 319.5$

$\frac{d}{L_o} = \frac{16.9}{319.5} = .05290$

From SPM Appendix Table C-1

$K_s = 1.013$

$H = K_s K_R H_o = 1.013\,(.98)\,9.8 = 9.7'$

$H_o' = \frac{H}{K_s} = \frac{9.7}{1.013} = 9.6'$

$\frac{d}{L} = .09726$ $L = 173.8'$

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COMPUTATION SHEET

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WAVE: WSW

$d_{co} = 16.4$ $H_o = 14.8$ $T = 9.2$ $K_R = .96$

$L_o = 5.12\,T^2 = 5.12\,(9.2)^2 = 433.4'$

$\frac{d}{L_o} = \frac{16.4}{433.4} = .03784$

From C-1, SPM Appendix

$K_s = \frac{H}{H_o'} = 1.076$

$H = K_s K_R H_o = 1.076(.96)\,14.8 = 15.3'$

$H_o' = \frac{H}{K_s} = \frac{15.3}{1.076} = 14.2'$

$\frac{d}{L} = .08$ $L = 205.0'$

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. ___ OF ___ SHEETS

ITEM BREAKING WAVE ANALYSIS — DATE _____ 19___

FILE _____

COMPUTED BY SLN — CHECKED BY _____ — REF. DRWG. NO. _____

GODA METHOD

slope 1:100 N/A Not Applicable

	WAVE DIRECTION NNE	NNW x W	WSW
h at AB	N/A	16.9	N/A
h at BC	N/A	16.7	N/A
h at C on CD	N/A	N/A	16.4
h at D on CD	N/A	N/A	4.7
h at EF	15.7	N/A	N/A
h at G on FG	4.7	N/A	N/A
H_o'	3.8	9.6	14.2
L_o	154.9	319.5	433.4
H_o'/L_o	.025	.030	.033

FROM GODA (1975) FIG. 15:

$H_{1/3}pk/H_o'$	1.0	.97	.96

$H_{1/3}pk = \frac{H_{1/3}pk}{H_o'} \times H_o'$

$H_{1/3}pk$	3.8	9.3	13.6

FROM GODA (1975) FIG. 16: Depth

$h_{1/3}pk/H_o'$	2.19	2.19	2.19
$h_{1/3}pk$	8.3	21.0	31.1

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If: $h_{\frac{1}{3}pk} > d_{SWL}$ Wave is Broken (Br)

$h_{\frac{1}{3}pk} < d_{SWL}$ Wave is Nonbreaking (NB)

$h_{\frac{1}{3}pk} = d_{SWL}$ Wave is Breaking (B)

WAVE CONDITION

	NNE	NNWxW	WSW
at AB	N/A	Br	N/A
BC	N/A	Br	N/A
C on CD	N/A	N/A	Br
D on CD	N/A	N/A	Br
EF	NB	N/A	N/A
G on FG	Br	N/A	N/A

$\frac{h}{H_o'}$

at AB	N/A	1.76	N/A
BC	N/A	1.74	N/A
C on CD	N/A	N/A	1.15
D on CD	N/A	"	.33
E	4.13	"	N/A
F	2.03	"	N/A
G	1.24	"	N/A

FROM GODA (1977) charts .01 slope

$H_{\frac{1}{3}}/H_o'$

AB	—	.92	—
BC	—	.92	—
C	—	—	.73
D	—	—	.28
E	.97	—	—
F	.97	—	—
G	.78	—	—

$H_{\frac{1}{3}}$

AB	—	8.8	—
BC	—	8.8	—
C	—	—	10.4
D	—	—	4.0
E	3.7	—	—
F	3.7	—	—
G	3.0	—	—

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. ___ OF ___ SHEETS
ITEM RUNUP — DATE ___ 19___
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RUNUP, SECTIONS AB and BC H_s = 8.8' from NNWxW

from CETA 77-6:

$$R = H_s \left[\frac{.692}{.504 + \left(\sqrt{H_s/L_o} \right) \cot\theta} \right]$$

$H_s = H_I$ θ = Breakwater slope

1:1.5 slope

$$R = 8.8 \left[\frac{.692}{.504 + \sqrt{8.8/314.5}\,(1.5)} \right] = 8.1'$$

1:2 slope (2) = 7.3'

1:3 slope (3) = 6.1'

RUNUP, SECTION CD at C H_s = 10.4 from WSW

1:1.5 slope

$$R = 10.4 \left[\frac{.692}{.504 + \sqrt{10.4/433.4}\,(1.5)} \right] = 9.8'$$

1:2 slope (2) = 8.8'

1:3 slope (3) = 7.4'

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. ___ OF ___ SHEETS
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RUNUP, SECTION CD at D $H_{\frac{1}{3}} = 4.0$ From WSW

1:1.5 slope

$$R = 4.0 \left[\frac{.692}{.504 + \sqrt{4.0/433.9}\,(1.5)} \right] = 4.3'$$

1:2 slope (2) = 4.0'

1:3 slope (3) = 3.5'

RUNUP, SECTION EF $H_{\frac{1}{3}} = 3.7$ From NNE

1:1.5 slope

$$R = \left[\frac{.692}{.504 + \sqrt{3.7/154.9}\,(1.5)} \right] = 3.5'$$

1:2 slope (2) = 3.1'

1:3 slope (3) = 2.6'

RUNUP, SECTION FG at G $H_{\frac{1}{3}} = 3.0$ From NNE

1:1.5 slope

$$R = \left[\frac{.692}{.504 + \sqrt{3.0/154.9}\,(1.5)} \right] = 2.9'$$

1:2 slope (2) = 2.7'

1:3 slope (3) = 2.3'

COMPUTATION SHEET

PROJECT CREST HEIGHTS — SHEET NO. ___ OF ___ SHEETS
ITEM CREST HEIGHTS — DATE ___ 19___
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CREST HEIGHTS

Use CETA 79-6 equation:

$$K_T = \frac{H_T}{H_I} = \left(.51 - .11\frac{B}{h}\right)\left(1 - \frac{h - d_s}{R}\right)$$

CREST HTS. WILL BE DETERMINED FOR 1:1.5 and 1:3 slopes

SECTIONS AB and BC
assume $B = 10'$
use $d_s = 16.9$
$H_I = 8.8$

1:1.5 slope $R = 8.1$
1:3 $R = 6.1$

For .5' wave in berthing areas:

* $H_T = .83$ $\quad .83 \times K_D = .83 \times .6 = .5'$

1:1.5 slope $\quad K_T = \frac{.83}{8.8} = \left(.51 - \frac{.11(10)}{h}\right)\left(1 - \frac{h - 16.9}{8.1}\right)$

guess h
$h = 23.4$

$.094 \geq .091$

CREST HT = 23.4 − 12.2 = +11.2'

1:3 slope $\quad K_T = \frac{.83}{8.8} = \left(.51 - \frac{1.1}{h}\right)\left(1 - \frac{h - 16.9}{6.1}\right)$

guess $h = 21.8$

$.094 \geq .090$

CREST HT = 21.8 − 12.2 = +9.6'

Diffraction due to overtopping has been considered where appropriate. The validity of this procedure was confirmed (and suggested) by C. Johnson NCDED-C, in an August 80 telecon.

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PROJECT CROSS VILLAGE — SHEET NO. ___ OF ___ SHEETS
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SECTIONS AB and BC, 1.5' wave in berthing areas

$H_T = 2.5$ $\quad 2.5 \times K_D = 2.5 \times .6 = 1.5$

1:1.5 $\quad K_T = \frac{2.5}{8.8} = \left(.51 - \frac{1.1}{h}\right)\left(1 - \frac{h-16.9}{8.1}\right)$

guess $h = 20.0$

$.284 \geq .281$

CREST HT = 20.0 - 12.2 = +7.8'

1:3 slope $\quad K_T = \frac{2.5}{8.8} = \left(.51 - \frac{1.1}{h}\right)\left(1 - \frac{h-16.9}{6.1}\right)$

guess $h = 19.2$

$.284 \geq .282$

CREST HT = 19.2 - 12.2 = +7.0'

SECTION CD at C .5' wave in berthing area

$H_T = 1.25$ $\quad 1.25 \times K_D = 1.25 \times .4 = .5$ $\quad d_s = 16.4$ $\quad H_I = 10.4$

1:1.5 slope $R = 9.8$
1.3 $R = 7.4$

1:1.5 slope $\quad K_T = \frac{1.25}{10.4} = \left(.51 - \frac{1.1}{h}\right)\left(1 - \frac{h-16.4}{9.8}\right)$

guess $h = 23.7$

$h = 23.7$

$.120 \geq .118$

CREST HT = 23.7 - 11.7 = +12.0'

1:3 slope $\quad K_T = \frac{1.25}{10.4} = \left(.51 - \frac{1.1}{h}\right)\left(1 - \frac{h-16.4}{7.4}\right)$

guess $h = 21.9$

$.120 \geq .118$

CREST HT = 21.9 - 11.7 = +10.2'

COMPUTATION SHEET

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SECTION CD at C 1.5' wave in berthing areas

$H_T = 3.75$ $\quad 3.75 \times K_D = 3.75 \times .4 = 1.5$

1:1.5 slope

$$K_T = \frac{3.75}{10.4} = \left(.51 - \frac{1.1}{h}\right)\left(1 - \frac{h-16.4}{9.8}\right)$$

guess $h = 18.4$

$.361 \geq .358$

CREST HT $= 18.4 - 11.7 = +6.7'$

1:3 slope

$$K_T = \frac{3.75}{10.4} = \left(.51 - \frac{1.1}{h}\right)\left(1 - \frac{h-16.4}{7.4}\right)$$

guess $h = 17.9$

$.361 \geq .358$

CREST HT $= 17.9 - 11.7 = +6.2'$

SECTION CD at D .5' interior wave

$H_T = .5$ $\quad d_s = 4.7$ $\quad H_I = 4.0$

1:1.5 slope $R = 4.3$

1:3 slope $R = 3.5$

1:1.5

$$K_T = \frac{.5}{4.0} = \left(.51 - \frac{1.1}{h}\right)\left(1 - \frac{h-4.7}{4.3}\right)$$

guess $h = 7.6$

$.125 \geq .119$

CREST HT $= +7.6'$

1:3 slope

$$K_T = \frac{.5}{4.0} = \left(.51 - \frac{1.1}{h}\right)\left(1 - \frac{h-4.7}{3.5}\right)$$

guess $h = 7.0$

$.125 \geq .121$

CREST HT $= 7.0 - 0.0 = +7.0'$

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SECTION CD at D — 1.5' interior wave

$H_T = 1.5$

1:1.5 slope $K_T = \frac{1.5}{4.0} = (.51 - \frac{1.1}{h})(1 - \frac{h-4.7}{4.3})$

guess $h = 4.4$

$.375 \geq .278$ (max. value)

CREST HT = +4.4'

1:3 slope $K_T = \frac{1.5}{4.0} = (.51 - \frac{1.1}{h})(1 - \frac{h-4.7}{3.5})$

guess $h = 4.2$

$.375 \geq .284$ (max. value)

CREST HT = 4.2 − 0.0 = +4.2'

IF 4.4' and 4.2' are used, the breakwater would be submerged at this point at the design water level. NCDED-C says keep above SWL to maintain fishing access, eliminate boating hazards. So, set crest height at +5.0'.

SECTION EF — .5' interior wave

$H_T = .5$ $d_s = 15.7$ $H_I = 3.7'$

1:1.5 slope R: 3.5'
1:3 R: 2.6'

1:1.5 slope $K_T = \frac{.5}{3.7} = (.51 - \frac{1.1}{h})(1 - \frac{h-15.7}{3.5})$

guess $h = 18.2$

$.135 \geq .128$

CREST HT = 18.2 − 11.0 = +7.2'

1:3 slope $K_T = \frac{.5}{3.7} = (.51 - \frac{1.1}{h})(1 - \frac{h-15.7}{2.6})$

guess $h = 17.6$

$.135 \geq .120$

CREST HT = 17.6 − 11.0 = +6.6'

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SECTION EF 1.5' interior wave

1:1.5 $K_T = \frac{1.5}{3.7} = (.51 - \frac{1.1}{h})(1 - \frac{h-15.7}{3.5})$

guess $h = 16.0$

$.405 \geq .403$

CREST HT: $16.0 - 11.0 = +5.0'$

1:3 slope $K_T = \frac{1.5}{3.7} = (.51 - \frac{1.1}{h})(1 - \frac{h-15.7}{2.6})$

guess $h = 16.0$

$.405 \geq .390$

CREST HT = $16.0 - 11.0 = +5.0'$

SECTION FG .5' interior wave

$H_T = .5$ $d_s = 4.7$ $H_I = 3.0'$

1:1.5 slope $R = 2.9'$
1:3 slope $R = 2.3'$

1:1.5 slope $K_T = \frac{.5}{3.0} = (.51 - \frac{1.1}{h})(1 - \frac{h-4.7}{2.9})$

guess $h = 6.2$

$.167 \geq .161$

CREST HT = $6.2 - 0.0 = +6.2'$

1:3 slope $K_T = \frac{.5}{3.0} = (.51 - \frac{1.1}{h})(1 - \frac{h-4.7}{2.3})$

guess $h = 5.9$

$.167 \geq .155$

CREST HT = $5.9 - 0.0 = +5.9'$

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SECTION FG 1.5' interior wave

$H_T = 1.5$

1:1.5 $K_T = \frac{1.5}{3.0} = (.51 - \frac{1.1}{h})(1 - \frac{h-4.7}{2.9})$

guess $h = 4.1$

$.500 \geq .292$ (max. value)

CREST HT = $4.1 - 0.0 = +4.1'$

1:3 slope $K_T = \frac{1.5}{3.0} = (.51 - \frac{1.1}{h})(1 - \frac{h-4.7}{2.3})$

guess $h = 3.9$

$.500 \geq .307$ (max value)

CREST HT = $3.9 - 0.0 = +3.9'$

4.1' and 3.9' are below design water level. To maintain access for fishermen and to eliminate the navigational hazard of a partially submerged breakwater, NCDED-C says keep it above design SWL.
So, set the crest height along FG to +5.0'.

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. ___ OF ___ SHEETS
ITEM ARMOR STONE SIZES — DATE ___ 19___
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ARMOR STONE SIZING

Use SPM Equation 7-110:

$$W = \frac{W_r H^3}{K_D (S_r - 1)^3 \cot \alpha}$$

W = weight armor stone, lbs.
W_r = sp. wt. of armor stone unit, lbs/cu. ft.
= 165 lbs/cu. ft. at Cross Village
H = wave height, ft.
S_r = sp. gravity of armor stone relative to the water ($S_r = 165/62.4$)
α = angle of breakwater slope
K_D = coefficient depending on shape, roughness, sharpness, and degree of interlock of the armor stone.

For Cross Village all waves are breaking, and a 2 layer rough angular armor stone was considered. From SPM Table 7-7, the following K_D values are obtained:

	Structure Trunk	Structure Head	
			slope
K_D values:	3.5	2.9	1:1.5
		2.5	1:2
		2.0	1:3

The significant wave height of 20 year winter deepwater waves will be used. From the WES report Design Wave Info . . . , Sturgeon Bay and Harbor Springs grid points, the waves attacking the breakwater sections at Cross Village are:

Section	Attacking Wave Direction, Ht, Period		
AB and BC	NNWxW	15.4	10.2
CD	WSW	20.3	10.9
EF and FG	NNE	5.2	5.7

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The waves must be refracted to find H_o'

WAVE: NNE

$dat\,E = 15.7 \quad H_o = 5.2 \quad T = 5.7 \quad K_R = .82$

$L_o = 5.12\,T^2 = 5.12(5.7)^2 = 166.3$

$\frac{d}{L_o} = \frac{15.7}{166.3} = .09441$

from SPM Appendix Table C-1:

$K_s = \frac{H}{H_o'} = .9377$

$H = K_s K_R H_o = .9377\,(.82)\,5.2 = 4.0$

$H_o' = \frac{H}{K_s} = \frac{4.0}{.9377} = 4.3'$

WAVE: NNWxW

$dat\,AB = 16.9 \quad H_o = 15.4 \quad T = 10.2 \quad K_R = .98$

$L_o = 5.12\,T^2 = 5.12\,(10.2)^2 = 532.7$

$\frac{d}{L_o} = \frac{16.9}{532.7} = .03173$

Table C-1:

$K_s = \frac{H}{H_o'} = 1.113$

$H = K_s K_R H_o = 1.113\,(.98)\,15.4 = 16.8$

$H_o' = \frac{H}{K_s} = \frac{16.8}{1.113} = 15.1'$

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WAVE: WSW

$d_{at\ C} = 16.4 \quad H_o = 20.3 \quad T = 10.9 \quad K_R = .96$

$L_o = 5.12\,T^2 = 5.12\,(10.9)^2 = 608.3$

$\frac{d}{L_o} = \frac{16.4}{608.3} = .02696$

from Table C-1,

$K_s = H/H_o' = 1.15$

$H = K_s K_R H_o = 1.15\,(.96)\,20.3 = 22.4$

$H_o' = \frac{H}{K_s} = \frac{22.4}{1.15} = 19.5'$

To determine significant wave height using GODA (1975) diagrams for .01 slope:

WAVE	h/H_o'		H_o'/L_o	$H_{\frac{1}{3}}/H_o'$	$H_{\frac{1}{3}}$
NNE	at EF	$\frac{15.7}{4.3} = 3.7$	.026	.98	4.2
	at G	$\frac{4.7}{4.3} = 1.1$	.026	.71	3.1
NNWxW	at AB + BC	$\frac{16.9}{15.1} = 1.1$	.028	.72	10.9
WSW	at C	$\frac{16.4}{19.5} = .84$	.032	.56	10.9
	at D	$\frac{4.7}{19.5} = .24$	.032	.23	4.5

Check SPM fig. 7-4, If $H_b < H_{\frac{1}{3}}$, use H_b

Wave	d/gT^2		H_b/d_s	H_b	$H_{\frac{1}{3}}$	use
NNE	at EF	= .015	.79	12.4	4.2	4.2
	at G	= .0045	.85	4.0	3.1	3.1
NNWxW	at AB + BC	= .005	.85	14.4	10.9	10.9
WSW	at C	= .0043	.85	13.9	10.9	10.9
	at D	= .0012	.87	4.1	4.5	4.1

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COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. ___ OF ___ SHEETS
ITEM ARMOR STONE SIZES — DATE ___ 19___
FILE ___
COMPUTED BY SEN — CHECKED BY ___ — REF. DRWG. NO. ___

ARMOR STONE CALCULATIONS

SECTIONS AB and BC, trunk

$H = 8.9$ $K_D = 3.5$

1:1.5 slope

$$W = \frac{165\,(10.9)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(1.5)} = 9156 \text{ lbs}$$

1:2 slope

$$W = \frac{165\,(10.9)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(2)} = 6867 \text{ lbs}$$

1:3 slope

$$W = \frac{165\,(10.9)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(3} = 4578 \text{ lbs}$$

at A and B, (head)

1:1.5 slope

$$W = \frac{165\,(10.9)^3}{2.9\left(\frac{165}{62.4}-1\right)^3(1.5)} = 11{,}051 \text{ lbs}$$

1:2 slope

$$W = \frac{165\,(10.9)^3}{2.5\left(\frac{165}{62.4}-1\right)^3(2)} = 9615 \text{ lbs}$$

1:3 slope

$$W = \frac{165\,(10.9)^3}{2.0\left(\frac{165}{62.4}-1\right)^3(3} = 8011 \text{ lbs}$$

SECTION CD (trunk) H = 10.2

1:1.5 slope

$$W = \frac{165\,(10.9)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(1.5)} = 9156 \text{ lbs}$$

1:2 slope

$$W = \frac{165\,(10.9)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(2)} = 6867 \text{ lbs}$$

1:3 slope

$$W = \frac{165\,(10.9)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(3} = 4578 \text{ lbs}$$

at C (head)

1:1.5 slope

$$W = \frac{165\,(10.9)^3}{2.9\left(\frac{165}{62.4}-1\right)^3(1.5)} = 11051 \text{ lbs.}$$

1:2 slope

$$W = \frac{165\,(10.9)^3}{2.5\left(\frac{165}{62.4}-1\right)^3(2)} = 9615 \text{ lbs}$$

1:3 slope

$$W = \frac{165\,(10.9)^3}{2.0\left(\frac{165}{62.4}-1\right)^3(3} = 8011 \text{ lbs}$$

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. ___ OF ___ SHEETS
ITEM ARMOR STONE SIZES — DATE ___ 19___
FILE ___
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at D

stone size does not need to be as large at the landward end, so it can be tapered to the following size if possible:

$H = 4.0$ $K_D = 3.5$

1:1.5 slope

$$W = \frac{165(4.1)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(1.5)}$$

$= 487$ lbs.

1:2 slope

$$W = \frac{165(4.1)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(2)}$$

$= 365$ lbs.

1:3 slope

$$W = \frac{165(4.1)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(3)}$$

$= 243$ lbs.

SECTION EF (trunk)

$H = 4.7$ $K_D = 3.5$

1:1.5 slope

$$W = \frac{165(4.2)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(1.5)}$$

$= 524$ lbs.

1:2 slope

$$W = \frac{165(4.2)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(2)}$$

$= 393$ lbs.

1:3 slope

$$W = \frac{165(4.2)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(3)}$$

$= 262$ lbs.

at E and F (head)

1:1.5 slope

$$W = \frac{165(4.2)^3}{2.9\left(\frac{165}{62.4}-1\right)^3(1.5)}$$

$= 632$ lbs.

1:2 slope

$$W = \frac{165(4.2)^3}{2.5\left(\frac{165}{62.4}-1\right)^3(2)}$$

$= 550$ lbs.

1:3 slope

$$W = \frac{165(4.2)^3}{2.0\left(\frac{165}{62.4}-1\right)^3(3)}$$

$= 458$ lbs.

SECTION FG

due to the orientation, use wave height at G $H = 3.9$

1:1.5 slope

$$W = \frac{165(3.1)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(1.5)}$$

$= 210$ lbs.

1:2 slope

$$W = \frac{165(3.1)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(2)}$$

$= 158$ lbs.

1:3 slope

$$W = \frac{165(3.1)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(3)}$$

$= 105$ lbs.

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COMPUTATION SHEET

PROJECT Cross Village Harbor

ITEM Littoral Transport - Shoreline Recession - Accretion

COMPUTED BY RVE CHECKED BY

SHEET NO. 1 OF 3 SHEETS

DATE 19

FILE

REF. DRWG. NO.

1. Nearshore bluff height (Foredune) — 30 Feet

Sources: (a.) Michigan State Univ. Shoretype Classification Bulletin for Emmett County

(b.) Field trip to Cross Village area.

2. Average annual bluff recession rate in Cross Village area — 1.2 Feet

Source: Michigan Dept of Nat. Res. Bluff Recession Rate Study Emmett County.

3. Estimated zone of influence of harbor — 5,000 feet

(a.) Estimated erosion zone = 2200 Feet

(b.) Estimated accretion zone = 2800 Feet

Sources: (a) 1973, 1977 aerial photographs

(b.) Comparison to effect of Frankfort Harbor.

(c.) Field trip

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COMPUTATION SHEET

PROJECT Cross Village
ITEM Littoral Transport - Shoreline Recession - Accretion
COMPUTED BY RJE CHECKED BY

SHEET NO. 3 OF 3 SHEETS
DATE ____ 19__
FILE ____
REF. DRWG. NO. ____

4. Estimate of Littoral Transport Rates

nearshore bluff height (30') x average annual nearshore bluff recession rate (1.2')

$30 \times 1.2 = 36 \text{ FT}^2$

estimated length of harbor effect (5,000)

$36 \text{ Ft}^2 \times 5{,}000 = 180{,}000 \text{ FT}^3$

convert above figure to cubic yards

$180{,}000 \text{ ft}^3 \div 27 = 6{,}666 \text{ yd}^3$

estimated that 90 percent of sediment material in nearshore bluff capable of being incorporated into littoral drift

$6{,}666 \text{ yd}^3 \times 90\% = 5999 \text{ yd}^3$

say **6000 yd³**

5. Estimated that 80 % of littoral transport moves from southwest to northeast

$6{,}000 \times 80\% =$ **4800 yd³**

6. Remainder moves from northeast to southwest

$6{,}000 - 4800 =$ **1200 yd³**

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COMPUTATION SHEET

PROJECT Cross Village Harbor

ITEM Littoral Transport - Harbor Erosion

COMPUTED BY RVL CHECKED BY

SHEET NO. 3 OF 3 SHEETS

DATE 7 APR 80

FILE

REF. DRWG. NO.

7. Estimated that an average quantity of about 3800 cubic yards or about 80 percent of littoral drift moving from the south west direction will be blocked by proposed harbor structures in first 6 years (average between 4 and 8 years that bypassing would likely occur) after construction of harbor. The quantity of littoral drift expected to be blocked by harbor after 6 years will be reduced by about 25 to 50 percent once natural by passing around harbor occurs. Thus quantity of beach nourishment required on an average to mitigate harbor induced erosion estimated to be [3800 cubic yards] annually. It is further estimated that the proposed harbor will be responsible for about [15 percent] of total erosion that would occur northeast of harbor and that the harbor erosion will extend to approximately [4000 feet] northeast of the harbor. The above amounts were based primarily on engineering judgement although the effects of the harbor structure at Frankfort Harbor were used as a general guide.

COMPUTATION SHEET

PROJECT CROSS VILLAGE | SHEET NO. 1 OF 18 SHEETS
ITEM GOOD HART PLAN | DATE _____ 19__
FILE _____
COMPUTED BY SFN | CHECKED BY RJE | REF. DRWG. NO. _____

GOOD HART WAVE ANALYSIS

offshore slope 1:50 (.02)

design water level: 581.5 Ft. IGLD (+4.7') as selected for the Cross Village site.

design wave information: Summer 20 year deep water waves were selected from WES T.R. H-76-1, Harbor Springs and Sturgeon Bay grid points.

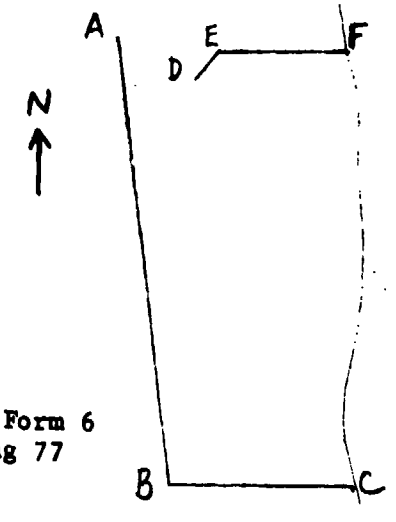
Wave Direction	Height (Ft.)	Period (Sec.)	KR (Refraction Coef.)
N	5.6	6.5	.69
NNW	9.8	7.9	1.10
W	14.8	9.2	.95
WSW	14.8	9.2	.85

Refraction coefficients were determined from computer-drawn refraction diagrams for the wave directions above.

It appears that the NNW wave will have a greater impact than the N wave due to higher waves and less refraction; therefore, the NNW wave will be used for runup and crest height determination on Sections DE and EF.

Depths at Structure toe:

Location	Depth (LWD)	Depth (at d.w.l.)
A	} use 10.2	14.9
B		
C	0.0	4.7
D	} use 5.0	9.7
E		
F	0.0	4.7



Schematic (No Scale, roughly proportional to plan)

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 2 OF 12 SHEETS

ITEM GOOD HART REFRACTION — DATE _____, 19__

FILE _____

COMPUTED BY SFN — CHECKED BY RJE — REF. DRWG. NO. _____

REFRACTION

NNW Wave

$d_{DE} = 9.7$ $H_o = 9.8'$ $T = 7.9$ $K_R = 1.10$

$L_o = 5.12\,T^2 = 319.5$

$\frac{d}{L_o} = \frac{9.7}{319.5} = .03036$

from Table C-1, SPM Vol. III

$K_s = \frac{H}{H_o'} = 1.122$

$H = K_s K_R H_o = 1.122(1.1)\,9.8 = 12.1'$

$H_o' = \frac{H}{K_s} = \frac{12.1}{1.122} = 10.8'$

$\frac{d}{L} = .0718$ $L = 135.1$

W Wave

$d_{AB} = 14.9$ $H_o = 14.8'$ $T = 9.2$ $K_R = .95$

$L_o = 5.12\,T^2 = 5.12(9.2)^2 = 433.4'$

$\frac{d}{L_o} = \frac{14.9}{433.4} = .03438$

from Table C-1, SPM Appendix

$K_s = \frac{H}{H_o'} = 1096$

$H = K_s K_R H_o = 1.096(.95)\,14.8 = 15.4'$

$H_o' = \frac{H}{K_s} = \frac{15.4}{1.096} = 14.1'$

$\frac{d}{L} = .07675$ $L = 194.1'$

N wave

$d = 9.7$ $H_o = 5.6$ $T = 6.5$ $K_R = .69$

$L_o = 5.12\,T^2 = 5.12(6.5)^2 = 216.3$

$\frac{d}{L_o} = \frac{9.7}{216.3} = .04485$

$K_s = \frac{H}{H_o'} = 1.043$ $H = K_s K_R H_o = 1.043(.69)\,5.6 = 4.0'$

$H_o' = H/K_s = \frac{4.0}{1.043} = 3.8'$

$\frac{d}{L} = .08867$ $L = 109.1$

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COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 3 OF 18 SHEETS

ITEM GOOD HART REFRACTION — DATE _____ 19 ____

FILE _____

COMPUTED BY CFN — CHECKED BY RVL — REF. DRWG. NO. _____

WSW Wave

$d_B = 14.9$ $H_o = 14.8'$ $T = 9.2$ $K_R = .85$

$L_o = 5.12\,T^2 = 5.12\,(9.2)^2 = 433.4$

$\frac{d}{L_o} = \frac{14.9}{433.4} = .03438$

From Table C-1, SPM Appendix

$K_s = \frac{H}{H_o'} = 1.096$

$H = K_s K_R H_o = 1.096\,(.85)\,14.8 = 13.8'$

$H_o' = \frac{H}{K_s} = \frac{13.8}{1.096} = 12.6'$

$\frac{d}{L} = .07675$ $L = 194.1'$

BREAKING WAVE ANALYSIS

using GODA method

slope = 1:50 = .02 use .02 charts

N/A = Not Applicable

	WAVE DIRECTION		
	NNW	N'	WSW
h at AB	N/A	14.9	N/A
BC at B	N/A	N/A	8.7
BC at C	N/A	N/A	4.7
DE	9.7	N/A	N/A
EF at E	9.7	N/A	N/A
EF at F	4.7	N/A	N/A
H_o'	10.8	14.1	12.6
L_o	319.5	433.4	433.4
$\frac{H_o'}{L_o}$	.034	.033	.029

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 4 OF 18 SHEETS
ITEM GOOD HART — DATE ____ 19__
FILE ____
COMPUTED BY SFN — CHECKED BY RVE — REF. DRWG. NO. ____

FROM GODA (1975) Fig. 16:

	NNW	W	WSW
$\frac{h_{\frac{1}{3}pk}}{H_o'}$	2.11	2.10	2.09
$h_{\frac{1}{3}pk} = \frac{h_{\frac{1}{3}pk}}{H_o'} H_o'$	22.8	29.6	26.3

IF $h_{\frac{1}{3}pk} > h = d_{SWL}$ Wave is Broken (Br)
$h_{\frac{1}{3}pk} < d_{SWL}$ Wave is Nonbreaking (NB)
$h_{\frac{1}{3}pk} = d_{SWL}$ Wave is Breaking (B)

WAVE CONDITION at:

AB	N/A	Br	N/A
B on BC	N/A	N/A	Br
C on BC	N/A	N/A	Br
DE	Br	N/A	N/A
E on EF	Br	N/A	N/A
F on EF	Br	N/A	N/A

DETERMINE SIGNIFICANT WAVE HEIGHT:
using GODA chart for .02 slope

		WAVE NNW	W	WSW
h/H_o' at	AB	N/A	1.06	N/A
	B on BC	N/A	N/A	.69
	C on BC	N/A	N/A	.37
	DE	.90	N/A	N/A
	E on EF	.90	N/A	N/A
	F on EF	.44	N/A	N/A
$H_{\frac{1}{3}}/H_o'$	AB	—	.71	—
	B on BC	—	—	.50
	C on BC	—	—	.33
	DE	.62	—	—
	E on EF	.62	—	—
	F on EF	.36	—	—
$H_{\frac{1}{3}}$ at	AB	—	10.0	—
	B on BC	—	—	6.3
	C on BC	—	—	4.2
	DE	6.7	—	—
	E on EF	6.7	—	—
	F on EF	3.9	—	—

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COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 5 OF 18 SHEETS

ITEM GOOD HART — DATE ____ 19__

FILE ____

COMPUTED BY SEN — CHECKED BY RDE — REF. DRWG. NO. ____

RUNUP CALCULATIONS

use CERC CETA 79-6 formula:

$$R = H_I \left[\frac{.692}{.504 + \sqrt{H_I/L_o}} \cot\theta \right]$$

$H_I = H_{1/3}$ θ = Breakwater slope

Runup, Section AB $H_{1/3} = 10.0$ from W

1:1.5 slope $R = 10.0 \left[\frac{.692}{.504 + \sqrt{10.0/433.4}\ (1.5)} \right] = 9.5'$

1:2 slope (2) = 8.6'

1:3 slope (3) = 7.2'

Runup, Section BC at B $H_{1/3} = 6.3'$ from WSW

1:1.5 slope $R = 6.3 \left[\frac{.692}{.504 + \sqrt{6.3/433.4}\ (1.5)} \right] = 6.4'$

1:2 slope (2) = 5.9'

1:3 slope (3) = 5.0'

Runup, Section BC at C $H_{1/3} = 4.2'$ from WSW

1:1.5 slope $R = 4.2 \left[\frac{.692}{.504 + \sqrt{4.2/433.4}\ (1.5)} \right] = 4.6'$

1:2 slope (2) = 4.1'

1:3 slope (3) = 3.6'

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 6 OF 18 SHEETS

ITEM GOOD HART — DATE _____ 19___

FILE _____

COMPUTED BY SFN — CHECKED BY KVE — REF. DRWG. NO. _____

Runup, Section DE and EF at E $H_{\frac{1}{3}} = 6.7'$ from NNW

1:1.5 slope $R = 6.7 \left[\frac{.692}{.504 + \sqrt{6.7/319.5}\,(1.5)} \right] = 6.4'$

1:2 slope (2) = 5.8'

1:3 slope (3) = 4.9'

Runup, Section EF at F $H_{\frac{1}{3}} = 3.9$ from NNW

1:1.5 slope $R = 3.9 \left[\frac{.692}{.504 + \sqrt{3.9/319.5}\,(1.5)} \right] = 4.0'$

1:2 slope (2) = 3.7'

1:3 slope (3) = 3.2'

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 7 OF 18 SHEETS
ITEM GOOD HART — DATE _____ 19__
FILE _____
COMPUTED BY SFN — CHECKED BY RJE — REF. DRWG. NO. _____

CREST HEIGHT DETERMINATION

use CERC CETA 79-6 equation:

$$K_T = \frac{H_T}{H_I} = \left(.51 - .11\frac{B}{h}\right)\left(1 - \frac{h - d_s}{R}\right)$$

assume $B = 10$ $\quad H_I = H_{\frac{1}{3}}$

crest heights determined for 1.5' wave in berthing areas.

SECTION AB

$d_s = 14.9$ $\quad H_I = 10.0$ $\quad H_T = 1.5$

1:1.5 slope $\quad R = 9.5$
1:2 slope $\quad R = 8.6$
1:3 slope $\quad R = 7.2$

1:1.5 slope $\quad K_T = \frac{1.5}{10.0} = \left(.51 - \frac{1.1}{h}\right)\left(1 - \frac{h - 14.9}{9.5}\right)$

guess h to fit K_T
$h = 21.4$
$.15 \geq .145$

CREST HT = h − datLWD = 21.4 − 10.2 = +11.2'

1:2 slope $\quad K_T = \frac{1.5}{10} = \left(.51 - \frac{1.1}{h}\right)\left(1 - \frac{h - 14.9}{8.6}\right)$

guess $h = 20.7$
$.15 \geq .149$
CREST HT = 20.7 − 10.2 = +10.5'

1:3 slope $\quad K_T = \frac{1.5}{10} = \left(.51 - \frac{1.1}{h}\right)\left(1 - \frac{h - 14.9}{7.2}\right)$

guess $h = 19.8$
$.15 \geq .145$
CREST HT = 19.8 − 10.2 = +9.6'

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 8 OF 18 SHEETS
ITEM GOOP HART — DATE ____ 19__
FILE ____
COMPUTED BY SEN — CHECKED BY R.W.E — F.C.P. DRWG. NO. ____

Section BC at B

1:1.5 slope R = 6.4' H_I = 6.3' d_s = 8.7
1:2 slope R = 5.9'
1:3 slope R = 5.0'

1:1.5 slope $K_T = \frac{1.5}{6.3} = (.51 - \frac{1.1}{h})(1 - \frac{h-8.7}{6.4})$

guess h = 11.5

.24 ≥ .233

CREST HT = 11.5 - 4.0 = +7.5

1:2 slope $K_T = \frac{1.5}{6.3} = (.51 - \frac{1.1}{h})(1 - \frac{h-8.7}{5.9})$

guess h = 11.2

.242 ≥ .237

CREST HT = 11.2 - 4.0 = +7.2'

1:3 slope $K_T = \frac{1.5}{6.3} = (.51 - \frac{1.1}{h})(1 - \frac{h-8.7}{5.0})$

guess h = 10.8

.24 ≥ .237

CREST HT = 10.8 - 4.0 = +6.8'

SECTION BC at C

1:1.5 slope R = 4.6
1:2 slope R = 4.1
1:3 slope R = 3.6

$K_T = \frac{1.5}{4.2} = (.51 - \frac{1.1}{h})(1 - \frac{4.7}{4.6})$

guess h =

.36 ≥

unworkable without having crest ht < 4.7'; so use crest ht $h = d_s + R - 1.5 - d_{LWD}$

1:1.5 slope $h = 4.7 + 4.6 - 1.5 - 0 = +7.8'$
1:2 slope $h = 4.7 + 4.1 - 1.5 - 0 = +7.3'$
1:3 slope $h = 4.7 + 3.6 - 1.5 - 0 = +6.8'$

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 9 OF 18 SHEETS
ITEM GOOD HART — DATE ____ 19__
FILE ____
COMPUTED BY SFN — CHECKED BY R DE — REF. DRWG. NO. ____

Section DE and EF at E

$H_I = 6.7'$ $d_s = 9.7$

1:1.5 slope $R = 6.4'$
1:2 slope $R = 5.8'$
1:3 slope $R = 4.9'$

1:1.5 slope $K_T = \frac{1.5}{6.7} = (.51 - \frac{1.1}{h})(1 - \frac{h-9.7}{6.4})$

guess $h = 12.8$

$.22 \geq .219$

CREST HT = 12.8 − 5.0 = +7.8'

1:2 slope $K_T = \frac{1.5}{6.7} = (.51 - \frac{1.1}{h})(1 - \frac{h-9.7}{5.8})$

guess $h = 12.5$

$.22 \geq .218$

CREST HT = 12.5 − 5.0 = +7.5'

1:3 slope $K_T = \frac{1.5}{6.7} = (.51 - \frac{1.1}{h})(1 - \frac{h-9.7}{4.9})$

guess $h = 12.1$

$.22 \geq .214$

CREST HT = 12.1 − 5.0 = +7.1'

SECTION EF at F

$H_I = 3.9'$ $d_s = 4.7$

1:1.5 slope $R = 4.0$
1:2 slope $R = 3.7$
1:3 slope $R = 3.2$

use $h = d_s + R - 1.5$, subtract d_{LWD} to determine crest height

1:1.5 slope $h = 4.7 + 4.0 - 1.5 - 0 = +7.2$
1:2 slope $h = 4.7 + 3.7 - 1.5 - 0 = +6.9$
1:3 slope $h = 4.7 + 3.2 - 1.5 - 0 = +6.4$

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 10 OF 18 SHEETS

ITEM GOOD HART ARMOR STONE — DATE ____ 19__

FILE ____

COMPUTED BY ____ CHECKED BY SFN JA — REF. DRWG. NO. ____

ARMOR STONE SIZES

For the purpose of selecting armor stone, 20 year winter deep water waves are selected from WES T.R. H-76-1.

Wave Direction	Height (Ft.)	Period (Sec.)	K_R
N	8.9	7.1	.69
NNW	15.4	10.2	1.10
W	20.3	10.9	.95
WSW	20.3	10.9	.85

NNW wave direction and height (15.4') will be used in place of N wave direction and height of 8.9 ft.

WAVE : NNW

$d_{at\ DE} = 9.7$, $H_o = 15.4$, $T = 10.2$, $K_R = 1.10$

$L_o = 5.12\,T^2 = 5.12\,(10.2)^2 = 532.7$

$d/L_o = 9.7/532.7 = .0182$

From Table C-1, SPM 111

$K_S = H/H_o = 1.252$

$H = K_S K_R H_o = 1.252\,(1.10)15.4 = 21.21'$

$H_o' = H/K_S = 21.21/1.252 = 16.94'$

WAVE : NNW

$d_{EF\ at\ E} = 9.7$, $H_o = 15.4$, $T = 10.2$, $K_R = 1.10$

$\Rightarrow H_o' = 16.94'$ (see previous computation

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COMPUTATION SHEET

PROJECT Gross Village

ITEM Good Hart armor stone

SHEET NO. 11 OF 18 SHEETS

DATE _____ 19 ____

FILE _____

REF. DRWG. NO. _____

COMPUTED BY _____ CHECKED BY SFN JA

WAVE: NNW

$d_{EF \text{ at } F} = 4.7'$, $H_o = 15.4'$, $T = 10.2$, $K_R = 1.10$

$L_o = 5.12\,T^2 = 5.12(10.2)^2 = 532.7$

$d/L_o = 4.7/532.7 = .0088$

From Table C-1, SPM 111

$K_S = H/H_o = 1.478$

$H = K_S K_R H_o = 1.478(\overset{1.1}{\cancel{1.252}})(15.4) = \overset{25.0}{\cancel{28.497}}$

$H_o' = H/K_S = \overset{25.0}{\cancel{28.497}}/1.478 = \overset{16.9}{\cancel{19.28}}'$

WAVE: W

$d_{AB} = 14.9$, $H_o = 20.3'$, $T = 10.9$, $K_R = .95$

$L_o = 5.12\,T^2 = 5.12(10.9)^2 = 608.3$

$d/L_o = 14.9/608.3 = .0245$

From Table C-1, SPM 111

$K_S = H/H_o = 1.173$

$H = K_S K_R H_o = 1.173(.95)(20.3) = 22.62$

$H_o' = H/K_S = 22.62/1.173 = 19.28$

WAVE: WSW

$d_{BC \text{ at } B} = 8.7$, $H_o = 20.3$, $T = 10.9$, $K_R = .85$

$L_o = 5.12\,T^2 = 5.12(10.9)^2 = 608.3$

$d/L_o = 8.7/608.3 = .0143$

COMPUTATION SHEET

PROJECT Cross Village

ITEM Good Hart armor stone

COMPUTED BY _____ CHECKED BY SFN JA

SHEET NO. 12 OF 18 SHEETS

DATE _____ 19 ____

FILE _____

REF. DRWG. NO. _____

From Table C-1, SPM 111

$K_S = H/H_o = 1.32$

$H = K_S K_R H_o = 1.32(.85)20.3 = 22.776$

$H_o' = H/K_S = 22.776/1.32 = 17.255'$

WAVE : WSW

$d_{BC\ at\ C} = 4.7$; $H_o = 20.3$, $T = 10.9$, $K_R = .85$

$L_o = 5.12\,T^2 = 5.12(10.9)^2 = 608.3$

$d/L_o = 4.7/608.3 = .0077$

From Table C-1, SPM 111

$K_S = H/H_o = 1.526$

$H = K_S K_R H_o = 1.526(.85)20.3 = 26.33$

$H_o' = H/K_S = 26.33/1.526 = 17.255$

B

COMPUTATION SHEET

PROJECT Cross Village
ITEM Good Hart armor stone

SHEET NO. 13 OF 18 SHEETS
DATE _____ 19__
FILE _____
REF. DRWG. NO. _____

COMPUTED BY _____ CHECKED BY SFN JA

To determine significant wave height using GODA (1975) diagrams for .02 slope

WAVE	h/H_o'	H_o'/L_o	H_{V_3}/H_o'	H_{V_3}
NNW				
h @ DE & EF = 9.7	$9.7/16.9 = .57$	$16.9/632.7 = .032$	.44	7.4
W h @ AB = 14.9	$14.9/19.3 = .77$	$19.3/608.3 = .032$	.55	10.6
@ A = 9.4	$9.4/19.3 = .49$	.032	.39	7.5
@ B = 8.7	$8.7/19.3 = .45$	.032	.37	7.1
@ BC = 8.7	~~$8.7/19.3 = .45$~~ $8.7/17.3 = .50$	~~$17.3/608.3 = .032$~~ $.020/.032$	~~.37~~ .40	~~7.1~~ 6.9

check SPM Fig 7-4, if $H_b < H_{V_3}$) use H_b

WAVE	d/gT^2	H_b/d_s	H_b	H_{V_3}	use
NNW					
DE & EF	$9.7/32.2(10.2)^2 = .0029$	.95	9.2	7.4	7.4
W					
AB	.0039	.94	14.0	10.6	10.6
A	00245	.96	9.0	7.5	7.5
B	.00227	.96	8.4	7.1	7.1
BC	.00227	.96	8.4	~~7.1~~ 6.9	~~7.1~~ 6.9

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 14 OF 18 SHEETS
ITEM GOOD HART — DATE ____ 19__
FILE ____
COMPUTED BY ____ CHECKED BY SFT VA — REF. DRWG. NO. ____

ARMOR STONE CALCULATIONS

use SPM equation 7-110

$$W = \frac{W_r H^3}{K_D (S_r - 1)^3 \cot\theta}$$

W = weight of armor stone, lbs.
W_r = unit weight of stone, lbs/ft^3
= 165 lbs/ft^3 at Good Hart.
H = design wave height = significant wave height
K_D = a coefficient
$S_r = \frac{W_r}{W_w}$ W_w = 62.4 lbs/ft^3
θ = angle of breakwater slope.

H = SECTION AB, trunk 10.6 K_D = 3.5

1:1.5 slope

$W = \frac{165(10.6)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(1.5)}$ = 8421 lbs

1:2 slope

$W = \frac{165(10.6)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(2)}$ = 6316 lbs

1:3 slope

$W = \frac{165(10.6)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(3)}$ = 4211 lbs

H = at A (head) 7.5

1:1.5 slope

$W = \frac{165(7.5)^3}{2.9\left(\frac{165}{62.4}-1\right)^3(1.5)}$ = 3600 lbs

1:2 slope

$W = \frac{165(7.5)^3}{2.5\left(\frac{165}{62.1}-1\right)^3(2)}$ = 3132 lbs

1:3 slope

$W = \frac{165(7.5)^3}{2.0\left(\frac{165}{62.4}-1\right)^3(3)}$ = 2610 lbs

H = at B (head) 7.1

1:1.5 slope

$W = \frac{165(7.1)^3}{2.9\left(\frac{165}{62.1}-1\right)^3(1.5)}$ = 3054 lbs

1:2 slope

$W = \frac{165(7.1)^3}{2.5\left(\frac{165}{62.1}-1\right)^3(2)}$ = 2657 lbs

1:3 slope

$W = \frac{165(7.1)^3}{2.0\left(\frac{165}{62.4}-1\right)^3(3)}$ = 2214 lbs

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COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 15 OF 18 SHEETS
ITEM GOOD HART — DATE ____ 19__
FILE ____
COMPUTED BY ____ CHECKED BY SFN VA — REF. DRWG. NO. ____

SECTION BC, trunk
H = ~~7.1~~ 6.9 K_D = 3.5

1:1.5 slope

$$W = \frac{165\left(\frac{6.9}{7.1}\right)^3}{(3.5)\left(\frac{165}{62.4}-1\right)^3 1.5}$$

= ~~2531~~ 2323 lbs

1:2 slope

$$W = \frac{165\left(\frac{6.9}{7.1}\right)^3}{(3.5)\left(\frac{165}{62.4}-1\right)^3 2}$$

= ~~1898~~ 1742 lbs

1:3 slope

$$W = \frac{165\left(\frac{6.9}{7.1}\right)^3}{(3.5)\left(\frac{165}{62.4}-1\right)^3 3}$$

= ~~1265~~ 1161 lbs

SECTION DE and EF
H = 7.4 K_D = 3.5

1:1.5 slope

$$W = \frac{165\,(7.4)^3}{(3.5)\left(\frac{165}{62.4}-1\right)^3 1.5}$$

= 2865 lbs

1:2 slope

$$W = \frac{165\,(7.4)^3}{3.5\left(\frac{165}{62.4}-1\right)^3 (2)}$$

= 2149 lbs

1:3 slope

$$W = \frac{165\,(7.4)^3}{3.5\left(\frac{165}{62.4}-1\right)^3 (3)}$$

= 1433 lbs

at D and E (head)
H = 7.4

1:1.5 slope

$$W = \frac{165\,(7.4)^3}{(2.9)\left(\frac{165}{62.4}-1\right)^3 1.5}$$

= 3458 lbs

1:2 slope

$$W = \frac{165\,(7.4)^3}{2.5\left(\frac{165}{62.4}-1\right)^3 (2)}$$

= 3008 lbs

1:3 slope

$$W = \frac{165\,(7.4)^3}{2.0\left(\frac{165}{62.4}-1\right)^3 (3)}$$

= 2507 lbs

COMPUTATION SHEET

PROJECT Cross Village — SHEET NO. 16 OF 18 SHEETS

ITEM Littoral Transport at Good Hart — DATE ____ 19__

FILE ____

COMPUTED BY SEN — CHECKED BY BVS — REF. DRWG. NO. ____

Littoral Transport Analysis

1. Bluff Height 3-6 feet to 30 feet
   Source: Shoreline Classification, Emmett Co., MSU.

   In some areas a low sandy bluff (3-6') is encountered along the shoreline. In places where the moraine runs closer to shore, bluff heights may be as high as 30 feet. From the air photos and from USGS topographic maps, the bluff height in the vicinity of the site averages less than 20 feet. Bluffs just south of Good Hart and north of Island View Hill are 30 to 60 feet high. Considering that the bluffs in the reach of influence are low but that nearby bluffs are very high, we will consider the average bluff height to be 20 feet. 20'

2. Average bluff recession rate

   Source: DNR measurements 1.2'/y

3. Estimated zone of influence of the proposed harbor:

   Existing rock groins about 200 feet long affect the shoreline downdrift for about 3 to 6 times their length.
   The proposed harbor extends 500 feet into the lake

   500 x 6 = 3000 Ft. downdrift

   compares reasonably well with Cross Village, Frankfort.

