DRAFT FINAL REPORT

GREEN BAY PORT DEVELOPMENT STUDY

The Port of Green Bay, Wisconsin

TAMS TIPPETTS-ABBETT-McCARTHY-STRATTON
ENGINEERS & ARCHITECTS

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Prepared for the Brown County Board of Harbor Commissioners, with financial assistance provided by the State of Wisconsin, Coastal Management Program, Department of Administration, and the Coastal Zone Management Act of 1972, as amended, administered by the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration.

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ENGINEERS & ARCHITECTS

TAMS

TIPPETTS-ABBETT-McCARTHY-STRATTON
ENGINEERS AND ARCHITECTS

PARTNERS
John Lowe, III, P.E.
Wilson V. Binger, P.E.
Andrew S. Balbiani, P.E.
Raymond J. Hodge, P.E.
Austin E. Brant, Jr., P.E.
John E. Bardes, P.E.
Robert F. Heins, P.E.
Dana E. Low, P.E.
Eugene O'Brien, P.E.
Donald R. Peirce, R.A.

ASSOCIATE PARTNERS
Ernest Jonas, P.E.
Patrick J. McAward, Jr., P.E.
Philip Perdichizzi, P.E.
Robert E. Prasch, P.E.
Mario Asin, P.E.
Edward C. Regan, P.E.
William C. Tindal, P.E.

CONSULTANTS
E. Per Sorensen, P.E.
Frederick J. Clarke, P.E.
Ronald W. Pulling, P.E.
Robert O. Swain
Armando Balloffet, P.E.

CONTROLLER
Francis A. Rohrer

August 29, 1980

Mr. John Seefeldt
Port Director
The Port of Green Bay
Court House
Green Bay, Wisconsin 54301

Dear Mr. Seefeldt:

Transmitted herewith is our draft final report on the proposed development of port facilities at Bay Port, Green Bay.

Our conclusions and recommendations arising from the study are presented in Chapter 1 of the report and are followed by supporting documentation and analysis.

The existing physical characteristics of the Fox River are reviewed and their impact on waterborne traffic and riverfront industrial development are assessed.

Existing river traffic figures and potential future levels of waterborne commerce likely to be handled through Bay Port are presented and emphasis has been given to the feasibility of incorporating a western coal transfer station in the port project.

The functional requirements for the port are developed from an analysis of current and future shipping trends on the Great Lakes, the waterborne commerce forecasts, materials handling needs and preferred distribution and transshipment modes.

A master plan strategy for the port has been formulated in two phases; the initial development involves minimum facilities required to provide a satisfactory level of service to the baseline demand. The long range plan provides for the port to expand to accommodate both the forecasted increases in traffic and unforeseen developments.

Environmental issues associated with Bay Port are discussed and the overall impact of the port development is considered to be compatible with the designation of the area for industrial use. The transfer of existing riverfront industries to Bay Port will have beneficial environmental effects

THE TAMS BUILDING, 655 THIRD AVENUE, NEW YORK, N.Y. 10017 (212) 867-1777 CABLE: TAMSENG NEW YORK TELEX: ITT 422188/RCA 223055/WU 125674

resulting from the removal of traffic and industries from the center of the City. The principal environmental concern relates to the disposal of dredged spoil, which will have to be accomplished with great care.

The estimated capital costs associated with the port development are presented and an assessment made of the total annual costs including debt service attributable to the Port Commission at a local level, operating, maintenance and administration costs are shown.

Direct port revenues are calculated for the baseline traffic forecasts and a comparison made with expenditure. The economic benefits and effects of the port are also assessed at both direct and indirect levels.

We are pleased to have been given the opportunity to participate in this interesting and important study. We should be pleased to receive your comments on the draft report and are available to discuss any aspects of the project. The cooperation of the many interests in Green Bay concerned with the project is gratefully acknowledged.

Sincerely yours,

TIPPETTS-ABBETT-McCARTHY-STRATTON

Albert T. Rosselli

Albert T. Rosselli

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CHAPTER 1
SUMMARY

INTRODUCTION

Use of the Bay Port site as an industrial park having waterfront facilities has been the subject of study since 1969.

This report investigates the potential levels of waterborne commerce likely to be handled at a new facility unrestricted by the physical limitations of navigation in the Fox River. The functional requirements associated with potential traffic are evaluated and development strategies prepared for both short and long term port requirements. The report also evaluates the financial and environmental aspects of the initial development and investigates alternative transshipment modes based on the provision of a modern bulk handling facility.

CONCLUSIONS AND RECOMMENDATIONS

Physical Limitations of the Fox River

The combined effects of limited draft, turning basin diameters and horizontal bridge clearances effectively limit the size of vessel able to reach the existing navigable sections of the Fox River to a maximum of 18,000 dwt. The most critical factors restricting vessel size are the 75 ft. haorizontal bridge clearances at the CM St. P and P and C & NW railroad bridges.