   Updrift effects, about 2000 ft.

   TOTAL: 2000 + 3000 = 5000 ft. zone of influence. 5000 ft

COMPUTATION SHEET

PROJECT Cross Village
ITEM Littoral Transport at Good Hart

SHEET NO. 17 OF 18 SHEETS
DATE _____ 19__
FILE _____
REF. DRWG. NO. _____

COMPUTED BY SEN CHECKED BY RVE

4. Littoral Transport Rates

a) Gross:

$$\frac{\text{Avg. Bluff Ht} \times \text{Recess Rate} \times \text{Zone Influence}}{27\ ft^3/yd^3}$$

$$= \frac{20 \times 1.2 \times 5000}{27} = \frac{120000}{27} = 4444\ yd^3/yr$$

Bluff material is gravelly sand w/some clay. Estimate that 90% is transportable and not lost

$$4444 \times .9 = 4000\ yd^3/yr = \text{gross rate}$$

b) The dominant direction of littoral drift is South to North. From wind data at Pellston, winds resulting in S - N transport at GoodHart occur about 70% of the time for onshore winds.

So, net drift S-N:

$$4000 \times .7 = 2800\ yd^3/yr$$

Net drift N-S
$4000 \times .3 = 1200\ yd^3/yr$

5. The proposed harbor plan extends to a 10.2 foot depth at LWD. From the most recent soundings, the 12' contour, inside which most littoral material would move, is found within 800 feet of shore. The photos appear to indicate a much narrower zone of significant transport, about 300 feet, the width of the zone from shore to a 4 to 6 foot depth. The harbor plan will block 80 to 100% of this zone. In the first few years following construction and before natural bypassing begins, we estimate that the harbor will block 90% of the material moving in the area.

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COMPUTATION SHEET

PROJECT Cross Village — SHEET NO. 18 OF 18 SHEETS

ITEM Littoral Transport at Good Hart — DATE _____, 19__

FILE _____

COMPUTED BY _____ CHECKED BY RVL — REF. DRWG. NO. _____

The harbor will block about

$2800 \times .9 = 2520$ yd³/yr of drift

moving S to N.

The quantity of littoral material blocked by the harbor will decrease significantly with time as the south beach is built up and natural bypassing occurs. Up to a 50% reduction in blockage may occur as the south fillet builds up an average of 1 yard and out (lakeward) to the present 3 foot contour.

To mitigate harbor induced erosion, beach nourishment is the most cost effective action. Since the harbor will block about 2500 yd³/yr of S-N drift, it is recommended that 2500 yd³/yr be placed north of the harbor to mitigate harbor induced erosion. Since conditions at Cross Village and Good Hart are similar, it is estimated that the proposed harbor at Good Hart will be responsible for 15% of the erosion within about 3000 feet downdrift.

COMPUTATION SHEET

PROJECT CROSS VILLAGE

ITEM STURGEON BAY SITE

COMPUTED BY GFN CHECKED BY RJE

SHEET NO. 1 OF 18 SHEETS

DATE ____ 19__

FILE ____

REF. DRWG. NO. ____

STURGEON BAY WAVE ANALYSIS

offshore slope 1:150 (.0067)

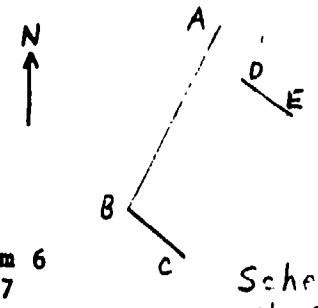
Design water level - 581.5 ft. IGLD (+4.7) as selected for the Cross Village site.

Design Wave Information: Summer 20 year Deep water waves were selected from WES TR H-76-1, Harbor Springs grid point, and SPM Fig. 3-29. Due to the location of the proposed site in the south portion of Sturgeon Bay, neither the Sturgeon Bay or Harbor Springs grid points provide an estimate of a NNE wave which would impact on Section DE of the proposed plan.

Wave Direction	Height (Ft.)	Period (Sec)	K_R - Refraction Coef.
40 mph wind 22,500 ft. fetch NNE (N10°E)	3.2	3.6	.82
NxW (N5°W)	5.6	6.5	.83
NW (N45°W)	9.8	7.9	.73
W	5.2	5.9	.46

Refraction coefficients were determined from computer-drawn refraction diagrams for the wave directions above.

It appears that the NW wave will have a greater impact than the NxW wave since the NW wave is much higher; therefore, the NW wave will be used for runup and crest height determination on Section AB, the W wave on BC, and the NNE wave will be used on Section DE.



Schematic
No Scale
but roughly proportional

Depths at Structure Toe:

Location	Depth (LWD)	Depth (at d.w.l.)
A	9.4	14.1
B	8.4	13.1
C	0.0	4.7
D	7.0	11.7
E	0.0	4.7

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COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 2 OF 18 SHEETS

ITEM STURGEON BAY REFRACTION — DATE ____ 19__

FILE ____

COMPUTED BY SEN — CHECKED BY RVE — REF. DRWG. NO. ____

REFRACTION

NNE WAVE

$d = 11.7$ $H_o = 3.2$ $T = 3.6$ $K_R = .82$

(shallow) $L = T\sqrt{gd} = 3.6\sqrt{32.2(11.7)} = 69.9'$

$\frac{d}{L} = \frac{11.7}{69.9} = .16738$

Table C-2, SPM Vol. III,

$K_s = \frac{H}{H_o'} = .9166$

$H = K_s K_R H_o = .9166\,(.82)\,3.2 = 2.4'$

$H_o' = \frac{H}{K_s} = \frac{2.4}{.9166} = 2.6'$

NW WAVE

$d = 14.1$ $H_o = 9.8$ $T = 7.9$ $K_R = .73$

$L_o = 5.12\,T^2 = 5.12\,(7.9^2) = 319.5'$

$\frac{d}{L_o} = \frac{14.1}{319.5} = .04413$

Table C-1, SPM Vol III,

$K_s = \frac{H}{H_o'} = 1.045$

$H = K_s K_R H_o = 1.045\,(.73)\,9.8 = 7.5'$

$H_o' = \frac{H}{K_s} = \frac{7.5}{1.045} = 7.2'$

$\frac{d}{L} = .0879$ $L = 160.4'$

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 3 OF 18 SHEETS

ITEM STURGEON BAY REFRACTION — DATE _____ 19____

FILE _____

COMPUTED BY SFN — CHECKED BY RJE — REF. DRWG. NO. _____

W WAVE

$d = 13.1$ $H_o = 5.2$ $T = 5.9$ $K_R = .46$

$L_o = 5.12\,T^2 = 5.12\,(5.9^2) = 178.2'$

$\frac{d}{L_o} = \frac{13.1}{178.2} = .07351$

from Table C-1, SPM Vol. III,

$K_s = \frac{H}{H_o'} = .9649$

$H = K_s K_R H_o = .9649(.46)5.2 = 2.3'$

$H_o' = \frac{H}{K_s} = \frac{2.3}{.9649} = 2.4'$

$\frac{d}{L} = .1173$ $L = 111.7'$

NXW Wave

$d = 14.1$ $H_o = 5.6$ $T = 6.5$ $K_R = .83$

$L_o = 5.12\,T^2 = 5.12\,(6.5)^2 = 216.3$

$\frac{d}{L_o} = \frac{14.1}{216.3} = .06519$

from Table C-1, SPM Vol. III,

$K_s = \frac{H}{H_o'} = .9811$

$H = K_s K_R H_o = .9811\,(.83)\,5.6 = 4.6'$

$H_o' = \frac{H}{K_s} = \frac{4.6}{.9811} = 4.7'$

$\frac{d}{L} = .1094$ $L = 128.9'$

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 4 OF 18 SHEETS

ITEM STURGEON BAY SITE — DATE _____ 19__

FILE _____

COMPUTED BY SFN — CHECKED BY RJE — REF. DRWG. NO. _____

BREAKING WAVE ANALYSIS

Using GODA method

Slope = 1:150 = .0067 use .008 charts.

N/A = Not Applicable

		WAVE DIRECTION		
		NNE	NW	W
h at	A	N/A	14.1	N/A
	B	N/A	13.1	13.1
	C	N/A	N/A	4.7
	D	11.7	N/A	N/A
	E	4.7	N/A	N/A
H_o'		2.6	7.2	2.4
L_o		69.9	319.5	178.2
H_o'/L_o		.037	.023	.013

FROM GODA (1975) Fig. 16:

$h_{\frac{1}{3}pk}/H_o'$	2.22	2.20	2.35
$h_{\frac{1}{3}pk}$	5.8	15.8	5.6

If $h_{\frac{1}{3}pk} > (h = d_{SWL})$ Wave is Broken (Br)

$h_{\frac{1}{3}pk} < d_{SWL}$ Wave is Nonbreaking (NB)

$h_{\frac{1}{3}pk} = d_{SWL}$ Wave is Breaking (B)

WAVE CONDITION				
at	A	N/A	Br	N/A
	B	N/A	Br	NB
	C	N/A	N/A	Br
	D	NB	N/A	N/A
	E	Br	N/A	N/A

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 5 OF 18 SHEETS

ITEM STURGEON BAY SITE — DATE _____ 19__

FILE _____

COMPUTED BY SFN — CHECKED BY RJE — REF. DRWG. NO. _____

DETERMINE SIGNIFICANT WAVE HEIGHT

using GODA chart for slope .008

		WAVE NNE	WAVE NW	WAVE W
h/H_o' at	A	N/A	1.96	N/A
	B	N/A	1.82	5.46
	C	N/A	N/A	1.96
	D	4.5	N/A	N/A
	E	1.8	N/A	N/A
$H_{\frac{1}{3}}/H_o'$	A	—	.98	—
	B	—	.98	1.00
	C	—	—	1.00
	D	.92	—	—
	E	.92	—	—
$H_{\frac{1}{3}}$	A	—	7.1	—
	B	—	7.1	2.4
	C	—	—	2.4
	D	2.4	—	—
	E	2.4	—	—

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 6 OF 18 SHEETS
ITEM STURGEON BAY SITE — DATE ____ 19__
FILE ____
COMPUTED BY SEN — CHECKED BY RVE — REF. DRWG. NO. ____

RUNUP CALCULATIONS

use CETA 79-6 formula:

$$R = H_I \left[\frac{.692}{.504 + \sqrt{H_I / L_o}} \tan\theta \right]$$

$H_I = H_{\frac{1}{3}}$ θ = Breakwater Slope

Runup, Section AB $H_{\frac{1}{3}} = 7.1'$ from NW

1:1.5 slope

$$R = 7.1 \left[\frac{.692}{.504 + \sqrt{7.1/319.5}} (1.5) \right] = 6.8'$$

1:2 slope (2) = 6.1'

1:3 slope (3) = 5.2'

Runup, Section BC $H_{\frac{1}{3}} = 2.4'$ from W

1:1.5 slope

$$R = 2.4 \left[\frac{.692}{.504 + \sqrt{2.4/178.2}} (1.5) \right] = 2.5'$$

1:2 slope (2) = 2.3'

1:3 slope (3) = 1.9'

Runup, Section DE $H_{\frac{1}{3}} = 2.4'$ from NNE

1:1.5 slope

$$R = 2.4 \left[\frac{.692}{.504 + \sqrt{2.4/69.9}} (1.5) \right] = 2.1'$$

1:2 slope (2) = 1.9'

1:3 slope (3) = 1.6'

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 7 OF 18 SHEETS
ITEM STURGEON BAY CREST HEIGHTS — DATE ____ 19__
FILE ____
COMPUTED BY SEN — CHECKED BY ____ — REF. DRWG. NO. ____

CREST HEIGHT DETERMINATION

use CETA '79-6 equation:

$$K_T = \frac{H_T}{H_I} = \left(.51 - .11\frac{B}{h}\right)\left(1 - \frac{h-d_s}{R}\right)$$

Due to the proposed location of the berthing areas, diffraction due to wave transmission cannot be considered.

SECTION AB

assume $B = 10$

use $d_s = 14.1$

$H_I = 7.1$

1:1.5 slope	$R = 6.8$
1:2	$R = 6.1$
1:3	$R = 5.2$

For 1.5' wave in berthing areas:

$H_T = 1.5$

1:1.5 slope $\quad K_T = \frac{1.5}{7.1} = \left(.51 - \frac{1.1}{h}\right)\left(1 - \frac{h-14.1}{6.8}\right)$

guess $h = 17.7$

$.211 \geq .211$

CREST HEIGHT = h - datLWD = 17.7 − 9.4 = +8.3'

1:2 slope $\quad K_T = \frac{1.5}{7.1} = \left(.51 - \frac{1.1}{h}\right)\left(1 - \frac{h-14.1}{6.1}\right)$

guess $h = 17.4$

$.211 \geq .205$

CREST HT = 17.4 − 9.4 = +8.0'

1:3 slope $\quad K_T = \frac{1.5}{7.1} = \left(.51 - \frac{1.1}{h}\right)\left(1 - \frac{h-14.1}{5.2}\right)$

guess $h = 16.9$

$.211 \geq .205$

CREST HT = 16.9 − 9.4 = +7.5'

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COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 8 OF 18 SHEETS
ITEM STURGEON BAY SITE — DATE ____ 19__
FILE ____
COMPUTED BY SFN — CHECKED BY KJE — REF. DRWG. NO. ____

SECTION BC & E 1.5' interior wave

$K_T = \frac{1.5}{2.4} = .625$

CETA equation becomes meaningless at high K_T values.

From 20 oct 80 conversation with C. Johnson NCDED-C, in these situations (large K_T), make crest height as high as wave runup for zero transmission ($d_s + R$). To allow a 1.5' interior wave, determine the crest height as

$h = d_s + R - 1.5$

Assume B = 10*

SECTION BC $d_s = 13.1$ same at B and C (h differs because of depth but height above LWD is the same)

1:1.5 slope $R = 2.5$

$h = 13.1 + 2.5 - 1.5 = 14.1$

CREST HT = $h - d_{LWD} = 14.1 - 8.4 = +5.7'$

*This does not take into account the width of the crest, which would play a part in wave damping; therefore a conservative determination of crest height.

1:2 slope $R = 2.3$

$h = 13.1 + 2.3 - 1.5 = 13.9$

CREST HT = $13.9 - 8.4 = +5.5'$

1:3 slope $R = 1.9$

$h = 13.1 + 1.9 - 1.5 = 13.5$

CREST HT = $13.5 - 8.4 = +5.1'$

SECTION DE $d_s = 4.7$

1:1.5 slope CREST HT = $4.7 + 2.1\ 1.5 - 0.0 = +5.3'$

1:2 slope CREST HT = $4.7 + 1.9 - 1.5 - 0.0 = +5.1'$

1:3 slope CREST HT = $4.7 + 1.6 - 1.5 - 0.0 = +4.8'$

COMPUTATION SHEET

PROJECT CROSS VILLAGE
ITEM STURGEON BAY
COMPUTED BY SFN CHECKED BY RJS

SHEET NO. 9 OF 18 SHEETS
DATE ____ 19 ____
FILE ____
REF. DRWG. NO. ____

ARMOR STONE SIZES

For the purpose of selecting armor stone, 20 year winter deep water waves are selected from WES T.R. H-76-1. The NNE wave is selected from SPM Fig. 3-29, as for the summer wave condition in the first part of the analysis.

Wave Direction		Height (Ft.)	Period (sec)	K_R
40 mph wind 22500 ft. fetch	NNE (N10°E)	3.2	3.6	.82
	NxW (N5°W)	8.9	7.1	.83
	NW (N45°W)	15.4	10.2	.73
	W	6.6	6.6	.46

Refraction and Breaking Wave Analyses must be performed on the waves.

NxW wave (use on DE)

$d_{DE} = 11.7$ $H = 8.9$ $T = 7.1$ $K_R = .83$

$L_o = 5.12\,T^2 = 5.12\,(7.1)^2 = 258.1$

$\frac{d}{L_o} = \frac{11.7}{258.1} = .04533$

from Table C-1, SPM Vol III:

$K_s = \frac{H}{H_o} = 1.041$

$H = K_s K_R H_o = 1.041\,(.83)\,8.9 = 7.7'$

$H_o' = \frac{H}{K_s} = \frac{7.7}{1.041} = 7.4'$

NW wave (use on AB)

$d_{AB} = 14.1$ $H = 15.4$ $T = 10.2$ $K_R = .73$

$L_o = 5.12\,T^2 = 5.12\,(10.2)^2 = 532.7'$

$\frac{d}{L_o} = \frac{14.1}{532.7} = .02647$

from Talle C-1, SPM Vol. III:

$K_s = \frac{H}{H_o} = 1.155$

$H = K_s K_R H_o = 1.155\,(.73)\,15.4 = 13.0$

$H_o' = \frac{H}{K_s} = \frac{13.0}{1.155} = 11.3'$

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 10 OF 13 SHEETS

ITEM STURGEON BAY SITE — DATE _____ 19 ____

FILE _____

COMPUTED BY SFN — CHECKED BY R-VE — REF. DRWG. NO. _____

W wave

$d_{BC} = 13.1$ $H_o = 6.6$ $T = 6.6$ $K_R = .46$

$L_o = 5.12\ T^2 = 5.12\ (6.6)^2 = 223.0$

$\frac{d}{L_o} = \frac{13.1}{223.0} = .05874$

from Table C-1, SPM Vol. III:

$K_s = \frac{H}{H_o'} = .9964$

$H = K_s K_R H_o = .9964\ (.46)\ 6.6 = 3.0$

$H_o' = \frac{3.0}{.9964} = 3.0$

Since K_D will depend upon the breaking state of the waves, a breaking wave analysis must be performed.

BREAKING WAVE ANALYSIS

using GODA method slope 1:150 use .008 charts

N/A = Not Applicable

	WAVE DIRECTION NxW	NW	W
h at A	N/A	14.1	N/A
B	N/A	13.1	13.1
C	N/A	N/A	4.7
D	11.7	N/A	N/A
E	4.7	N/A	N/A
H_o'	7.4	11.3	3.0
L_o	258.1	532.7	223.0
H_o'/L_o	.029	.021	.013

FROM GODA (1975) Fig. 16:

$h_{\frac{1}{3}pk}/H_o'$	2.19	2.20	2.35
$h_{\frac{1}{3}pk}$	16.2	24.9	7.1

If: $h_{\frac{1}{3}pk} > (d_{swl} - h)$ Wave is Broken (Br)
$h_{\frac{1}{3}pk} < d_{swl}$ Wave is Nonbreaking (NB)
$h_{\frac{1}{3}pk} = d_{swl}$ Wave is Breaking (B)

WAVE CONDITION at	NxW	NW	W
A	—	Br	—
B	—	Br	NB
C	—	—	Br
D	Br	—	—
E	Br	—	—

All waves break except the W wave at B. Therefore at B, use $K_D = 4.0$ on trunk.

K_D values will be as follows: (from SPM Table 7-7)

Location	Slope	K_D
Section AB (trunk)	1:1.5	3.5
	1:2	
	1:3	
at A and B (head)	1:1.5	2.9
	1:2	2.5
	1:3	2.0
Section BC	1:1.5	4.0
	1:2	
	1:3	
Section DE	1:1.5	3.5
	1:2	
	1:3	
at D (head)	1:1.5	2.9
	1:2	2.5
	1:3	2.0

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 12 OF 18 SHEETS

ITEM STURGEON BAY SITE — DATE _____ 19__

FILE _____

COMPUTED BY SFN — CHECKED BY R.N.E. — REF. DRWG. NO. _____

DETERMINE SIGNIFICANT WAVE HEIGHT

Using GODA chart for slope .008

		NXW	WAVE NW	W
h/H_o' at	A	—	1.25	—
	B	—	1.16	4.37
	C	—	—	1.57
	D	1.58	—	—
	E	.64	—	—
$H_{1/3}/H_o'$	A	—	.81	—
	B	—	.75	1.05
	C	—	—	1.00
	D	.93	—	—
	E	.46	—	—
$H_{1/3}$	A	—	9.2	—
	B	—	8.5	3.2
	C	—	—	3.0
	D	6.9	—	—
	E	3.4	—	—

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 13 OF 18 SHEETS
ITEM STURGEON BAY SITE — DATE ____ 19 ____
FILE ____
COMPUTED BY SFN — CHECKED BY RJE — REF. DRWG. NO. ____

ARMOR STONE CALCULATIONS

use SPM equation 7-110:

$$W = \frac{W_r H^3}{K_D (S_r - 1)^3 \cot \theta}$$

W = weight of armor stone, lbs.
W_r = unit weight of stone, lbs / ft³
= 165 lbs/ft³ at Sturgeon Bay

H = design wave height = significant wave height
K_D = a coefficient
$S_r = W_r / W_w$ $\quad W_w$ = 62.4 lbs/cu. ft.
θ = angle of breakwater slope

SECTION AB, trunk

$H = 9.2$ $\quad K_D = 3.5$

1:1.5 slope

$$W = \frac{165 (9.2)^3}{3.5 \left(\frac{165}{62.4} - 1\right)^3 (1.5)} = 5506 \text{ lbs.}$$

1:2 slope

$$W = \frac{165 (9.2)^3}{3.5 \left(\frac{165}{62.4} - 1\right)^3 (2)} = 4129 \text{ lbs.}$$

1:3 slope

$$W = \frac{165 (9.2)^3}{3.5 \left(\frac{165}{62.4} - 1\right)^3 (3)} = 2753 \text{ lbs.}$$

at A (head)

$H = 9.2$

1:1.5 slope

$$W = \frac{165 (9.2)^3}{2.9 \left(\frac{165}{62.4} - 1\right)^3 (1.5)} = 6645 \text{ lbs.}$$

1:2 slope

$$W = \frac{165 (9.2)^3}{2.5 \left(\frac{165}{62.4} - 1\right)^3 (2)} = 5781 \text{ lbs.}$$

1:3 slope

$$W = \frac{165 (9.2)^3}{2.0 \left(\frac{165}{62.4} - 1\right)^3 (3)} = 4817 \text{ lbs.}$$

at B (head)

$H = 8.5$

1:1.5 slope

$$W = \frac{165 (8.5)^3}{2.9 \left(\frac{165}{62.4} - 1\right)^3 (1.5)} = 5240 \text{ lbs.}$$

1:2 slope

$$W = \frac{165 (8.5)^3}{2.5 \left(\frac{165}{62.4} - 1\right)^3 (2)} = 4559 \text{ lbs.}$$

1:3 slope

$$W = \frac{165 (8.5)^3}{2.0 \left(\frac{165}{62.4} - 1\right)^3 (3)} = 3719 \text{ lbs}$$

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COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 14 OF 18 SHEETS

ITEM STURGEON BAY SITE — DATE ____ 19__

FILE ____

COMPUTED BY SFN — CHECKED BY RVC — REF. DRWG. NO. ____

SECTION BC, trunk

$H = 3.2$ $K_D = 4.0$

1:1.5 slope

$$W = \frac{165(3.2)^3}{4.0\left(\frac{165}{62.4}-1\right)^3(1.5)} = 203 \text{ lbs.}$$

1:2 slope

$$W = \frac{165(3.2)^3}{4.0\left(\frac{165}{62.4}-1\right)^3(2)} = 152 \text{ lbs.}$$

1:3 slope

$$W = \frac{165(3.2)^3}{4.0\left(\frac{165}{62.4}-1\right)^3(3.0)} = 101 \text{ lbs.}$$

SECTION DL, trunk

$H = 6.9$ $K_D = 3.5$

1:1.5 slope

$$W = \frac{165(6.9)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(1.5)} = 2323 \text{ lbs.}$$

1:2 slope

$$W = \frac{165(6.9)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(2)} = 1742 \text{ lbs.}$$

1:3 slope

$$W = \frac{165(6.9)^3}{3.5\left(\frac{165}{62.4}-1\right)^3(3)} = 1161 \text{ lbs.}$$

at D (head)

$H = 6.9$

1:1.5 slope

$$W = \frac{165(6.9)^3}{2.9\left(\frac{165}{62.4}-1\right)^3(1.5)} = 2803 \text{ lbs.}$$

1:2 slope

$$W = \frac{165(6.9)^3}{2.5\left(\frac{165}{62.4}-1\right)^3(2)} = 2439 \text{ lbs.}$$

1:3 slope

$$W = \frac{165(6.9)^3}{2.0\left(\frac{165}{62.4}-1\right)^3(3)} = 2032 \text{ lbs.}$$

COMPUTATION SHEET

PROJECT CROSS VILLAGE — SHEET NO. 15 OF 18 SHEETS
ITEM LITTORAL TRANSPORT AT STURGEON BAY — DATE ____ 19__
FILE ____
COMPUTED BY CFK — CHECKED BY RVE — REF. DRWG. NO. ____

LITTORAL TRANSPORT ANALYSIS

1. Bluff Height 6 to 30 feet
   Source: Shoretype Classification, Emmett Co., MSU

   Most of the area seems to tend toward high foredune, so say avg bluff ht = 25 ft. — 25 feet
   Source: 1973, 1980 air photos

2. Average bluff recession rate — 1.7 Ft/yr

   Source: Measurements from 1973, 1980 photos and compare to Cross Village DNR measurements.

3. Estimated zone of influence of proposed harbor: — 4500 ft.

   Sources: a) compare to Cross Village
   b) compare to Frankfort Hbr.
   c) 1973, 1980 air photos

   2500'-3000' downdrift effects
   1500 feet updrift effects

   TOTAL = 4500'

4. Gross littoral transport rate

   a) method 1

   bluff ht x zone of influence x rec. rate

   $$\frac{25' \times 4500' \times 1.7'/yr}{27\ ft^3/yd^3} = 7083, \text{ say } 7000\ yd^3/yr$$

   b) method 2

   measurement of sand accretion east of Sturgeon Bay Pt.

   1973 area of sand 225 000 ft²
   1980 " " 450000 ft²
   Difference = 225 000 ft²
   per yr = 225 000/7 = 32,143 ft²/yr

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b) continued

32,143 ft^2/yr

Possible Avg Depths of Sand Accreted (Ft)	Rate, Ft^3/yr	Rate of Accretion yd^3/yr
1.0	32143	1190
2.0	64286	2381
3.0	96429	3571
4.0	128572	4762
5.0	160715	5952
6.0	192858	7143

It is reasonable to assume that the accreted depth averages 3 to 4 ft (1 yard +)

Therefore, this method yields a rate of around 4000 yd^3/yr

5. The dominant direction of littoral drift appears to be SW to NE, evidence the 1973 and 1980 photos. Also from the photos and from the MSU shoreline classification study, wind erosion is significant. Considering wind data from Pellston, onshore winds are of a considerable frequency so as to transport a significant amount of sand. However, the winter freeze period and wet days during the remainder of the year must be excluded. In addition, a threshold shear velocity must be attained in order to initiate movement of grains of a certain diameter, so that light breezes must also be excluded since they would not cause any movement. In addition, most sand moving by saltation within 25 feet of the beach surface would be trapped by the bluff and remain on the beach. Therefore, a significant amount of littoral material is lost off the beach only where the bluff is low and where most grains of sediment are very fine sand or smaller. To be conservative, we consider that wind erosion losses are accounted for when we say that 90 to 95% of the bluff

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5. (cont.)
material is capable of being transported and remaning in the littoral zone.

6. To be conservative, since the bluff in the area is mostly an erodible sand dune, we consider that 95% of the bluff material is capable of being transported. The remaining 5% accounts for wind erosion and other losses.

From 4a) 7000 yd^3/yr X .95 = 6650 yd^3/yr

method 4b will not be reduced since accretion patterns would naturally include only transportable material.

7. From wind data at Pellston, incoming waves resulting in SW-NE transport are experienced about 77% of the time for onshore winds. More importantly, winds from WSW-NW of greater velocity (13+ mph) are experienced 85% of the time. From this, we consider that about 80% of littoral transport moves SW-NE and 20% moves NE-SW.

Using the larger of the two estimates of littoral drift,

SW-NE transport:

6650 x .8 = 5320 yd^3

NE-SW transport

6650 x .2 = 1330 yd^3

It is important to consider that the above logic applies to the south part of Sturgeon Bay. As the shoreline curves and faces the opposite direction and as shoretype conditions change to the north, we expect that littoral transport rates and, possibly, the direction changes to the north end of the bay.

COMPUTATION SHEET

PROJECT C. VIII. SHEET NO. 18 OF 18 SHEETS

ITEM Littoral Transport at Sturgeon Bay DATE _____ 19__

FILE _____

COMPUTED BY STN CHECKED BY RJE REF. DRWG. NO. _____

8. The transport rate derived compares favorably for that developed at Cross Village, 6000 yd^3.

9. The proposed harbor plan extends to a 9.4 foot depth at LWD. From the most recent soundings, the 12' contour, inside which most littoral material would move, is 800' to 1000' offshore at the site. The harbor extends about 600' offshore. We estimate that the proposed harbor will block about 80% of the littoral drift moving SW-NE in the first 6 years after harbor construction. The quantity of littoral material blocked by the harbor will be reduced 25 to 50% when natural bypassing is attained. Correspondingly, the rate at which an increasing amount of downdrift shoreline is affected by the harbor will also decrease with time.

To mitigate harbor induced erosion, beach nourishment is normally the most cost effective action. The quantity of sand required annually for nourishment to downdrift shoreline is about:

$$5320 \times .8 = 4256 \text{ yd}^3, \text{ say } 4300 \text{ yd}^3$$

Since conditions at Cross Village and Sturgeon Bay are very similar, it is estimated that the proposed harbor at Sturgeon Bay will be responsible for 15% of the total erosion down drift. Harbor effects will not extend as far downdrift as at Cross Village due to the curvature of the shoreline at the site. Effects of Sturgeon Bay Pt appear to be about 3000 ft. downdrift (1973, 1980 photos). Therefore, we esti[illegible] that the proposed harbor will affect about 3000 ft. of downdrift shoreline. A comparison of this zone of influence with that at Frankfort Harbor is favorable.

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COST ESTIMATES

Breakwater Design

The location and arrangement of the breakwaters are based upon the results of a detailed design analysis of wind and wave patterns at the recommended harbor site at Cross Village and the proposed harbor sites for Good Hart and Sturgeon Bay Point (shown in Figures 1, 10, and 15, respectively). The breakwaters are designed to limit wave heights at the proposed public docking area to 1.5 feet. A second analysis was made of the recommended plan at Cross Village to obtain an interior wave height of 0.5 foot. This was done to determine if a harbor would still be economically feasible using that design criteria. The smaller interior wave would prevent excessive damage to berthed boats as has occurred at other harbors with higher interior waves.

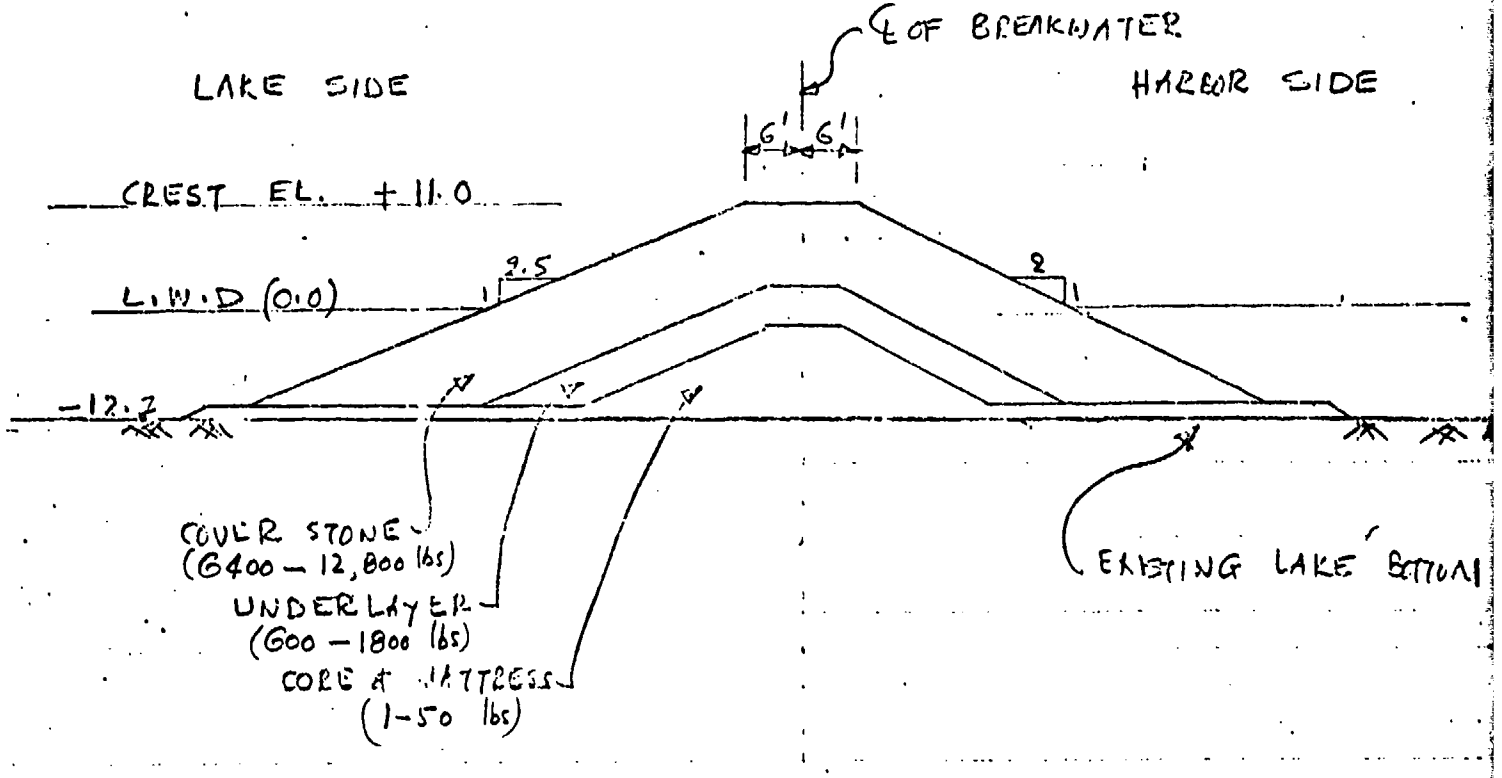
Typical cross-sections for the proposed breakwaters for each plan are shown on pages A-88 thru A-105. For locations of cross-sections at Cross Village, reference Figure 1, for Good Hart, reference Figure 10, and for Sturgeon Bay Point, reference Figure 15. A typical cross-section showing the recreational walkway and handrail is shown on page A-106. The information shown on the cross-sections and the recommended and proposed harbor plans was used in determining the quantities of materials required for construction of the breakwaters. Tables 16 thru 19 on pages A-107 thru A-110 present the information on quantities of items and costs involved in the construction of the proposed harbors. The values are approximate, with costs based on October 1980 values. Stone construction materials involved are common for this type of work.

Maintenance

The maintenance of this project would be routine. Periodic repair of the breakwater structure and maintenance dredging would be required. The maintenance dredging would be disposed of in the general area. The U.S. Coast Guard would maintain the aids to navigation at an annual cost of approximately $1,000. The recreational walkway and handrail would be maintained by the local sponsor (Michigan Department of Natural Resources). Average Annual maintenance costs are shown in Table 20, page A-111.

I *

CROSS VILLAGE SITE



CROSS VILLAGE SITE
SECTION AT A, B & C

*Wave height in berthing area: 0.5 ft.

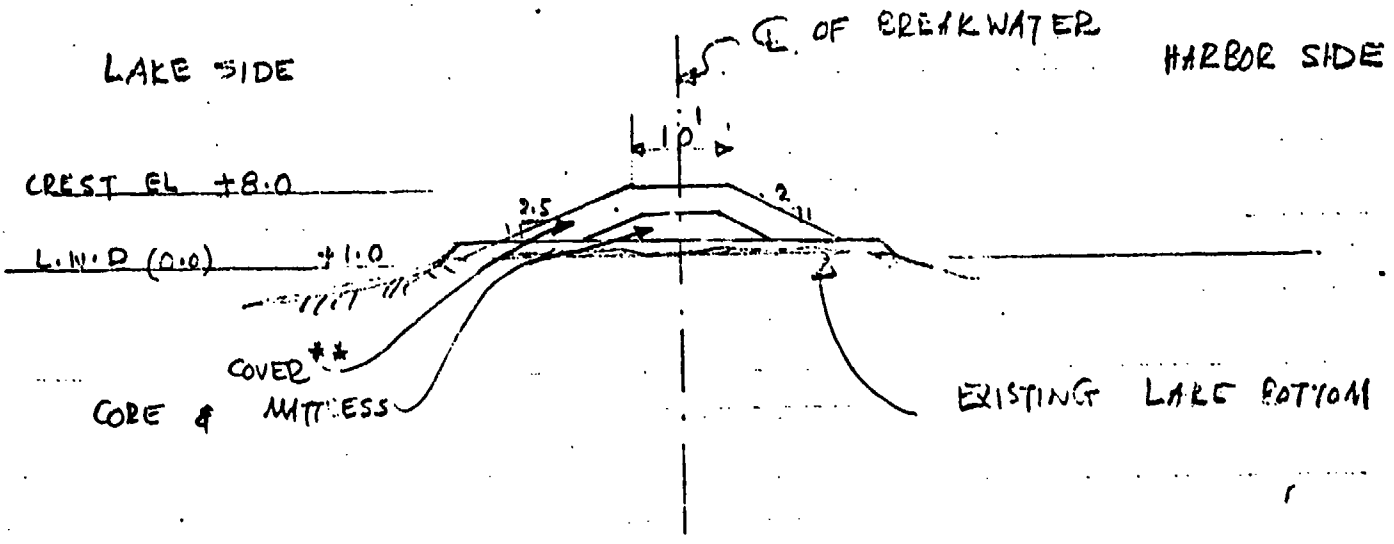
Scale 1" = 20'

OCT. 29, 8

N.K

I *

CROSS VILLAGE SITE



** Graded riprap (3' THICK)
(100 – 1650 lbs.)

CROSS VILLAGE SITE

SECTION AT JD

* Wave height in berthing area: 0.5 ft.

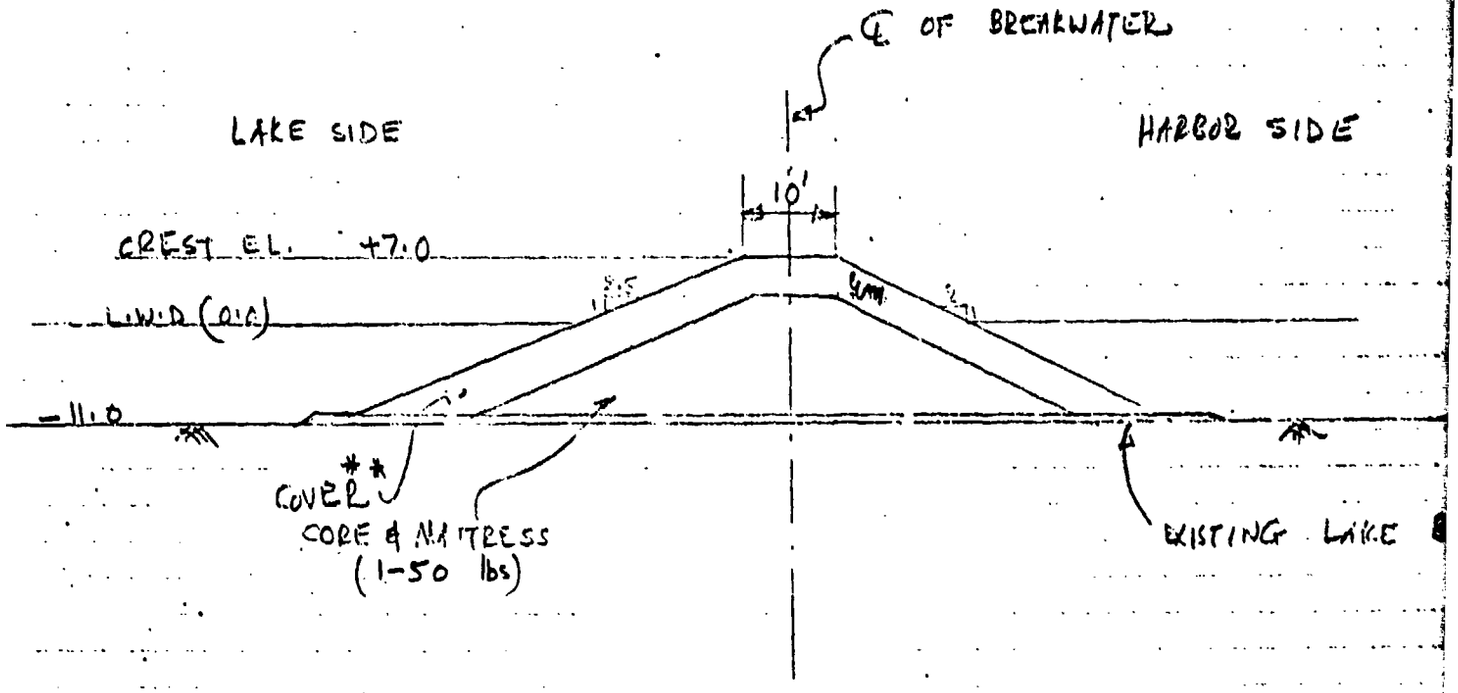
Scale 1" = 20'

Oct. 29, 8c

M.K

I*

CROSS VILLAGE SITE



** Graded riprap cover (3' THICK)
(100 - 1650 lbs)

CROSS VILLAGE SITE

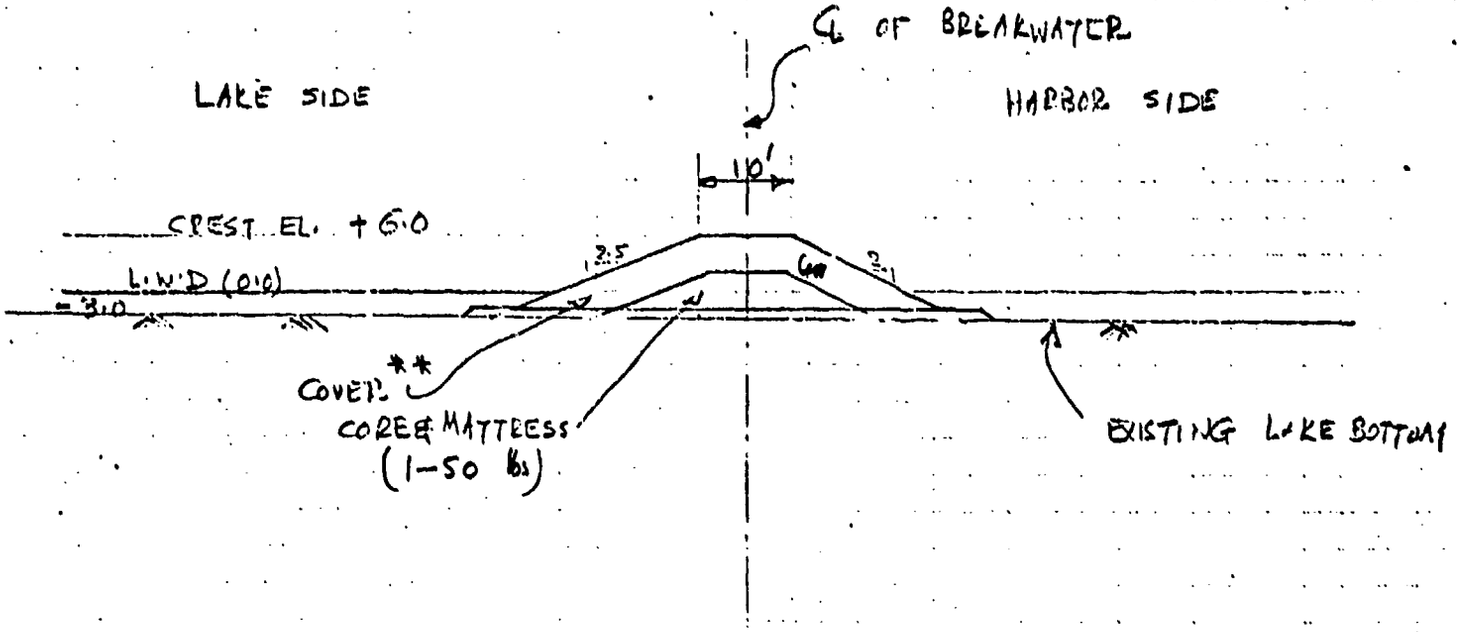
SECTION AT E

* Wave height in berthing area : 0.5 ft.

Scale 1" = 20'

I *

CROSS VILLAGE SITE



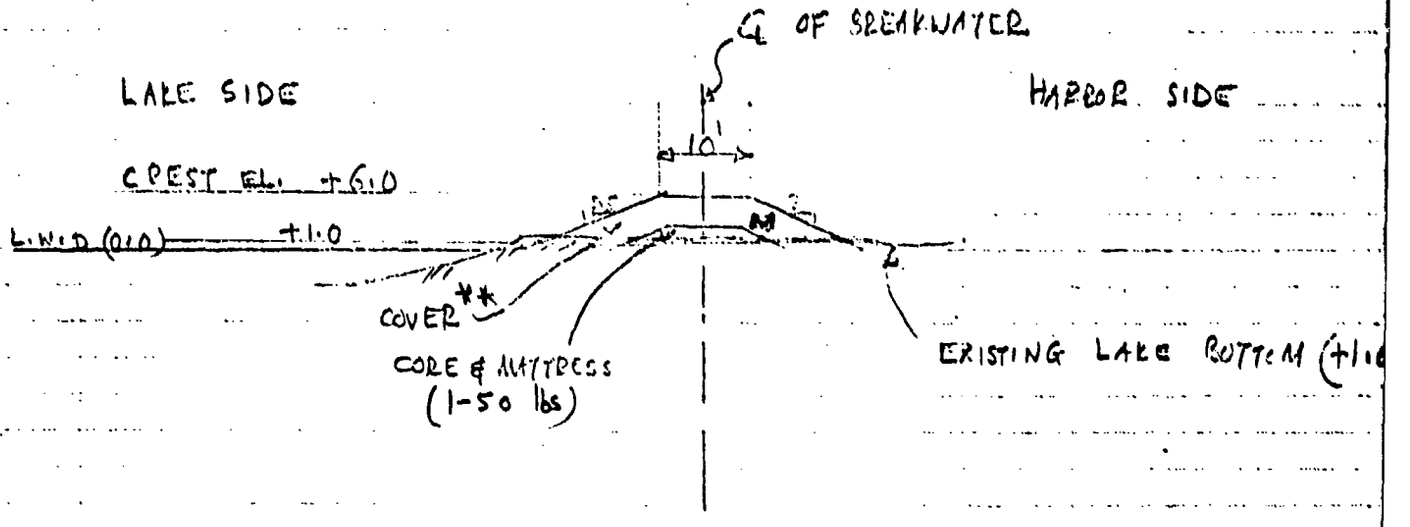
** Graded riprap cover (3' THICK)
(100 - 1650 lbs)

CROSS VILLAGE SITE

SECTION AT F

* Wave height in berthing area : 0.5 ft

Scale 1" = 20'



** Graded riprap cover (3' THICK)
(100 - 1650 lbs)

CROSS VILLAGE SITE

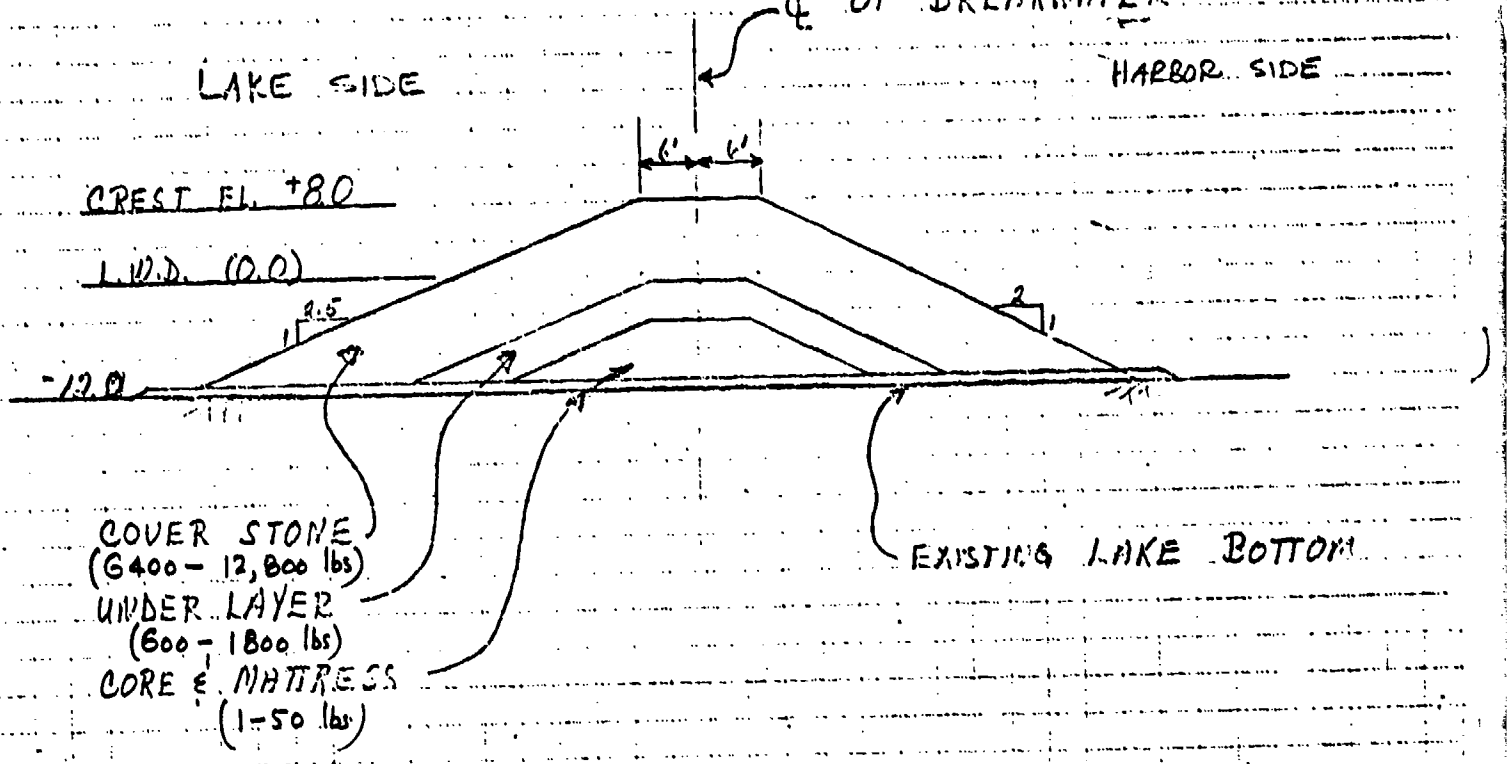
SECTION AT ℄

* Wave height in berthing area: 0.5 ft.

Scale 1" = 20'

II*

CROSS VILLAGE SITE



CROSS VILLAGE SITE

SECTION AT A, B & C

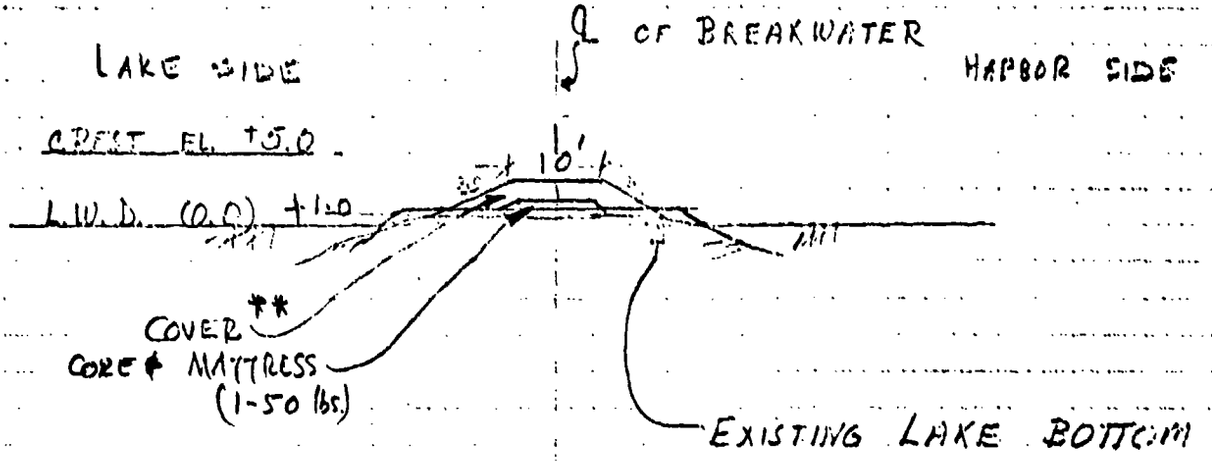
* Wave height in berthing area: 1.5 ft.

Scale 1" = 20'

3 NOV 80
MED.

II. *

CROSS VILLAGE SITE



** Graded riprap cover (3' THICK)
(100 - 1650 lbs)

SECTION AT D

CROSS VILLAGE SITE

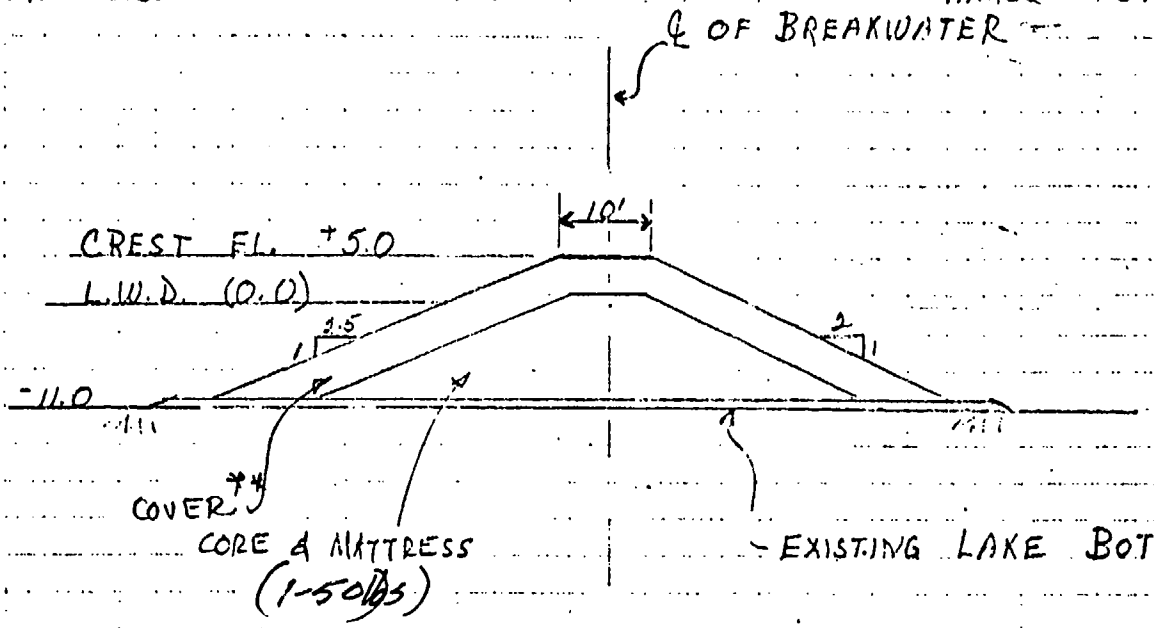
* Wave height in berthing area : 1.5 ft

Scale 1" = 20'

3 NOV 80
MED

II *

CROSS VILLAGE SITE



** Graded riprap cover (3' THICK)
(100–1650 lbs)

SECTION AT E

CROSS VILLAGE SITE

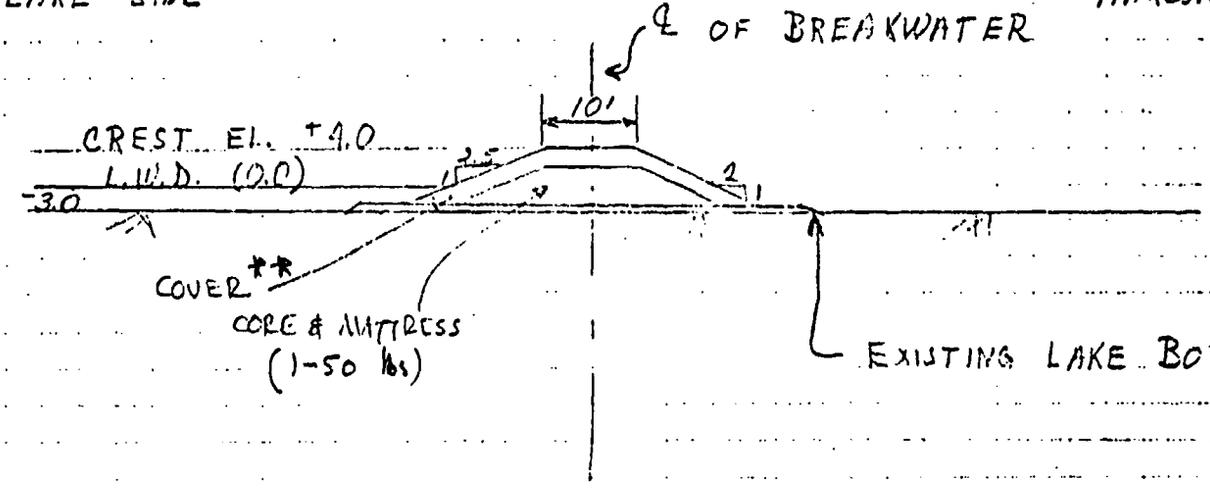
* Wave height in berthing area: 1.5 ft

Scale 1" = 20'

3 NOV 80
MED

II *

CROSS VILLAGE SITE



** Graded riprap cover (3' THICK)
(100-1650 lbs)

SECTION AT F

CROSS VILLAGE SITE

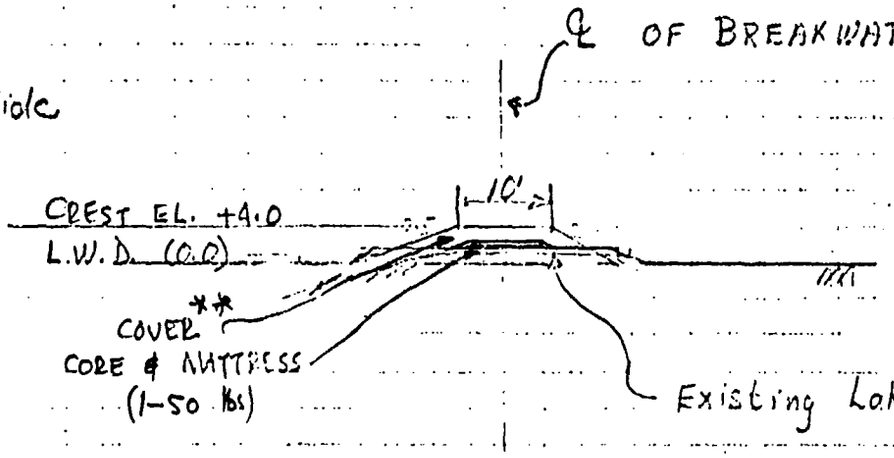
* Wave height in berthing area: 1.5 ft.

Scale 1" = 20'

3 NOV 80
MED

II *

CROSS VILLAGE SITE



** Graded riprap cover (2' THICK)
(100-1650 lbs.)

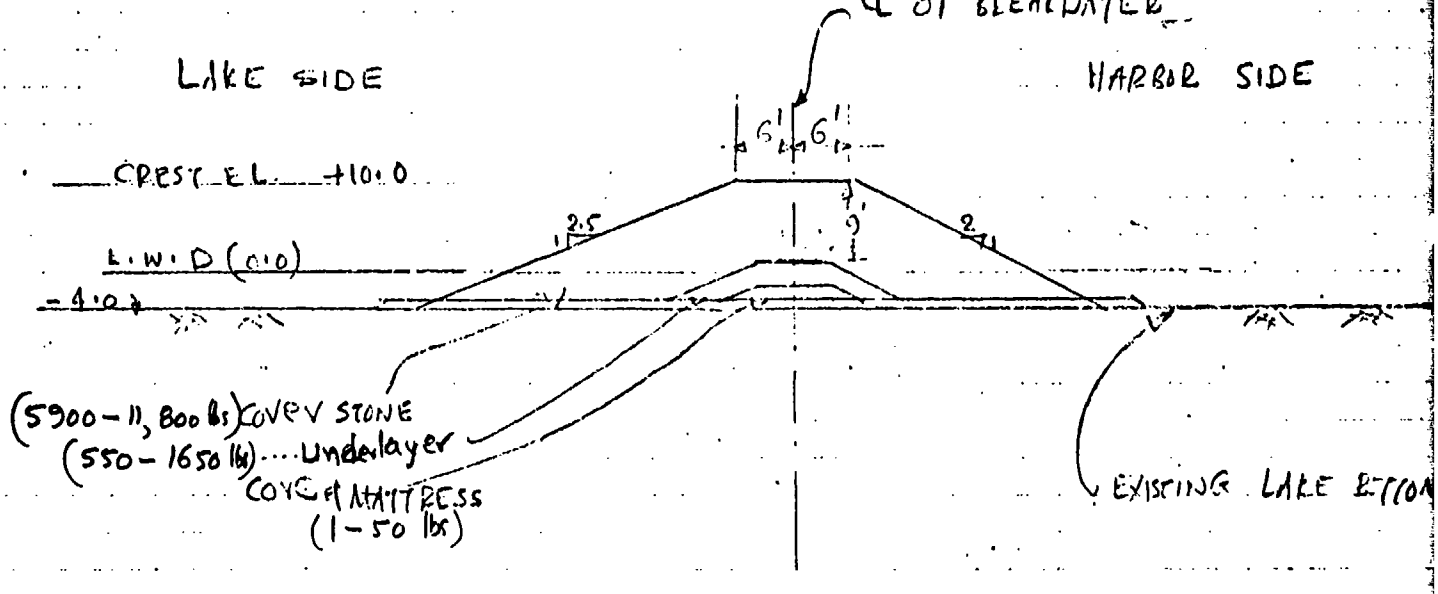
SECTION AT ℄

CROSS VILLAGE SITE

* Wave height in berthing area: 1.5 ft

Scale 1" = 20'

3 NOV 80
MEB



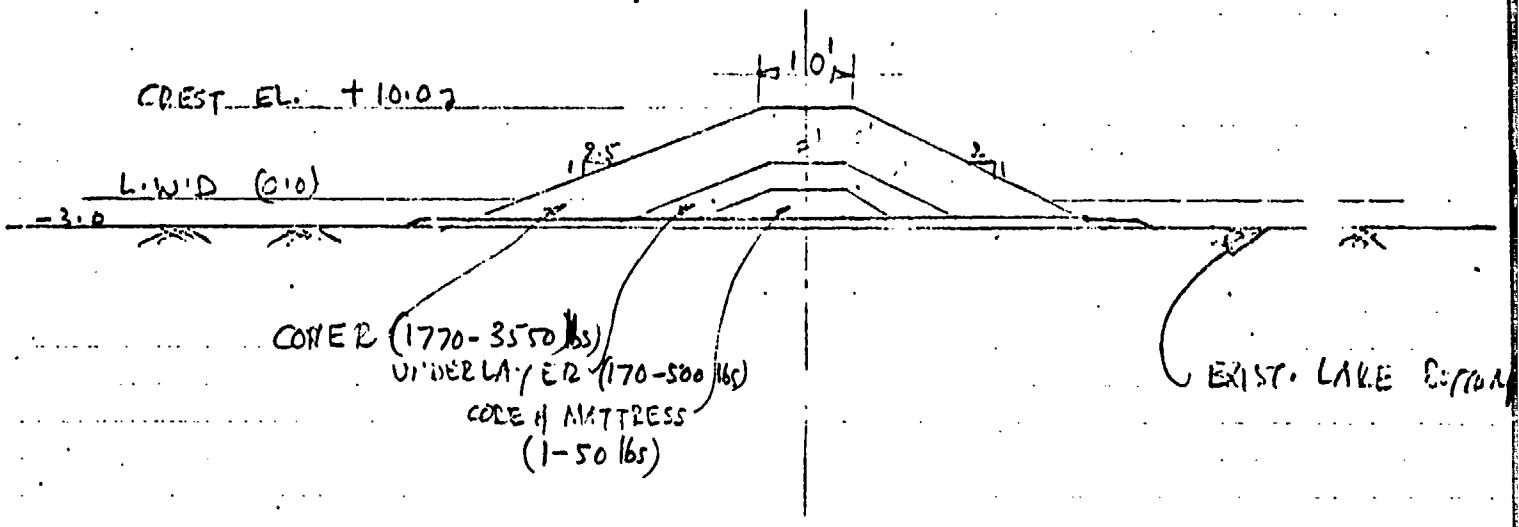
GOOD HART SITE

SECTION AT A

SCALE: 1" = 20'

REV. 3, 80

M.K

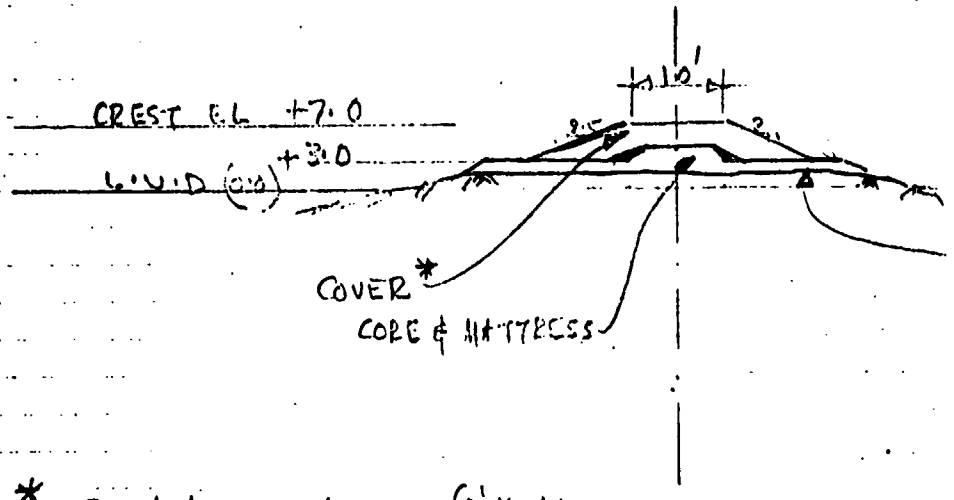


GOOD HART SITE

SECTION AT B

NOV. 3, 80
M.K

GOOD HART SITE



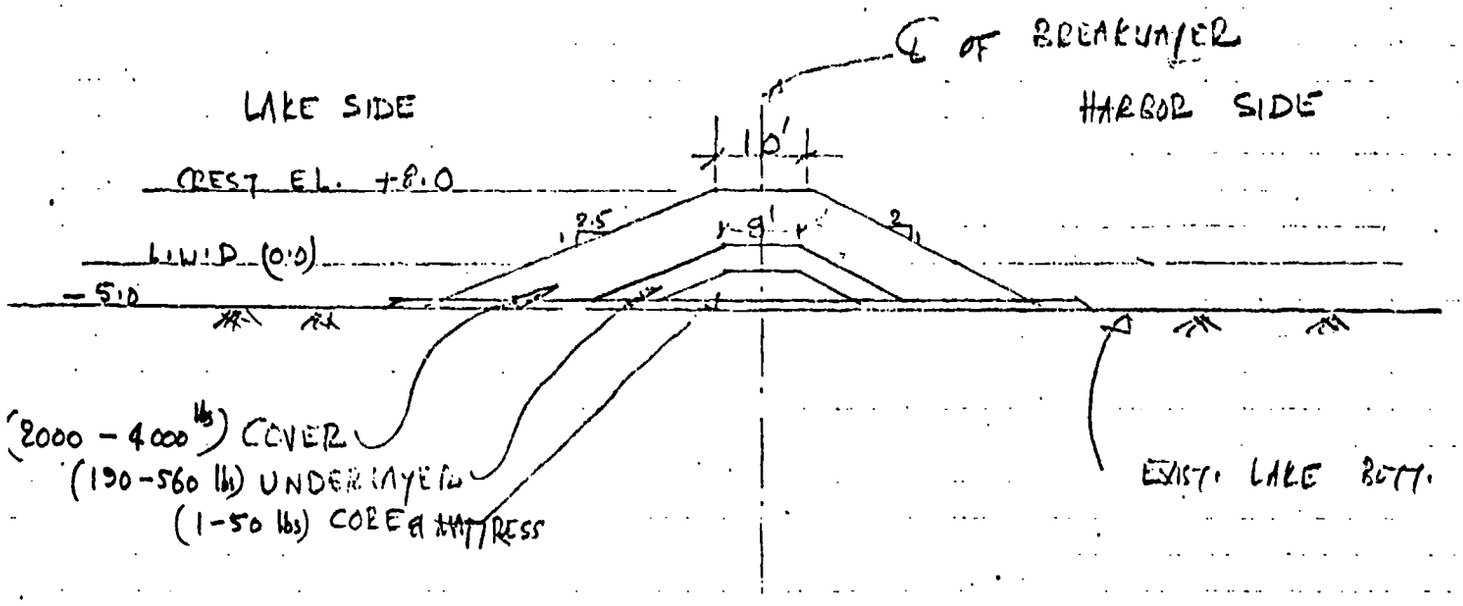
* Graded riprap cover (3' thick) (100 – 1650 lbs)

SECTION AT C & F

GOOD HART SITE

NOV. 3, 80
M.K

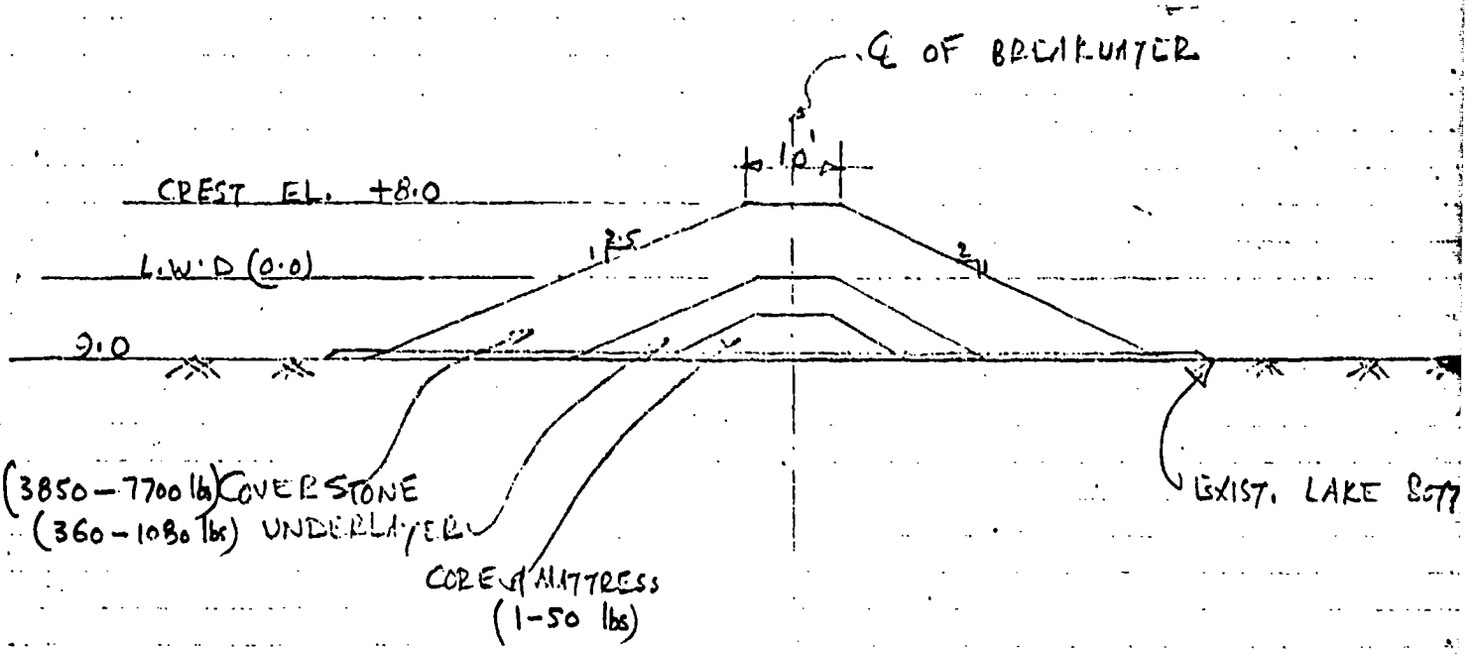
GOOD HART SITE



SECTION AT D & E
GOOD HART SITE

NOV. 3, 80
M.K

STURGEON BAY P.P. SITE



STURGEON BAY SITE

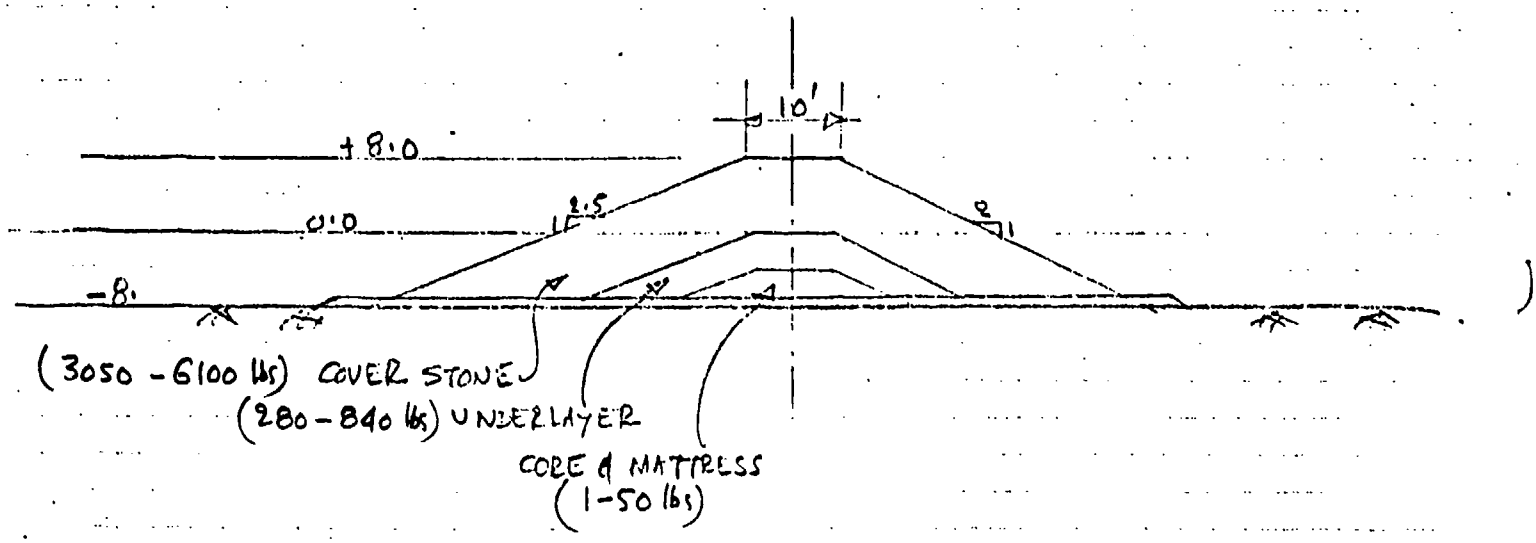
SECTION AT A

SCALE: 1" = 20'

Nov. 4, 80

ILK

STURGEON BAY DZ. SI

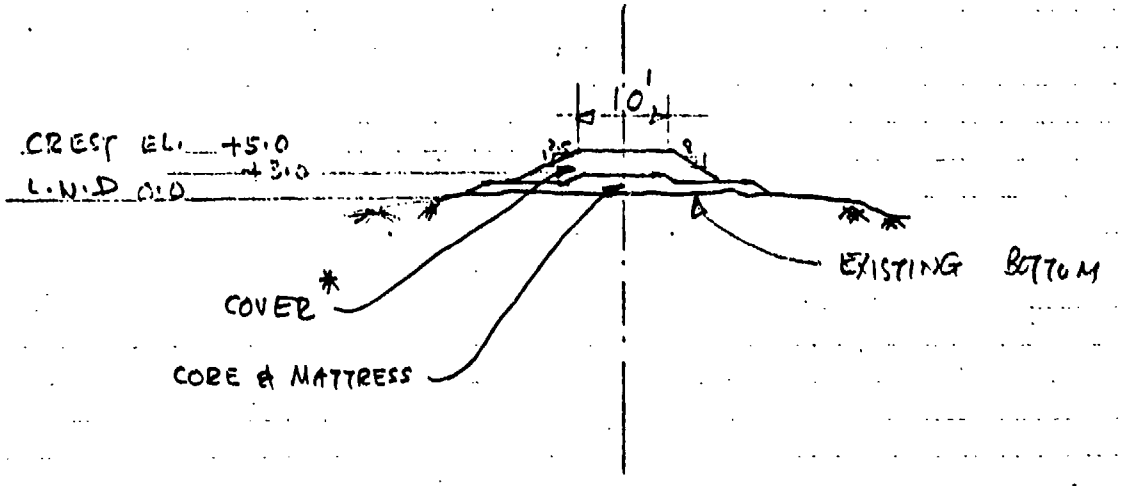


STURGEON BAY SITE

SECTION AT B

NOV. 9, 82
NHC

S.B.P SITE

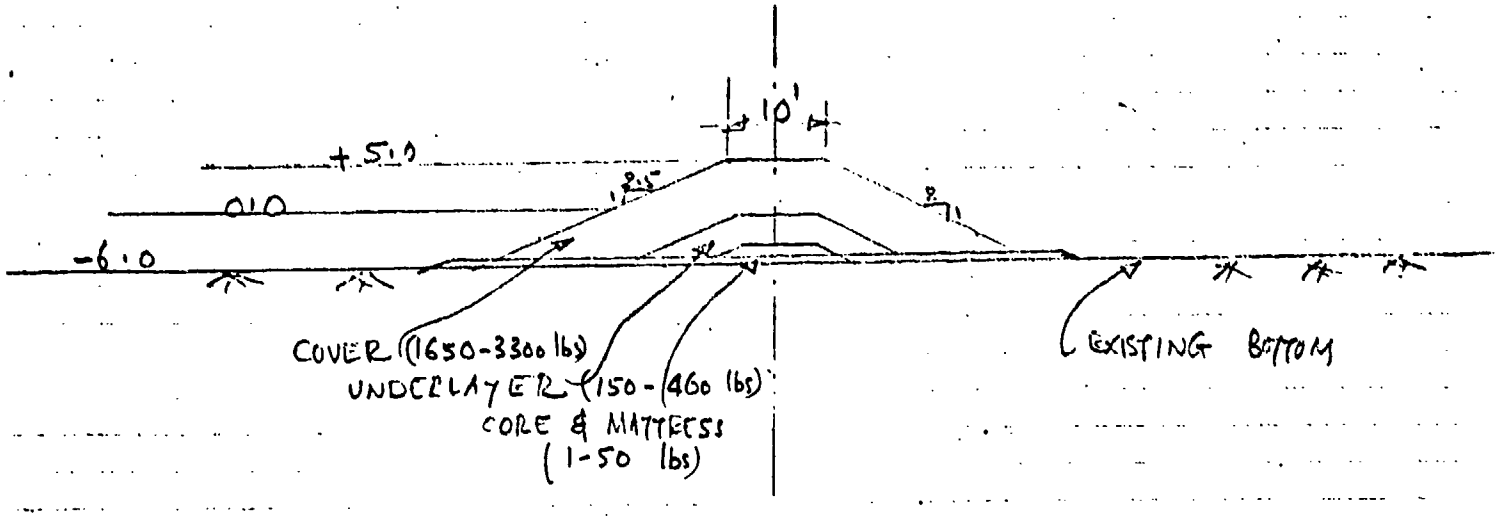


* Graded riprap (3' thick)
(100-1650 lbs)

SECTION AT C & E
STURGEON BAY SITE

Nov. 4, 80
M.K

S.B.P. SITE



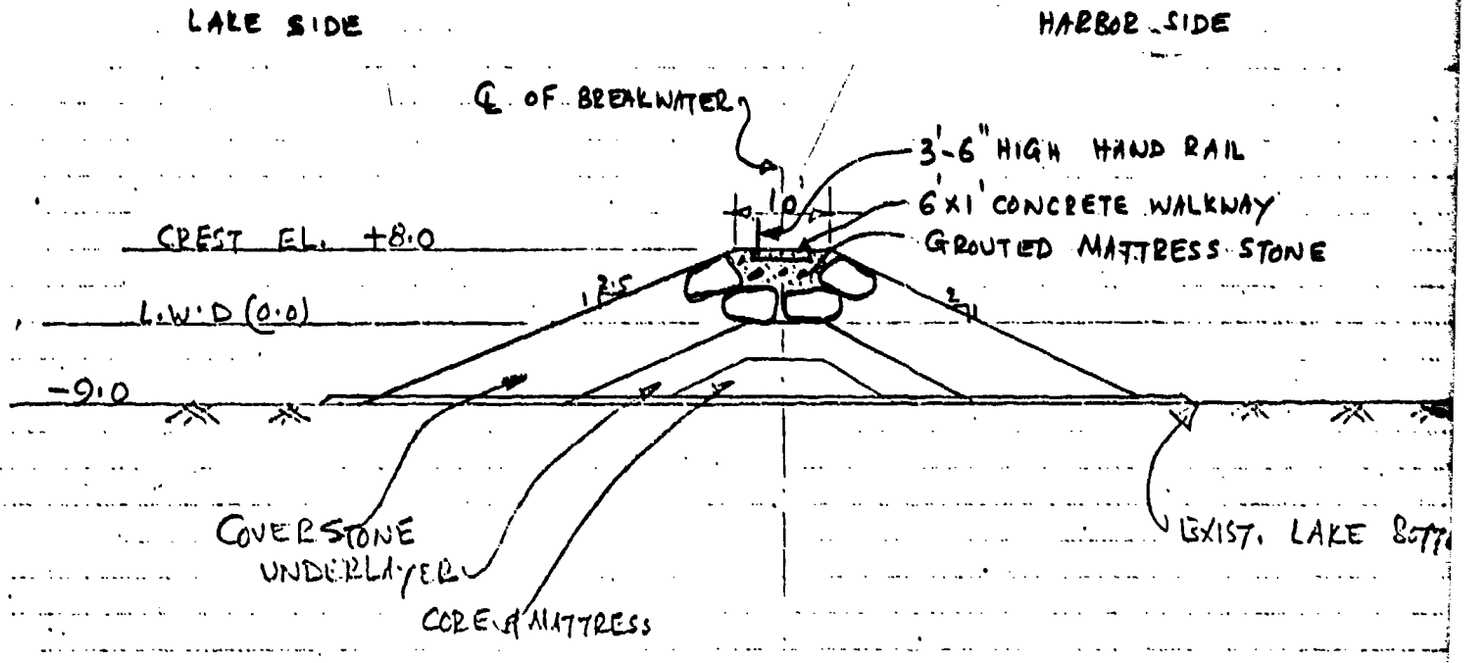
SECTION AT D

STURGEON BAY SITE

Nov. 4, 80

M.K.

SMALL BOAT HARBOR
AT CROSS VILLAGE



TYPICAL CROSS SECTION
SHOWING
RECREATIONAL WALKWAY

SCALE: 1" = 20'

NOV. 25, 80
M.K

TABLE 16

ESTIMATED CONSTRUCTION COST
CROSS VILLAGE, MICHIGAN
(0.5 Foot Wave)

Item	Unit	Quantity	Unit Price	Cost
1. BREAKWATERS				
Cover Stone	cyd	55,000	$ 43.50	$2,392,500
Underlayer Stone	cyd	13,000	$ 35.00	455,000
Core & Mattress Stone	cyd	32,000	$ 27.00	864,000
TOTAL				$3,711,500
2. DREDGING OF CHANNELS AND ANCHORAGE INCLUDING LAKE DISPOSAL	cyd	67,000	$ 5.00	$ 335.000
3. RECREATION FACILITIES				
Concrete Walkway	L-FT	1,670	$200.00	$ 334,000
3 1/2 Feet High Handrail	L-FF	1,670	$ 35.00	58,450
TOTAL				$ 392,450
4. REMOVAL OF EXISTING BREAKWATER				$ 151,600
5. AIDS TO NAVIGATION	ea.	2	$35,000	$ 70,000
ESTIMATED CONSTRUCTION COST				$4,660,550

TABLE 17

ESTIMATED CONSTRUCTION COST
CROSS VILLAGE, MICHIGAN
(1.5 Foot Wave)

Item	Unit	Quantity	Unit Price	Cost
1. BREAKWATERS				
Cover Stone	cyd	46,000	$ 43.50	$2,001,000
Underlayer Stone	cyd	11,000	$ 35.00	385,000
Core & Mattress Stone	cyd	22,000	$ 27.00	594,000
TOTAL				$2,980,000
2. DREDGING OF CHANNELS AND ANCHORAGE INCLUDING LAKE DISPOSAL	cyd	67,000	$ 5.00	$ 335,000
3. RECREATION FACILITIES				
Concrete Walkway	L-FT	1,670	$200.00	$ 334,000
3 1/2 Feet High Handrail	L-FT	1,670	$ 35.00	58,450
TOTAL				$ 392,450
4. REMOVAL OF EXISTING BREAKWATER				$ 151,600
5. AIDS TO NAVIGATION				
(Lights)	ea.	2	$35,000	$ 70,000
ESTIMATED CONSTRUCTION COST				$3,929,050

TABLE 18

ESTIMATED CONSTRUCTION COST
GOOD HART, MICHIGAN
(1.5 Foot Wave)

Item	Unit	Quantity	Unit Price	Cost
1. BREAKWATERS				
Cover Stone	cyd	27,000	$ 43.50	$1,174,500
Underlayer Stone	cyd	6,000	$ 35.00	210,000
Core & Mattress Stone	cyd	8,000	$ 27.00	216,000
TOTAL				$1,600,500
2. DREDGING OF CHANNELS AND ANCHORAGE INCLUDING LAKE DISPOSAL	cyd	98,000	$ 5.00	$ 490,000
3. RECREATION FACILITIES				
Concrete Walkway	L-FT	2,150	$200.00	$ 430,000
3 1/2 Feet High Handrail	L-FT	2,150	$ 35.00	75,250
TOTAL				$ 505,250
4. AIDS TO NAVIGATION				
(Lights)	ea.	2	$35,000	$ 70,000
ESTIMATED CONSTRUCTION COST				$2,665,750

TABLE 19

ESTIMATED CONSTRUCTION COST
STURGEON BAY POINT
(1.5 Foot Wave)

Item	Unit	Quantity	Unit Price	Cost
1. BREAKWATERS				
Cover Stone	cyd	31,000	$ 43.50	$1,348,500
Underlayer Stone	cyd	9,000	$ 35.00	315,000
Core & Mattress Stone	cyd	9,000	$ 27.00	243,000
TOTAL				$1,906,500
2. DREDGING OF CHANNELS AND ANCHORAGE INCLUDING LAKE DISPOSAL	cyd	67,000	$ 5.00	$ 335,000
3. RECREATION FACILITIES				
Concrete Walkway	L-FT	2,080	$200.00	$ 416,000
3 1/2 Feet High Handrail	L-FT	2,080	$ 35.00	72,800
TOTAL				$ 488,800
4. AIDS TO NAVIGATION				
(Lights)	ea.	2	$35,000	$ 70,000
ESTIMATED CONSTRUCTION COST				$2,800,300

TABLE 20

AVERAGE ANNUAL MAINTENANCE COSTS

	Cross Village Michigan	Good Hart Michigan	Sturgeon Bay Point
General Navigation	$33,405	$27,425	$35,705
Recreation	1,700	2,200	2,100
Aids to Navigation	1,000	1,000	1,000
TOTAL	$36,105	$30,625	$38,805

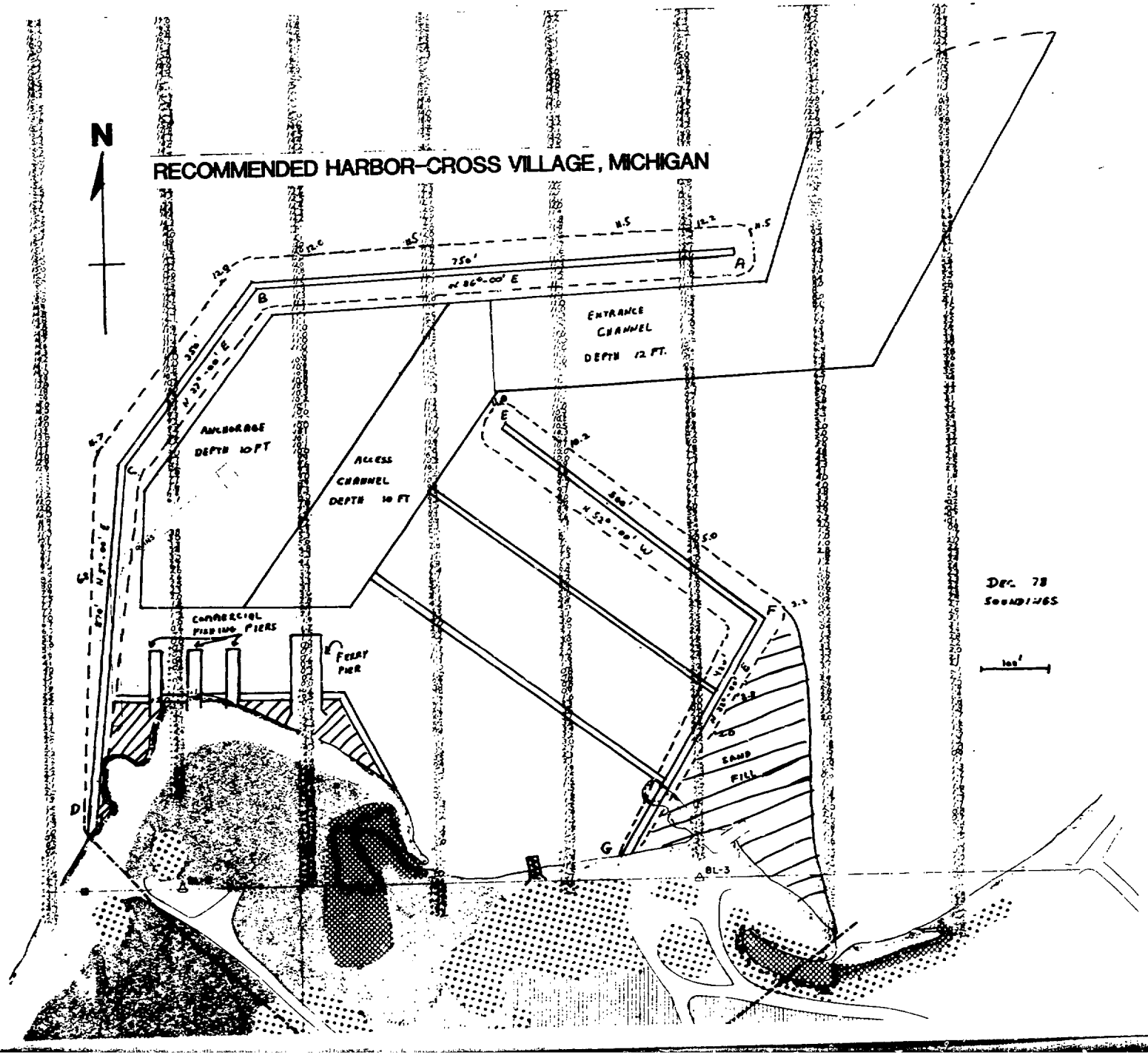

N
RECOMMENDED HARBOR-CROSS VILLAGE, MICHIGAN
ENTRANCE CHANNEL DEPTH 12 FT.
ANCHORAGE DEPTH 10 FT
ACCESS CHANNEL DEPTH 10 FT
COMMERCIAL FISHING PIERS
FERRY PIER
SAND FILL
Dec. 78 SOUNDINGS
BL-3
A
B
C
D
E
F
G

Figure 1

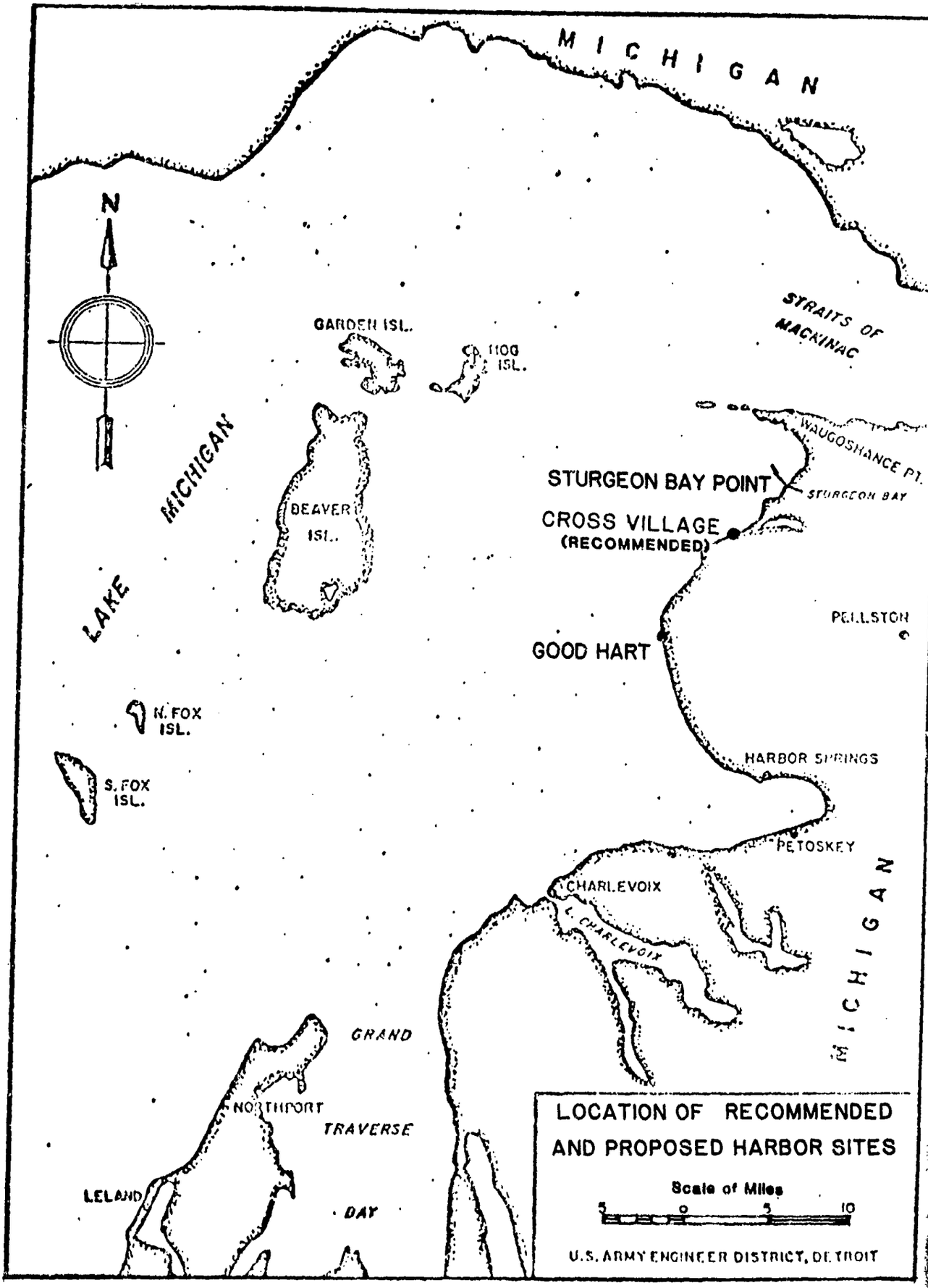

MICHIGAN
N
GARDEN ISL.
ISL.
STRAITS OF MACKINAC
WAUGOSHANCE PT.
STURGEON BAY POINT
STURGEON BAY
CROSS VILLAGE
(RECOMMENDED)
BEAVER ISL.
MICHIGAN
LAKE
PELLSTON
GOOD HART
N. FOX ISL.
S. FOX ISL.
HARBOR SPRINGS
PETOSKEY
CHARLEVOIX
L. CHARLEVOIX
MICHIGAN
GRAND
NORTHPORT
TRAVERSE
LELAND
BAY
LOCATION OF RECOMMENDED AND PROPOSED HARBOR SITES
Scale of Miles
5 0 5 10
U.S. ARMY ENGINEER DISTRICT, DETROIT