Traffic Patterns and Shipping Technology

In recent years the Great Lakes shipping industry has undergone a number of major changes resulting in a trend to fewer but larger vessels with emphasis on automated cargo handling systems to ensure optimization of vessel utilization.

Self unloading bulk carriers are now common. Obsolete land based unloaders are not being replaced and the "straight deckers" of the past are being phased out.

The present maximum vessel size is dictated by the dimensions of locks which limit the length of vessel to 730 ft., with the exception of the Sault St. Marie which permits passage of a vessel having 1,000 ft. length and a 105 ft. beam. The Standard Seaway depth is 27 ft. limiting effective vessel draft to a maximum of 25.5 ft. None of these large vessels would be able to enter a Bay Port facility fully loaded without major dredging of the main approach channel.

The Waterborne Traffic Forecast

Coal

The potential use of Bay Port as a Transfer and Blending Station for Western Coal was evaluated. Likely clients were considered to be paper mills and power utility companies located within a 50 mile radius of Green Bay and utilities in the lower perimeter of Michigan along the lake shoreline.

The potential public utility demand for coal within the study area is expected to stabilize at 6.8 million tons per year by 1985 and remain static thereafter while the paper mills in the Green Bay region will consume 1.01 million tons in 1985 rising to 1.66 million tons by 2010.

Analysis of mining and transportation costs indicate that paper mills in the Fox River valley might realize a marginal savings from the use of western coal but costs clearly favored eastern/mid-western coal in the case of the power utility companies.

It was concluded that no large scale demand exists for a western coal brokerage center at Bay Port in the initial stages of development but local paper mills are likely to continue to experiment with blending of both coals and could realize some economic advantages by so doing.

The difference between the costs of the two coals is marginal. National energy and environmental policies are in a state of flux and future changes in emphasis could lead to the Port of Green Bay playing a more significant role in satisfying the nation's energy demand.

It was concluded that coal shipments through a Bay Port facility will attain a level of 660,000 tons in 1985 rising to 1,310,000 tons by 2010.

Aggregates and Miscellaneous Bulk

It is considered that bulk cement movements through Fox River terminals may be diverted to a Bay Port bulk handling facility. Throughput will reach 345,000 tons in 1985 increasing at approximately two percent per annum. Movements of salt and miscellaneous bulk products are also anticipated unless environmental constraints restrict the use of salt for ice control purposes.

Transshipment Modes

Movement of bulk commodities out of a Bay Port terminal may be by rail, truck or barges. Study was given to the analysis of the latter; in particular, investigation of the use of barges to deliver bulks and general cargoes to Fox River waterfront industries, thus reducing the existing navigational problems associated with the physical limitations of the river channel and reducing vessel turn-around time.

The cost of providing and operating a barge system was seen to exceed the current cost of shipping coal from

Lake Erie to Green Bay mainly as a result of underutilization of tugs and barges due to the low commodity volumes and the short haul distance. It is also evident that the most economical size of barge would approach the size of vessels currently able to reach the Ft. Howard wharf (10,000 dwt) and use of a number of barges of lesser size would increase the number of bridge transits to the detrement of rail and vehicular traffic in the City of Green Bay.

It is concluded that the operation of a barge system will be disproportionally expensive based on the forecast traffic levels available at the time. Movement of bulk products from Bay Port will be mainly by truck and provision for a rail link should be included in the overall planning concepts.

First Phase Development - Bulk Handling Facilities

Early development is expected to involve the transfer of existing Fox River terminals to the new site where a higher level of service can be offered unhindered by the present physical limitations of the river channel and bridges.

Consequently the first stage planning will be developed to accommodate those vessels now calling at Green Bay but will also have the capacity for expansion to handle large lake vessels in the future.

The design vessel selected is a 15,000 dwt bulk carrier of length 650 ft and laden draft of 22 ft. No additional dredging work to the approach channel would be necessary to accommodate such a vessel.

A total wharf length of 800 ft. will permit berthing of one ship and allow space for a tug, pilot launch, etc.

Storage facilities for up to 500,000 tons of coal and miscellaneous dry bulk products will require an area of 45 acres. Self unloading vessels will discharge into a stationary hopper and coal is then moved to the live storage area by enclosed conveyor and a travelling radial stacker.

Silos for the storage of 20,000 tons of cement are provided together with the necessary pipework and connections at the berth face.

An area is allocated for the storage of salt. Environmental factors may require that stockpiles be covered or alternatively a storage shed may be necessary. Unloading hoppers and conveyors for salt are kept separated from coal handling systems to avoid contamination.

Administration, control and associated buildings will be also required and space is allocated in the first phase development plan.