Figure 2

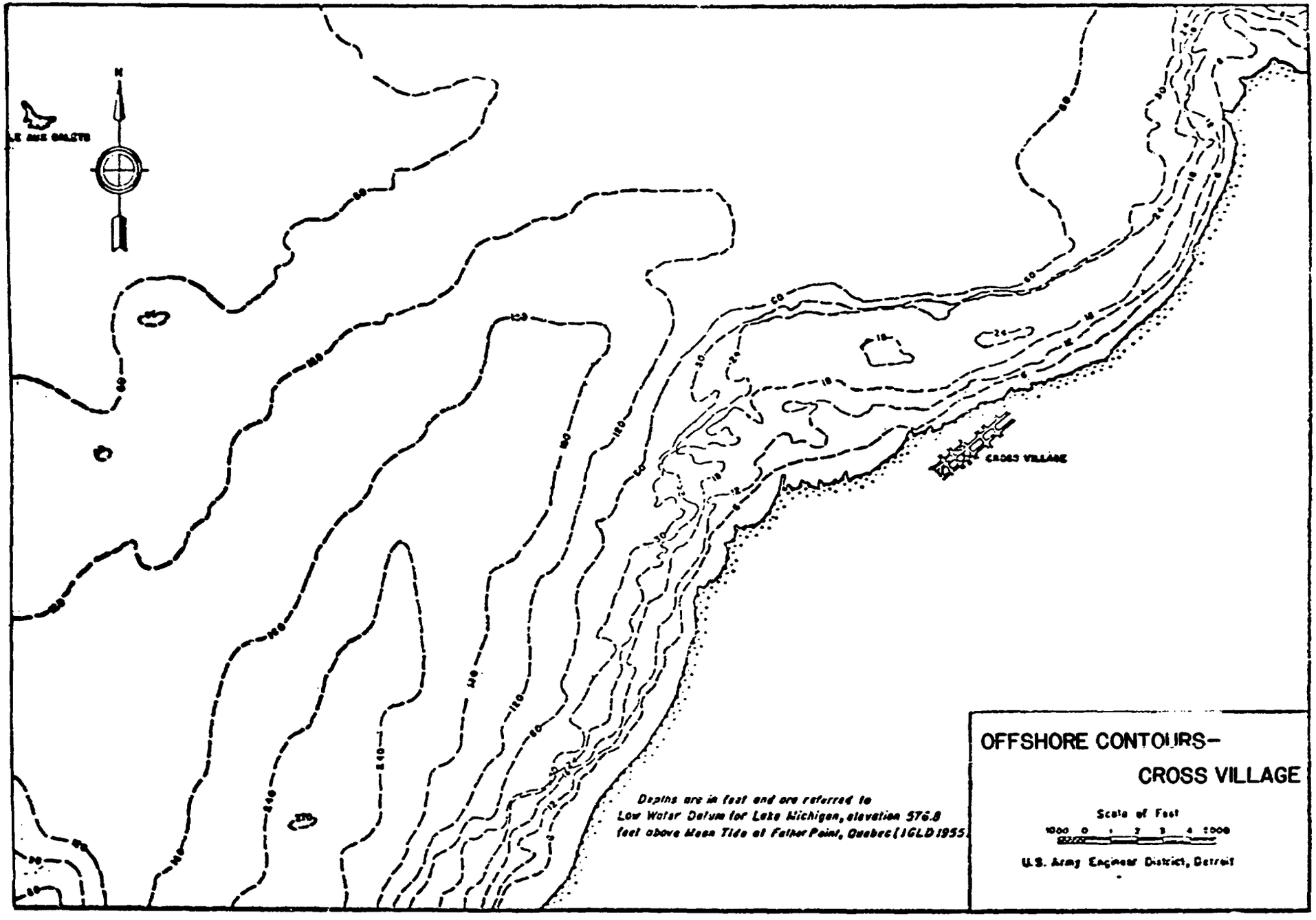
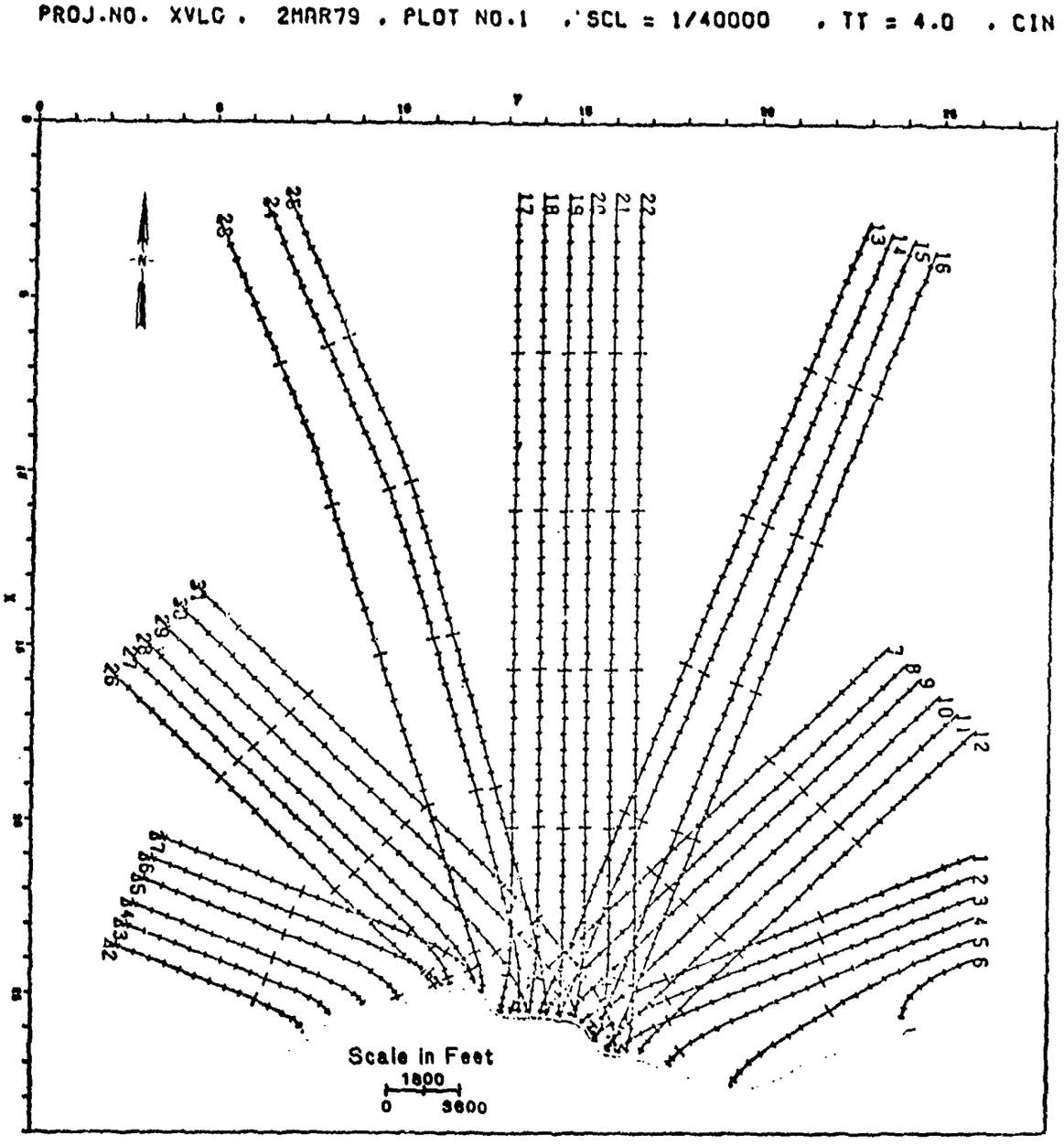

N
CROSS VILLAGE
Depths are in feet and are referred to
Low Water Datum for Lake Michigan, elevation 576.8
feet above Mean Tide at Father Point, Quebec (IGLD 1955)
OFFSHORE CONTOURS–
CROSS VILLAGE
Scale of Feet
1000 0 1 2 3 4 5000
U.S. Army Engineer District, Detroit

Figure 3



REFRACTION DIAGRAM – CROSS VILLAGE

Figure 4

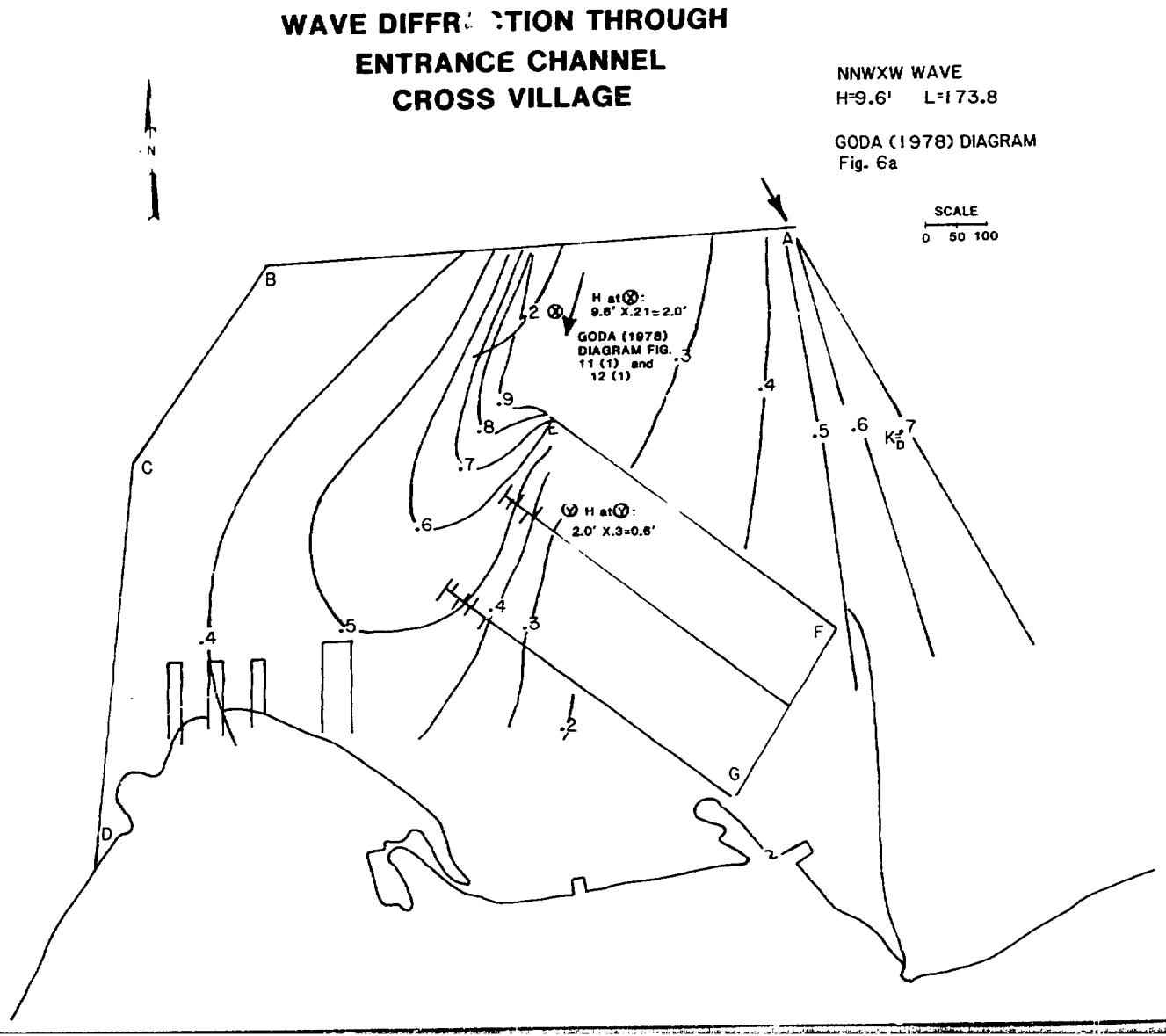

WAVE DIFFRACTION THROUGH
ENTRANCE CHANNEL
CROSS VILLAGE
NNWXW WAVE
H=9.6' L=173.8
GODA (1978) DIAGRAM
Fig. 6a
SCALE
0 50 100
N
A
B
C
D
E
F
G
H at ⊗:
9.6' X.21=2.0'
GODA (1978)
DIAGRAM FIG.
11 (1) and
12 (1)
H at Ⓨ:
2.0' X.3=0.6'
.2
.3
.4
.5
.6
.7
.8
.9
K_D

Figure 5

DIFFRACTION DUE TO WAVE OVERTOPPING
CROSS VILLAGE

H_s=9.6' from NNW×W (~N30W)

L=173. GODA (1978) FIG. 11 B/L=1.0

S=75 more conservative

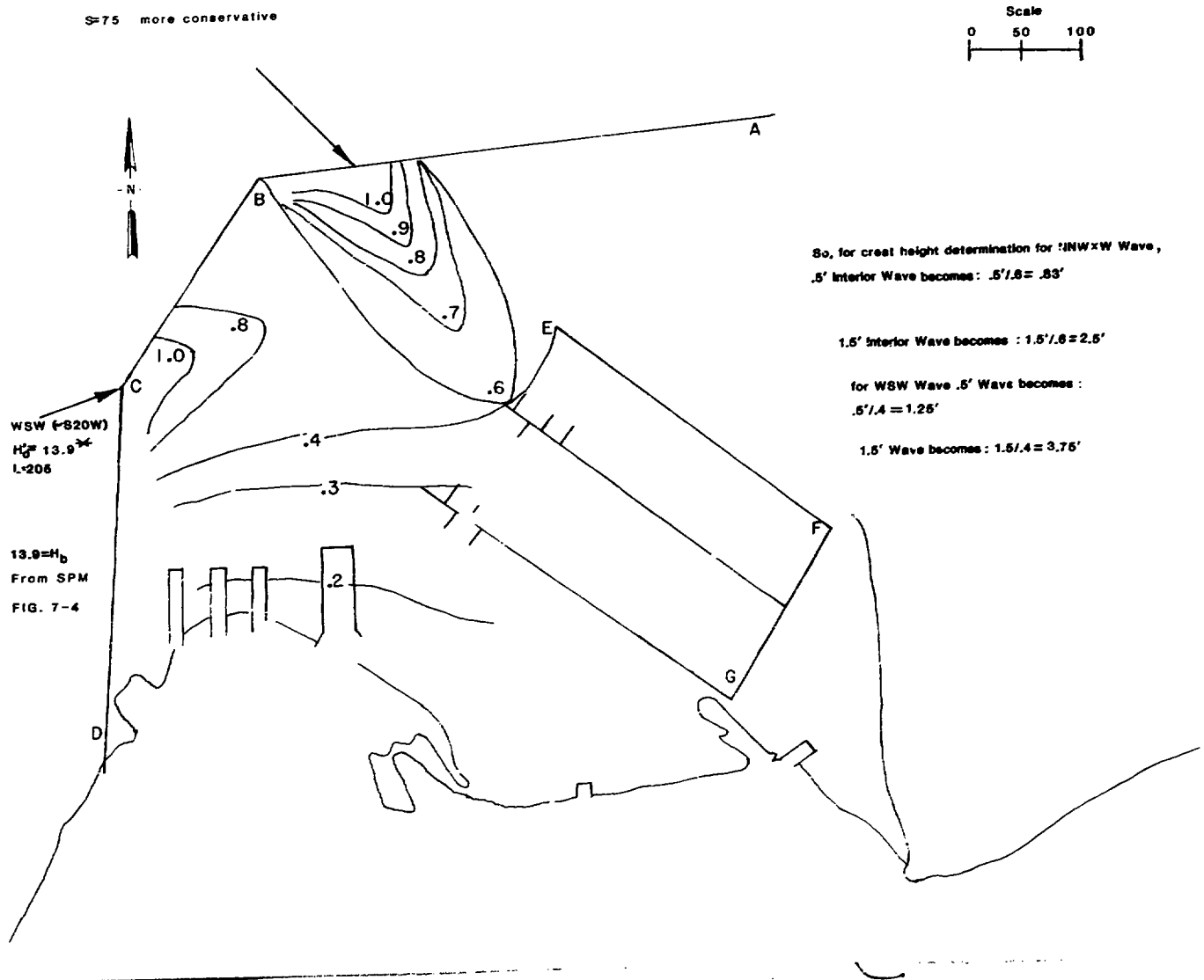
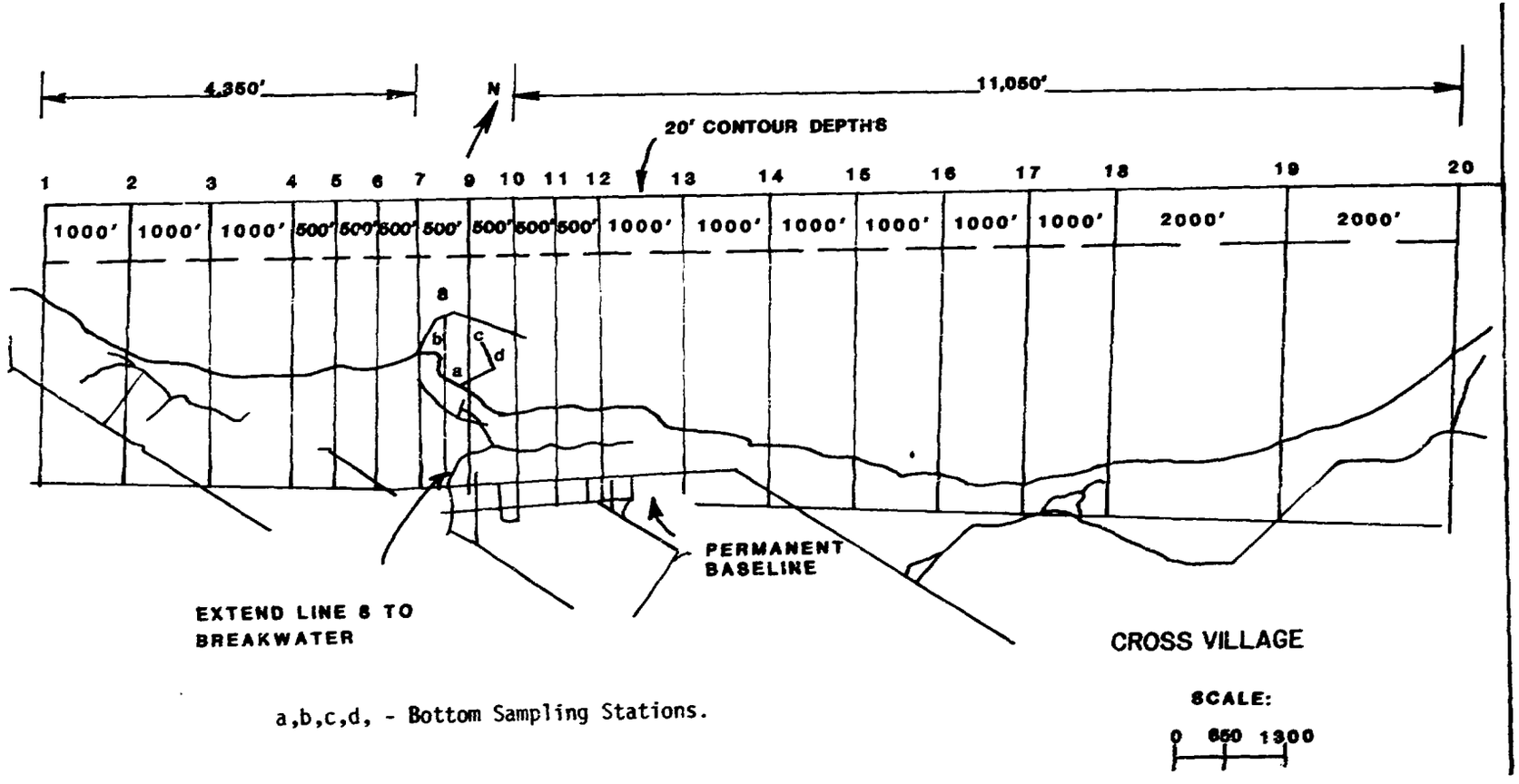


Figure 6

FIGURE 7

FIGURE 8

SHORELINE MONITORING PLAN



a,b,c,d, - Bottom Sampling Stations.

Figure 9

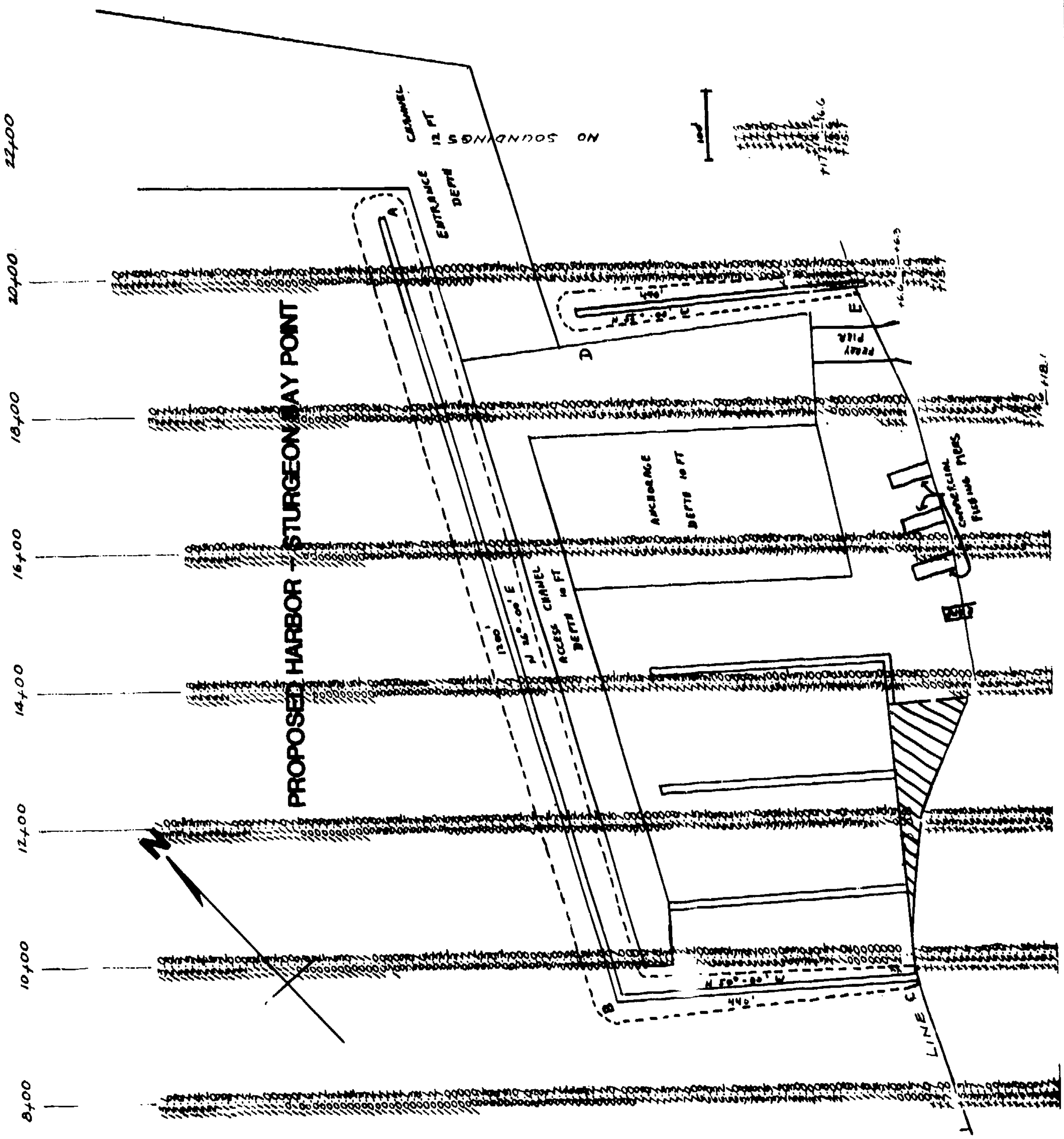


Figure 10

Refraction Diagram – Good Hart

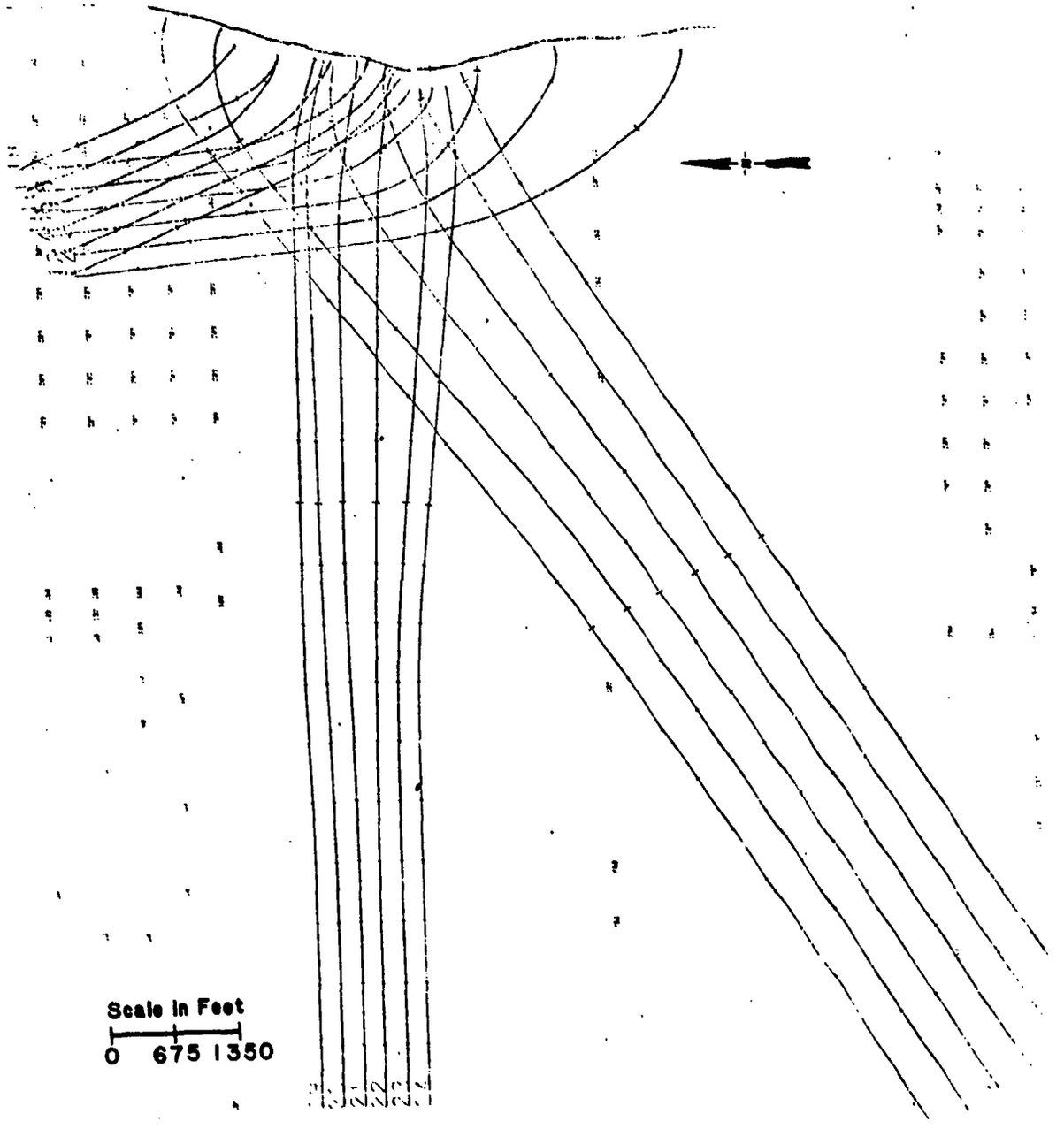


Figure 11

DIFFRACTION OF A N.22° W.WAVE
GOOD HART

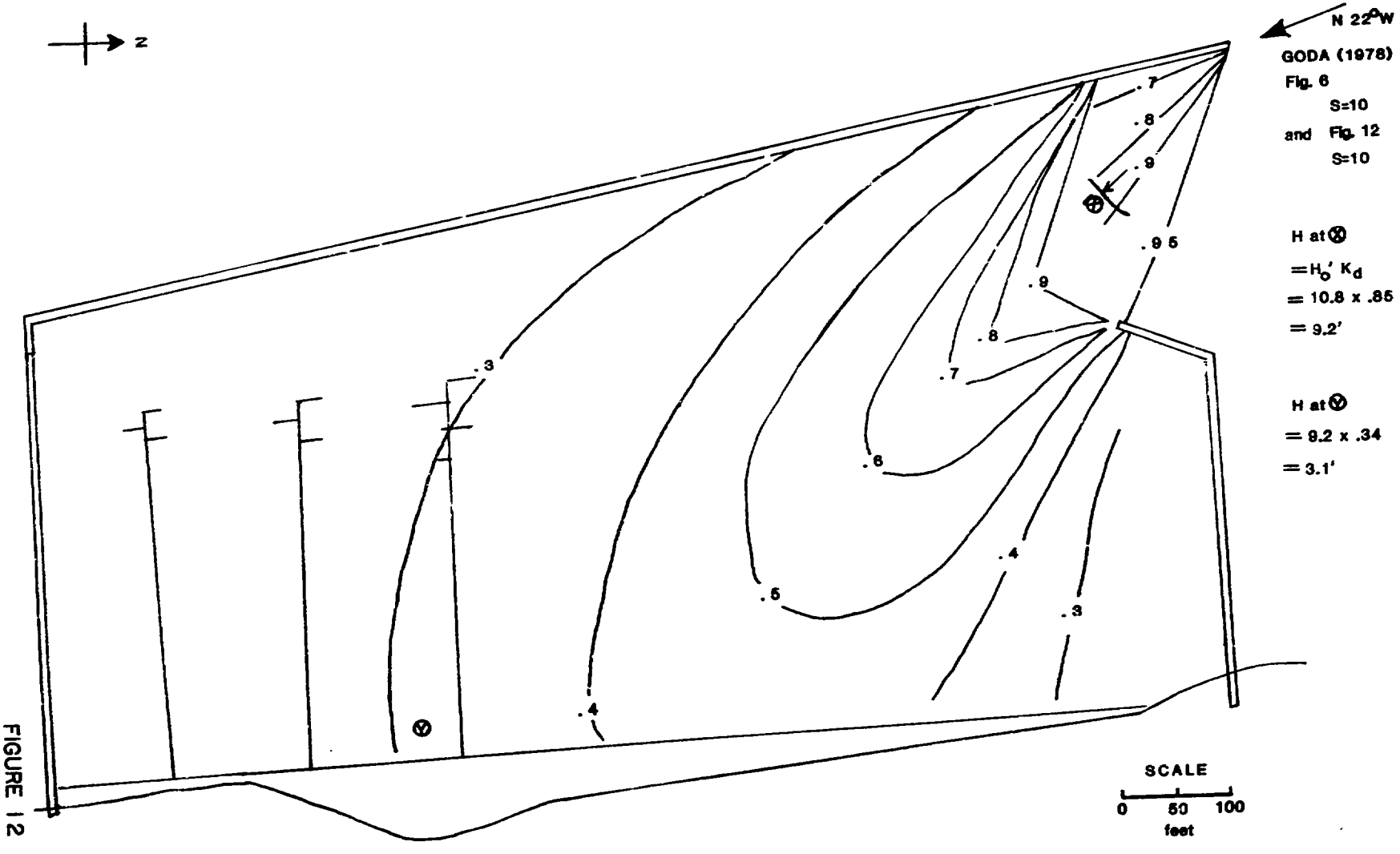


FIGURE 12

DIFFRACTION OF A N90°W. WAVE
GOOD HART

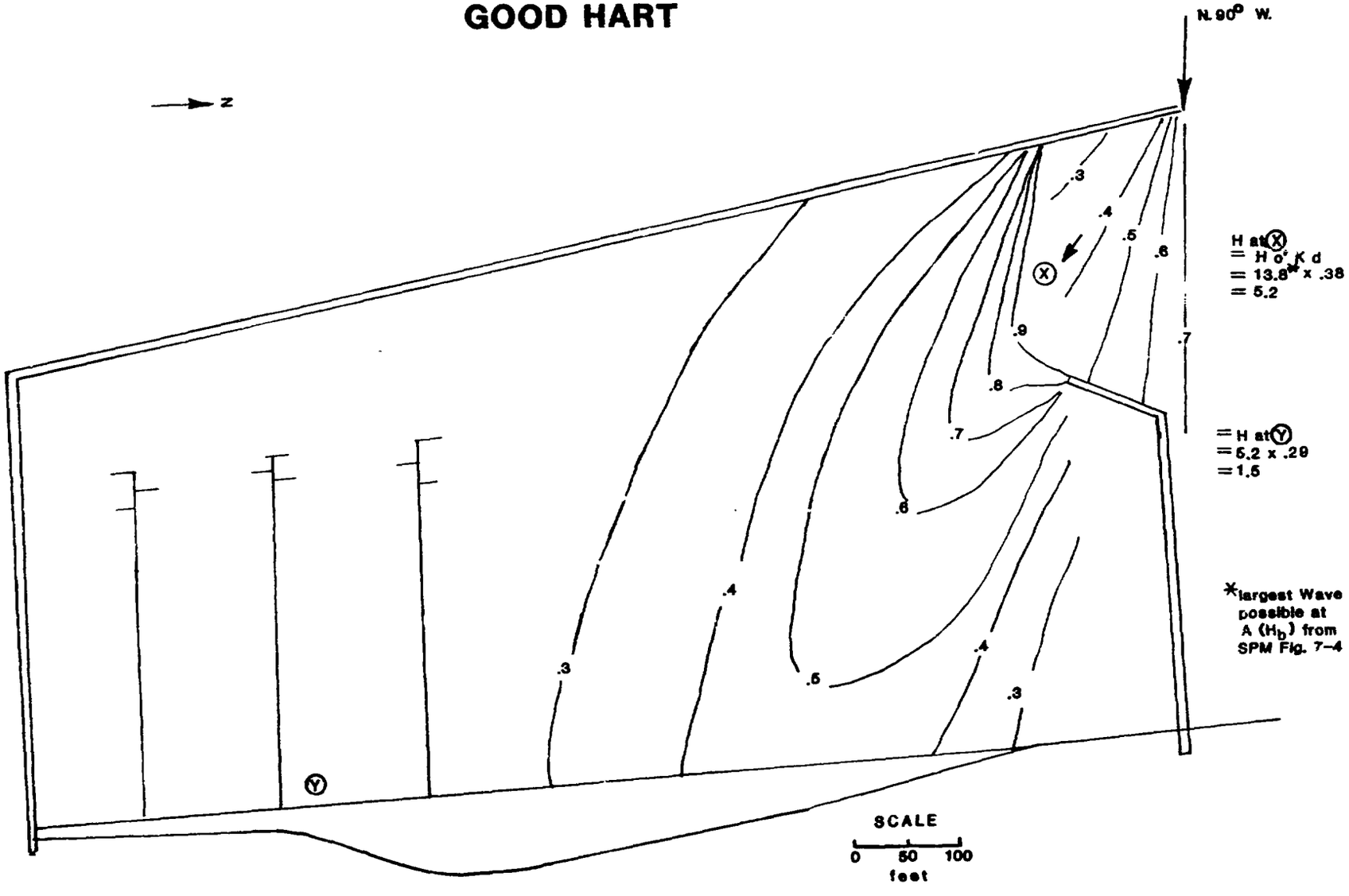


FIGURE 13

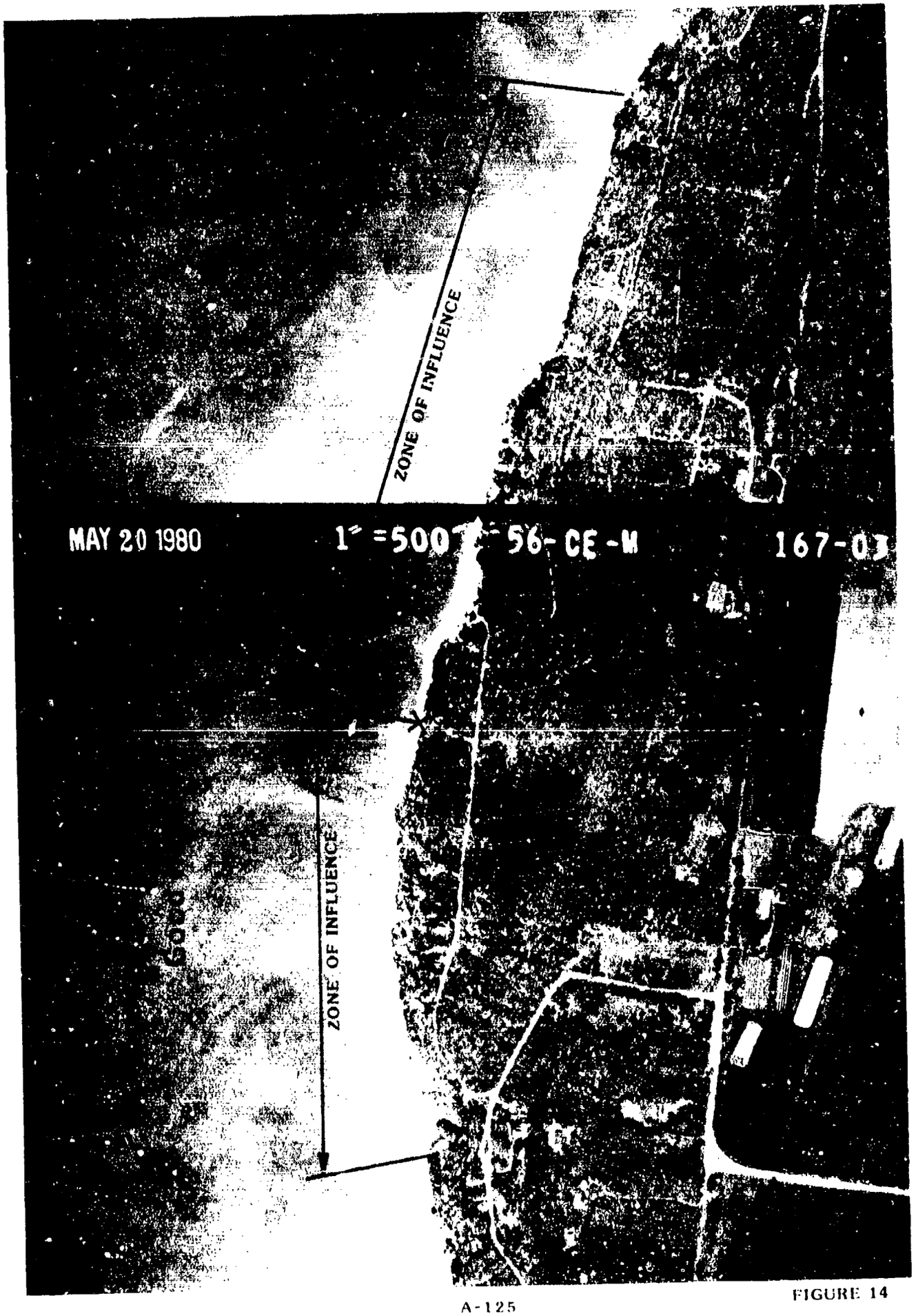


FIGURE 14

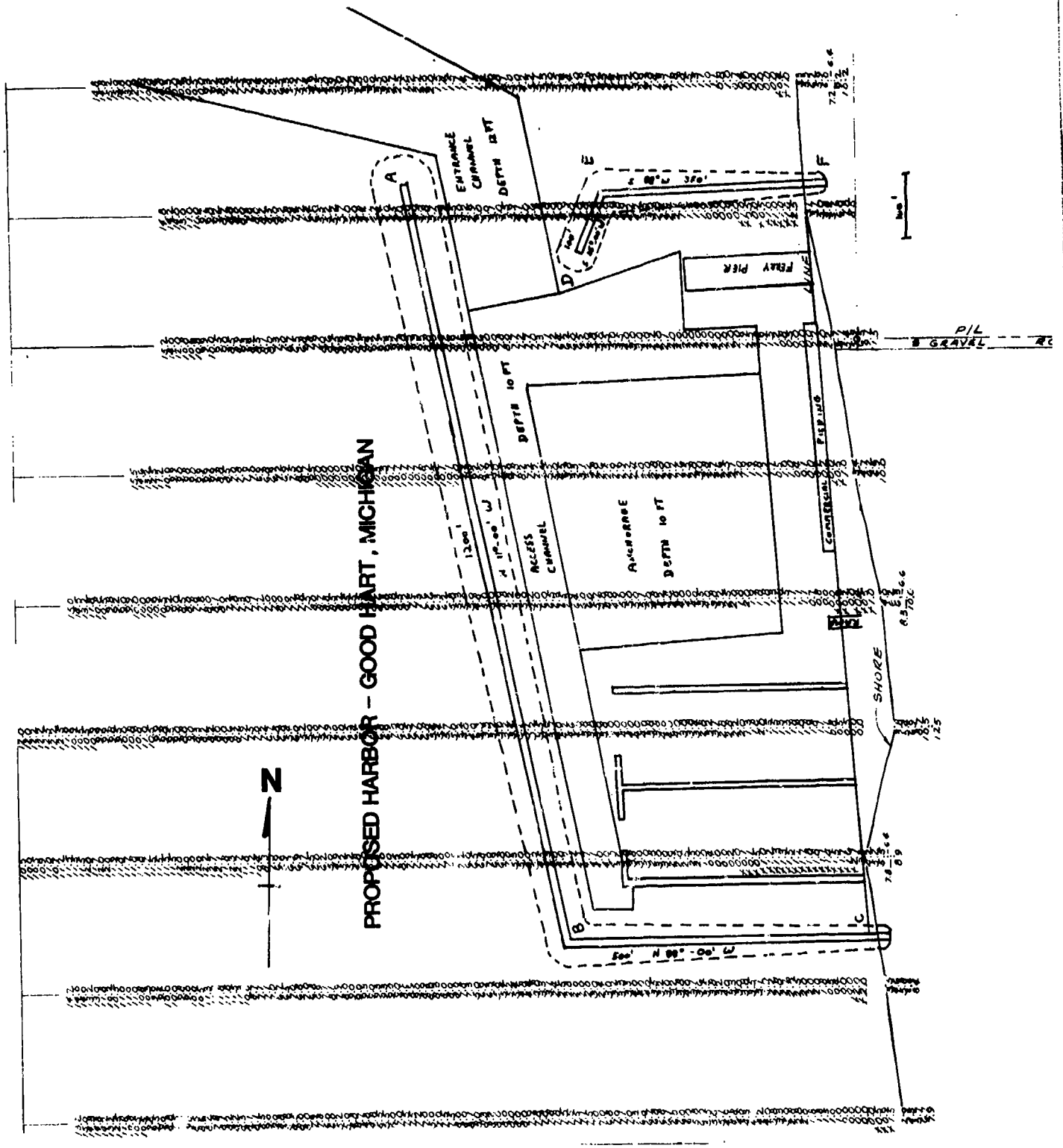

PROPOSED HARBOR – GOOD HART, MICHIGAN
N
A
B
C
D
E
F
ENTRANCE CHANNEL DEPTH 12 FT
DEPTH 10 FT
ACCESS CHANNEL
ANCHORAGE DEPTH 10 FT
FERRY PIER
P/L
GRAVEL
SHORE
1 inch

Figure 15

Refraction Diagram – Sturgeon Bay Point

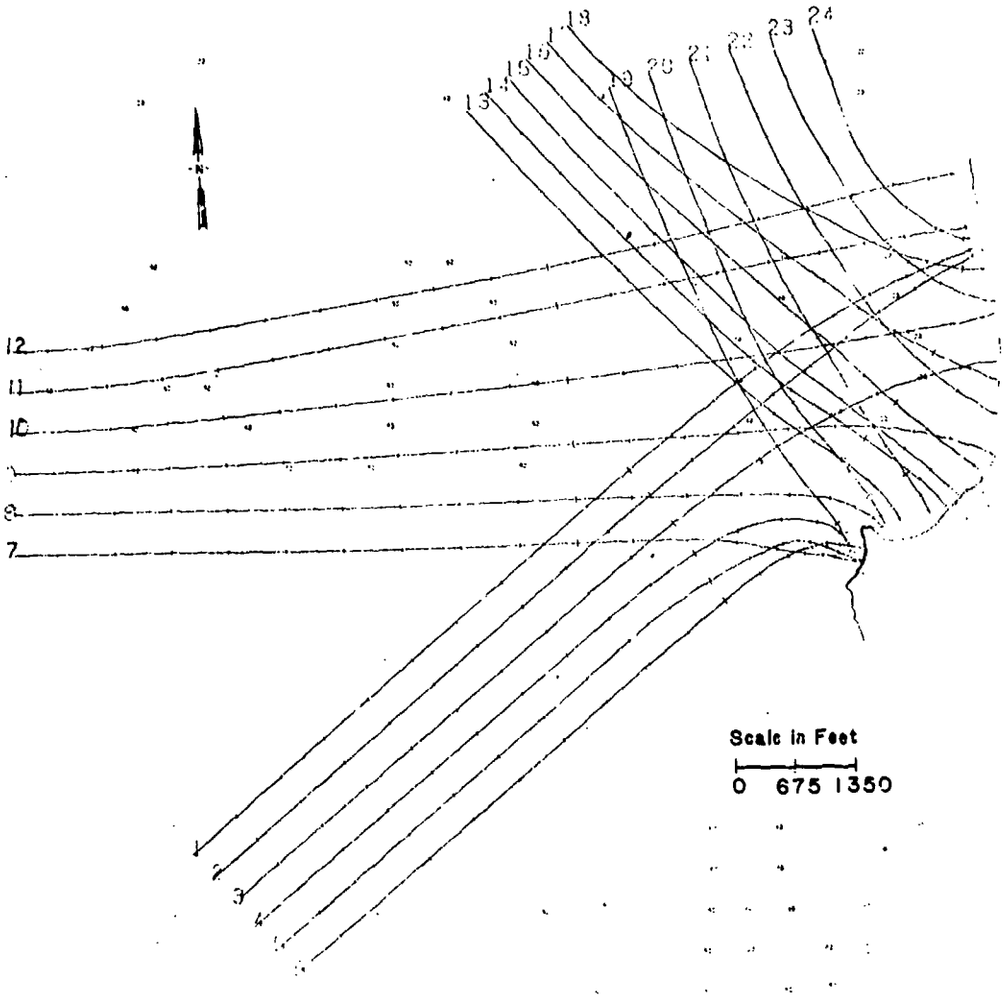
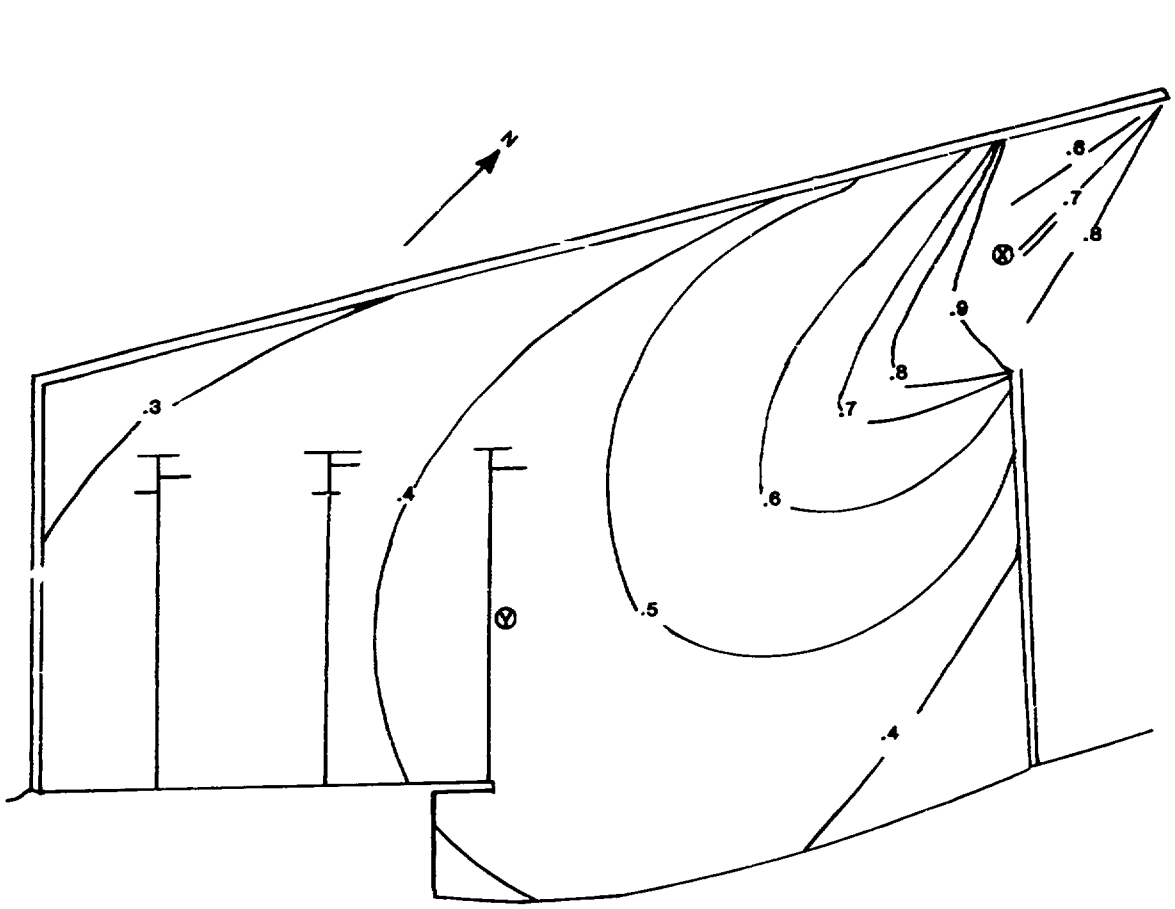


Figure 16



N5 W
$H_o' = 4.7'$
$L = 128.9'$

USE GODA Fig. 6
S = 10

H at X
$= H_o' K_d$
$= 4.7 \times .7$ 3.3'

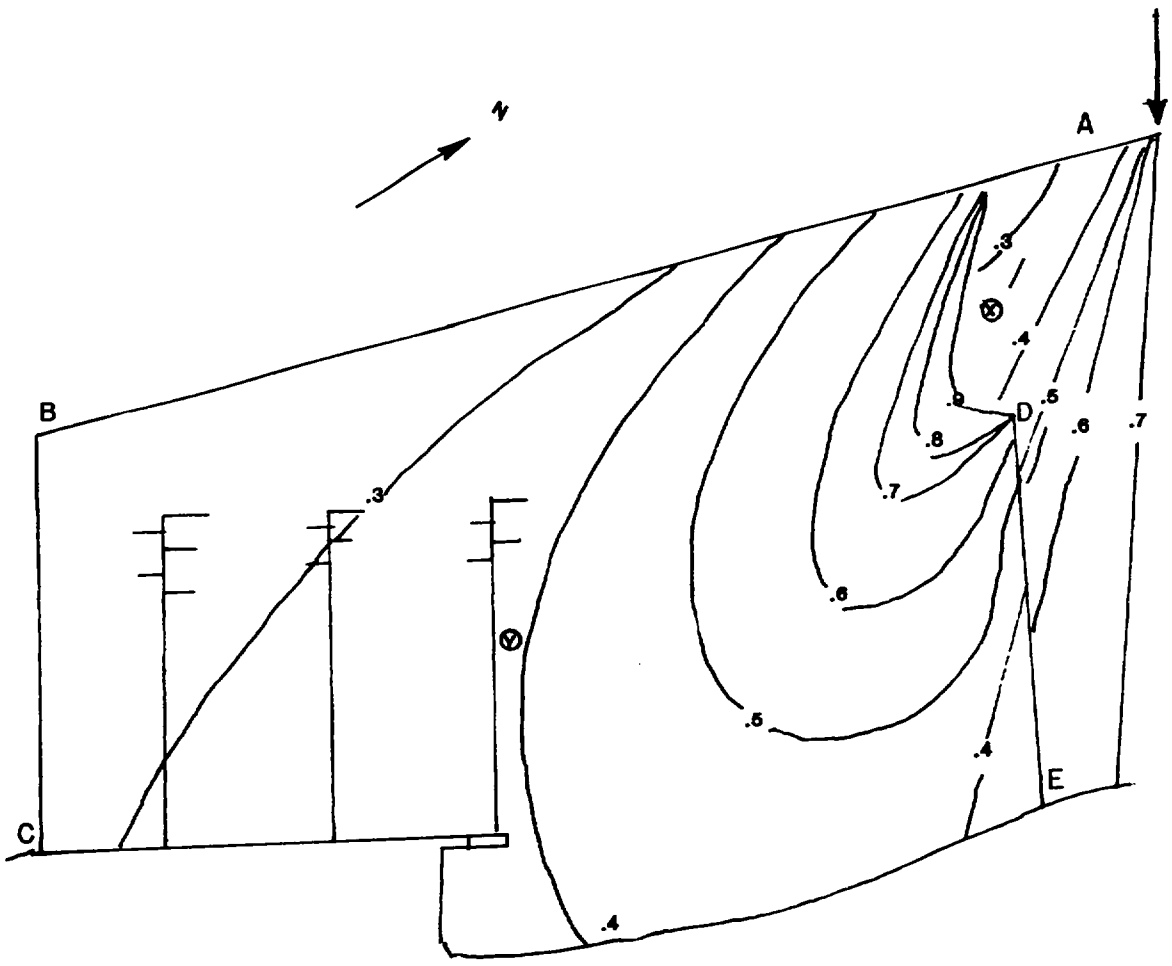
DIFFRACTION THROUGH GAP, USE GODA Fig. 12
S = 10

H at Ⓨ
$3.3 \times .45 = 1.5'$

DIFFRACTION DIAGRAM FOR N. 5 W. WAVE STURGEON BAY POINT

0 65 130

FIGURE 17



N. 45° W. Wave
$H_o' = 7.2'$ GODA Fig. 6 S=10
L =160.4

Scale
0 65 130

H at ⓧ
$= H_o' K_d = 7.2\ (.36)\ 2.6'$

DIFFRACTION THROUGH
GAP, USE GODA Fig 11 and 12.
S=10

H at Ⓨ :
2.6' x .39= 1.0'

DIFFRACTION OF N. 45° W. WAVE
STURGEON BAY POINT

FIGURE 18

FIGURE 19

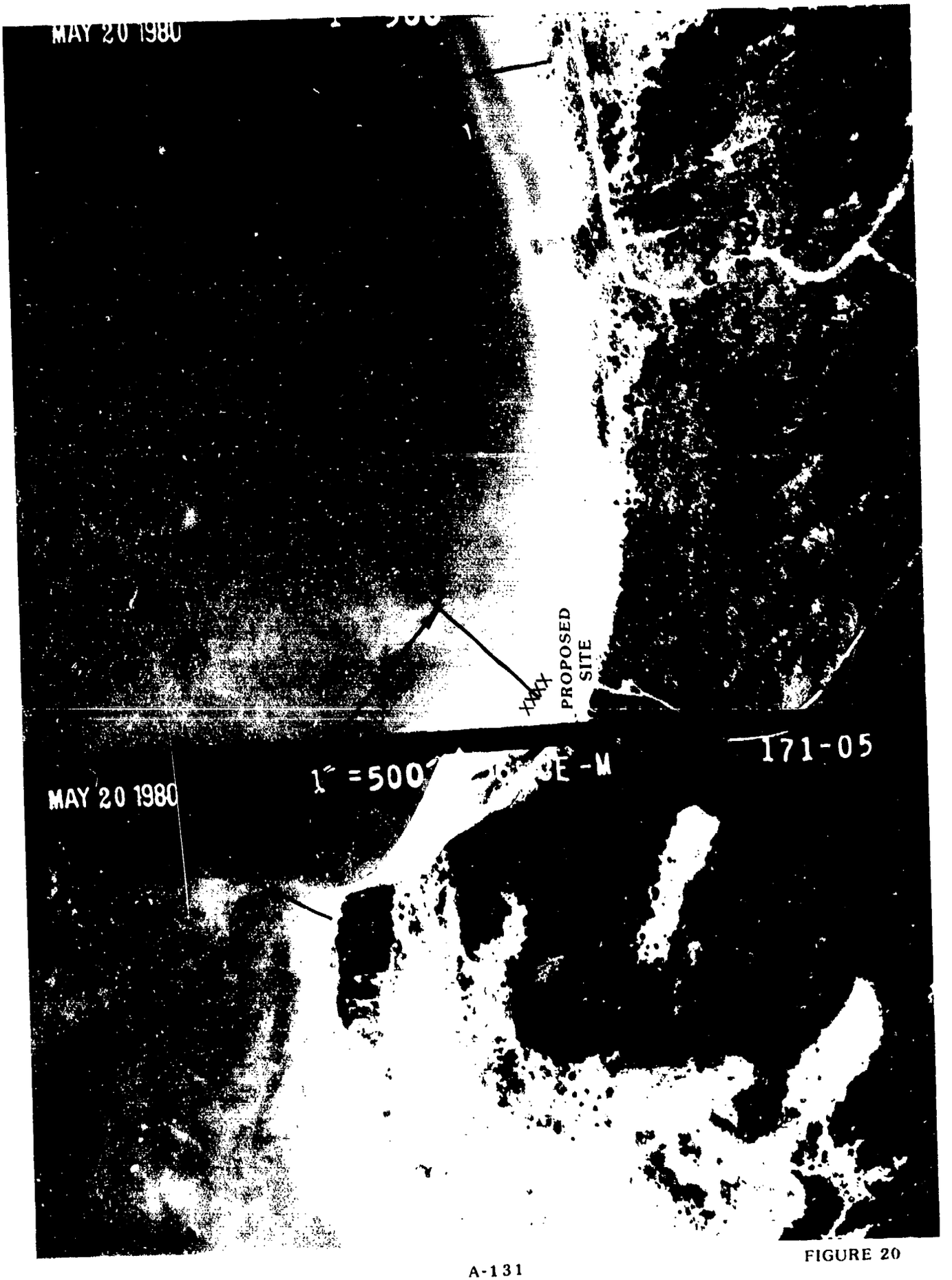


FIGURE 20

REFERENCES

1. Resio and Vincent, DESIGN WAVE INFORMATION FOR THE GREAT LAKES, Report 3, Lake Michigan", Vicksburg, Mississippi; U.S. Army Waterways Experiment Station Technical Report H-76-1.

2. Goda, "Irregular Wave Deformation in the Surf Zone", COASTAL ENGINEERING IN JAPAN, Japan; Vol. 18, (1975) pp 13-25.

3. Goda, "Diffraction Diagrams for Directional Random Waves", Contribution to the 16TH COASTAL ENGINEERING CONFERENCE, Hamburg, Germany; 1978.

4. W. Seelig, "Estimation of Wave Transmission Coefficients for Permeable Breakwaters", U.S. Army Coastal Engineering Research Center, Civil Engineering Technical Article, Publication 79-6; Fort Belvoir, Virginia.

5. U.S. Army Coastal Engineering Research Center, SHORE PROTECTION MANUAL, Volumes I, II, and III, Fort Belvoir, Virginia; U.S. Army Coastal Engineering Research Center, 1977.

APPENDIX B

PHASE I GENERAL DESIGN MEMORANDUM
STUDY FOR A HARBOR FOR LIGHT-DRAFT VESSELS AT
CROSS VILLAGE, MICHIGAN

ECONOMIC STUDIES

DEPARTMENT OF THE ARMY
DETROIT DISTRICT CORPS OF ENGINEERS

APPENDIX B

ECONOMIC STUDIES

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TABLE OF CONTENTS (Cont.)

LIST OF TABLES

APPENDIX B
ECONOMIC STUDIES

ECONOMICS OF ALTERNATIVE PLANS

The purpose of this section is to analyze the various economic aspects of each alternative plan insofar as it is possible to quantify those aspects in monetary terms. Benefits and costs are displayed to describe the overall economic impact of a harbor for light-draft vessels at each of the three alternative sites; Cross Village, Good Hart, and Sturgeon Bay Point. Four plans for a light-draft harbor were developed, two at Cross Village and one each at Good Hart and Sturgeon Bay Point as described below:

Alternative 1A: Cross Village, Michigan - designed for an interior wave height at the recreational boat docks of 0.5 feet.

Alternative 1: Cross Village, Michigan - designed for an interior wave height at the recreational boat docks of 1.5 feet.

Alternative 2: Good Hart, Michigan - designed for an interior wave height at the recreational boat docks of 1.5 feet.

Alternative 3: Sturgeon Bay Point, Michigan - designed for an interior wave height at the recreational boat docks of 1.5 feet.

Alternatives 1 thru 3 were evaluated based on the 1.5 feet wave height for the purpose of making an economic comparison of the three sites. The 1.5 feet wave height was used to keep the construction costs of the harbor to a minimum. Concern was raised that an interior wave height of 1.5 feet may cause an unacceptable amount of damage to boats at the docks. Therefore a second analysis (Alternative 1A) was made of the Cross Village site (the recommended plan) with a design for an interior wave height of 0.5 foot to provide a comparison of the costs of the two plans.

METHODOLOGY

Benefits and costs accruing over the 50-year life of a project are evaluated such that equivalent average annual costs can be compared to equivalent average annual benefits. The comparison is accomplished by identifying currently established costs (including amortization and maintenance costs); and applying the authorized interest rate of 3-1/4 percent (the interest rate applicable to this project).

The comparison of equivalent average annual costs and benefits is the primary means by which economic justification of the project is possible. Such a comparison allows for identification of those proposed projects whose average annual benefits exceed or equal the annual costs of the project. This is the preferable situation if there is to be a Federal contribution toward the project.

The choice of 50 years as the project life (and therefore the economic life) is based on a number of factors. Economic and physical constraints such as physical depreciation of adjacent shore structures, shoaling, obsolescence, changing requirements for project services, and inaccuracies of overly lengthy projections are considered in this choice.

Benefits and costs are evaluated in accordance with standard Corps of Engineers practices. Guidelines presented in EM 1120-2-113 "Benefit Evaluation for Small Boat Harbors" establish the means by which pertinent benefits can be quantified. Recreational boating benefits are evaluated as the gain in annual return received by recreational boaters if the harbor is improved; annual return represents "the net return on depreciated investment in boats as received by owners of 'for-hire' vessels, after all expenses have been paid." Once this is established, it is possible to estimate the difference between returns to the existing recreational fleet with the existing facilities and returns to this same fleet in the event of harbor improvements. The increase in net return is a part of the navigation benefit.

It is also possible that harbor improvements may promote an increase in the number of recreational boats using the harbor. In this case, the full value of the ascribed annual return to owners of these vessels is used in the compilation of navigation benefits. It should be noted that straight line depreciation is used to estimate the average depreciated value by boat classes over the service life of the boats. Average depreciated value for a given class of boats in this analysis is considered to be one-half of the average market value of boats in that same class, taking into account the mix of old and new boats in the fleet at any given time. The approximate range of annual return to recreational boating using the "for-hire" analogy has been estimated in a study of recreational boating in the United States. The ranges are 10 to 15 percent for outboards; 8 to 12 percent for inboards; 6 to 9 percent for cruisers; and 8 to 12 percent for sailboats.

Additional benefits considered are commercial fishing benefits, benefits to the Beaver Island Ferry, benefits resulting from a harbor of refuge, and sport fishing benefits. Harbor of refuge benefits accrue in those instances when the proposed development provides additional safety and refuge. Recreational sport fishing benefits represent the value of additional angler-days enjoyed by fishermen because of the proposed harbor improvements. Finally, commercial fishing and Beaver Island Ferry benefits are evaluated as those cost savings associated with moving existing operations to the Cross Village vicinity.

COSTS

First Costs

The estimated components of first costs for the considered improvements are shown in Tables 1 thru 4. Costs are allocated to either navigation facilities, or recreation facilities. Costs are based on October 1960 price levels and include allowances for engineering and design, and supervision and administration. An appropriate allowance has been made

TABLE 1

ESTIMATED FIRST COSTS

ALTERNATIVE 1A

CROSS VILLAGE, MICHIGAN (.5')

Item	Navigation Facilities	Recreation Facilities	Total
Breakwaters	$3,711,500	---	$3,711,500
Dredging of Channels & Anchorage	335,000	---	335,000
Removal of Existing Stone/ Timber Piles	151,600	---	151,600
Walkway	---	392,450	392,450
Est. Construction Cost	$4,198,100	$392,450	$4,590,550
Contingency (15%)	629,700	58,900	688,600
Subtotal	$4,827,800	$451,350	$5,279,150
Engineering & Design	430,000	40,000	470,000
Supervision & Administration	352,100	32,700	384,800
Gross Construction Cost	$5,609,900	$524,050	$6,133,950
Less Local Contribution	$2,131,800	$262,025	$2,393,820
Net Federal First Cost	$3,478,100	$262,025	$3,740,125
Aids to Navigation	70,000	---	70,000
TOTAL FEDERAL FIRST COSTS	$3,548,100	$262,025	$3,810,125
TOTAL NON-FEDERAL FIRST COSTS	$2,131,800	$262,025	$2,393,825
TOTAL FEDERAL & NON-FEDERAL FIRST COSTS	$5,679,900	$524,050	$6,203,950

TABLE 2

ESTIMATED FIRST COSTS

ALTERNATIVE 1

CROSS VILLAGE, MICHIGAN (1.5')

Item	Navigation Facilities	Recreation Facilities	Total
Breakwaters	$2,980,000	---	$2,980,000
Dredging of Channels & Anchorage	335,000	---	335,000
Monitoring Plan - Initial Survey	62,000	---	62,000
Removal of Existing Stone/ Timber Piles	151,600	---	151,600
Walkway	---	392,450	392,450
Est. Construction Cost	$3,528,600	$392,450	$3,921,050
Contingency (15%)	529,300	58,850	588,150
Subtotal	$4,057,900	$451,300	$4,509,200
Engineering & Design	423,000	47,000	470,000
Supervision & Administration	311,700	34,600	346,300
Gross Construction Cost	$4,792,600	$532,900	$5,325,500
Less Local Contribution	$1,821,200	$266,450	$2,087,650
Net Federal Construction Cost	$2,971,400	$266,450	$3,237,850
Aids to Navigation	70,000	---	70,000
TOTAL FEDERAL FIRST COSTS	$3,041,400	$266,450	$3,307,850
TOTAL NON-FEDERAL FIRST COSTS	$1,821,200	$266,450	$2,087,650
TOTAL FEDERAL & NON-FEDERAL FIRST COSTS	$4,862,600	$532,900	$5,395,500

TABLE 3

ESTIMATED FIRST COSTS

ALTERNATIVE 2

GOOD HART, MICHIGAN (1.5')

Item	Navigation Facilities	Recreation Facilities	Total
Breakwaters	$1,600,500	---	$1,600,500
Dredging of Channels & Anchorage	490,000	---	490,000
Walkway	---	$505,250	505,250
Est. Construction Cost	$2,090,500	$505,250	$2,595,750
Contingency (15%)	313,600	75,800	389,400
Subtotal	$2,404,100	$581,050	$2,985,150
Engineering & Design	378,300	91,700	470,000
Supervision & Administration	217,400	52,700	270,100
Gross Construction Cost	$2,999,800	$725,450	$3,725,250
Less Local Contribution	$1,139,900	$362,725	$1,502,625
Net Federal Construction Cost	$1,859,900	$362,725	$2,222,625
Aids to Navigation	70,000	---	70,000
TOTAL FEDERAL FIRST COSTS	$1,929,900	$362,725	$2,292,625
TOTAL NON-FEDERAL FIRST COSTS	$1,139,900	$362,725	$1,502,625
TOTAL FEDERAL & NON-FEDERAL FIRST COSTS	$3,069,800	$725,450	$3,795,250

TABLE 4

ESTIMATED FIRST COSTS

ALTERNATIVE 3

STURGEON BAY POINT, MICHIGAN (1.5')

Item	Navigation Facilities	Recreation Facilities	Total
Breakwaters	$1,906,500	---	$1,906,500
Dredging of Channels & Anchorage	335,000	---	335,000
Walkway	---	488,800	488,800
Est. Construction Cost	$2,241,500	$488,800	$2,730,300
Contingency (15%)	336,200	73,300	409,500
Subtotal	$2,577,700	$562,100	$3,139,800
Engineering & Design	385,900	84,100	470,000
Supervision & Administration	228,100	49,700	277,800
Gross Construction Cost	$3,191,700	$695,900	$3,887,600
Less Local Contribution	$1,212,800	$347,950	$1,560,750
Net Federal Construction Cost	$1,978,900	$347,950	$2,326,850
Aids to Navigation	70,000	---	70,000
TOTAL FEDERAL FIRST COSTS	$2,048,900	$347,950	$2,396,850
TOTAL NON-FEDERAL FIRST COSTS	$1,212,800	$347,950	$1,560,750
TOTAL FEDERAL & NON-FEDERAL FIRST COSTS	$3,261,700	$695,900	$3,957,600

in the estimated costs for contingencies. After selection of Alternative 1 - Cross Village, Michigan (1.5 feet interior wave height) as the recommended plan, costs of the initial survey for the shoreline monitoring plan were included in the total first costs. As selection of Alternative 1 was based primarily on non-economic data and the fact that the cost would be the same for all alternatives, these costs are not shown for Alternatives 1A, 2, and 3. The derivation of the costs for the monitoring plan is shown in Table 5.

TABLE 5

DERIVATION OF FIRST COSTS

SHORELINE MONITORING PROGRAM

Item	Initial Survey*	Periodic Surveys**
Perform Survey & Obtain Sediment Samples	$35,000	$20,000
Sieve Analysis	2,500	2,500
Contaminant Analysis	2,500	2,500
Aerial Photography	2,000	2,000
Topographic Mapping	10,000	10,000
Analysis & Reporting of Data	10,000	10,000
	$62,000	$47,000

*Initial Survey is performed prior to harbor construction and is included as part of the project first costs.

**Periodic Surveys are performed prior to maintenance dredging (approximately every three years over a twelve year period) and their costs are annualized over the life of the project.

Average Annual Charges

Average annual charges are displayed in Tables 6 thru 9. Charges include interest and amortization on investment costs, and maintenance costs. The first costs and total investment costs are equal as no

TABLE 6

ESTIMATED AVERAGE ANNUAL CHARGES

CROSS VILLAGE, MI - ALTERNATIVE 1A (0.5')

Investment Charges	Navigation Facilities	Recreation Facilities	Total
Federal First Costs	$3,548,100	$262,025	$3,810,125
Non-Federal First Costs	2,131,800	262,025	2,393,825
Total First Costs	$5,679,900	$524,050	$6,203,950
ANNUAL CHARGES			
Federal			
Interest 3-1/4%	$115,315	$8,515	$123,830
Amortization (.008230)[1/]	29,200	2,160	31,360
Maintenance			
Corps of Engineers	33,405	0	33,405
Coast Guard (Aids to Nav.)	1,000	0	1,000
Total	$178,920	$10,675	$189,595
Non-Federal			
Interest 3-1/4%	$69,285	$ 8,515	$77,800
Amortization (.008230)[1/]	17,545	2,160	19,705
Maintenance	0	1,700	1,700
Total	$86,830	$12,375	$99,205
TOTAL ANNUAL CHARGES	$265,750	$23,050	$288,800

[1/] Amortization factor based on a 50-year project life at 3-1/4% interest rate.

TABLE 7

ESTIMATED AVERAGE ANNUAL CHARGES

CROSS VILLAGE, MI - ALTERNATIVE 1 (1.5')

Investment Costs	Navigation Facilities	Recreation Facilities	Total
Federal First Costs	$3,041,400	$266,450	$3,307,850
Non-Federal First Costs	1,821,200	266,450	2,087,650
Total First Costs	$4,862,600	$532,900	$5,395,500
ANNUAL CHARGES			
Federal			
Interest 3-1/4%	$ 98,800	$ 8,700	$107,500
Amortization (.008230)[1/]	25,000	2,200	27,200
Monitoring Plan	7,000		7,000
Maintenance			
Corps of Engineers	33,405	0	33,405
Coast Guard (Aids to Nav.)	1,000	0	1,000
Total	$165,205	$10,900	$176,105
Non-Federal			
Interest 3-1/4%	$ 59,200	$ 8,700	$ 67,900
Amortization (.008230)[1/]	15,000	2,200	17,200
Maintenance	0	1,700	1,700
Total	$ 74,200	$12,600	$ 86,800
TOTAL ANNUAL CHARGES	$239,405	$23,500	$262,905

[1/] Amortization factor based on a 50-year project life at 3-1/4% interest rate.

TABLE 8

ESTIMATED AVERAGE ANNUAL CHARGES

GOOD HART, MI - ALTERNATIVE 2 (1.5')

Investment Costs	Navigation Facilities	Recreation Facilities	Total
Federal First Costs	$1,929,900	$362.725	$2,292,625
Non-Federal First Cost	1,139,900	362,725	1,502,625
Total First Costs	$3,069,800	$725,450	$3,795,250
ANNUAL CHARGES			
Federal			
Interest 3-1/4%	$ 62,720	$11,790	$ 74,510
Amortization (.008230)[1/]	15,885	2,985	18,870
Maintenance			
Corps of Engineers	27,425	0	27,425
Coast Guard (Aids to Nav.)	1,000	0	1,000
Total	$107,030	$14,775	$121,805
Non-Federal			
Interest 3-1/4%	$37,045	$11,790	$48,835
Amortization (.008230)[1/]	9,380	2,985	12,365
Maintenance	0	2,200	2,200
Total	$46,425	$16,975	$63,400
TOTAL ANNUAL CHARGES	$153,455	$31,750	$185,205

[1/] Amortization factor based on a 50-year project life at 3-1/4% interest rate.

TABLE 9

ESTIMATED AVERAGE ANNUAL CHARGES

STURGEON BAY POINT, MI - ALTERNATIVE 3 (1.5')

Investment Charges	Navigation Facilities	Recreation Facilities	Total
Federal First Costs	$2,048,900	$347,950	$2,396,850
Non-Federal First Costs	1,212,800	347,950	1,560,750
Total First Costs	$3,261,700	$695,900	$3,957,600
ANNUAL CHARGES			
Federal			
Interest 3-1/4%	$ 66,590	$11,310	$ 77,900
Amortization (.008230)[1/]	16,860	2,865	19,725
Maintenance			
Corps of Engineers	35,705	0	35,705
Coast Guard (Aids to Nav.)	1,000	0	1,000
Total	$120,155	$14,175	$134,330
Non-Federal			
Interest 3-1/4%	$39,415	$11,310	$50,725
Amortization (.008230)[1/]	9,980	2,865	12,845
Maintenance	0	2,100	2,100
Total	$49,395	$16,275	$65,670
TOTAL ANNUAL CHARGES	$169,550	$30,450	$200,000

[1/] Amortization factor based on a 50-year project life at 3-1/4% interest rate.

interest is charged during the construction phase due to that period being less than two years. Federal annual maintenance will entail dredging, maintenance to breakwaters, and maintenance to navigation aids. Non-Federal maintenance will be periodic repairs to walkways and handrails on the breakwaters. The Federal and non-Federal cost sharing distribution is based on the previously authorized formula of 62 percent Federal and 38 percent non-Federal for navigation facilities. Recreation facilities are based on a cost sharing policy of 50 percent Federal and 50 percent non-Federal (see Tables 1 thru 4). Again, charges for the shoreline monitoring program are shown only for Alternative 1. Derivation of the annual charges for the shoreline monitoring plan is shown in Table 10.

TABLE 10

DERIVATION OF
ESTIMATED AVERAGE ANNUAL CHARGES
SHORELINE MONITORING PROGRAM

Year of Survey	Estimated Cost (Present Worth)		Present Worth Factor		Value
Year 3	$47,000	X	.908510	=	$42,700
Year 6	47,000	X	.825391	=	38,800
Year 9	47,000	X	.749876	=	35,240
Year 12	47,000	X	.681270	=	32,019
				Sub-Total	$148,759
				15% Contingency	22,300
				Total	$171,059

Over a project life of 50 years with an interest rate of 3-1/4%, annual charges are equal to $7,000.

BENEFITS

The recommended construction of a harbor at Cross Village, Michigan, would benefit recreational boaters in the region by providing dockage area to meet the present and future demand for permanent and transient boat slips.

Benefits will also accrue to the Beaver Island Ferry as the Cross Village area is a safer, shorter route to St. James Harbor on Beaver Island. Another category of benefits will be recreational and commercial fishing. Recreational fishing is determined by the length of useable breakwater, and commercial fishing benefits resulting from the closer location of the harbor to local markets and reduction in operating costs.

Finally, the recommended harbor would benefit both recreational and commercial navigation along the northeastern shore of Lake Michigan where activities are presently limited by the lack of a safe mainland refuge along the 61 mile reach of shoreline between Harbor Springs and Mackinaw City. A harbor at St. James is available on Beaver Island which is located approximately 24 miles west of Cross Village in Lake Michigan.

PROSPECTIVE RECREATIONAL BOAT TRAFFIC

Estimates of prospective recreational boat traffic are based primarily on the amount of traffic occurring at eight nearby municipal recreational boat harbors. These harbors include Boyne City, Charlevoix, Harbor Springs, Mackinaw City, Mackinac Island, Petoskey, St. Ignace, and St. James. The 1979 boating statistics compiled by the Michigan Department of Natural Resources (MDNR) indicate that during July only Harbor Springs and Mackinaw City are operating below their present available capacity, 97.3 percent and 83.0 percent, respectively. The remaining six harbors had more boats in the harbor area than there were slips available. This involves broadside mooring and, when possible, double occupancy of ships. They range from 101.9 percent at Petoskey to 175.9 percent at

Boyne City. These statistics only represent MDNR operated marinas and do not account for the activity occurring at other public and private marinas in each harbor.

The Michigan Department of Natural Resources (MDNR), Waterways Division, has indicated their intent to provide facilities for boats of various sizes upon completion of the Federal project. Their plan is to provide 104 boat slips, which will be available for both seasonal and transient craft. The 104 slips were based on results of the final analysis of a 1977 MDNR mail survey of registered boaters in Michigan. This analysis identified a demand in District 10 (10 counties in Michigan's northwestern lower peninsula) for 518 additional boat slips by 1989. The extent of the boating demand was also verified by a 1980 telephone survey of 51 public and private marinas in nine counties. This survey indicated an existing demand for approximately 700 additional seasonal berths (this number is considered somewhat of an overestimate as boaters could be on more than one waiting list). Benefits have been based on an allocation of 59 transient slips and 45 seasonal slips, determined from present allocation at the previously mentioned eight municipal harbors.

RECREATIONAL NAVIGATION BENEFITS

Light-draft navigation benefits, as described earlier, are evaluated as the gain in annual return which owners of pleasure craft would receive as a result of the considered improvement, and if their boats were used as "for-hire" vessels. Within the ranges discussed earlier, the annual rate of return assigned to a particular type of boat depends on such factors as length of season, concentration of population, availability and cost of other types of outdoor recreation, cost of access to other small boat harbors, and income range of the using public. For conditions prevailing on Lake Michigan in the Cross Village area, it is estimated that reasonable annual rates of return are 8 percent for inboards; 12 percent for the mix of outboards/inboards/inboard-outdrives; 10 percent for sailboats; and 8 percent for auxiliary sailboats.

Following completion of the project, it is assumed that recreational boaters will receive a 100 percent future return on their depreciated investment. Benefits for locally based craft greater than 20 feet in length are reduced by an appropriate percentage (12-25 percent) which corresponds to the estimated number of days per season spent away from Cross Village on cruise (e.g. 120 day boating season x .25 = 30 days on cruise). Boats on cruise are able to take advantage of improvements at other harbors, therefore this value is not included in the analysis (see Table 11).

The calculations of recreational navigation benefits are shown in Tables 11 thru 13. The number of locally based power and sail boats was estimated from corresponding 1979 boat populations at t eight municipal bo ors. The craft projected to use the proposed harbor are expected to similar characteristics to those existing area boats. For example, the number of power boats, estimated to be 20-29 f in length, was based on the 24.7 percent occupancy of slips at the eight municipal harbors by 20'-29' power boats. Approximately sixty percent of the boats in the harbor greater than 20 feet in length are expected to be transient craft. (It is assumed that the majority of boats less than 20 feet in length do not have adequate sleeping or sanitary facilities necessary for extended overnight travel.) The remaining 40 percent of the boats over 20 feet in length are designated as locally based craft. The total number of boats less than 20 feet is seven, thus 59 boats are transient and 45 are locally based. The approximate sixty-forty allocation of the transient and seasonals was based on present slip designation at the eight municipal harbors. In 1979 an estimated 68 percent of their total slips were reserved for transient boaters, with 32 percent rented on a seasonal basis. The transient percentage was adjusted downward for Cross Village as it is assumed that transient boaters would be able to occupy those slips vacated by seasonal boaters when on cruise. Based on a 1980 State inventory of marinas within a 75 mile cruising radius of Cross Village, which encompassed nine Michigan counties, there are 26 boat harbors with 1,087 permanent boat slips and 31 launch ramps that accommodated 6,304

TABLE 11

RECREATIONAL CRAFT BENEFITS -- LOCALLY BASED

Type of Craft	Length	Number of Boats	Depreciated Investment Ave $[1]	Depreciated Investment Total $	Depreciated Investment Ideal[2] %	Return of Depreciated Investment Present %	Return of Depreciated Investment Future %	Return of Depreciated Investment Gain %	Return of Depreciated Investment Value $	On Cruise During 120 Day Season Ave No. Days	On Cruise During 120 Day Season % Season	On Cruise During 120 Day Season Value
Cruisers												
	<19'	5	4,000	20,000	12	0	100	12	2,400	0	0	0
	20'-29'	10	6,800	68,000	12	0	100	12	8,160	15	12	980
	30'-39'	6	22,200	133,200	8	0	100	8	1,070	30	25	270
	40'-49'	2	62,200	124,400	8	0	100	8	9,950	30	25	2,490
	50'+	1	107,800	107,800	8	0	100	8	8,620	30	25	2,160
Sailboats												
	<19'	2	3,600	7,200	12	0	100	12	860	0	0	0
	20'-29'	11	13,800	151,800	10	0	100	10	15,180	15	12	1,820
	30'-39'	7	23,980	167,860	8	0	100	8	13,430	30	25	3,360
	40'+	1	59,950	59,950	8	0	100	8	4,800	30	25	1,200
Totals									$64,470			$12,280

Annual Benefits: $64,470 - $12,280 = $52,190.

1/ One-half of the market value of both old and new boats in the same class; taken from the BOAT OWNERS BUYERS GUIDE.

2/ EM 1120-2-113 "Benefit Evaluation for Small Boat Harbors".

TABLE 12

RECREATIONAL CRAFT BENEFITS -- TRANSIENT*

Type of Craft	Length	Number of Boats	Depreciated Investment Ave $ 1/	Depreciated Investment Total $	Return of Depreciated Investment Ideal 2/ %	Return of Depreciated Investment Present %	Return of Depreciated Investment Future %	Return of Depreciated Investment Gain %	Return of Depreciated Investment Value $
Cruisers									
	20'-29'	18	6,800	122,400	12	0	100	12	14,690
	30'-39'	10	22,200	222,000	8	0	100	8	17,760
	40'-49'	5	62,200	311,000	8	0	100	8	24,880
	50'+	1	107,800	107,800	8	0	100	8	8,620
Sailboats									
	20'-29'	18	13,800	248,400	10	0	100	10	24,840
	30'-39'	13	23,980	311,740	8	0	100	8	24,940
	50'+	2	59,950	119,900	8	0	100	8	9,590
Totals		67							$125,320

Annual Benefits: $125,320

*Equivalent to locally based craft.

1/ One-half of the market value of both old and new boats in the same class; taken from the BOAT OWNERS BUYERS GUIDE.

2/ EM 1120-2-113 "Benefit Evaluation for Small Boat Harbors."

TABLE 13

RECREATIONAL CRAFT BENEFITS -- TRAILER DRAWN*

Type of Craft	Length	Number of Boats	Depreciated Investment			Return of Depreciated Investment			
			Ave $ 1/	Total $	Ideal 2/ %	Present %	Future %	Gain %	Value $
Cruisers									
	<19'	2*	6,800	13,600	12	0	100	12	$1,630

*Equivalent locally based craft.

1/ One-half of the market value of both old and new boats in the same class; taken from the BOAT OWNERS BUYERS GUIDE.

2/ EM 1120-2-113 "Benefit Evaluation for Small Boat Harbors."

launchings in 1979. This existing area fleet is estimated to provide a sufficient demand for Cross Village's planned boat slips and launch ramp.

The transient craft benefits for Cross Village were evaluated by taking a weighted average of the occupancy rates at the eight municipal harbors and applying it to the 59 transient slips plus eight seasonal slips. The eight seasonal slips are those expected to be vacant when seasonal craft are on cruise which is an estimated 12-25 percent of the 120 day boating season. For example: 10 locally based 20'-29' powerboats are on cruise 12 percent of the 120 day season (10 x 15 days = 250 days that a slip would be vacant). This is then divided by the 120 day season to equate it to an equivalent slip (250/120 = 2 equivalent slips). This procedure was followed for all locally based craft thus allowing an additional eight slips for transient boaters to occupy. Data was taken from the 1979 Michigan Department of Natural Resources daily log sheets for the eight municipal harbors and was weighted according to harbor size. Thus, the weighted occupancy rate for July was 109 percent and the rate for August was 98 percent. Data was not available for June or September. Accordingly, the transient craft benefit is valued at $125,320 (see Table 12).

A benefit was also estimated for those launched craft expected to use the planned launch ramp. These boats are also evaluated as being equivalent to locally based craft, in this case it was two. The number was determined from the actual 1979 launched craft at three of the eight previously discussed municipal boat harbors (the five not included were unable to provide data regarding the number of launches that occurred). There were 733 launches which was an average of 261 launches per harbor. This average was then divided by the total boating season to give us equivalent locally based craft (261 launches/120 season = 2.2 equivalent locally based craft). The benefit for trailer drawn craft was determined to be $1,630 (see Table 13).

HARBOR OF REFUGE BENEFITS

Coast Guard data from 1970 through 1979 indicated that eleven boating accidents occurred in Lake Michigan waters off Emmet County. These included water skiing accidents, collisions, and swamping or sinking due to rough water. This data cannot be considered a complete enumeration of area boating accidents as many boaters do not request Coast Guard assistance and would not be recorded in the tally. Participants at the public meetings have indicated that the stretch of water from Harbor Springs to Mackinaw City is one of the most hazardous on the Great Lakes. They cite many incidents involving boaters (both recreational and commercial) caught in storms near Cross Village. It is their opinion that a harbor of refuge in the Cross Village area would allow boaters the opportunity to operate with a greater degree of safety along the northeastern shore of Lake Michigan.

The harbor of refuge benefit was determined from the probability that a previously identified number of severe weather days will occur on a given number of peak boating days. These peak days have been identified for each month of the five month boating season. A severe weather day is identified as a day when waves would be five feet or higher, and winds would be 22 knots or greater. The actual small craft warning, as issued by the National Weather Service, is for waves of four feet or more and winds greater than or equal to 18 knots. Because historical data was not available for those parameters, available data for 5-foot waves and 22 knot winds was used. This fact alone will undercount the number of days in a given month when a small craft warning could be issued. The historical data is for the northeastern shore of Lake Michigan between 1960 and 1973 (Summary of Synoptic Meteorological Observations for Great Lakes Areas, Volume 3, Lake Michigan, January 1975). The number of severe weather days for May is approximately 25.7 percent of the total days, or 8 days. The number of days for June, July, August, and September have been estimated as 6 days, 6 days, 9 days, and 12 days, respectively, for a total of 41 days out of 153 total days. This average was compared

to actual 1980 data which was 50 days from May thru September on which small craft warning were issued.

The number of peak days was set for each month; they were generally weekends and holidays. For example, May had one holiday and one weekend that were estimated to have peak useage, June was estimated at four weekends and one day each week, July was similar to June but had an additional four weekdays and one holiday, August had the same number as July minus the holiday, and finally, September had five peak days composed of two weekends and one holiday. The total peak days for the boating season are 53, with 100 non-peak days (May 1 thru September 30).

Boat damage was estimated from the actual damage that occurred to craft moored at Port Washington, Wisconsin, during a 1970 storm (Lake Michigan Regional Boating Survey, 1974). This damage would be incurred mainly from boats striking the dock structures and would not produce exactly the same damage as swamping or sinking, but the data is the best available. Insurance figures for damage claims are unavailable, which necessitated using the updated Port Washington figure of $1,850 per boat.

The number of boats projected to be in the lake when a storm occurs is based on the following information; "The cruising speed (of transient boats) combined with an average of a one hour warning implied that boats farther than ten miles from a harbor might be caught in a storm." (Lake Michigan Regional Boating Survey, 1974.) As Harbor Springs and Cross Village are 20 miles apart, it is expected that all boaters along that shore could reach a safe refuge. Cross Village and Mackinaw City are 35 miles apart which would allow boats to reach either harbor safely if they were within 10 miles of one harbor, but would place boats in the central 15 mile shore reach out of cruising distance to a safe harbor. Although Beaver Island is 23 miles west, it is considered unlikely that small boat operators cruising in the area would proceed out into the lake toward an unseen island in the event of bad weather, but would rather attempt to find shelter along the mainland. For calculation purposes one boat was

estimated to be in the central 15 mile shore reach between Cross Village and Mackinaw City.

The probability was determined that a severe weather day would occur on a given number of peak days for each boating month. For example: the probability that exactly zero severe weather days (of the historical average of eight that could possibly occur) will occur on any of the three peak boating days in May is 39.4 percent. The probability of exactly one severe weather day occurring on any of the three days is 45.0 percent, exactly two days occurring on any of the three days is 14.3 percent, and finally, all three peak days having severe weather is 1.2 percent. These probabilities are then applied to the $1,850 damage figure in the following manner: one severe weather day occurring assumes damage to the previously determined one boat to be caught out in the lake (45.1% x $1,850 = $834), two severe weather days assumes one boat will be caught on each day (14.3% x $3,700 = $529), three severe weather days occurring on all three peak days assumes that one boat will be damaged each day (1.2% x $5,550 = $67). These dollar damages are added together to measure the total damage that could occur in May, $834 + $529 + $67 = $1,430. This method was applied for each month and the following values were determined to exist; June, $4,440; July, $6,087; August, $8,593; and September, $3,689. Thus the total harbor of refuge benefit is $24,239.

FISHING BENEFITS

Sport Fishing. Breakwater walkways in each harbor would provide additional recreational fishing opportunities for non-boating area fishermen. The Wisconsin Creel Census 1969-1975 provided the basic data necessary for sport fishing analysis, such as 50 lineal feet of breakwater are necessary for each fisherman to minimize overcrowding, and each fishing position would turnover three times daily. The number of peak breakwater fishing days was estimated for each month from April through November (see column B, Table 14). The remaining non-peak days during each month were calculated as equivalent peak days by assuming that three non-peak days

TABLE 14

SPORT FISHING

EQUIVALENT PEAK DAY ESTIMATION

A Month	B Total Days	C Peak Days	D Non-Peak Days(B-C)	E Equivalent Peak Days(D÷3)	F Total Equivalent Peak Days(C+E)
April	30	8	22	7	15
May	31	9	22	7	16
June	30	12	18	6	18
July	31	17	14	5	22
August	31	16	15	5	21
September	30	13	17	6	19
October	31	8	23	8	16
November	30	4	26	9	13

would equal one peak day (column E, Table 14). Thus, the total equivalent peak days for each month were designated as follows: April, 15 days; May, 16 days; June, 18 days; July, 22 day; August, 21 days; September, 19 days; October, 16 days; and, November, 13 days. A percentage was applied to each month and is assumed to be representative of Lake Michigan charter fishing activity. The resultant number was determined to be an adjusted equivalent peak day and was then multiplied by the instantaneous breakwater capacity (fishermen every 50 feet x turnover rate of 3 daily) to obtain the monthly breakwater useage. Tables 15 thru 17 display the derivation for each of the four alternatives, (1A and 1 have the same value as the breakwater length is equal).

The Michigan Department of Natural Resources indicates that approximately 84 percent of the fish caught in Emmet County are either trout or salmon, and 16 percent are non-trout. Therefore, the corresponding values

TABLE 15

SPORT FISHING MONTHLY BREAKWATER USE
ALTERNATIVE 1A AND 1 -- CROSS VILLAGE, MICHIGAN

Month	Equivalent Peak Days	Percent Charter Fishing Activity	Adjusted Equivalent Peak days	Instantaneous Capacity*	Monthly Use
April	15	15%	2.25	0	225
May	16	25	4.00	100	400
June	18	55	9.90	100	990
July	22	80	17.60	100	1,760
August	21	85	17.85	100	1,785
September	19	55	10.45	100	1,045
October	16	15	2.40	100	240
November	13	5	0.65	100	65
					6,510

*1,670 useable feet of breakwater ÷ 50 feet per fishermen x daily turnover rate of 3.

TABLE 16

SPORT FISHING MONTHLY BREAKWATER USE
ALTERNATIVE 2 -- GOOD HART, MICHIGAN

Month	Peak Days	Percent Charter Fishing Activity	Adjusted Peak days	Instantaneous Capacity*	Monthly Use
April	15	15%	2.25	129	290.2
May	16	25	4.00	129	516.0
June	18	55	9.90	129	1,277.1
July	22	80	17.60	129	2,270.4
August	21	85	17.85	129	2,302.6
September	19	55	10.45	129	1,348.0
October	16	15	2.40	129	309.6
November	13	5	0.65	129	83.8
					8,397.7

*Based on 2,150 useable feet of breakwater ÷ 50 feet per fisherman x daily turnover rate of 3.

TABLE 17

SPORT FISHING MONTHLY BREAKWATER USE
ALTERNATIVE 3 -- STURGEON BAY POINT, MICHIGAN

Month	Peak Days	Percent Charter Fishing Activity	Adjusted Peak days	Instantaneous Capacity*	Monthly Use
April	15	15%	2.25	126	283.5
May	16	25	4.00	126	504.0
June	18	55	9.90	1'	1,247.4
July	22	80	17.60	126	2,217.6
August	21	85	17.85	126	2,249.1
September	19	55	10.45	126	1,316.7
October	16	15	2.40	126	302.4
November	13	5	0.65	126	81.9
					8,202.6

*Based on 2,080 useable feet of breakwater : 50 feet per fisherman x daily turnover rate of 3.

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of $7.70 per trout-salmon angler day, and $3.29 per non-trout angler day are applied to the appropriate percentages for angler days from each breakwater (see Table 18). This final value is counted as the sport fishing benefit.

TABLE 18

SPORT FISHING BENEFITS

	ANGLER DAYS AND VALUE		
	Alternative 1A and 1	Alternative 2	Alternative 3
Trout-Salmon (84%)	5,468	7,054	6,890
$7.70	$42,100	$54,320	$53,050
Non-Trout (16)%	1,042	1,344	1,313
$3.29	$ 3,430	$ 4,420	$ 4,320
Total Days	6,510	8,398	8,203
Total Value	$45,530	$58,740	$57,370

Commercial Fishing. The commercial fishing industry on the Great Lakes is declining due to the increasing cost of managing and maintaining stocks of fish. The Michigan Department of Natural Resources feels that in light of the present controversy involving the Indian Treaty of 1836, which ceded portions of Lakes Michigan, Huron, and Superior to the Indian tribes, they cannot accurately predict the future of fisheries in the Cross Village area. Data from the Great Lakes Fishery Laboratory indicates that from 1972 to 1979 the whitefish catch in District 3, an area which includes Cross Village, has comprised at least 40 percent of the total catch of whitefish in those waters of Lake Michigan under the jurisdiction of the State of Michigan. Also shown in the historical data, is the fact that the 1979 District 3 whitefish catch was an increase over the whitefish catches taken in 1975, 1977, and 1978.

Additional support for a harbor at Cross Village came from surveys distributed to local commercial and charter fishermen by the Detroit District in an attempt to estimate potential use for a harbor near Cross Village. Data was received from three companies which stated an intent to use a harbor near Cross Village for their commercial fishing home port. Another respondent stated an intent to use Cross Village as a seasonal base. The reasons given for moving to a harbor near Cross Village were; it is closer to their fishing location in Lake Michigan, it is a shorter distance from their residence than present home port, and it would provide a savings in fuel costs for travel to fish sales markets. Based on the reduction in operating costs, fish spoilage, and potential vessel damage in adverse weather, the benefit is estimated to represent 25 percent of the total value of all fish that would be received. The Great Lakes Fishery Laboratory provided data on the value per ton of whitefish caught in Lake Michigan from 1972 to 1979. This value has increased from $1,136.50 per ton in 1972 to $1,947 per ton in 1979, while the tonnage has decreased from 1,250 in 1972 to 1,000 in 1979. The average 1979 value for the Lake Michigan catch is assumed to be representative of the potential Cross Village whitefish harvest. The fishing surveys indicated that 66 tons of whitefish were caught in 1979. Therefore, the total annual

benefits to commercial fishing from construction of a harbor near Cross Village would be $32,125 (66 tons x $1,947 x .25 = $32,125).

BEAVER ISLAND FERRY

The Beaver Island Ferry presently operates between Charlevoix and St. James on Beaver Island. The ferry company has expressed their intent to move their home port to Cross Village if a harbor is available. The difference in distance from Charlevoix to St. James, and Cross Village to St. James is 8 miles one way or 16 miles round trip. The advantage of the shorter, safer trip would be a reduction in travel time, reducing fuel and maintenance costs. Costs for fuel and maintenance have been identified by the company, in 1980 dollars, as $4.50 per mile and $3.92 per mile, respectively. The number of trips estimated for 1980 and 1981 is 232. Accordingly, the annual benefits for the Beaver Island Ferry from the Cross Village site (Alternatives 1A and 1) is $31,225. The distance reduction from the Good Hart site (Alternative 2) are $31,225. The distance annual benefit of $35,160. The cost savings for Sturgeon Bay Point is $21,690, based on a 12 mile reduction.

SUMMARY OF BENEFITS

The estimated average annual benefits attributable to each of the alternatives are summarized in Tables 19 and 20. The total benefits have been categorized as either general navigation or recreation.

ECONOMIC JUSTIFICATION

Through a comparison of estimated average annual costs and benefits, it is shown that the proposed construction of a harbor near Cross Village is justified for all four alternatives. The total benefit to cost ratio is the highest for the Good Hart site, Alternative 2, at 1.78 with net benefits of $144,199. Finally, all four alternatives are justified solely on their general navigation benefits with Alternative 2 the highest at 1.76 (see Table 20).

TABLE 19

SUMMARY OF ANNUAL BENEFITS

TYPE	CROSS VILLAGE SITE Alternative 1A	CROSS VILLAGE SITE Alternative 1	GOOD HART SITE Alternative 2	STURGEON BAY POINT Alternative 3
General Navigation Recreational Craft				
Seasonal	$ 52,190	$ 52,190	$ 52,190	$ 52,190
Transient	125,320	125,320	125,320	125,320
Launched	1,630	1,630	1,630	1,630
Total	$179,140	$179,140	$179,140	$179,140
Harbor of Refuge	24,239	24,239	24,239	24,239
Beaver Island Ferry	31,225	31,225	35,160	21,690
Commercial Fishing	32,125	32,125	32,125	32,125
Total General Navigation Benefits	$266,729	$266,729	$270,664	$257,194
Recreation Sport Fishing	45,530	45,530	58,740	57,370
Total Recreation Benefits	$ 45,530	$ 45,530	$ 58,740	$ 57,370
TOTAL BENEFITS	$312,259	$312,259	$329,404	$314,564

TABLE 20

COMPARISON OF BENEFITS AND COSTS @ 3-1/4%

	Annual Benefit	Annual Costs	Benefit/Cost Ratio	Net Benefits (Benefits-Costs)
ALTERNATIVE 1A				
General Navigation	$266,729	$265,750	1.00	$ 979
Recreational	$ 45,530	$ 23,050	1.98	22,480
Total	$312,259	$288,800	1.08	$23,459
ALTERNATIVE 1				
General Navigation	$266,729	$239,405	1.11	$27,324
Recreation	$ 45,530	23,500	1.94	22,030
Total	$312,259	$262,905	1.19	$49,354
ALTERNATIVE 2				
General Navigation	$270,664	$153,455	1.76	$117,209
Recreation	$ 58,740	31,750	1.85	26,990
Total	$329,404	$185,205	1.78	$144,199
ALTERNATIVE 3				
General Navigation	$257,194	$169,550	1.52	$ 87,644
Recreation	$ 57,370	30,450	1.88	26,920
Total	$314,564	$200,000	1.57	$114,564

APPENDIX C

PHASE I GENERAL DESIGN MEMORANDUM
STUDY FOR A HARBOR FOR LIGHT-DRAFT VESSELS AT
CROSS VILLAGE, MICHIGAN

HUMAN RESOURCES

Department of the Army
Detroit District Corps of Engineers

APPENDIX C

HUMAN RESOURCES

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APPENDIX C

HUMAN RESOURCES

POPULATION

The 1980 population of Cross Village Township is 217, a 17.3 percent increase over the 1970 township population of 185. Table 1 displays the 1960, 1970 and 1980 populations, and the percent growth in populations between 1970 and 1980 for the nearby communities of Charlevoix, Petoskey, Harbor Springs, Mackinaw City and Mackinac Island. From the table it can be seen that only Cross Village Township experienced an increase in population between 1970 and 1980, while the other five cities experienced slight decreases.

TABLE 1

1960, 1970, AND 1980 POPULATION FOR CROSS VILLAGE AND NEARBY COMMUNITIES WITH PERCENT GROWTH BETWEEN 1970 AND 1980

Community	Population 1960	1970	1980	1970-1980 Percent Growth	Distance from Cross Village
Cross Village Twp.	140	185	217	17.3	-
Charlevoix	2,751	3,519	3,309	-6.0	30
Petoskey	6,138	6,342	6,062	-4.4	29
Harbor Springs	1,433	1,662	1,561	-6.1	20
Mackinaw City	934	810	796	-1.7	35
Mackinac Island	942	517	468	-9.5	37

The six communities named in Table 1 are located in Mackinac, Charlevoix, Cheboygan, and Emmet Counties. All of those areas experienced population increases during the 10 year period between 1970 and 1980. Emmet had the greatest increase at 24.3 percent; Mackinac experienced only a 3.1 percent increase. Charlevoix and Cheboygan Counties experienced growth of 20.2 percent and 21.1 percent, respectively. This is in contrast to the data

presented in the preceeding table, as five of those communities experienced population decreases. People are evidently moving to the more outlying areas of the counties rather than the more populated locations. For example, Cross Village Township's population increased 17.3 percent and the surrounding townships of Bliss, Center, McKinley, and Readmond had increases of 55.7 percent, 24.6 percent, 15.0 percent, and 52.1 percent, respectively.

Major components of population changes are measured by number of births, deaths, and people migrating. As shown in Table 2, between 1970 and 1978 Cheboygan County experienced the largest net population change with an increase of 3,300 people, while Mackinac County had the smallest change, 1,600 people. Emmet County had the greatest number of both births and deaths with Mackinac County experiencing the least.

Emmet County experienced a 24.5 percent increase in their elderly (60 years old and over) population between 1970 and 1976. This is in comparison with the State increase of 10.3 percent during the same period. Between 1970 and 1976 the elderly proportion of the total county population has increased, 28.9 percent to 30.8 percent, respectively. This can also be examined in comparison to the State proportions of 20.7 percent in 1970 and 22.2 percent in 1976.

TABLE 2

POPULATION CHANGE BY BIRTHS, DEATHS, AND NET MIGRATION FOR 1970 AND 1978

County	Population Change	Births	Deaths	Net Migration
Emmet	3,200	2,600	1,700	+ 2,300
Charlevoix	2,800	2,300	1,600	+ 2,100
Cheboygan	3,300	2,500	1,600	+ 2,400
Mackinac	1,600	1,200	900	+ 1,300

Population changes are based on many factors, some of which are availability of facilities such as food stores, restaurants, service stations, and clothing stores; availability of suitable housing; and opportunities for employment. An additional consideration is the availability of public services such as suitable access roads, waste disposal, water systems, medical care, schools, and police and fire protection. It is true that many of these services will not precede people moving to an area, as they will be developed in response to demand, but these basic services are primary considerations for many people to move. Other services influencing population changes include availability of natural or bottled gas, television or cable television, public transportation, recreation facilities (tennis, golf, hiking, bicycling, and camping facilities), city water, pollution control, recycling programs, entertainment (movies, cultural programs, libraries), day care centers, parks, and safe, designated play areas for children (Marans, 1978).

It is possible that a recreational boat harbor could be an enticement for people to consider moving to the Cross Village area but it will not be the sole reason. The historical data in Table 3 also indicates that it is incorrect to infer that a boat harbor will lead to an immediate increase in population.

As can be seen from Table 3, only two harbors experienced population growth in the decade during construction of their recreational boat harbor. Port Sanilac Village experienced the largest increase in population, with an increase of 46.2 percent. This could be attributed to the fact that the Village is 32 miles from the city of Port Huron which has a population of approximately 35,000. Port Huron has many of the above-mentioned

TABLE 3

HISTORICAL POPULATION DATA FOR RECREATIONAL BOAT HARBORS

Harbor Const Date	Harbor	Number of Slips	Population 1940	1950	1960	1970	1980*	Pop. Change During Decade of Const.
1945	Harrisville City	22	437**	485	487	541	481	11.0%
1951	Port Sanilac Vil.	72	N/D	247**	361	493	355	46.2%
1957	Leland Twp.	63	1212	1170	1299	1219	1349	-0.8%
1956	St. James Twp.	45	346	294**	169	161	231	-42.5%
1964	Arcadia Twp.	60	691	677	610**	592	622	-3.0%
1959	Pentwater Vil.	175	N/D	1097**	1030	993	N/D	-6.1%
	Cross Village Twp	100	290	228	140	185	217	

*Estimated from preliminary 1980 data
**Decade harbor was constructed
N/D No data available

facilities, making Port Sanilac a more appealing area in which to live. Harrisville City also experienced a population growth of 11.0 percent following harbor completion. Alpena is nearby (approx. 35 miles), with a population of approximately 15,000. This could possibly encourage people to move to the Harrisville area since Alpena would supply their major shopping, entertainment and service needs.

St. James, Arcadia, and Pentwater harbors each experienced a decrease in population following completion of the harbor. It is not known why the population decreased, as many factors are involved, but none of these harbors are near a city with over 10,000 persons (The nearest cities are Charlevoix with 3,500 people, Manistee with 8,000 persons, and Ludington with 9,500 persons). It is possible that not having a large city nearby would limit the number of persons that would consider living in any of those areas. Cross Village would be comparable to St. James, Arcadia, and Pentwater, as Petoskey is the nearest large city with approximately 6,000 persons. The number of slips planned is 100, which is more than Port Sanilac (72) and less than Pentwater (175). Cross Village Township would be comparable to St. James Township with the size of its population (Cross Village - 217, St. James - 231). Those comparisons would lead us to believe that the presence of a boat harbor in Cross Village would not lead to an increase in population significantly greater than what would result from normal growth without the harbor.

Population projections provided by the Northwest Michigan Regional Planning Commission indicate that the population of Emmet County is expected to increase approximately 30 percent between 1980 and 2000. Their overall projection for the ten county planning area indicates a 43.5 percent increase for that same period. The ten counties include Antrim, Benzie, Charlevoix, Emmet, Grand Traverse, Kalkaska, Leelanau, Manistee, Missaukee and Wexford. Of that area, only Manistee is expected to experience a smaller change in population than Emmet (20.1 percent). Seven of the ten counties are estimated to experience over a 40 percent increase in population, the largest being Kalkaska with a 100 percent increase.

Emmet County's lower amount of growth (as compared to other counties in the planning region) could possibly be the result of limited opportunities for year-round employment.

Population projections have also been provided for communities within Emmet County. As shown in Table 4, the Cross Village Township population is estimated to increase 35.9 percent in the low case and 52.1 percent in the high case, between 1980 and 2000. This estimate is greater than the total county estimate of 19.3 percent in the low case and 31.6 percent in the high case. The three adjacent townships of Bliss, Readmond and Center are also expected to increase their populations, but their changes are not expected to be as large as Cross Village's.

LAND USE

Cross Village is zoned in accordance with the 30 October 1972 Emmet County Zoning Ordinance. The actual Village area is categorized in the following manner (See Figure 1):

a. A triangularly shaped area along the shoreline, surrounding the small general business area, is zoned for Residential Recreation (RR-2). This includes: cottages and recreation homes, one family detached dwellings but not permanent mobile homes, public parks and recreation lands, historical restoration or renovation projects, and farms and farm lands.

b. The area along M-119 is zoned as a scenic resource district (SR-1). These areas are established to protect the scenic resources along rivers, highways and streets, lake shores and impoundment waters. This area has been designated as a scenic resource in order to develop tourism, recreation, and environmental control, which are major features of the Emmet County plan for future development.

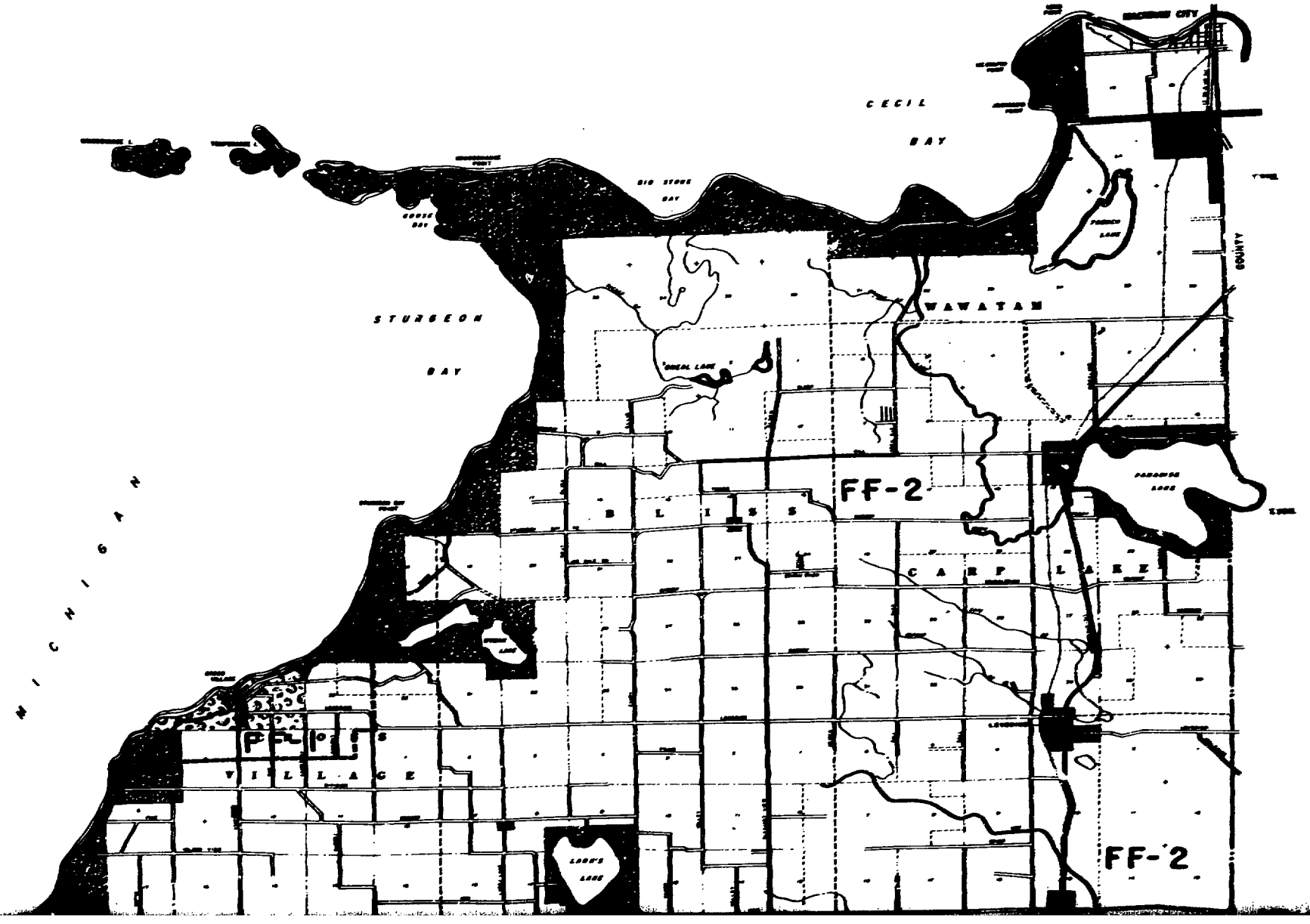
c. The small commercial area is zoned for general business (B-2) which is intended "...to provide sites for more diversified business types and are often located so as to serve passer-by traffic." (Emmet County Zoning

TABLE 4

EMMET COUNTY'S EXISTING 1980 POPULATION
WITH HIGH AND LOW POPULATION PROJECTIONS FOR 1990 AND 2000

Community	1980	1990		2000		Percent Change 1980-2000	
		Low	High	Low	High	Low	High
						35.9%	52.1%
Cross Village Twp.	217	250	290	295	330	0.2	11.6
Bliss Twp.	439	375	440	440	490	5.9	20.5
Readmond Twp.	356	325	374	377	426	27.8	42.1
Center Twp.	435	475	542	556	618	77.4	96.2
Harbor Springs City	1,561	2,400	2,698	2,769	3,062	24.1	34.5
Petoskey City	6,062	7,003	7,641	7,524	8,155	19.3	31.6
Emmet County	22,792	24,000	26,800	27,200	30,000		

Source: Northwest Michigan Regional Planning Commission Report, 1977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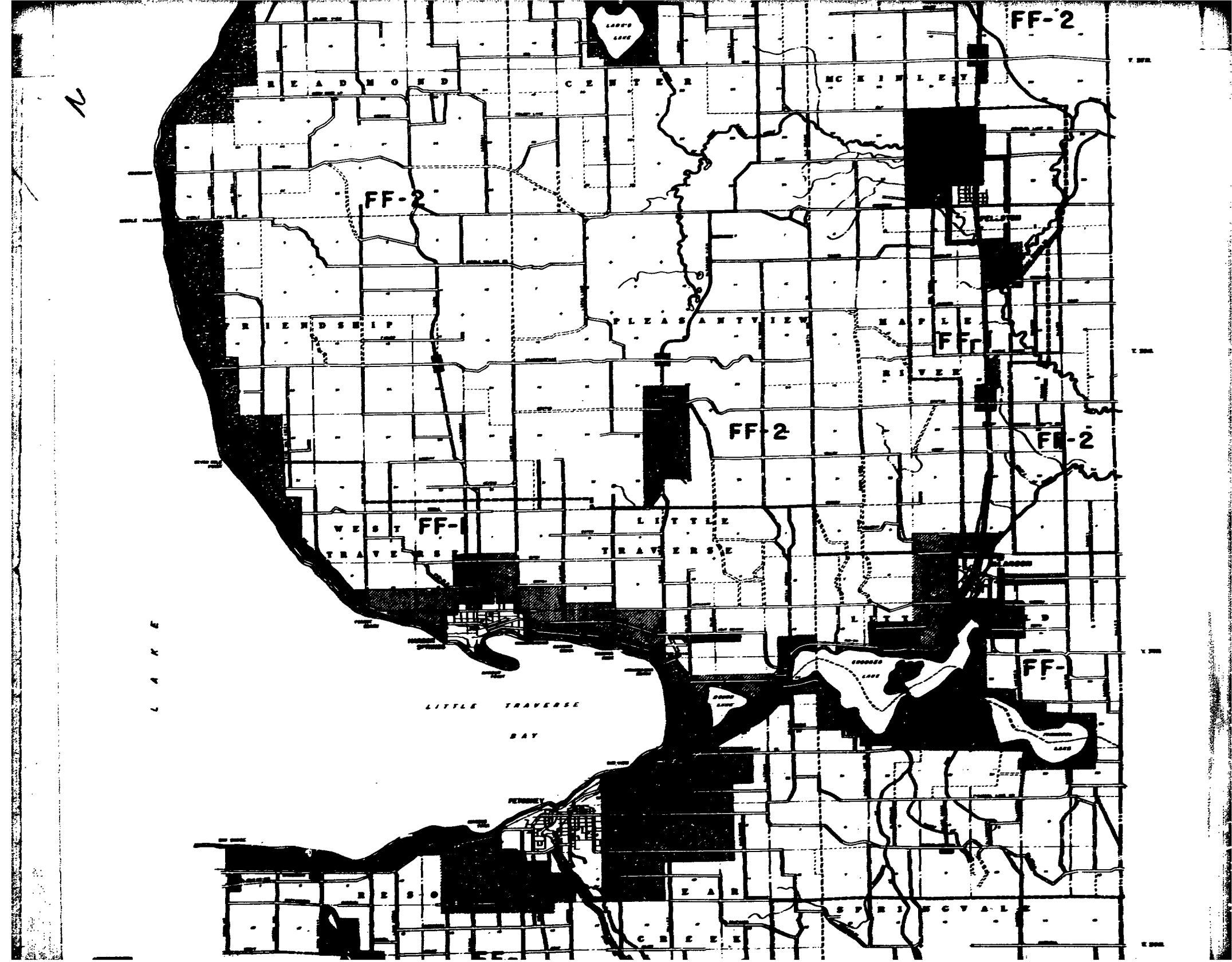
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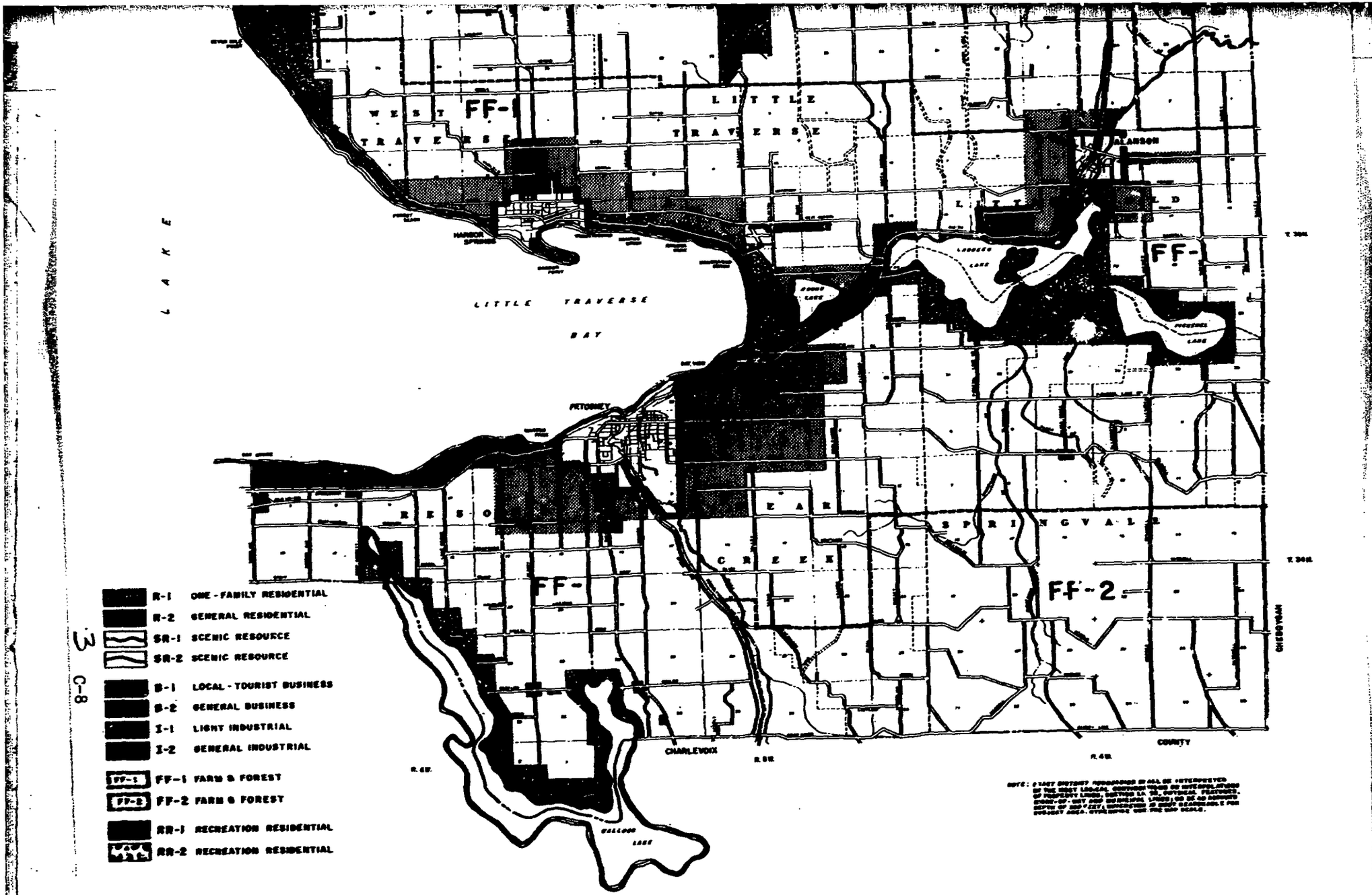

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ZONING DISTRICTS
EMMET COUNTY

Figure 1

Ordinance, 1972) These sites can include theaters, assembly halls, automobile, mobile home, or boat sales, taverns, restaurants, bowling alleys, and local-tourist related business such as shopping, personal services, and professional office areas.

d. Adjacent to the general business district is an area designated general residential (R-2B). This area allows for the construction of structures to house more than one family. These uses can include duplexes, multiple family dwellings, townhouses, housing for the elderly, motels and tourist inns, professional offices, halls and clubs, and personal services.

e. The land surrounding the residential arc, adjacent to the business area, is zoned as a farm and forest district (FF-1). The intent of this area is to provide for agriculture and forestry purposes, and related one-family detached dwellings and mobile homes, both seasonal and permanent, and recreation facilities (e.g. golf courses, parks, and wildlife preserves). The FF-1 area has a minimum lot size per dwelling unit of 44,000 sq. ft. and a width of 150 feet.

f. The land beyond the FF-1 area in Cross Village Township is zoned for farm and forestry use (FF-2). The use of the area is the same as FF-1 with the only exception being that the minimum lot size per dwelling unit is 88,000 sq. ft. with a width of 200 ft.

g. Lands to the north and south of the Village along the shore are also zoned as recreation residential districts (RR-1). These areas extend into both Readmond and Bliss Townships. These areas are similar to the RR-2 district with the exception being that permanent mobile homes may be used for dwelling purposes.

The area surrounding the proposed harbor site has not experienced extensive development in either of the residential or commercial areas. It is estimated, upon visual inspection of the area, that any development or expansion of existing facilities resulting from the construction of the proposed 100 slip recreational boat harbor could be adequately accomodated in full accordance with the existing zoning ordinances.

Table 5 provides the August 1978 Cross Village Township land use evaluation by zoning district for all of the previously described areas. This table displays the number of acres zoned for useage in each zone, and the number of acres of land area presently developed. From the table it can be determined that 2.2 percent of the township land is developed, which is an estimated 138.7 acres out of a total land area of 6,409.66 acres. The township land use count is as follows: 169 residential homes both seasonal and permanent, nine businesses, and four quasi-public uses.

The most developed zone is the general business area with approximately 82 percent development. Construction of the recreational boat harbor may promote some additional development in this area. It is estimated that this development can be adequately accomodated by the remaining undeveloped property in zone B-2 and the adjacent R2-B zone which is approximately 40 percent developed and is zoned for use similar to the general business district (B-2).

Individual zoning data is not available for Good Hart but visual inspection of the area indicates that the immediate area surrounding the harbor site is totally developed as residential use. There is some commercial development on M-119 which is quite removed from the harbor site. Based on the existing condition of Good Hart, it does not appear feasible to build a recreational boat harbor at the proposed site without causing negative social impacts. Major problems would be the displacement of approximately 4 to 6 homes, and that the present access road winds through a totally residential district and provides for less than two full lanes of traffic. This would provide an unsafe situation for area residents especially pedestrians and children playing near the road. Other problems could be encountered with the lack of nearby facilities for harbor visitors and the close proximity of residential homes. These could be trespassing, noise, vandalism, and temporary inconveniences caused by construction.

TABLE 5

CROSS VILLAGE TOWNSHIP

LAND USE EVALUATION BY ZONING DISTRICTS*

ZONING DISTRICT		
FF-1	Total land area - 1655 acres	
	Minus road area - 37.5 acres	
	Net land area 1617.5 acres	
	Total uses 19	
	Total land area developed	19.19 acres
	Percent land area developed	1.2%
FF-2	Total land area - 2280 acres	
	Minus road area - 47.5 acres	
	Net land area 2232.5 acres	
	Total uses 18	
	Total land area developed	36.36 acres
	Percent land area developed	1.6%
RR-1	Total land area - 1360 acres	
	Minus road area - 26 acres	
	Net land area 1334 acres	
	Total uses 32	
	Total land area developed	16.16 acres
	Percent land area developed	1.2%
RR-2	Total land area - 718.5 acres	
	Minus road area - 31 acres	
	Net land area 687.5 acres	
	Total uses 47	
	Total land area developed	23.73 acres
	Percent land area developed	3.5%

*Reference Figure 1

TABLE 5 (Cont)
CROSS VILLAGE TOWNSHIP
LAND USE EVALUATION BY ZONING DISTRICTS*

ZONING DISTRICT

SR-1

Total land area - 554 acres
Minus road area - 48.17 acres
Net land area 505.8 acres

Total uses 41
Total land area developed 28.23 acres

Percent land area developed 5.6%

R-2B

Total land area - 25.35 acres
Minus road area - 5.37 acres
Net land area 19.98 acres

Total uses 16
Total land area developed 8.08 acres

Percent land area developed 40.0%

B-2

Total land acres - 17.56 acres
Minus road acres - 5.38 acres
Net land area 12.18 acres

Total uses 10
Total land area developed 10.16 acres

Percent land area developed 83.4%

*Reference Figure 1

Similar problems exist with the Sturgeon Bay Point site. The existing access to the area is by a one and one-half lane dirt road. It is assumed that this would be inadequate to handle traffic associated with the boat harbor. A second road, which comes within the general area of the proposed harbor, winds through a residential area. Improving that road would cause an unsafe situation to exist for both pedestrians and children, and the possible need for additional property for widening it.

HOUSING

In 1970 approximately 80 percent of Emmet County's year-round housing units were occupied. Of that number approximately 80 percent were owner occupied and approximately 20 percent were renter occupied. Approximately 30 percent of the county's overall housing stock was classified as either seasonal or migratory. Housing figures for 1975 indicate that there was an estimated 5 percent increase in year-round housing in Emmet County, with an estimated 15 percent increase in occupied housing. It is not known what percentage corresponded to owner and rental occupation. It is estimated that 27 percent of the households in Emmet County are seasonal.

Total housing units in Readmond Township increased approximately 43 percent between 1970 and 1980 (185 and 265 housing units, respectively). Of that total, 61.6 percent are vacant. These are assumed to be seasonal homes as Readmond Township along the Lake Michigan shoreline is a popular place for vacation residences. In 1980 approximately 230 property owners were from outside of Emmet County.

Cross Village Township has similar housing statistics with a 33.1 percent increase in total housing units between 1970 and 1980. Vacant homes comprise 70.2 percent of the total 1980 housing units. Again, it is estimated that many of these vacant residences are seasonal homes.

EDUCATION

Educational services for Cross Village children are provided by a five member Cross Village Township School Board. The Board is responsible for determining the annual budget for the elementary school, located in Cross Village, and payment of those costs related to sending junior and senior high school students to Harbor Springs schools.

Cross Village Township has a two room school which serves children in kindergarten through grade six. As of October 1980 there were 31 students in school with 48 percent of those students in kindergarten and first grade. Two full-time teachers are employed by the school district. Approximately 20 Cross Village junior and senior high school students attend Harbor Springs High School. Cross Village has its own bus to transport students the 15 miles to Harbor Springs daily. Data is not available for only Cross Village students, thus, it is not known what percentage graduate from high school, but, the Michigan Department of Education estimates that in a school district the size of Harbor Springs (approximately 900 students) about 4.25 percent are expected to become dropouts (MDE, 1977).

Special education services are provided by the Charlevoix-Emmet Intermediate School District. A speech therapist visits Cross Village weekly, other services are provided on an as needed basis. Physically handicapped children attend classes in Pellston at the Intermediate School District Learning Center. The school district Service Center in Charlevoix has help available to teachers and students in the following categories: psychological and academic testing, social workers, teacher consultants, speech therapists, a preschool team, occupational therapy, programs for pregnant teens, a home-bound/hospital teacher, vocational and prevocational counseling, a curriculum resource consultant, and a gifted student consultant.

Projections of public school enrollment (Hecker, 1977) for the Charlevoix-Emmet Intermediate School District indicate that the kindergarten through sixth grade population will decrease 2.5 percent between 1976-77 and 1981-82. Grades seven through twelve will decrease 11.9 percent. This trend indicates that northern Michigan is attracting older families and retirees to the area. Also, young adult family members are leaving the region because employment opportunities are limited. But, it is significant to note that the 1980 enrollment in the Cross Village elementary school is the largest in approximately seven years (personal contact, 1980). It is possible that the family-forming age group is choosing to remain in Cross Village because of the poor employment situation throughout the State of Michigan.

EMPLOYMENT

Emmet County has experienced high unemployment rates during the last seven years. Compared to State of Michigan rates, Emmet County has continually been higher (1.6 percent higher in 1977 and 1979, to a maximum of 2.7 percent greater in 1973). Emmet County's unemployment rate is the result of limited year-round employment and extensive seasonal employment opportunities. This can clearly be seen in 1980 unemployment data. The January unemployment figure for Emmet County was 12.6 percent while the State had 10.3 percent; the August figure was 8.2 percent for Emmet County and 12.5 percent for Michigan.

Retail services in Emmet County are extremely dependent upon the seasonal tourist trade. Existing community services are oriented primarily toward rural residents and the sizeable influx of seasonal visitors. The September 1980 Michigan State Economic Record (Michigan State University, 1980) indicates that Emmet County is one of the three leading counties in the state in the relative importance of selected, service related industries. These services include lodging, personal, automotive, business, miscellaneous repair, amusement, legal, engineering and architectural surveying, and dental laboratories. Approximately $13.7 million was spent in retail service markets during 1962-63. This figure

rose to $20.0 million in 1966-67, and it has been estimated that tourist spending is increasing at approximately 16 percent annually. Based on this rate of increase, expenditures would amount to an estimated $140.0 million by 1990. Emmet County ranked first in the State of Michigan during 1972 and 1979, (92.7 percent and 88.7 percent, respectively) on the basis of sales by retail trade establishments as a percentage of personal income. (Michigan percentages were 47.5 and 45.9 during 1972 and 1979, respectively). Again, this is due to the large number of summer homes in the county and the many tourists attracted to the area (MSU, April 1980). A recreational boat harbor near Cross Village would be expected to draw recreation related service establishments to the area and associated community services. This should allow Cross Village residents to benefit somewhat from increased seasonal employment and possibly year-round employment opportunities. Without the recreational boat harbor at Cross Village, those tourist and summer resident centers located along the Great Lakes shoreline at Harbor Springs, Mackinaw City, and Petoskey would most probably continue to dominate the recreation service markets in Emmet County. The Emmet County Residential Area Plan states that for Cross Village Township, "additional seasonal home development is the most likely economic impact for the community." (Comprehensive Plan, 1971). A recreational boat harbor could possibly provide the stimulus necessary to fulfill this plan.

RECREATION

Emmet County is the location for a large number of northern Michigan's many outdoor recreation resources. Twenty percent of the total county land is in the Mackinaw State Forest; three percent of the total county land is devoted solely to recreation. Emmet County has 272 inland water bodies, of which 8 are larger than 200 acres. Ninety-eight miles of streams and sixty-eight miles of Great Lakes shoreline are located within the county. There are eleven public access sites on inland lakes in the county. There are also three recreational boat harbors along the shoreline at Petoskey, Harbor Springs and Mackinaw City.

The Mackinaw State Forest has a public campground located at Wycamp Lake which served an estimated 450 campers during 1979. The State also has property available in Bliss Township at Sturgeon Bay for swimming and picnicking. Petoskey State Park has one campground located outside of the City of Petoskey. Its 90 campsites served approximately 260,000 campers in 1978. There is also a free public boat ramp to Lake Michigan at the campground. Wilderness State Park has a campground with 210 campsites located at Mackinaw City, where there are also two boat launch ramps to Lake Michigan.

A summer outdoor recreation survey taken during 1977 asked rural Emmet County residents to rank their preference for participation in specific outdoor activities. The ordering was as follows: (1) swimming; (2) motorboating; (3) fishing; (4) bicycling; (5) golf and sailing (Tied); and (6) tennis. Emmet County is well equipped to respond to resident's golf and tennis needs with three public and five private golf courses, and eighteen public and 29 private tennis courts. A majority of these are located near Harbor Springs and Petoskey. The proposed recreational boat harbor near Cross Village would serve area residents by providing a closer location for the already popular summer activities of motorboating, sailing and fishing.

Nonsummer sports are also popular in Emmet County, as they have an estimated 300 miles of snowmobile trails and 31 ski runs at four ski resorts. These are Boyne Highlands, Kiwanis Sports Park, Nub's Nob and Petoskey Winter Sports. As of September 1978 Emmet County had 3,142 watercraft, 2,507 snowmobiles, and 291 off-road vehicles registered with the Secretary of State. The 1977 survey also ranked nonsummer sports by their popularity: (1) hunting; (2) snowmobiling; (3) fishing; (4) ice fishing; (5) downhill skiing; and (6) cross country skiing.

HEALTH CARE

Health care in Emmet County was evaluated quite favorably by area residents; more than four out of five respondents rated it very good or fairly good (Marans, 1978). The county is served by one 253 bed hospital, Little Traverse Hospital, located in Petoskey. There are 211 beds located in two nursing care facilities, and 70 beds in one home for the aged. There are approximately 260 persons per physician in Emmet County which can be viewed in comparison to the data in Table 6.

TABLE 6

1978 PHYSICIANS PER CAPITA IN MICHIGAN AND SELECTED NORTHERN MICHIGAN COUNTIES

County	Physicians*	Per Capita
Emmet	83	259
Cheboygan	16	1,237
Charlevoix	17	1,141
Grand Traverse	156	310
Leelanau	9	1,488
Mackinac	5	2,240
Presque Isle	5	2,820
Michigan	19,722**	464

*Both medical and Osteopathic
**Includes physicians licensed out of State and country
Source: Michigan Department of Licensing and Regulation, special release.

As can be seen in Table 6, Emmet County has the greatest number of doctors per capita than six other northern Michigan counties, and has a higher medical coverage per capita than the State average. Other medical care professionals per capita are: one nurse for every 56 residents compared to a state total of one nurse for every 86 residents, and 796 residents per pharmacist as compared to 1,222 residents per pharmacist for the State.

The above data does not evaluate the quality of medical care in the county, just its availability, but the data presented in the Marans study reveals that the majority of the sampled population in rural Emmet County felt that the quality of care was either fairly good, or very good. For the two county area of Cheboygan and Emmet Counties, including both urban and rural residents, approximately 60 percent evaluated medical care as being very good (Marans, 1978). This data seems to indicate that the gradual increase in population, both seasonal and year-round, will not put an undue burden on the medical care professionals or facilities in Emmet County.

EMERGENCY SERVICES

Police protection for Cross Village Township is provided by the Emmet County Sheriff's Department, located in Petoskey, and the Michigan State Police which operate out of Cheboygan. A volunteer police force is supported by Harbor Springs residents, and will respond to emergency situations in Cross Village when requested to do so by the Sheriff's Department. The Sheriff's Department and State Police facilities consist of approximately 14 police cars and 20 officers. Patrols of the Cross Village area are made approximately once or twice daily depending on the availability of cars and officers.

The Sheriff's Department feels that a majority of Cross Village Township's crime-related problems occur during the summer months. This could possibly be the result of the secluded location of Cross Village, and their attractive swimming beach which draws many people to the area. Most of the problems involve disorderly conduct, public drunkeness, and vandalism. Actual crime statistics are not available for Cross Village Township as they do not have their own police force, but data is available for Emmet County. Table 7 displays crime data during 1972, 1975, and 1979 for the total county which includes the Sheriff's Department, State Police, and any individual police department within the county. As can be seen from the table, the total number of offenses has decreased since 1975, but have shown a 15.5 percent increase since 1972. Index offenses are those crimes categorized by the FBI for their viciousness and frequency of occurrence. These crimes include homicides, rapes, robberies, aggravated

assault, burglaries, larcenies, and motor vehicle theft. Overall index offenses for Emmet County have increased approximately 8 percent since 1972; individually, only larcenies have shown a decrease during that seven year period. No homicides have been recorded in any of the three selected years. Non-index offenses have increased over 1972 figures by approximately 20 percent, but have shown a slight decrease over 1975 figures. As is also shown, substance abuse crimes have decreased overall. Specifically, driving under the influence and liquor law violations have increased while crimes involving narcotics laws and drunkenness have decreased over 1975 data. The previously discussed trends could be the result of increasing populations, or possibly, improved crime reporting and responding systems.

TABLE 7

CRIME STATISTICS FOR EMMET COUNTY AS REPORTED BY THE STATE POLICE, EMMET COUNTY SHERIFF'S DEPARTMENT AND LOCAL INDIVIDUAL POLICE AGENCIES

	1972	1975	1979
Index Offenses	942	1,343	1,025
Non-Index Offenses			
Arson	8	3	9
White Collar Crimes	100	268	321
Substance Abuse	244	374	280**
Vandalism	127	207	321
Disorderly Conduct	57	147	164
Family & Children	20	99	33
Other Non-Traffic*	746	580	503
Total	1,302	1,678	1,656
Total Offenses	2,244	3,021	2,656

*Includes: Stolen property, illegal possession of weapons, sex offenses, gambling, vagrancy, negligent manslaughter, simple assault, and other non-traffic offenses.

**Driving under influence, and liquor law violations increased while narcotics and drunkenness decreased over 1975 data.
Source: State Police Operations, 1980.

It is expected that local crimes would probably increase along with any increase in population. This would be true with or without a recreational boat harbor. It is possible that locally, crime around the harbor itself could increase just due to the presence of the boats and adjacent structures which could attract vandals. But, because a harbor may bring more people to the area, and accordingly, some degree of supervision to the harbor dockage area, the presence of a harbor could serve as a deterent to vandals who might create disturbances in the beach area. Also, the local residents could choose to create their own volunteer police force or to arrange for greater or more regular police coverage from existing police departments because of the boat harbor.

The situation concerning fire protection is similar to police protection as Cross Village Township contracts with the Village of Pellston to provide their fire fighting services. From Pellston, Cross Village is a 15 mile trip. The fire department is equipped with three pumper trucks, one tanker truck, and approximately 15 fire fighters. In a survey conducted in 1977 (Marans, 1978), rural Emmet County residents rated fire protection as being fairly good while urban residents rated it slightly more favorably. For residents to retain their high satisfaction with fire protection it will be necessary for that service to grow accordingly with population. As Cross Village Township's population is expected to increase at a constant rate during the next 20 years, it is assumed that this would not burden the Pellston fire fighting facilities. If construction within Cross Village is extensive, it may become possible for the township to support its own volunteer fire fighting force.

REFERENCES

Emmet County Planning Commission

1971 "Comprehensive plan for sewer and water facilities, Emmet County, Michigan. April 1971."

Hecker, Stanley E., and Frederick R. Ignatovich

1977 "Projections of Michigan public school enrollment, actual 1971-72 through 1976-77 and projections for 1977-78 through 1981-82." College of Education, Michigan State University, East Lansing,. Table X.

Marans, Robert W. and John D. Wellman

1978 "Quality of nonmetropolitan living: Evaluations, behaviors, expectations of northern Michigan residents." Institute for Social Research, University of Michigan: Ann Arbor

Michigan Department of Education

1977 "Public high school dropouts in Michigan, 1974-75 and 1975-76." Tables III and IV

Michigan State University Graduate School of Business

1980 "Michigan State economic record." September 1980

APPENDIX D

PHASE I GENERAL DESIGN MEMORANDUM
STUDY FOR A HARBOR FOR LIGHT-DRAFT VESSELS AT
CROSS VILLAGE, MICHIGAN

PUBLIC INVOLVEMENT AND COORDINATION

Department of the Army
Detroit District Corps of Engineers

APPENDIX D

PUBLIC INVOLVEMENT AND COORDINATION

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APPENDIX D

PUBLIC INVOLVEMENT AND COORDINATION

INTRODUCTION

Public involvement, as part of the planning process for this study, entailed various forms of communication between the study planners and identified publics which included governmental representatives, public and private organizations and agencies, and the study area citizenry. The purpose of public involvement is to identify and explore problems of the area as seen by the public, and to exchange ideas on solutions to these problems. All of this interaction is taken into consideration in selection of the recommended plan.

PUBLIC INVOLVEMENT

A mailing list of Congressional, Federal, State, county, and local officials; navigation and business interests; environmental and conservation groups; media; and private individuals was developed early in the study. The list has been kept up to date, with additions or deletions made as the study progresses, through the use of attendance lists of public meetings, periodic mailings, and written requests.

A public information fact sheet was distributed to interested parties on 8 November 1978, informing them of the initiation of the post authorization study. The notice stated the information compiled in the 1966 Report of the Chief of Engineers on Cross Village, Michigan, would be reexamined along with any new information which was available. Input concerning the proposed harbor was requested from the public and notice was provided to them of an upcoming public workshop.

On 6 December 1978, a public workshop was held in the Cross Village Township Hall and was attended by 115 persons representing the citizenry of Cross Village, the Corps of Engineers, the Michigan State Waterways Commission, and Congressional and Michigan State legislative liaison. The purpose of the workshop was to solicit public views on the proposed light-

draft vessel harbor improvements at Cross Village, Michigan. In general, opinion was in favor of some type of harbor at Cross Village; however, there was much discussion as to what types of uses were to be allowed in the harbor and what size of harbor was needed. There was a consensus among those people present that the authorized harbor design be altered to preserve as much of the township swimming beach as possible. It was also questioned what would be done with the material left from the ruins of the 1939 Works Progress Administration's breakwater at the site.

A second workshop was held on 27 August 1980 in the Holy Cross Community Hall at Cross Village. The workshop was attended by approximately 240 persons representing Federal, State, and local governments, local residents, and interested parties from adjacent communities. The majority of the concerns raised dealt with social and economic impacts on the area as a result of building a harbor at Cross Village. The people were concerned about the amount and type of development which might occur and any effects the harbor might have on local taxes. Other concerns expressed were, that the harbor size be kept as small as possible, that plans be looked at for developing a harbor for refuge purposes only, and that plans for controlling oil spills within the harbor be available. It was decided that another workshop would be held in the near future to present more detailed plans of the Good Hart and Sturgeon Bay Point sites and associated data on their respective benefits and costs.

On 13 November 1980 a third public workshop was held. The meeting was held primarily as a follow up to the 27 August meeting to present detailed plans of the three harbor locations still being considered. The sites included Cross Village, Good Hart, and Sturgeon Bay Point. Also presented were data on the benefits and costs associated with each harbor plan which had not been available at the previous workshop. Approximately 100 people attended. Most citizens in attendance appeared to favor the harbor at Cross Village; however, there were still concerns about the size and commercial aspects of the harbor, as well as any effects of the harbor on the property owners adjacent to the harbor site.

A formal public meeting was held on 16 June 1981 at the Holy Cross Community Hall in Cross Village following the distribution of the draft Phase I General Design Memorandum with Environmental Impact Statement to the public. The meeting was attended by approximately 100 people. The District Engineer's proposed recommendations for a harbor for light-draft vessels at Cross Village were presented and formal statements were accepted from the public. The concerns raised, again centered on support for the harbor or anticipated adverse effects on the local small town environment or tax base. A new concern highlighted at this meeting was the loss of use of the township park during construction.

A digest of the 16 June 1981 public meeting is found at the end of this Appendix.

STUDY COORDINATION

Assorted correspondence, telephone communications, and personal contacts have been made with the public since the beginning of the study. These actions facilitated the exchange of views and information concerning all aspects of the study. A list of those groups contacted is provided below.

Elected Officials. One of the major sources of information is from elected officials who represent various interests and concerns. Their input, as representatives of their constituencies, is of importance in the plan formulation process. A list of elected officials includes:

Honorable Carl M. Levin, United States Senator - Michigan

Honorable Donald W. Riegle, Jr., United States Senator - Michigan

Honorable Robert W. Davis, United States Representative - Michigan 11th District

Honorable William G. Milliken, Governor of the State of Michigan

Honorable Mitch Irwin, Michigan State Senator - 37th District

Honorable John M. Engler, Michigan State Senator - 36th District

Honorable Connie Binsfeld, Michigan State Representative - 104th District

Honorable Steve Andrews, Michigan State Representative - 106th District

Honorable Ralph Ostling, Michigan State Representative - 103rd District

Honorable Charles H. Varnum, Michigan State Representative - 107th District

Governmental Agencies. Many Federal, State, regional and local agencies are interested in water resources development and have contributed views and information during the study. A list of governmental agencies and units is included.

Federal

U.S. Department of Transportation

- Coast Guard
- Federal Highway Administration

U.S. Environmental Protection Agency

Federal Energy Regulatory Commission

U.S. Department of the Interior

- Geological Survey
- Heritage Conservation and Recreational Service
- National Park Service
- Fish and Wildlife Service
- Bureau of Indian Affairs

U.S. Department of Commerce

- Coast and Geodetic Survey
- Maritime Administration
- Economic Development Administration
- National Oceanic and Atmospheric Administration

U.S. Department of Agriculture

- Soil Conservation Service
- Forest Service

U.S. Department of Health Education and Welfare

U.S. Department of Housing and Urban Development

- Federal Housing Administration

State of Michigan

Michigan Department of Public Health

Michigan Department of State Highways & Transportation

Michigan Department of Natural Resources

- Water Resources Division
- Water Management Division
- Waterways Division

- Recreation & Cultural Arts Advisory Commission
- Fisheries Division
- Land Resources Programs Division, Coastal Management Program
- Great Lakes Fisheries Advisory Commission

Michigan Department of State

- Michigan History Division

Michigan Department of Agriculture

Michigan Department of Labor

Michigan Department of Commerce

State Planning Agency

State Clearinghouse, Division of Intergovernmental Relations

Local and Regional

Great Lakes Basin Commission

Great Lakes Commission

Northwest Michigan Regional Planning and Development Commission

Northwest Michigan Resource Conservation and Development Council

County of Emmet, Office of Planning and Zoning

Emmet County Board of Supervisors

Emmet County Soil Conservation District

Clerks of Antrim, Charlevoix, Cheboygan, Emmet, Grand Traverse, Kalkaska, Leelanau, and Mackinac Counties.

Township Supervisors of Bliss, Center, Cross Village, McKinley, Readmond and Wawatan Townships in Emmet County.

Cross Village Township Board

Cross Village Township Clerk

Organized Groups. These groups usually have varied interests and concerns. Some have major interests in the study itself while others have only a peripheral interest. They include such interests as business and conservation, and are identified because they may have some impact on, or may be impacted by, the study results. A list of organized groups follows.

Petoskey Regional Chamber of Commerce

Beaver Island Boat Company

Windjammer Marina, Inc.

Greenpeace

Michigan United Conservation Clubs

Michigan Bass Federation

Michigan Trailfinders

Emmet County Lakeshore Association

Little Traverse Bay Conservancy, Inc.

Lake Michigan Federation

Michigan Sea Grant Program

University of Michigan, Institute of Science & Technology

Yacht Clubs, Marinas, and Marina Supply Companies on Lake Michigan, Western Lake Huron, and at Duluth, Minnesota

General public. This includes individuals not represented by any of the above groups or organizations who have expressed interest in the study. To help reach the broadest range of private individuals possible, notices were also sent to Post Offices between Cheboygan and Traverse City that were within 25 miles of Lake Michigan, and to Media companies (Television, Radio, and Newspapers) in Petoskey, Harbor Springs, Cheboygan, Traverse City, and Sault Ste. Marie, Michigan.

The degree of participation varies with the individual organizations listed.

PERTINENT CORRESPONDENCE

Correspondence pertinent to the Phase I General Design Memorandum study follows. Additional correspondence can be found in Supplement 4 of the Final Environmental Impact Statement.

STATE OF MICHIGAN

GEORGE ROMNEY, Governor

DEPARTMENT OF NATURAL RESOURCES

RALPH A. MAC MULLAN, Director

Stevens T. Mason Buildir
Lansing, Michigan 4892(
373-0626

April 21, 1969

Serial No. 702-69
File No. EMT-CV

Mr. James T. White, Jr.
Colonel, Corps of Engineers
District Engineer, Detroit District
P.O. Box 1027
Detroit, Michigan 48231

Dear Colonel White:

This is in answer to your letter of February 20, 1969, advising of action taken by the Water Resources Council to establish a new procedure for evaluating benefits and costs of water resources projects and the effect of such action on the authorized project at Cross Village Harbor, Michigan.

At its meeting held April 16-17, 1969, the Michigan State Waterways Commission acted on this matter and authorized me to provide you with the following statement of assurance:

> This will certify assurance of the capability and willingness of the Michigan State Waterways Commission to provide the requirements of local cooperation or reimbursement outlined in your letter of inquiry regarding the Cross Village Harbor, Michigan project. These requirements will be provided at the time requested by the District Engineer, U.S. Army, Corps of Engineers, in accordance with applicable legislative authority governing the project.

Sincerely yours,

Keith Wilson
Director

KW:jaw

MICHIGAN
THE GREAT LAKE STATE

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS: G-BP-2
U.S. COAST GUARD
WASHINGTON, D.C. 20590
PHONE: 202-426-1062

5230/Ser No. 047

31 OCT 1978

Mr. Rob Fuller
U.S. Army Engineers District
Planning Branch
P.O. Box 1027
Detroit, Michigan 48231

Dear Mr. Fuller:

After reviewing our automated file of boating accidents (enclosure 1), I could find only four accidents that occurred on the Great Lakes in the counties you mentioned where the weather conditions were poor. Of these, only one of the cases could possibly be associated with the lack of a safe harbor around Beaver Island. This was case #27133 which occured on July 2, 1978. This case involved the sinking of a boat from taking on water over the transom during adverse weather conditions. Other than this case, I have no indications of accidents in this area where a safe harbor ~~on Beaver Island~~ At Cross Village would have been of benefit.

There are two additional information sources within the Coast Guard that you may wish to contact. The first is the Office of Operation. They maintain information concerning Coast Guard Search and Rescue Assistance in preventing Boating Accidents. The second is the Office of Marine Safety which maintains information concerning Commercial Vessel Accidents.

If you have any questions about this information, feel free to call me at 202-426-1062 (FTS 426-1062).

Sincerely,

E. J. Shirley

On Beautiful Crooked Lake — Gateway to the Inland Waterway

Windjammer Marina, Inc.

ODEN, MICHIGAN 49764 COMPLETE MARINA SERVICE

November 20, 1978

U. S. Army Corps of Engineers
Box 1027
Detroit, Michigan 48231

Attn: Rob Fuller, Project Manager

Gentlemen:

With respect to your memo regarding the proposed harbor development at Cross Village, Michigan, I again wish to offer our support to this project as it is urgently needed for the safety and convenience of the small boater as well as others in the marine industry.

The course around Gray's Reef and the Waugoschance Point area is in itself rather "touchy" and a port to find security if necessary can be essential. It has long been needed.

I write this letter as I will not be able to attend the workshop on December 6th.

Respectfully submitted,

Robert L. Meyer, Manager
The Windjammer Marina, Inc.

(616) 347-3918

Northwest Michigan

Regional Planning and Development Commission

PHONE (616) 946 5922
2334 AERO PARK CT.

TRAVERSE CITY,
MICHIGAN 49684

1 December 1978

P. McCallister, Chief Engineering Division
Department of the Army
Detroit District, Corps of Engineers
Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

We are writing in regards to the Cross Village harbor feasibility study. Several months ago, when this project was considered for deauthorization, our Commission passed a resolution indicating strong support for this project at the Regional level . We were happy to learn that funds have now been appropriated to begin the engineering and design studies. Our primary concerns regarding the development of a harbor of refuge are: 1) that local officals and citizens have the opportunity to participate in the planning process; and 2) that local, county, and Regional officials are made aware of the anticipated economic, social, and environmental impacts of the project. Your public workshop scheduled for 6 December 1978 should provide some good constructive input from the local citizens.

We would appreciate being kept informed on the progress of the feasibility study and receiving a copy of the final document when it is available. If we can be of any assistance in your study effort, please give us a call. Thank you.

Sincerely,

David J. Warner

David J. Warner
Coastal Zone Planner

DJW/el

Northwest Michigan
Resource Conservation and Development Area
10850 Traverse Hwy., Suite 1105
TRAVERSE CITY, MICHIGAN 49684
Telephone (616) 946-6811

Leelanau
Benzie
Grand Traverse
Manistee
Wexford
Mason
Lake

Emmet
Charlevoix
Antrim
Kalkaska
Missaukee
Oceola

December 15, 1978

Mr. Robert Fuller
Project Manager
P. O. Box 1027
Detroit, Michigan 48231

Dear Mr. Fuller,

On April 18, 1969 the Northwest Michigan Resource Conservation and Development Council reviewed and approved action on the establishment of a port of refuge in the Village of Cross Village.

It is our understanding that funding has been restored to prepare the economic and environmental reports on this project as Phase I.

The RC&D Area Council and RC&D County Committee have identified this project as one of top priority in Emmet County and have included it in the Resource Conservation and Development plans for Northwest Michigan.

We believe this project is still very much needed and should receive top priorities for engineering and construction from the Army Corps of Engineers. Establishment of this facility will provide a much needed harbor of refuge and create additional recreation opportunities as well as boost the economy of this small community.

The Northwest Michigan Resource Conservation and Development Council strongly endorses this project and offers its support and assistance where possible to bring it to reality.

Sincerely yours,

Russell W. Gingrich

Russell W. Gingrich
Chairman, RC&D Council

cc: Don Riegle, U.S. Senator
Sander Levin, U.S. Senator
Bob Davis, U.S. Representative
Harry Pintarelli

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

December 27, 1978

Serial No. 3456-78
File No. EMT CV

Mr. P. McCallister, Chief
Engineering Division
Department of the Army
Detroit District Corps of Engineers
Box 1027
Detroit, MI 48231

Dear Mr. McCallister:

This is in response to your letter requesting information concerning expected seasonal and transient berthing requirements at Cross Village. We have attempted to determine future requirements for such berthing based on expected growth trends in the recreational fleet and state-wide boat owner surveys. However, it is very difficult to predict figures for individual projects with data of this nature. We are therefore predicating our estimates on a regional basis and attempt to show that the berths provided by the Cross Village project will be helpful in meeting the regional needs.

Based on preliminary results of our mail surveys of boat owners and expected growth in the recreational fleet, we anticipate a need to provide 4,719 additional public wells for seasonal renters by 1989. Our surveys also show that about 8% of the boat days spent on the Great Lakes by craft over 20 feet are spent in waters off this area of the state (N.W. lower peninsula, Planning Region 10). We assumed that if this pattern remained similar, 8% of the seasonal public wells, 378 wells, should be made available in this area. We plan to fill this need with the projects listed below.

Project	Additional Seasonal Wells
Elk Rapids	102
Frankfort	40
Suttons Bay	16
Traverse City	150
Petoskey	50
Cross Village	20
	378

MICHIGAN
THE GREAT LAKE STATE

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CF ERB
EW.

To check on current demand for seasonal mooring in the area, we obtained waiting lists for seasonal wells from the communities of Petoskey, Mackinaw City, Harbor Springs, and Elk Rapids. The City of Petoskey has 42 boats on their waiting list for seasonal dockage at the community harbor. Similarly, Mackinaw City has 1 boat, Harbor Springs has 9 boats, and Elk Rapids has 45. While all of these boats could not be transferred to seasonal dockage at Cross Village, it does indicate some transfers would take place.

There is also the additional demand by people who do not now own a boat but would purchase one if dockage was available. These people don't necessarily appear on waiting lists and we cannot estimate their numbers for this facility. However, it should be noted that year-around and seasonal housing in this area continues to be in high demand.

Transient accommodations are provided at Petoskey and Harbor Springs south of Cross Village and Mackinaw City, and Mackinac Island and St. Ignace to the north. Mackinaw City and Mackinac Island are 85-90% occupied during July and August, as is Petoskey to the south. Harbor Springs is even busier with July over 140% and August at 93%. Most transient traffic would be cruising north to the Island and back. Therefore, a facility similar in size to Petoskey for transient accommodations would be logical or about 30 slips.

Adding this to the seasonal requirements indicates a facility of 50 total slips would be appropriate. If you have any questions, please let us know.

Sincerely,

Keith Wilson

Keith Wilson, Chief
Waterways Division

KW:JO:pas

EMMET COUNTY SOIL CONSERVATION DISTRICT

COURT HOUSE

PETOSKEY ·:· MICHIGAN

Colonel Melvyn Remus
District Engineer
Detroit District Corps of Engineers
Box 1027
Detroit, Michigan 48231

January 5, 1979

Dear Colonel Remus,

This is to re-confirm our support of the Cross Village Port of Refuge Project.

For your information--- The Cross Village Port of Refuge Project is also supported through the Northwest Michigan Resource Conservation Development Dist. whereby the U.S. Soil Conservation Service through their RC&D Basic Recreation & Facility Program could compliment a portion of the project providing funds are available.

For further information concerning the program-- contact--

Mr. Bill Grimm
District Conservationist
Soil Conservation Service
29 North Park Street
Boyne City, Michigan 49712
616-582-7341

Respectfully,
Leonard Overholt

Leonard Overholt

Secretary
Emmet Soil Conservation Dist.
7675 Valley Road
Levering, Michigan 49755

cc. Carl Argiroff

County Of Emmet

CITY-COUNTY BUILDING
Petoskey, Michigan 49770

Office of
PLANNING & ZONING
Phone: 1-616-347-7780

January 23, 1979

Department of the Army
Detroit District, Corps of Engineers
Box 1027
Detroit, Michigan
48231

ATTENTION: Mr. P. McCallister, Chief, Engineering Division

This office has reviewed the U.S. Corps of Engineers report concerning the Harbor of Refuge for Cross Village, Michigan, dated January 1979.

Please be advised that this office is in agreement with the Plan of Study for Reformulation Phase 1, General Design Memorandum, Harbor of Refuge, Cross Village, Michigan. To the extend feasible and in accordance with the wishes of Cross Village Township, this office encourages the development of a design plan that maximizes the retention of the Township's existing swimming beach. Also, some engineering review may be helpful in regards to access roads leading to the proposed Harbor of Refuge.

We appreciate having the opportunity to review study elements as they evolve.

Sincerely,

Max R. Putters

Max R. Putters
Office of Planning and Zoning

Copy: Mr. Harry Pintarelli, Supervisor, Cross Village Township

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING, BOX 30028, LANSING, MICHIGAN 48909
HOWARD A. TANNER, Director

January 24, 1979

Colonel Remus
Attn: P. McCalister
Department of the Army
Corps of Engineers
P.O. Box 1027
Detroit, Michigan 48231

Re: NCEED-PB

Dear Colonel Remus:

Michigan's Coastal Management Program has reviewed the plan of study for "Reformulation Phase I General Design Memorandum, Cross Village, Michigan Harbor of Refuge" and we favor the continuation of the study and construction planning.

We have recorded one Nominated Area of Particular Concern to this harbor of refuge. Each nomination documents the management need associated with an area by local/regional interests. Endorsement of these APC's means that management recommendations are consistent with established state and local/regional coastal management program goals.

APC 10-49 nominates Cross Village as a recreational area. Management recommendations are for the development of a harbor of refuge. This nomination was endorsed by the regional unit of government, the Northwest Michigan Regional Planning and Development Commission. The Corps proposed harbor is consistent with the documented APC.

A concern of the Coastal Management Program and of the local residents is that of erosion control. Breakwater construction should be planned to minimize beach erosion. The Michigan Waterways Division may contribute suggestions on harbor design.

Please call 517/373-1950 if I may help you further during any phase of this project.

Sincerely,

Chris A. Shafer

Chris A. Shafer, In Charge
Coastal Management Program
Land Resource Programs Division

MICHIGAN

CAS:MK:jg

R1026 10/76

United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

East Lansing Area Office
1405 South Harrison Road
East Lansing, Michigan 48823

January 26, 1979

Colonel Melvyn D. Remus
U.S. Army Engineer District
Detroit
P.O. Box 1027
Detroit, Michigan 48231

Attention: NCEED-PB

Dear Colonel Remus:

This responds to your letter received on January 15, 1979 requesting comments on the draft Plan of Study for Reformulation Phase I General Design Memorandum for a Harbor of Refuge at Cross Village, Michigan. These comments have been prepared under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

As proposed, the project consists of breakwaters, an anchorage and maneuver area, and an entrance channel. This harbor of refuge would be designed primarily for small commercial vessels and recreational boats.

We have reviewed the draft Plan of Study which outlines and defines procedures and studies which will be required to complete the General Design memorandum and the draft environmental statement. We believe that with the information gathered from the studies, inventories and surveys indicated in the Plan of Study, along with our onsite investigations, we will be able to determine the probable effects of the proposed project on the fish and wildlife resources and their habitats in the project area.

We appreciate this opportunity to comment on the draft Plan of Study and look forward to continued coordination regarding project planning activities.

Sincerely yours,

John K. Bowski

Area Manager

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

JAN 29 19[illegible]

Mr. P. McCallister
Chief, Engineering Division
U.S. Army Engineer District, Detroit
Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

Thank you for your letter of January 18, 1979, regarding the Plan of Study for a proposed harbor of refuge at Cross Village, Michigan. Your letter requested our comments and recommendations on the study.

The General Design Memorandum and Draft EIS should address the capabilities of any present or proposed sewage treatment facility to handle sanitary flow attributable to small boat harbors. The possibility of the Beaver Island Ferry using the harbor could aggravate any possible sewage treatment problems in the area. The secondary impacts upon the small community's water supply and waste-treatment facilities should be studied, and implications for environmental degradation should be carefully evaluated.

We appreciate this opportunity for an early coordination with your office and look forward to receiving the Draft EIS when it is issued. Please feel free to contact Mrs. Arlene Kaganove at 312/353-2307 for any further coordination regarding the subject proposal.

Sincerely yours,

Barbara J. Taylor

Barbara J. Taylor, Chief
Environmental Impact Review Staff
Office of Federal Activities

United States Department of the Interior

HERITAGE CONSERVATION AND RECREATION SERVICE
LAKE CENTRAL REGION
ANN ARBOR, MICHIGAN 48107

IN REPLY REFER TO:
D6427 GL
L. Mich.

January 31, 1979

P. McCallister, Chief
Engineering Division
Army Corps of Engineers
Detroit District
Box 1027
Detroit, Michigan 48231

Attn: NCEED-PB

Dear Mr. McCallister:

This is in response to your request for early coordination and comment relative to the Phase I General Design Memorandum investigations for Cross Village, Michigan.

Based on the information provided and our general knowledge of the area, it appears that the proposed improvement may impact on the swimming activities which take place at the site. Care should be taken in the design of the harbor so as to avoid conflict with this longstanding activity.

This comment is provided as technical assistance and does not satisfy our obligation under the National Environmental Policy Act with respect to any future documents which may be prepared.

Sincerely yours,

FRANK D. JONES
Regional Director

By: David H. Shonk
David H. Shonk
Acting

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING, BOX 30028, LANSING, MICHIGAN 48909

HOWARD A. TANNER, Director

February 1, 1979

Mr. Philip A. McCallister
Chief, Engineering Division
U. S. Corps of Engineers
P. O. Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

The following information is provided in response to your request of Mr. Ned Fogle of this department for data on sport and commercial fishing at Cross Village, Michigan.

Unfortunately, our data on the 1977 estimates on sportfishing for Emmet County do not separate Cross Village from Harbor Springs or Petoskey, so one must interpret from the following total figure. Department of Natural Resources field people from the subject area suggest that approximately 10-15% of the county's fishing occurs at and around the Cross Village area.

Type Fishing	Number of Fish Estimated Catch	Angler Days	Fishermen
Great Lakes Salmonids	59,380	43,953	5,957
Great Lakes Nonsalmonids	9,721	4,991	1,771

At the present time, it is estimated that an angler day is worth about $35.00 to the Great Lakes angler.

A single commercial fisherman docks at Cross Village. His annual catch of whitefish varies around 35,000 to 40,000 pounds. The going rate of whitefish for the market can be applied to this poundage for a dollar value estimate.

If you have any additional questions, please feel free to contact me.

Sincerely,

L. N. Witte

L. N. Witte, P.E., Acting Chief
Water Management Division

LNW/NEF:cjs

cc: N. Fogle

cf ERB Env.

R1026 10/78

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

P.O. Box 30028
Lansing, Michigan 48

June 15, 1979

Serial No. 2030-79
File No. EMT-CV

Ms. Marilyn Johnson
Detroit District
U.S. Army, Corps of Engineers
P.O. Box 1027
Detroit, Michigan 48231

Dear Ms. Johnson:

Enclosed is a conceptual plan for the development of mooring and launching facilities for the proposed harbor of refuge at Cross Village. The launching accommodation will probably be developed in two stages with half being installed shortly after completion of the harbor and half being installed about ten years later. The mooring facilities will probably be developed in three stages ten years apart. Of course many things could happen to alter these timetables.

In addition, of course, the Beaver Island Ferry, commercial fishermen, and charterboatmen are expected to develop moorage in the harbor.

The breakwater configuration shown is that which was provided by your office some months ago. You may wish to alter the plan in the interests of economy since a smaller harbor than that indicated on the plan should suffice.

Sincerely,

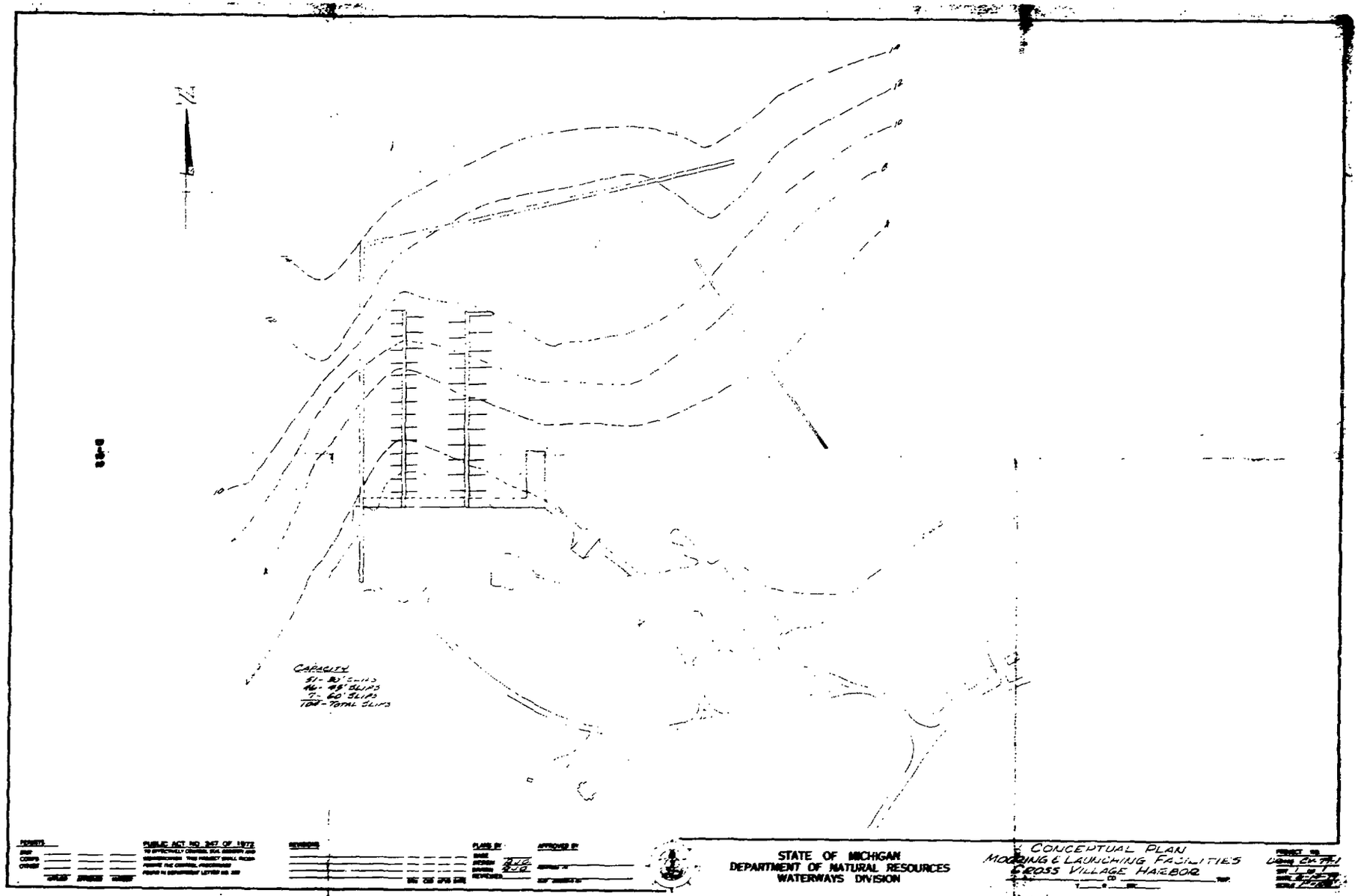
Raymond G. Lawrence
db

Raymond G. Lawrence
Chief Planner & Project Coordinator
Waterways Division

RGL:db
Enclosures

MICHIGAN
THE GREAT LAKE STATE

RI026-5 1 77



PUBLIC ACT NO. 347 OF 1972

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES
WATERWAYS DIVISION

CONCEPTUAL PLAN
MOORING & LAUNCHING FACILITIES
CROSS VILLAGE HARBOR

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

P.O. Box 30028
Lansing, Michigan 48

January 31, 1980

Serial No. 252-80
File No. EMT CV

Mr. P. McCallister, Chief
Engineering Division
U.S. Army Corps of Engineers
Detroit District
P.O. Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

Your letter dated January 11, 1980, to the Chief of the Waterways Division regarding proposed development of mooring facilities at Cross Village has been assigned to me for necessary action.

Enclosed is a conceptual plan indicating the proposed development as you requested. In addition, I am enclosing a suggested revision to the break-water configuration. It is anticipated that this change might contribute toward a more serene harbor. What I am suggesting is that an effort be made to reduce the size of the opening. Wave studies and other research would have to be done, of course, before the length and direction of the extension could be established.

If you wish to discuss this plan, please contact me.

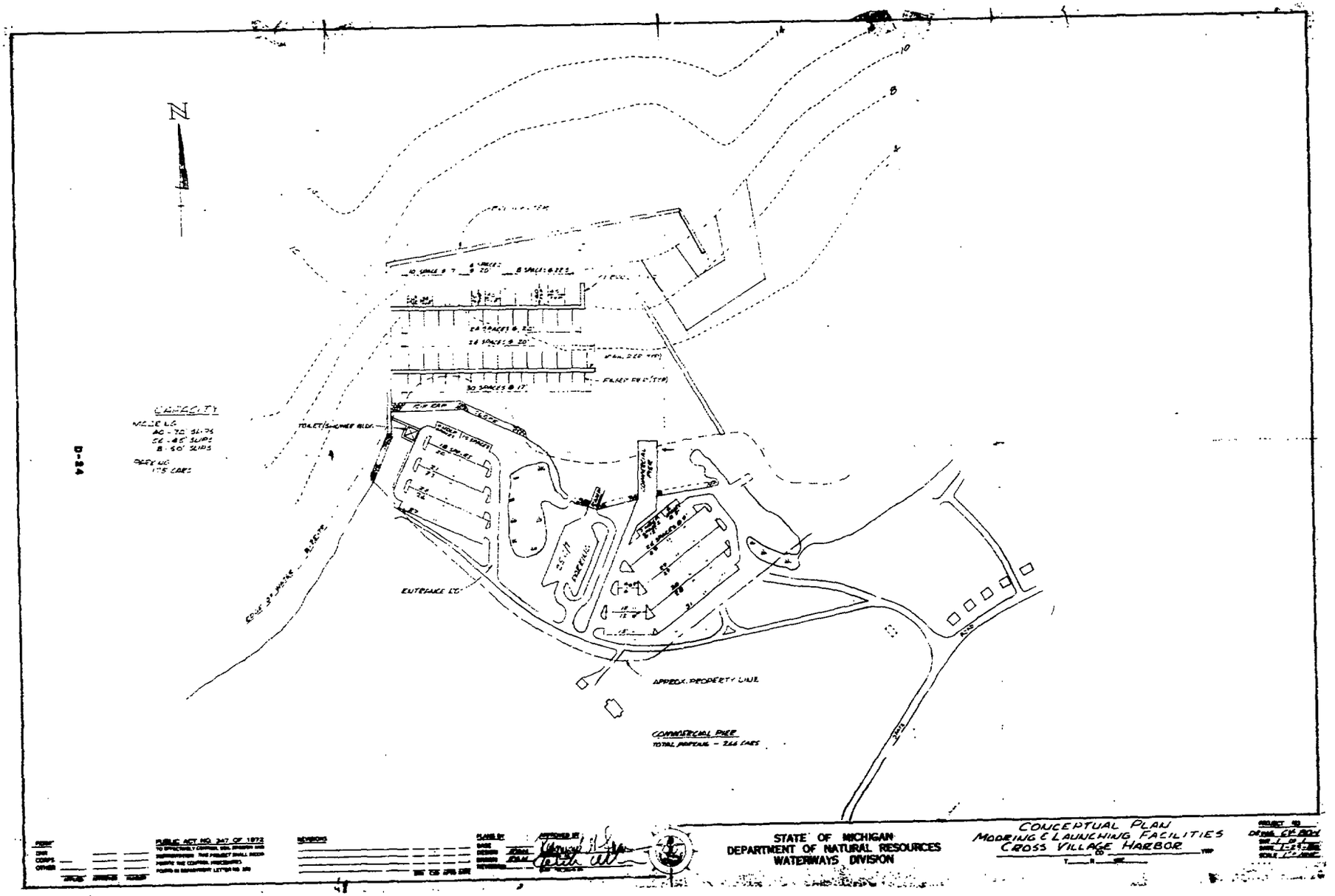
Sincerely yours,

Raymond G. Lawrence
Chief Planner & Project Coordinator
Waterways Division

RGL:pas
Enclosures

MICHIGAN THE GREAT LAKE STATE

R1026-5 1/7


N
CAPACITY
MOORING
AC - 30 SLIPS
CE - 45 SLIPS
B - 60 SLIPS
PARKING
175 CARS
TOILET/SHOWER BLDG.
ENTRANCE
APPROX. PROPERTY LINE
COMMERCIAL PIER
TOTAL PARKING - 246 CARS
STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES
WATERWAYS DIVISION
CONCEPTUAL PLAN
MOORING & LAUNCHING FACILITIES
CROSS VILLAGE HARBOR

STATE OF MICHIGAN

NATURAL RESOURCES COMMISSION
JACOB A. HOEFER
CARL T. JOHNSON
E.M. LAITALA
HILARY F. SNELL
HARRY H. WHITELEY
JOAN L. WOLFE
CHARLES G. YOUNGLOVE

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES
HOWARD A. TANNER, Director

Refer to:
9000.

STEVENS T MASON BUILDING
BOX 30028
LANSING, MI 48909

June 20, 1980

Mr. Jeff Groska
U.S. Army Corps of Engineers
Planning Branch
P.O. Box 1027
Detroit, Michigan 48231

Dear Mr. Groska:

As per our phone conversation the commercial fishermen on the enclosed list at times fish in the vicinity of Cross Village.

I have also enclosed a list of the 1980 licensed sport trollers (charter boaters). Any of the licensed sport trollers could move their operation to Cross Village. However, only commercial fishing operations presently in the nearby vicinity of Cross Village would be permitted to use Cross Village as a port for dockage.

I trust this information will be of use to you in your planning process.

Sincerely,

Asa T. Wright
BM

Asa T. Wright
Great Lakes Program Manager
FISHERIES DIVISION

ATW:bm

Enclosures

MICHIGAN
THE GREAT LAKE STATE

R1026 1/79

NORTHWEST MICHIGAN REGIOANL PLANNING
AND DEVELOPMENT COMMISSION

Cross Village Harbor of Refuge

WHEREAS, there exists a demonstrated need for a Harbor of Refuge for small craft in the area of Cross Village, and

WHEREAS, this site is an "Area of Particular Concern" under the Coastal Zone Management Program, nominated as a Harbor of Refuge, as previously approved by the State and this Commission, and

WHEREAS, the U.S. Army Corps of Engineers has recommended that Congress approve the project for construction, and

WHEREAS, the Congress of the United States has approved this project, and

WHEREAS, as part of the Michigan State Waterways Commission Plan for Harbors of Refuge, this project is considered of high priority, and

WHEREAS, the Michigan State Waterways Commission has provided assurances of local cooperation and a cash contribution for the project, and

WHEREAS, this project would serve the dual purpose of further ensuring boating safety and stimulating the economy of this depressed area,

NOW, THEREFORE, BE IT RESOLVED that the Northwest Michigan Regional Planning and Development Commission reaffirm its support for the Cross Village Harbor of Refuge as a necessary and beneficial project for Cross Village, Emmet County, and the Northwest Michigan Region, and

BE IT FURTHER RESOLVED, that the Congress of the United States be urged to appropriate funds for the completion of this project, and

BE IT FURTHER RESOLVED, that copies of this resolution be sent to Senator Donald Riegle, Senator Carl Levin, Representative Donald Albosta, Representative Robert Devis, and Representative Guy VanderJagt.

I certify that this resolution was passed on 1 August 1980.

Robert C. Morris AIP
Executive Director

STATE OF MICHIGAN

NATURAL RESOURCES COMMISSION
JACOB A. HOEFER
E. M. LAITALA
HILARY F. SNELL
PAUL H. WENDLER
HARRY H. WHITELEY
JOAN L. WOLFE
CHARLES J. YOUNGLOVE

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

WATERWAYS COMMISSION
CHARLES A. BOYER
LEONARD J. HEPFER
WILLIAM E. ROSE
STUART E. SHEILL
LEONARD H. THOMSON

P. O. Box 30028
Lansing, Michigan 48909

322-1311
Area Code 517

August 1, 1980

Serial No. 2430-80
File No. EMT-CV

Mr. P. McCallister, Chief
Engineering Division
Department of the Army
Detroit District, Corps of Engineers
P.O. Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

Your letter dated July 28, 1980 to the Chief of the Waterways regarding the proposed Harbor-of-Refuge at Cross Village has been assigned to me for reply.

All of the alternate sites you have suggested were examined and rejected, for various reasons many years ago. As a result of a telephone request from your office, I visited all of these proposed sites on July 23, 1980, and offer the following comments:

1. Sucker Creek - The distance from Mackinaw City to Sucker Creek is 34 miles. The distance from Sucker Creek to Harbor Springs is 32 miles. The trip between Grays Reef and Sucker Creek is over very shoal and rock strewn waters. Because of the length of the trip, the dangerous area over which a portion of the voyage must be made and the fact that there are no services available at Sucker Creek make it less attractive than Cross Village as a proposed Harbor-of-Refuge.

2. Sturgeon Bay Point - The distance from Mackinaw City to Sturgeon Bay Point is 35 miles. The distance from Sturgeon Bay Point to Harbor Springs is 30 miles. There are no services of any kind available at Sturgeon Bay Point. The entire area is an undeveloped beach surrounded by precariously stable sand dunes. Development of an access road, parking lot, and other structures may upset the dune balance. Because of the cruising distances involved, the lack of services and the possible undesirable effects of disturbing the dunes, Sturgeon Bay Point is less attractive than Cross Village as a proposed Harbor-of-Refuge.

R1026-5 1/80

3. Good Hart - The distance from Mackinaw City to Good Hart is 38 miles. The distance from Good Hart to Harbor Springs is 16 miles. Except for a very small community park all property in the area is privately owned and occupied by dwellings of considerable value. The distance from the village to the public property is one mile. Half of this distance is over a paved road, the other half is over a one lane dirt trail. The services in the village consist of a combination gas station-grocery store and two antique shops. The public property is quite high being at least twenty feet above IGLD. The distance from services, the inadequacy of public ownership, the inordinate amount of earthwork which would be required for development of shore facilities and the fact that this site requires the longest single leg from a protected harbor makes Good Hart less attractive than Cross Village as a proposed Harbor-of-Refuge.

4. Cross Village - The distance between Mackinaw City and Cross Village is 34 miles. The distance between Cross Village and Harbor Springs is 25 miles. The distance from the Village to the proposed site is 0.4 mile. Three fourths of this is over a paved road and the remaining quarter is over all weather gravel. Public ownership in the form of a township park is adequate for proposed development and of such an elevation that virtually no earthwork will be required. Village services consist of a gasoline station, grocery store, restaurant and bar, post office, township offices, school, and two churches. There is one minor problem with this site. A portion of the public ownership consists of a wetland. This problem is being resolved to the satisfaction of the environmental agencies by a judicious locating of the shore facilities.

I believe that the above provides adequate justification for the selection of Cross Village, as opposed to the other alternatives, as the site for the proposed Harbor-of-Refuge. If, however, you wish to discuss this further, please contact me.

Sincerely,

Raymond G. Lawrence

Raymond G. Lawrence
Assistant Chief
Waterways Division

RGL:db

BEAVER ISLAND BOAT COMPANY
102 Bridge Street
Charlevoix, Michigan 49720

PH: (616) 547-2311

20 August 1980

Mr. P. McCallister
Chief, Engineering Division
Dept. of The Army
Detroit District, Corps of Engineers
Box 1027
Detroit, MI 48231

Dear Mr. McCallister:

In response to your letter of 12 August 1980 it is our intention at this time to move our operation to Cross Village, MI should the harbor be constructed there. The other two sites you are considering do not have the advantages of Cross Village therefore if you decide on either of them we would have to reevaluate our position.

In response to your other questions I offer the following information. The Beaver Island Boat Co. has two (2) vessels. One being 95 feet in length the other 65 feet. The safe operating drafts being 12 feet as we draw 8 feet aft and 5 feet forward. In 1979 we made 282 trips between Beaver Island and Charlevoix. I anticipate 232 trips for 1980 and 232 trips in 1981. The average number of passengers I can only estimate for 1980 as being approximately 76 per trip. The cost per mile for fuel (@96.9¢ per gl.) for our vessels is $4.50. The maintenance cost per mile is $3.92.

Our frieght volume averages approximately 13 tons per day excluding vehicles. We haul a variety of frieght including vehicles, groceries, produce, meat, fish, livestock, lumber and building supplies, etc.

Below is a list of distances and running times from Beaver Islan to Charlevoix and the 3 proposed sites:

		Beaver Islander	South Shore
Beaver Island to Cross Village	24 M	1HR 45MIN	2HR 05MIN
Beaver Island to Good Hart	23 M	1HR 36MIN	1HR 55MIN
Beaver Island to Sturgeon Bay Pt.	26 M	1HR 53MIN	2HR 15MIN
Beaver Island to Charlevoix	32 M	2HR 15MIN	2HR 45MIN

The fuel savings alone would be about $17,000.00 if we were running out of Cross Village.

I hope this information aids you in reaching a favorable decision to construct a harbor in Cross Village. If I can be of any further assistance do not hesitate to contact me.

Sincerely,

J. Eric Kammermann

J. Eric Kammermann, MGR
Beaver Island Boat Co.

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor
DEPARTMENT OF NATURAL RESOURCES
HOWARD A. TANNER, Director

P. O. Box 30028
Lansing, Michigan 48909
322-1311
Area Code 517

September 2, 1980

Serial No. 2578-80
File No. EMT CV

Mr. G. J. Platz, Assistant Chief
Engineering Division
Detroit District
Corps of Engineers
Box 1027
Detroit, Michigan 48231

Dear Mr. Platz:

Reference is made to your letter dated August 26, 1980, regarding the proposed parking layout for the Cross Village study.

The Waterways Division will, when appropriate, make a new design for the referenced parking lot. The new design will take into account the concerns of the Corps, Fish and Wildlife Service and Wildlife Division of the Department of Natural Resources with respect to wetlands and threatened species. In the meantime, and for conceptual purposes, your layout is satisfactory.

When the time comes for actual construction, this agency will more carefully define present public ownership, establish the actual topography and hydrography existing at that time and design the necessary shore support facilities accordingly.

If you have any questions or wish to discuss this further, please contact me.

Sincerely yours,

Raymond G. Lawrence
Assistant Chief
Waterways Division

RGL:pas

R1026-5 1/80

STATE OF MICHIGAN

NATURAL RESOURCES COMMISSION
JACOB A HOEFER
CARL T JOHNSON
E M LAITALA
HILARY F SNELL
HARRY H WHITELEY
JOAN L WOLFE
CHARLES G YOUNGLOVE

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES
HOWARD A. TANNER, Director

Refer to:
9000.

STEVENS T MASON BUILDING
BOX 30028
LANSING, MI 48909

September 22, 1980

Mr. P. McCallister
Chief, Engineering Division
Detroit District
Corps of Engineers
Box 1027
Detroit, Michigan 48231

Dear Mr. McCallister:

I am writing you in response to your letter of August 15, 1980 to Mr. Scott, Chief of Fisheries Division, requesting information concerning the native American commercial fisheries in the vicinity of Cross Village. In answer to your questions, the following information is provided.

1. What is the present situation?

Answer: The United States of America, the Bay Mills Indian Community and the Sault Ste. Marie Indian Communities (maybe the Grand Traverse Indian Community also - their status in the suit is questionable) have sued the State of Michigan to obtain treaty fishing rights for descendents of Indians who ceded the Michigan territory in 7 Stat 491 (Map I.). Presently these Indians are fishing and the state has been precluded from regulating their fisheries by order of Federal District Judge Noel P. Fox. The case is on appeal in the U.S. Sixth Circuit Court of Appeals in Cincinnati. The appeal will most likely be continued to the U.S. Supreme Court, regardless of the decision of the appellate court.

2. Who is being affected by the court rulings?

Answer: Persons being affected by the decision are all the citizens of the United States.

3. What geographical area is encompassed by this controversy?

Answer: All the ceded portion of Michigan referred to in 7 U.S. Stat 491, minus a few small areas ceded prior to 1836. (See Map I.)

4. What species of fish are involved and what is their value and annual catch in tons?

Answer: The Indian fishery that developed in the 1836 treaty area (7 Stat 491) took in excess of the pounds of fish listed on Table I in 1979. The poundage figures given are for those fish sold in the wholesale fish trade within Michigan only (no record is available for the total Indian catch which would also include

fish sold locally to restaurants, sold in the retail trade, consumed for subsistance, etc., as well as those sold in the wholesale trade out of state). These figures are for fish caught throughout the Michigan waters of the Great Lakes within the 7 Stat 491 treaty area.

The pounds of fish caught by licensed Michigan commercial fishermen in the same area are listed in Table II. These figures represent the total catch as reported by the nontreaty fishers.

5. What is the projected future of the fishing industry in this area?

Answer: The cost of managing and maintaining stocks of fish in the Great Lakes appears to be rising at a faster rate than the value of the commercial product. Consequently, the future for the commercial fisheries does not look very bright unless we can turn the declines in stocks around. This will take the full cooperation of the fishers and a considerably larger amount of money than is presently available. As it is most uncertain at this time whether or not the state will be in a position to manage the fish stocks in the Great Lakes area ceded in 7 Stat 491, we cannot with any degree of accuracy predict what may be the future of the fish stocks and fisheries in the Cross Village area. However, we can say with certainty that the fish stocks in northern Lake Michigan are again showing severe stress and decline due to overharvest. Further, the populations of lake trout, which had been rebuilt through 10 years of stocking and on which we had high hopes for developing self-sustaining populations, have been nearly harvested out. The chances for rehabilitation of the trout populations are most slim if possible at all under present conditions.

I apologize for not being more specific on the future of commercial fishing in the Cross Village area. However, until we can determine whether or not the state will have the authority to manage its Great Lakes fishing opportunities in this area, a projection of what may happen in the future is not possible with any degree of confidence.

If I can provide you any further information, please do not hesitate to contact me.

Sincerely,

Asa T. Wright
Great Lakes Program Manager
FISHERIES DIVISION

ATW:bm

Enclosures

Table I

REPORTED CATCH BY THE MICHIGAN LICENSED NON-INDIAN COMMERCIAL FISHERIES

POUNDS CAUGHT

Date	Lake Trout	Menominee	Perch	Whitefish	Chubs	Pike	Other	Total
1976	6,883	80,115	85	2,885,555	304,748	—0—	163,661	3,441,047
1977	8,988	30,073	77	2,554,273	176,035	—0—	124,870	2,894,316
1978	8,102	18,923	92	2,735,124	143,705	77	117,446	3,023,469
1979	8,966	8,824	90	2,990,132	299,447	24	147,169	3,454,652

Total catch reported by licensed non indian commercial fishers.

Table I

REPORTED CATCH BY THE MICHIGAN LICENSED NON-INDIAN COMMERCIAL FISHERIES

POUNDS CAUGHT

Date	Lake Trout	Menominee	Perch	Whitefish	Chubs	Pike	Other	Total
1976	6,883	80,115	85	2,885,555	304,748	—0—	163,661	3,441,047
1977	8,988	30,073	77	2,554,273	176,035	—0—	124,870	2,894,316
1978	8,102	18,923	92	2,735,124	143,705	77	117,446	3,023,469
1979	8,966	8,824	90	2,990,132	299,447	24	147,169	3,454,652

Table II

REPORTED WHOLESALE FISH TRANSACTIONS BY INDIAN COMMERCIAL FISHERIES

POUNDS SOLD

Date	Lake Trout	Menominee	Perch	Whitefish	Chubs	Pike	Other	Total
1976	233,667	50,245	8,182	316,194	31,925	———	10,981	651,194
1977	464,421	87,769	9,173	406,136	33,083	775	8,136	1,011,070
1978	670,652	155,663	43,676	1,073,752	104,968	599	11,018	2,060,328
1979	867,112	238,130	61,108	1,259,940	108,867	403	18,201	2,553,761

This table includes only the fish caught And sold to wholesale fish dealers licensed in the State of Michigan by treaty indians

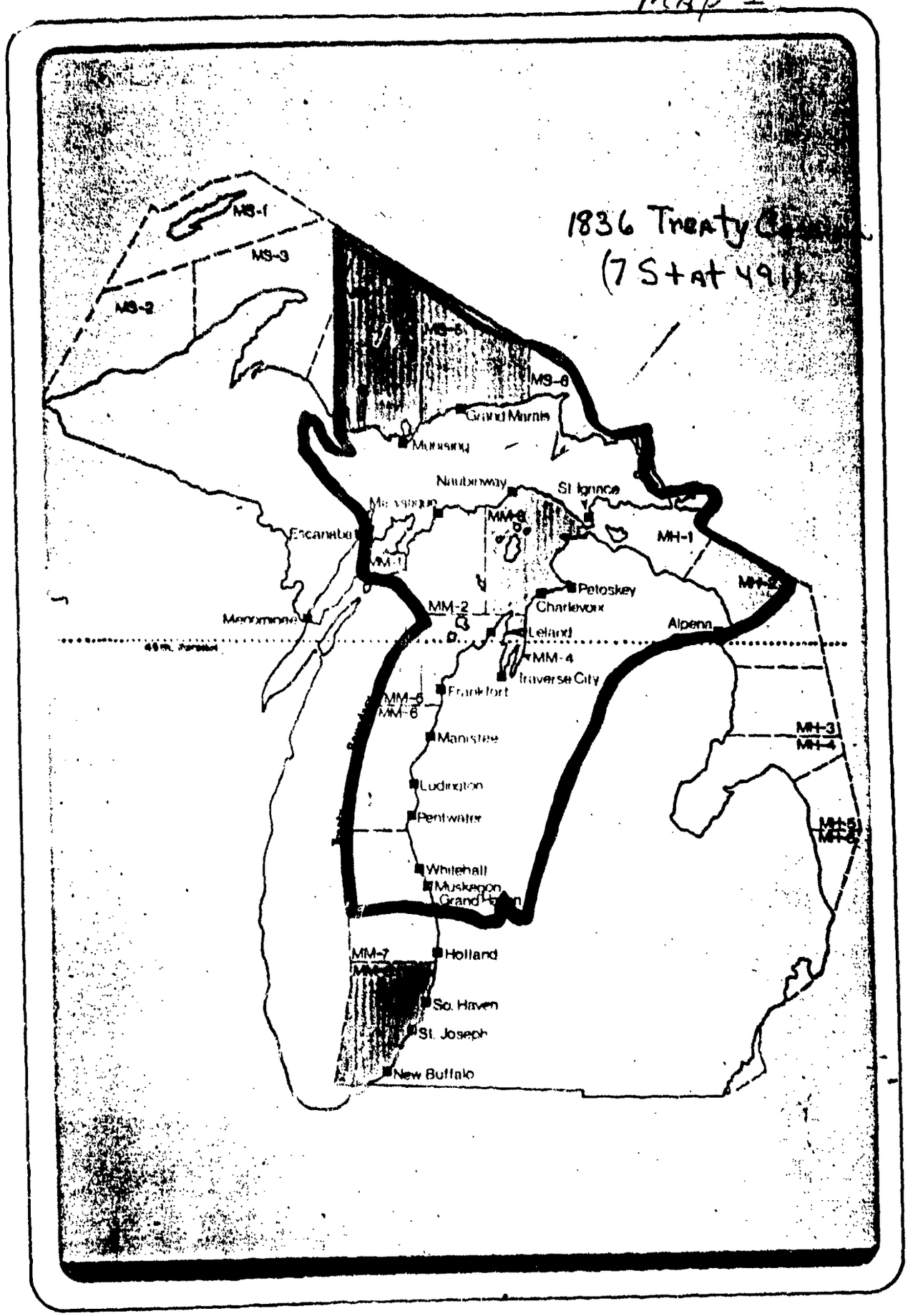
Table II

REPORTED WHOLESALE FISH TRANSACTIONS BY INDIAN COMMERCIAL FISHERIES

POUNDS SOLD

Date	Lake Trout	Menominee	Perch	Whitefish	Chubs	Pike	Other	Total
1976	233,667	50,245	8,182	316,194	31,925	———	10,981	651,194
1977	464,421	87,769	9,173	406,136	33,083	775	8,136	1,011,070
1978	670,652	155,663	43,676	1,073,752	104,968	599	11,018	2,060,328
1979	867,112	238,130	61,108	1,259,940	108,867	403	18,201	2,553,761

MAP I


1836 Treaty
(7 Stat 491)
MS-1
MS-3
MS-2
MS-5
MS-6
Grand Marais
Munising
Naubinway
St Ignace
Manistique
MM-8
MH-1
Escanaba
MM-1
Petoskey
Charlevoix
MM-2
Menominee
Leland
Alpena
MM-4
Traverse City
Frankfort
MM-6
MM-6
Manistee
MH-3
MH-4
Ludington
Pentwater
Whitehall
Muskegon
Grand Haven
MM-7
Holland
So. Haven
St. Joseph
New Buffalo

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
COMMANDER (oan)
Ninth Coast Guard District
1240 East 9th St.
Cleveland, Ohio 44199
Phone: (216) 522-3991

16500
Ser 313
15 October 1980

From: Commander, Ninth Coast Guard District
To: District Engineer, Detroit District, U.S. Army Corps of Engineers, P.O. Box 1027, Detroit, Michigan 48231

Subj: Phase I General Design Memorandum: Study for a Harbor for Light-Draft Vessels in the Vicinity of Cross Village, Michigan

Ref: (a) NCEED-PB dtd 3 Oct 80

1. All three sites under consideration will require the establishment of two battery operated minor lights mounted on standard 20' poles. The lights would be located near the outer end of each breakwater. First costs are estimated at $35,000 each. Estimated annual maintenance cost is $500 per light.

2. Although vandalism to aids to navigation is a serious and growing problem, we do not believe that merely ending the walkway a few feet short of the lights will keep it from happening. We have no objection to your providing a safe walkway the entire length of the breakwaters if you deem it appropriate to do so. It would also benefit our servicing personnel.

C. A. MILLRADT
By direction

Encl: (1) Harbor plans (3 sheets)

BEAVER ISLAND BOAT COMPANY
102 Bridge Street
Charlevoix, Michigan 49720

PH: (616) 547-2311

October 23, 1980

Mr. P. McCallister, Chief
Department of the Army
Detroit District, Corps of Engineers
Box 1027
Detroit, MI 48231

Dear Mr. McCallister:

I am taking this opportunity to clarify our position on the Cross Village Harbor Project. At your public workshop on August 27, 1980, a new member of our Board of Directors, Ronald L. Wojan, stated that the Beaver Island Boat Company had no immediate interest in moving to Cross Village.

This was a very inaccurate and misleading statement. Being a new member of our Board, Mr. Wojan was at that time unaware of our future plans. Let me reassure you that the Beaver Island Boat Company has every intention at this time to relocate our operation to Cross Village should a Harbor be constructed there.

If there is anything that I or the Manager, John E. Kammermann, of the Beaver Island Boat Company can do to help in any way in pushing this project through do not hesitate to call. We are behind it 100%.

Sincerely,

BEAVER ISLAND BOAT COMPANY

Joseph L. McDonough

Joseph L. McDonough
President

JLM:mmh

cc: J. E. Kammermann

County Of Emmet

CITY-COUNTY BUILDING
Petoskey, Michigan 49770

Office of
PLANNING & ZONING
Phone: 1-616-347-7780

October 29, 1980

Mr. Jeff Groski
Planning Branch
Army Corps of Engineers
P.O. Box 1027
Detroit, Michigan
48231

Dear Mr. Groski:

Sorry for the error in the land use evaluation. Thank-you for bringing it to my attention. The corrections have been made and you should find everything in order.

The only error found in the land use count was the total number of businesses. There are nine instead of the original eight. There was a private campground overlooked, which will have an effect on the total number of uses being equal on both inventories. The land use count total is 182 and the evaluation by zoning districts total is 183. The campground extends into two zoning districts, the RR-2 and SR-1, and it is accounted for in both districts adding one extra use to that total.

The other errors were mistakes in the land use evaluation by zoning districts, and have been corrected as well.

Sincerely,

Jeffery Phillips
Office of Planning and Zoning

Emmet County
Office of Planning and Zoning

CROSS VILLAGE TOWNSHIP

LAND USE COUNT

USE TYPE

1. Total no. of permanent and seasonal homes.....169
2. Total business..... 9
3. Qusi public uses..... 4

TOTAL USES.....182

DATA COMPLIED

AUGUST 1978

CROSS VILLAGE TOWNSHIP

LAND USE EVALUATION BY ZONING DISTRICTS

ZONING DISTRICTS

FF-1

Total land area-1655 acres
Minus road area- 37.5 acres
Net land area 1617.5 acres

Total uses 19
Total land area developed 19.19 acres

Percent land area developed 1.2%

FF-2

Total land area-2280 acres
Minus Road area- 47.5 acres
Net Land area 2232.5 acres

Total uses 18
Total land area developed 36.36 acres

Percent land area developed 1.6%

RR-1

Total land area- 1360 acres
Minus Road area- 26 acres
Net land area 1334 acres

Total uses 32
Total land area developed 16.16 acres

Percent land area developed 1.2%

RR-2

Total land area- 718.5 acres
Minus road area- 31 acres
Net land area 687.5 acres

Total uses 47
Total land area developed 23.73 acres

Percent land area developed 3.5%

SR-1

Total land area 554 acres
Minus road area 48.17 acres
Net land area 505.8 acres

Total uses 41
Total land area developed 28.23 acres

Percent land area developed 5.6%

CROSS VILLAGE TOWNSHIP

LAND USE EVALUTION CONTINUED

ZONING DISTRICTS

R-2B

Total land area -	25.35 acres
Minus road area	5.37 acres
Net land area	19.98 acres

Total uses 16
Total land area developed 8.08 acres

Percent land area developed 40.0%

B-2

Total land acres	17.56 acres
Minus road acres	5.38 acres
Net Land area	12.38 acres

Total uses 10
Total land area developed 10.16

Percent land area developed 82.1%

County Of Emmet

Phone 616-347-2801

CITY-COUNTY BUILDING

Petoskey, Michigan 49770

November 17, 1980

BOARD of COMMISSIONERS

P. McCallister
Chief, Engineering Division
Dept. of the Army
Detroit Corps of Engineers
Box 1027
Detroit, Mi 48231

Dear Mr. McCallister:

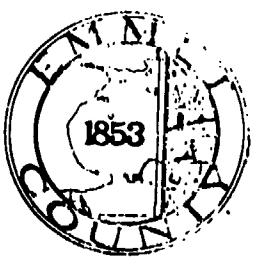
The construction of the proposed Harbor of Refuge at Cross Village, Michigan will not only benefit that area economically, but will most certainly be an improvement to safe navigation in northern Lake Michigan.

The Emmet County Board of Commissioners is, therefore, very supportive of this project and on behalf of the Board I hereby reaffirm its support of the Harbor of Refuge as a necessary and beneficial project for Cross Village.

Sincerely,

Irene D. Granger

Irene D. Granger
Chief Deputy Clerk



February 17, 1981

Serial No. 273-81
File No. EMT-CV

Mr. P. McCallister, Chief
Engineering Division
Corps of Engineers
Detroit District
P.O. Box 1027
Detroit, MI 48231

Dear Mr. McCallister:

Reference is made to the proposed plan for developing a small craft harbor at Cross Village, and more particularly, to a meeting between representatives of various divisions of the Michigan Department of Natural Resources and members of your planning staff which was held in Lansing on February 12, 1981.

At that meeting, Mr. Lou Marchinda, project engineer, brought up four items of concern to the Detroit District. They are as follows:

1. Attitude of the Waterways Division to the proposed breakwater design which would permit development of a maximum 1 1/2 foot wave within the basin.

2. Method of handling the wastewater from the proposed toilet-shower building and sewage pump-out facility.

3. Impact of the proposed development on any threatened plant species.

4. Impact of recently passed legislation regarding sand dune mining on the proposed plan.

The Waterways Division is prepared to accept a maximum 1 1/2 foot high wave within the basin. The decision is based primarily upon economics and the feeling that such waves will only very occasionally occur during the navigation season.

When the time comes for developing the mooring and launching facilities, this agency will construct wastewater facilities in full compliance with the then applicable rules of the Michigan Department of Health.

Regarding items 3 and 4 above, I expect you will hear directly from Dr. Taylor of Wildlife Division and Mr. Roethele of Geological Survey Division. If I can be of any further assistance, please contact me.

Sincerely,

Raymond G. Lawrence
Assistant Chief
Waterways Division

RGL:db
cc: Ms. Watson
Dr. Taylor
Mr. Roethele

Northern Michigan Electric Cooperative, Inc.

TELEPHONE 582-6572 • AREA CODE 616 • P. O. BOX 138

Boyne City, Michigan 49712

March 9, 1981

U.S. Corp of Engineering
Engineering Division
P.O. Box 1027
Detroit, Michigan 48231

Attention: Mr. Jeff Groska

Dear Sir:

Thank you for your call of inquiry concerning the submarine cable that feeds Beaver Island, Michigan from the shore take-off point at Cross Village, Michigan.

I am sending one (1) copy of the three property assessments involved from the top of the hill to the take-off point at the shore line. Also included is a copy of the Department of Army permit number 71-56-7. The paragraph V on page four (4) of the Department of Army permit.

Thank you.

NORTHERN MICHIGAN ELECTRIC COOPERATIVE, INC.

Richard B. Chappell
Transmission Manager

RBC: gb

Enclosures

DEPARTMENT OF THE ARMY PERMIT NO. 71-56-7

PERMIT

District Engineer
U.S. Army Engineer District, Detroit
Corps of Engineers
Detroit, Michigan 48231

Northern Michigan Electric Cooperative
P. O. Box 138
Boyne City, Michigan

Sirs:

Referring to written request dated 19 February 1971

upon the recommendation of the Chief of Engineers, and under the provisions of Section 10 of the Act of Congress approved March 3, 1899 (33 U.S.C. § 403), entitled "An act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," you are hereby authorized by the Secretary of the Army

to place a submarine cable (28,000 volt)

in Lake Michigan

at Cross Village, Michigan, extending from the mainland to Beaver Island; said cable to be buried out to the 15 foot contour on both sides with all dredged material to be used as backfill

in accordance with the plans and drawings attached hereto marked:
"Proposed Electric Cable from Cross Village to Beaver Island, Michigan
Application by Northern Michigan Electric Cooperative Boyne City, Michigan
February 19, 1971"

subject to the following conditions:

(a) That this instrument does not convey any property rights either in real estate or material, or any exclusive privileges; and that it does not authorize any injury to private property or invasion of private rights, or any infringement of Federal, State or local laws or regulations, nor does it obviate the necessity of obtaining State or local assent required by law for the structure or work authorized.

(b) That the structure or work authorized herein shall be in accordance with the plans and drawings attached hereto and construction shall be subject to the supervision and approval of the District Engineer, Corps of Engineers, in charge of the District in which the work is to be performed.

(c) That the District Engineer may at any time make such inspections as he may deem necessary to assure that the construction or work is performed in accordance with the conditions of this permit and all expenses thereof shall be borne by the permittee.

(d) That the permittee shall comply promptly with any lawful regulations, conditions, or instructions affecting the structure or work authorized herein if and when issued by the Federal Water Quality Administration and/or the State water pollution control agency having jurisdiction to abate or prevent water pollution, including thermal or radiation pollution. Such regulations, conditions or instructions in effect or hereafter prescribed by the Federal Water Quality Administration and/or the State agency are hereby made a condition of this permit.

(e) That the permittee will maintain the work authorized herein in good condition in accordance with the approved plans.

(f) That this permit may, prior to the completion of the structure or work authorized herein, be suspended by authority of the Secretary of the Army if it is determined that suspension is in the public interest. *

(g) That this permit may at any time be modified by authority of the Secretary of the Army if it is determined that, under existing circumstances, modification is in the public interest.* The permittee, upon receipt of a notice of modification, shall comply therewith as directed by the Secretary of the Army or his authorized representative.

(h) That this permit may be revoked by authority of the Secretary of the Army if the permittee fails to comply with any of its provisions or if the Secretary determines that, under the existing circumstances, such action is required in the public interest.*

(i) That any modification, suspension or revocation of this permit shall not be the basis for a claim for damages against the United States.

(j) That the United States shall in no way be liable for any damage to any structure or work authorized herein which may be caused by or result from future operations undertaken by the Government in the public interest.

(k) That no attempt shall be made by the permittee to forbid the full and free use by the public of all navigable waters at or adjacent to the structure or work authorized by this permit.

(l) That if the display of lights and signals on any structure or work authorized herein is not otherwise provided for by law, such lights and signals as may be prescribed by the United States Coast Guard, shall be installed and maintained by and at the expense of the permittee.

(m) That the permittee shall notify the District Engineer at what time the construction or work will be commenced, as far in advance of the time of commencement as the District Engineer may specify, and of its completion.

(n) That if the structure or work herein authorized is not completed on or before thirty-first day of December, 1974, this permit, if not previously revoked or specifically extended, shall cease and be null and void.

(o) That the legal requirements of all Federal agencies be met.

(p) That this permit does not authorize or approve the construction of particular structures, the authorization or approval of which may require action by the Congress or other agencies of the Federal Government.

(q) That all the provisions of this permit shall be binding on any assignee or successor in interest of the permittee.

(r) That if the recording of this permit is possible under applicable State or local law, the permittee shall take such action as may be necessary to record this permit with the Registrar of Deeds or other appropriate official charged with the responsibility for maintaining records of title to and interests in real property.

(s) That the permittee agree to make every reasonable effort to prosecute the construction or work authorized herein in a manner so as to minimize any adverse impact of the construction or work on fish, wildlife and natural environmental values.

(t) That the permittee agrees that it will prosecute the construction of work authorized herein in a manner so as to minimize any degradation of water quality.

(u) That the permittee, upon receipt of a notice of revocation of this permit or upon its expiration before completion of the authorized structure or work, shall, without expense to the United States, at the direction of the Secretary of the Army and in such time and manner as the Secretary or his authorized representative may direct, restore the waterway to its former condition. If the permittee fails to comply with the direction of the Secretary of the Army or his authorized representative, the Secretary or his designee may restore the waterway to its former condition, by contract or otherwise, and recover the cost thereof from the permittee.

(v) That should there be any interference with construction of the proposed Federal Project at Cross Village, the permittee will relocate that portion of the cable as directed and at no cost to the Federal Government.

*A judgment as to whether or not suspension, modification or revocation is in the public interest involves a consideration of the impact that any such action or the absence of any such action may have on factors affecting the public interest. Such factors include, but are not limited to navigation, fish and wildlife, water quality, economics, conservation, aesthetics, recreation, water supply, flood damage prevention, ecosystems and, in general, the needs and welfare of the people.

BY Authority of the Secretary of the Army:

Permittee hereby accepts the terms and conditions of this permit.

A.E. Steinbrecher — May 18, 1971
Permittee — Date

A.E. Steinbrecher

NCE 119
MAY 1970

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

P. O. Box 30028
Lansing, Michigan 48909
322-1311
Area Code 517

March 16, 1981

Serial No. 466-81
File No. EMT CV

Colonel Robert V. Vermillion
Corps of Engineers, Detroit District
P.O. Box 1027
Detroit, Michigan 48231

Dear Colonel Vermillion:

This will certify assurance of the present capability and willingness of the Waterways Division of the Michigan Department of Natural Resources to provide the requirements of local cooperation as outlined in your letter dated February 24, 1981, regarding the Cross Village Harbor, Michigan project. The requirements will be provided at the time requested by the District Engineer, U.S. Army Corps of Engineers, in accordance with applicable legislative authority governing the project.

Sincerely yours,

Keith Wilson, Chief
Waterways Division

KW:rgl:pas
cc: Larry Witte

R1026-5 1/80

Melrose Park, Il. 60160
May 19, 1981

U.S. Army Engineer District, Detroit
ATTN: NCEED-Fß
P.O. BOX 1027
DETROIT, MI. 48231

Gentlemen,

We are long time visitors to Cross Village, Michigan, and have been enthusiastic promoters for a Harbor in Cross Village, along with our many boating friends, who frequent , and love the area. We all feel a proper facility, would make the area so much more welcome and beautiful.

We know Harry Pintarelli, a life long resident, and the greatest humanitarian anywhere, who has for many many years earnestly tried to get a proper facility for the Village, realizing full well what it would do for the area,and the boats trying to come there.

We had been on your mailing list from previous communication, however, since we relocated, we no longer receive mail, Will greatly appreciate receiving progress reports again, for which we wil be most grateful, and will share with our boating friends.

Sincerely,

Eleanor Schechtel

E. A. Schechtel
1537 N. Eagle Av.
Melrose Park, Il. 60160

June 11, 1991

U. S. Army Engineer District, Detroit
Attention: NCEED-ER
P.O.Box #1027
Detroit, Mi., 48231

Gentlemen:

If available still, kindly forward a copy of the Draft Report on the proposed harbor for CROSS VILLAGE, Michigan to the undersigned.

Although we are tardy in making a statement in support of such a harbor in the Cross Village area, we are nonetheless wholeheartedly in agreement with the cause.

We have been owners of sail and power yachts on Lake Michigan especially and on the high seas as well. Currently in the process of diposing of a 120' diesel yacht, we are in hopes of returning to something that would permit cruising the small harbors of the Lakes again.

P O. Box 858
Barrington, Il., 60010

Sincerely Yours,

Julian Armstrong

Mr. & Mrs Julian Armstrong

CARL LEVIN
MICHIGAN

140 RUSSELL BUILDING
WASHINGTON, D.C. 20510
(202) 224-6221

United States Senate

WASHINGTON, D.C. 20510

COMMITTEES:
ARMED SERVICES
GOVERNMENTAL AFFAIRS
SMALL BUSINESS

June 16, 1981

Col. Robert Vermillion
District Engineer
U.S. Army Corps of Engineers
P.O. Box 1027
Detroit, MI 48231

In reply
refer to: A-CD187

Dear Col. Vermillion:

My letter is concerning the U.S. Army Corps of Engineers proposal for a harbor for light-draft vessels in the vicinity of Cross Village, Michigan.

It is my request that the Corps address the following questions as they pertain to the Corps summary of proposed recommendations for the harbor which were issued May 14, 1981.

Under the sub-heading Social Considerations, it is mentioned that "some means of treating harbor wastewater would be required." What plan does the Corps have to address this problem?

Under Environmental Considerations, it is stated that "a swimming beach would be constructed on the eastern side of the harbor with a portion of the sand dredged from the harbor basin." Has this sand been tested for pollutants? Does the Environmental Protection Agency (EPA) or the State of Michigan have any objections to the sand being placed on the beach?

It is further indicated that the "remaining dredged material would be placed along the shoreline downdrift of the harbor to help alleviate some of the current shoreline erosion and prevent any further shoreline erosion which would otherwise result from the presence of the harbor." Will the relocation of the dredged material be sufficient to prevent downdrift shoreline erosion? Has the dredged material been tested for pollutants? Does the EPA or the State of Michigan have any objections to the use of the dredged material along the downdrift shoreline? Will the Corps maintain responsibility in the event of future shoreline erosion due to the presence of the harbor? Is there any anticipation by the Corps of an over abundance of dredged material from the harbor? If so, what does the Corps plan to do with the material?

ALPENA
106 WATER STREET
ALPENA, MI 49707
(517) 356-6122

DETROIT
1860 MCNAMARA BUILDING
DETROIT, MI. 48226
(313) 226-6020

SAGINAW
500 FEDERAL STREET
P. O. BOX 817
SAGINAW, MI. 48606
(517) 754-2494

WARREN
30500 VAN DYKE
ROOM 205
WARREN, MI. 48093
(313) 751-0477

It is also mentioned that "the rock material (from the removal of the existing breakwater ruins) would be reused to build an offshore underwater reef as a new habitat (for sea life)." Has there been any objection by the EPA or the State of Michigan to the relocation of the rock?

Additionally, due to the interruption of the literal drift, will a bypass system be used in the construction of the harbor breakwaters?

My concern for the Cross Village Harbor project stems from the experience of my office in obtaining approval of a Section 111 for the small draft harbor at Lexington, Michigan. These questions are an attempt to prevent a similar occurrence at Cross Village.

I would appreciate being apprised of the Corps position regarding my concerns and look forward to your response. Thank you for your attention and consideration.

Sincerely,

Carl Levin

Carl Levin

kp

Laurelynne Harris
4346 Elmhurst Drive
Saginaw, Mi. 48603

June 21, 1981

Dear Sir:

While our residence is in Saginaw, we own Lake Michigan frontage in Cross Village Township. Unfortunately we were not notified of the recent meeting concerning the proposed harbor of refuge. Inasmuch as our property is quite close to the proposed site, we would like you to know that we support the project. We are aware of the need for this shelter and feel any delay will simply result in increased costs.

One of the reasons we decided to purcase property in Cross Village Township was the quietness. Another was the clean water. We do not feel the proposed project will have an adverse affect on these.

Sincerely
Dr. and Mrs. Geo. Harris

RESOLUTION

WHEREAS, the Cross Village, Michigan HARBOR OF REFUGE Project is a long awaited and much needed improvement to the safe navitation of northern Lake Michigan and its access to the waters of the other Great lakes; and

WHEREAS, this project will aid in the economic and social growth of northwestern Michigan, will help in reducing unemployment and will produce other related benefits;

NOW, THEREFORE, BE IT RESOLVED that this Board of Commissioners hereby affirms its complete support of this very worthwhile project; and

FURTHER, that copies of this resolution be forwarded to Senators Reigle and Levin, Representative Bob Davis and Col. Robert Vermillion of the District Corps of Engineers.

STATE OF MICHIGAN)
) ss
County of Emmet)

I, Irene D. Granger, Clerk of the County of Emmet and of the Emmet County Board of Commissioners, do hereby certify that this is a true and complete copy of the resolution adopted by unanimous vote of the Board of Commissioners at a regular meeting held on June 23, 1981 at Petoskey, Michigan.

IN TESTIMONY WHEREOF I hereunto set my hand and affixed the seal of said County this 23rd day of June, 1981

Irene D. Granger
Irene D. Granger
Emmet County Clerk

HARRY PINTARELLI
Supervisor

MARIE KRUPA
Clerk

Helen Kunys
~~WILHELMINA VINTOR~~
Treasurer

CROSS VILLAGE TOWNSHIP BOARD
CROSS VILLAGE, MICHIGAN 49723

July 9, 1981

Mr. C. Argiroff
Chief, Planning Branch
Engineering Division
Detroit District, Corps of Engineers
Box 1027
Detroit, Michigan 48231

Dear Mr. Argiroff,

Please be advised that the Cross Village Township Board has resolved to support the reasonable efforts of the U.S. Corps of Engineers and the Michigan State Waterways Commission to create a harbor at Cross Village, Michigan.

Sincerely,
Marie Krupa

Marie Krupa, Clerk
Cross Village Township Board

cc: Raymond G. Lawrence
Assistant Chief
Waterways Division

Cross Village

- memo -

8 NOV 1978

A public information fact sheet describing the status of proposed harbor improvements at Cross Village, Emmet County, Michigan

DETROIT DISTRICT, U.S. ARMY CORPS OF ENGINEERS

THIS IS THE FIRST IN A SERIES OF MEMOS CONCERNING THE PROPOSAL TO CONSTRUCT A HARBOR OF REFUGE FOR LIGHT-DRAFT VESSELS AT CROSS VILLAGE, MICHIGAN.

Funds have been appropriated to begin the advanced engineering and design studies for the Cross Village, Michigan, harbor of refuge. The project was authorized by the River and Harbor Act of 1966. First, the Corps will review and update the project document (the Survey Report) done in 1965. All of the elements of that report will be re-examined to close the 13-year gap. The economic justification of the project will require a complete restudy. The Corps will validate or discard certain 1965 assumptions concerning the harbor, such as the intent of the Beaver Island Ferry Company to use it as a base of operations; the prospects, if any, for commercial fishing use; the projections for recreational boating use, and other key factors that formed the economic justification in the 1965 report. The restudy will also examine any new alternatives desired for the design of the harbor, such as adjusting the location of the breakwaters to preserve as much beach front as possible. The 1965 report contained no environmental impact statement. Now, a complete environmental impact statement for the project will determine if the project is environmentally feasible. Technical design criteria have changed significantly in the last 13 years. The Corps will update those studies which were completed prior to authorization, to establish present engineering, environmental, social, economic and institutional feasibility and acceptability.

The Detroit District is now in the process of beginning the restudy; this phase of the study will be completed in September of 1980. If funding continues and the project remains feasible, it is expected that construction would begin in 1983.

Early public input is essential, so that citizens' views on harbor improvements desired can be taken into account early in the study. Therefore, a public workshop has been scheduled for Wednesday, 6 December 1978, at 7:00 p.m. in the Cross Village Township Hall. This will be an informal workshop. Corps personnel will make a short presentation on the current status of the project. Interested citizens are invited to attend and offer any comments or questions concerning the proposed improvements.

Inclosed with this notice is a copy of the plan of improvement, dated 1965, which will be the basis of the review and update. Also inclosed is a copy of the workshop notice. If further information is desired, please contact the Project Manager, Rob Fuller, at P.O. Box 1027, Detroit, Michigan 48231 or telephone 313-226-6760. Comments or suggestions on the proposal should also be directed to the above address.

P. McCALLISTER
Chief, Engineering Division

Incl
as

DIGEST OF PUBLIC MEETING
Concerning a Harbor for Light-Draft Vessels at
Cross Village, Michigan
16 June 1981

GENERAL

A formal public meeting was held on 16 June 1981 at the Holy Cross Community Hall in Cross Village, Michigan, by the District Engineer, Detroit District, U.S. Army Corps of Engi . The meeting began at approximately 7:12 p.m. and adjourned at oximately 9:10 p.m. The meeting was attended by approximately 100 people representing various Federal and State agencies, business and concerned interests, and private citizens.

MEETING

The purpose of the public meeting was to present the District Engineer's proposed recommendations for the construction of a harbor for light-draft vessels at Cross Village, Michigan. A talk and slide presentation was given by Mr. Jeff Groska, setting forth those recommendations as contained in the draft Phase I General Design Memorandum and draft Environmental Impact Statement. The floor was then opened to those persons who had indicated a desire to make a formal statement to do so, after which a question and answer period was held for those people seeking clarification of concerns relating to the proposed harbor.

STUDY BRIEFING

In Section 101 of the 7 November 1966 River and Harbor Act (Public Law 89-789), the Congress authorized the construction of a harbor for light-draft vessels at Cross Village, Michigan. Funds were appropriated in early fiscal year 1979 to conduct pre-construction planning studies to determine if the proposed harbor was still a feasible project and if Cross Village was the best location. The draft reports, which were distributed in April 1981, presented the Corps of Engineers proposed recommendations based on information gathered from three public workshops, site visits, technical studies, and coordination with other governmental agencies and private organizations.

During the course of the study four alternative locations for a harbor in the Cross Village area were investigated. These were Good Hart, Michigan; Cross Village, Michigan; Sturgeon Bay Point, and a location near Little Sucker Creek in the Wilderness State Park. The sites at Good Hart, Sturgeon Bay Point, and Little Sucker Creek were found unacceptable from environmental and social points of view, and Cross Village was selected as the best location for the proposed harbor.

Principal features of the proposed harbor include:

a. Two rubblemound breakwaters totalling 2,590 feet in length enclosing the harbor and opening to the northeast.

b. A twelve foot deep entrance channel, a minimum of 140 feet wide where it enters the harbor, extending 1,100 feet and flaring out at its lakeward end. An inner harbor access channel 10 feet deep, 140 feet wide, and extending 500 feet to the docking areas;

c. A two acre anchorage area also ten feet deep;

d. A concrete walkway and safety handrail 1,670 feet long on the west breakwater for use by sport fishermen and others;

e. The use of rock material from the ruins of the existing W.P.A. breakwater to form offshore reefs to encourage the buildup of fish populations in the area;

f. The use of uncontaminated lake bottom material, which is to be dredged from the proposed harbor site, to build a swimming beach on the east side of the harbor and to nourish the shoreline a distance of 1,500 to 3,000 feet northeast of the harbor within the 6-foot contour line. Maintenance dredging every three years would contribute an additional 15,000 cubic yards to this reach at each dredging; and

g. A monitoring plan, consisting of topographic surveys, aerial photographs, and testing of bottom sediments, to verify that the initial beach nourishment and periodic maintenance dredging would compensate for any effects of the proposed harbor on area accretion and erosion processes, and to check if harbor bottom sediments are becoming polluted.

The first costs of the proposed harbor are presently estimated to be 5.3 million dollars. Of this amount, 3.2 million dollars would be the Federal government's share and 2.1 million dollars would be a local responsibility. Using an economic project life of 50 years and an interest rate of 3-1/4 percent, the project first costs result in total annual charges of $253,000.

The average annual benefits are presently estimated to be $312,000 and the project's benefit to cost ratio is 1.24 to 1 indicating the project's economic feasibility. The annual benefits are derived as follows:

Recreational Boating	-	$179,000
Harbor of Refuge	-	24,000
Beaver Island Ferry	-	31,000
Recreational Fishing	-	46,000
Commercial Fishing	-	32,000
Total	-	$312,000

The proposed harbor at Cross Village would be expected to contribute to the growth of a stable year-round tourism in the region by providing increased opportunities for summer activities which would complement the region's winter activities. Some related service facilities (gift shops, restaurants, bait stores) would be established to meet the needs of harbor users and tourists. These would create limited job opportunities as would the Beaver Island Ferry operations and actual maintenance and operation of harbor facilities. Some growth in the community would probably result from the presence of the harbor but not substantially greater than that caused by the demand for vacation and retirement homes.

Utilities and roads presently available in the area are capable of handling the projected increases in growth and the seasonal influx of tourists. However, the increased traffic may present an increased safety problem for pedestrians in the harbor area.

The harbor design and construction activities would all be done in a manner to preserve a 2.4 acre wetland located on the proposed harbor site. Provision of on-shore facilities would require the removal of several stands of three State of Michigan threatened plant species but would not affect the species overall survival. Some grassland, wooded areas, and foredune areas would also be removed for the construction of on-shore facilities.

The schedule for completion of the harbor project is as follows:

Preconstruction Planning Document	-	October 1981
Technical Design Report	-	September 1982
Detailed Plans and Specifications	-	July 1983
Harbor Construction Completed	-	November 1985

FORMAL STATEMENTS

Ms. Kathy Pelleran representing U.S. Senator Carl Levin's Alpena Office.

Ms. Pelleran stated a letter had been sent to Colonel Vermillion outlining some concerns relating to a possible Section 111 at the proposed harbor. The questions were merely fact finding in nature and in no way meant to delay or thwart the project at Cross Village. Copies of the letter and the Corps of Engineers' response would be made available to anyone requesting them from Ms. Pelleran.

Mr. Harry Mellen of Cross Village, Michigan.

Mr. Mellen was concerned as to where 5.3 million dollars for the harbor would be obtained in these days of cuts in programs such as welfare, social security, and food stamps. He understood from the presentation that the funds had not been appropriated and would not be until sometime in 1984.

Ms. Suzanne Roche-Pierce of Cross Village, Michigan.

Ms. Roche-Pierce is a property owner in Cross Village Township concerned about constructively shaping the future of the Village. She stated the workshop approach used on the harbor project revealed pro and con sentiments but barely scratched the surface of a very real issue. The residents of Cross Village must do their own research and decide the size, compatability, and acceptability of the harbor plan as it relates to the community. A systematic approach is needed to determine the economic and social impacts of the community before deciding. The township planning and zoning board should organize, coordinate and supervise the local research studies and determine what demands the community would have to meet concerning increased taxes, road maintenance, fire protection, police force, emergency services, the possibility of limited beach facilities during construction, who would maintain the beach if the harbor should go in, harbor size, and zoning laws.

An ad hoc citizens group should be formed to support and supply the board with information. A questionnaire should be circulated and collected to get a consensus of the wants of the whole village. A condensed form of the report would be circulated and a vote taken. The decision should be made collectively to give Cross Village a fair shake and to continue a desirable quality of living in the area.

Mrs. Virginia Hume of Cross Village, Michigan.

Mrs. Hume's questions had been answered.

Mr. Raymond A. Kruskie of Cross Village, Michigan.

Mr. Kruskie is in favor of the breakwater. His questions had been answered.

Mr. Jack R. Pierce of Cross Village, Michigan.

Mr. Pierce is concerned that the presentations at the workshops and meetings are all on the positive aspects of the project. He stated that no negative impacts are presented and this is quite unbelievable if not negligent.

Mr. H. G. McMullen of Cross Village, Michigan.

Mr. McMullen had some questions which were deferred to the question and answer period.

Mr. William H. Cranmer of Cross Village.

Mr. Cranmer stated the Cross Village people had been looking at a mess down at the lakefront and wanted to see something done. He has been

supporting Harry Pintarelli as he tried to get something done for the past 20 years.

Mr. Alex Smolak of Cross Village, Michigan.

Mr. Smolak did not have a statement.

Mr. James Benham of Cross Village, Michigan.

Mr. Benham, a property owner in Cross Village, has attended all the meetings in the last four years related to the harbor and visited other harbors around northern Michigan. He developed an opinion of what the residents of Cross Village could expect if a harbor is constructed in the township park:

Local residents would have a place to moor their sailboats and yachts. Property values would rise. There would be increased tourism and profits for businesses. Local residents would have higher taxes due to increased land values, the need for better roads, and the eventual need for police and fire protection.

The environmental impact would include pollution from heavy construction and dredging equipment, disruption of the park for three years during construction, one season without use of the beach, water pollution from boat discharges, oil spills, and sewage, and increased auto and individual traffic.

People are repeatedly expressing concern at the size of the proposed project and asking for a more moderate version which would offer refuge to boaters and still retain the unique, quiet, out-of-the-way atmosphere of Cross Village.

Mr. Benham stated that a resort was being created, accessible and enjoyed by outside people at the exclusion of the present economic class of people in the area. Local residents would bear all the costs and receive none of the benefits. He proposed a vote of the residents to determine if the required land should be donated to build the harbor.

Mr. Vincent McPharlin of Port Huron, Michigan.

Mr. McPharlin did not have a statement.

Letters from Mr. Joseph Pawlus and Mrs. Agatha C. Coulter were entered into the record in favor of the proposed harbor.

QUESTIONS FROM THE FLOOR

Susan Day of Bear Creek Township representing Little Traverse Conservancy.

Q. The E.I.S. does not adequately address the question of increased shoreline erosion that may be caused by the structure. Also, local concerns regarding planning secondary impacts should be addressed.

A. Colonel Vermillion stated that while the study of the effects of placing a structure on the lake is not an exact science, the Detroit District had made a good prediction for the proposed harbor and have addressed the subject. First, the existing erosion rates in the area from a State of Michigan study were determined. From this data the quantity of material moving in the littoral zone could be determined. Next, from a study of Frankfort Harbor which is similar to the proposed harbor at Cross Village, erosion due to the proposed harbor at Cross Village was determined and is estimated to be about 15 percent of the total erosion occurring in the area.

He further stated that because this is not an exact science, a monitoring plan, to determine if the harbor does act in the manner predicted, would be instituted. Also from the initial dredging of the harbor, about 50,000 cubic yards of clean sand would be placed in a 3,000 to 4,000 foot erosion zone northeast of the harbor. Maintenance dredging, every three years, would contribute an additional 15,000 cubic yards of clean sand to this area. These measures are expected to more than compensate for the erosion that would be attributed to the harbor. If the results of the monitoring plan show the effects are not as predicted, the Corps would have to take other corrective action.

Mr. H. G. McMullen of Cross Village Township.

Q. Who will finance the operation of the harbor if it is built? After it is built, it is going to be a tremendous burden to the community to provide police protection, hire employees, build roads and water facilities. What is the projected annual cost to the taxpayers in Cross Village Township?

A. Mr. Lawrence of the State of Michigan stated that if the community is not interested in operating and maintaining the facility, it would be operated and maintained totally and completely by the Waterways Division of the Department of Natural Resources. No communities have had to put on additional police due to the presence of a harbor. If the community choses to operate the harbor it would be done on a break-even basis; costs would be paid out of revenues generated from the harbor.

Mr. Robert Rekasi of Brutus, Michigan.

Q. Does the $1,700 maintenance figure include the following services: establishing and operating a harbor commission, insurance for the harbor, repairing damage caused by vandalism, resurfacing of the parking lot, annual maintenance of the recreational walkway and clean-up of oil spills in the harbor.

A. It was inadvently indicated that the $1,700 did cover many of these services, however, it in fact applies only to the maintenance of the recreational walkway and handrail.

Mr. Lawrence stated that a body to operate the harbor is a requirement of the items of local cooperation between the State of Michigan and the Corps of Engineers. A citizen commission is set up only if the township elects to operate the harbor. The members would serve as unpaid volunteers.

He also stated that the harbors under the jurisdiction of the Waterways Division are not insured. If accidents occur the parties involved would have to sue the state for alleged compensation.

Colonel Vermillion stated that there is no cost attributed for the Coast Guard to clean up potential oil spills. A harbor the size being proposed would not increase operational expenses of the Coast Guard over the long term.

Mr. Lawrence further indicated that the items relating to harbor maintenance and operation are the responsibility of the operator of the harbor whether it be the township or the Waterways Division. Revenues from operation of the harbor are expected to cover these costs.

Q. Do you at this time have some idea of how many parking spaces will be put in?

A. Mr. Lawrence stated that the parking and mooring spaces would be put in on a phased basis. The first phase would probably have 30 slips and 40 parking spaces.

Q. Every 3 years you are going to dredge the harbor. Part of the material will be used to replace the swimming beach that will be eroded away. Have there been any studies done on the effect of boats on the dredged material?

A. Colonel Vermillion stated that as part of the monitoring plan, the material would be tested for contaminants. No polluted material would be used. If the material becomes polluted, the sand would be obtained from other sources.

Q. Do you have any history of harbors being expanded?

A. Mr. Argiroff of the Corps of Engineers stated that generally once the harbor breakwaters are completed they are pretty well fixed. It is expensive to make alterations and would require a study similar to what is being done now. Federal participation is not likely because the incremental benefits would not justify it. Mr. Lawrence indicated that mooring facilities within a harbor have been expanded by the state when needed.

Mrs. Mary Beth Mellen of Cross Village.

Q. Is it legally necessary to have a public referendum of the voters in Cross Village before the property could be turned over for the project?

A. Colonel Vermillion stated it was not required from a Federal standpoint. The Corps of Engineers deals with the local sponsor, who agrees to provide the necessary lands. The local sponsor, which is the State, deals with the communities involved.

Mr. Lawrence stated that it is not required on a state level, although it has been done in the past. The actual decision to provide the land is up to the Cross Village Township Board.

Ms. Audrey Van Hulle stated that Michigan law states that in order to use a park for any purpose other than it's present use requires a vote of the citizens.

Mr. Stanley McRae of Mackinaw City.

Statement: Mackinaw City has a marina which was built after I arrived in town. The Village of Mackinaw City operates the marina. The marina provides some employment opportunities for local residents. The Village has always been able to break even. To my knowledge there has been no increase in requests for local taxes because of the marina. There are no noticeable disturbances caused by users of the harbor. There is a need for a harbor somewhere between Mackinaw City and Harbor Springs.

Mr. Peter Forster of Cross Village.

Q. I would like to know how the people from Harbor Springs, Petoskey, Mackinaw City, and Beaver Island compare with Cross Village. They have been tourist areas for decades and have a built-up base of business. Their tax base is able to absorb a lot more than Cross Village can if problems arise. If people think that our taxes aren't going to go up because of that breakwater, they're mistaken. If we turn the operation over to the State, what control would we have over pollution, noise, and transients?

A. Colonel Vermillion repeated that the state's position that the harbor would be operated on a break-even basis no matter who operates it. The major operating expenses would be covered by fees collected. Major repairs would be discussed with the State and they would pay the cost or work out a cost sharing system. There is a potential for increased property taxes and that is something the people will have to consider. No boom in that area is anticipated but nobody can predict it.

Mr. Richard Pichiotino of Readmond Township

Q. As far as the harbor of refuge, when you come to Waugochance Point it's just as close to Beaver Island, maybe closer. If you are in a small boat and you really had to, you could beach it. I really question the need for a harbor of that size.

A. Colonel Vermillion stated that if the Corps was proposing just a harbor of refuge the economics are not there to justify it. Harbor of refuge benefits for a harbor at Cross Village are justified because the mainland site is more advantageous for that area than heading into the lake to find an island harbor. If there is to be a Federal interest in this harbor it must meet the recreational boating potential of the area. The harbor of refuge benefits are only a part of the total project. If the locals want something smaller they would have to proceed without Federal funds.

Q. What you're calling benefits depends on whether you're pre-development or anti-development. That is an ambiguous term.

A. Colonel Vermillion staced that the term benefits refers strictly to economic benefits. However, we have addressed the environmental and social impacts which could occur as a result of the harbor. Our evaluation is that the negative impacts are not of a magnitude that we would not recommend the harbor. That is a decision which also needs to be decided by the local residents before they provide the property.

Mr. Jack Pierce of Cross Village Township.

Q. You stated a harbor of refuge is not cost effective enough to warrant Federal involvement. What I don't understand is the marina that you're proposing is larger than the marina at Petoskey for a community who has all of 200 registered voters in it. Why is it not cost feasible if we build a smaller harbor.

A. Colonel Vermillion stated that the community would not be constrained from building a smaller harbor, however, if the Federal Government is to participate, the annual economic benefits from recreational boating, fishing, a harbor of refuge, and commercial activities must exceed the annual cost of the harbor over a 50-year project life. The size of the proposed harbor is based on the recreational boating need of the northern Lake Michigan region not just Cross Village. When looking at a larger national scope the proposed harbor is not really very large.

Ms. Natalie Zlotow

Q. It was mentioned at a preliminary meeting that benefits could be derived by people selling their homes due to increased property values. At this stage of the game I am not looking to sell my house. I also do not see the benefits to a lot of people who are not boat owners. As was stated before, it borders on the ridiculous to consider such a large harbor for

this town. I wish there were some way in our elections to determine once and for all who wants the harbor and who doesn't.

A. Colonel Vermillion stated that the potential increase in real estate values, if that were to happen, cannot be calculated into our cost and benefits. It may be a benefit to some individuals personally, but is not considered in our economic analysis.

Mr. Edwin Hulbert of Readmond Township

Q. Are there any communities of the size of Cross Village having a marina which could be compared to Cross Village?

A. Mr. Lawrence stated that the harbor at Detour is probably about the same size. The State has developments where there is no community at Hammond Bay and Little Lake. Cedarville and Grand Marais are smaller.

Mr. Vincent McPharlin of Port Huron.

Q. How does the size of the proposed harbor compare with Lexington?

A. Mr. Lawrence stated they are comparable in size.

Ms. Suzanne Roche-Pierce of Cross Village.

Q. Who would have a listing of personal correspondence from residents or interested parties stating their views? Where can we get copies to find out the ratio of pro and con letters?

A. Mr. Lunetta of the Corps of Engineers stated that a list of all the correspondence that comes in concerning the draft report will appear in the final Environmental Impact Statement.

Q. How was it decided at the past meetings that the majority of people were favorable towards the harbor?

A. Colonel Vermillion stated that was an estimate of the official who was running the meeting based on his impressions of the meeting.

Father John Kent of Cross Village.

Q. Would you explain the statement in the presentation that certain facilities would be built by private enterprise or the State to be operated by the individuals.

A. Mr. Willis of the Corps of Engineers stated that in a recreational harbor such as is proposed, it is the Federal responsibility to provide breakwaters, and dredging of the major access channels within the harbor. The development of the remaining facilities is the responsibility of the State of Michigan as the local sponsor. The operators of the Beaver Island

ferry and several commercial fishing operations have indicated an intent to operate out of the harbor. Areas have been provided within the harbor to develop docking facilities for these operations. The State would build the actual recreational boating facilities and the private groups could build their own facilities.

Q. What control would the local community have over these facilities?

A. Mr. Lawrence stated that if the community was operating the harbor they would lease the property to them. The lease agreement would state the terms of use.

Q. With respect to State control of the facility, what and how much would the local community be able to determine how the State will lease and to whom?

A. Mr. Lawrence stated that would be an item of negotiation with the State in turning over the property.

Dr. L. Jerome Fink of Petoskey.

Statement: I just wanted to point out from my perspective as a new property owner, I see the Corps of Engineers as a consultant firm here to help you understand the pros and cons. They are presenting information based on probability and statistics and cannot guarantee anything.

I think that the tax base of our community here can only increase over the years and I would caution any of you in favor of the harbor to build big enough, because the only problems that I've seen in the past are when people think small. I think Cross Village is going to grow whether we like it or not and it is important that we assure that it's going to grow appropriately.

The tourist industry in this area is only going to increase and is the salvation of this area. When we start thinking of tourism, we've got to think in terms that we're not providing a harbor for Cross Village, but we're talking about bringing money into Cross Village from harbor users.

I think Cross Village is fortunate to have been chosen to provide a site for this facility and I haven't heard anything to the contrary to change my mind.

Mrs. Helen Pawlus of Carp Lake.

Statement: From all appearances, I don't think they want progress.

Mr. David Irish of Harbor Springs.

Statement: The question here is one that is likely to be resolved by local government. The basic question, as I hear it is --- Does the community

want to have a harbor here? And the question seems to hinge on the decision of local government to make land available for such a use. So the decision rests locally. I really think that much of the discussion we've had here tonight really belongs in the township hall.

HEARING EXH.
#1
6-16-81
J.M.V.

Joseph R. Pawlus

101 Bluejay Road

Traverse City, Mich.

49684

Re. Cross Village Harbor Project

Dear Sirs,

I am writing this letter because I am not sure I'll be able to attend the meeting on June 16th. at Cross Village.

I want to voice my approval of the harbor project.

I do this from the perspective of one who was born and raised in Cross Village and has spent the last thirty three years closely intune with the progress and problems of the village area, and, as a current taxpayer in the Village.

sincerely.

Joseph R. Pawlus.

HEARING EXH.
#2
6-16-81
J.M.V.

Cross Village, Mi.,
May 26, 1981

Dept. of the Army
Detroit District of Engineers

Dear Sir:

I am very much interested in a harbor for light-draft vessels in the vicinity of Cross Village, Michigan. I think it would make a safe harbor for vessels and it would make more business. My people have to drive about 60 miles 5 days a week to work, and there will be jobs as some pay a little more tax on the harbor. As all the gas & meals etc. to our income. It would also mean a nice swimming beach and clean [illegible] to me which we don't have now.

Sincerely
Agatha C. Coulter
a Citizen of Cross Village, Mi. and

a tax of ages.

I would be in [illegible] [illegible]
me, at the time of the meeting
but some of my people will
be there.

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