Dredging and Dredge Disposal

Dredging of the harbor area and turning basin will generate 2.5 million cu. yds. of spoil which is required to be placed in a contained, controlled disposal area. Up to 1 million cu. yds. may be used to complete the filling of the existing diked area and it is recommended that the remainder be placed in a penninsular form of off-shore breakwater. It is most unlikely that an alternative disposal site could be found for such a large quantity of material at an acceptable cost. Construction on recently deposited dredge spoil is regarded as undesirable due to the fine, silty nature and poor compaction qualities of the material.

The Long Term Plan

The location of the breakwater is such that the port may be expanded to accommodate up to six vessels of sizes varying from 15,000 dwt to the present maximum lake vessel. Occupancy levels of the first stage both are within acceptable limits into the mid 1990's by which time a clearer pattern of traffic development will have emerged, enabling the long term plan for the port to be more clearly defined.

The location of storage areas, accesses to the site, breakwater and turning basin are planned to enable expansion to take place with a minimum disruption of port activities. The area bounded by the power transmission lines to the north and east and Hurlbut St. and the 50 ft. easement to the south and west should be reserved for bulk or open storage to facilitate future expansion.

Environmental Effects

The major environmental effects associated with development of the Bay Port site would arise from the continued filling of the wetlands in the area designated for industrial development. Impacts arising from the construction of the port facility may be minimized to a large extent by design techniques that respond to statutory controls.

A detailed environmental and technical study will be required before the designated bulkhead line may be amended to incorporate the breakwater structure, which is also to be used for disposal of dredge spoil.

It is concluded that the project development is compatible with the policies of the Brown County Planning Commission and that environmental impacts will be moderate at a local level and small in regional terms.

The transfer of existing waterfront facilities from the Fox River bank to Bay Port is considered to be beneficial to the City in that the land vacated may be allowed to revert to other urban or open space area following the pattern successfully established on the east river bank.

The use of the land created by the off-shore breakwater is not essential to the short term development plan for the port and could be put to useful service as open space or a recreational area. The Wisconsin Department of Natural Resources also wish to retain an area of 40 acres of the existing partially filled diked disposal area. Both schemes can be incorporated in the overall plan for the area and as such are considered to have a positive environmental effect.

Financial Analysis and Economic Benefits

Subject to the receipt of necessary construction permits and approvals, financial assistance may be available in the form of state or Federal grants to cover a proportion of the capital cost of the port development. It is assumed that bulk handling and storage facilities will be leased to a private operator who will be responsible for the provision of equipment, etc. and that dredging costs will be borne by Federal funds.

Combined capital repayment and operating costs attainable to the Port Commission for the first phase of development will be in the order of $900,000 per year expressed in 1980 dollars.

Direct earnings from port revenues were calculated on the basis of a fee per ton moved, giving a yield of $110,000 per year by 1985, rising to $206,000 by 2010.

A large discrepancy exists between estimated port revenues and expenditure and the project cannot, therefore, be justified solely on the basis of the financial analysis.

However, it is estimated that the transfer of existing riverside industries to Bay Port will result in a savings of $240,000 per year in transportation costs.

The further development of Green Bay as a regional industrial growth centre will be enhanced as a result of the availability of adequate waterfront facilities which will be an undoubted attraction for potential clients for land in the adjacent Bay Port industrial park.

Conversely it is evident that any reduction of traffic through the port facilities will erode the economic foundation of the City and have significant detrimental impacts on the community at a local and regional level. Each ton of bulk cargo that moves through the port, for example, is estimated to generate direct and indirect income of about $16.

CHAPTER 2
INTRODUCTION

The Port of Green Bay is an important focus of commerce in the industrial and agricultural region of northeastern Wisconsin.

The main industrial area of the city is located on the banks of the Fox River and city planning policy effectively prohibits further use of the east river bank for industrial use south of the East River, whereas the western bank is zoned for industrial and waterborne commercial users.

The Bay Port site to the west of the river mouth has been designated as a future site for industrial port development. Development of the site offers the opportunity to attract new industries to the area and would provide a port facility capable of future expansion to accommodate the current trend in Great Lakes shipping towards larger vessels.

A facility that has been mentioned as a possibility at Bay Port is a coal transshipment terminal for supplying western coal by rail and Great Lakes shipping to consumers outside the Green Bay region.

A recent study of marine-related land use recommended developing Bay Port for docking deep draft vessels, and further study of the economic feasibility of a coal transfer and blending station. The study also indicated that a lighterage system might be feasible to take advantage of the economies of larger vessels and minimize the existing bridge and channel constraints on river navigation.

The concept of the development of Bay Port is a sensitive environmental issue and the impact of the project on the area causes concern to both public and private sectors of the local population, particularly in view of Green Bay's designation as a non-attainment area in oxide air pollutants.

This report investigates the likely commercial demand for the project and identifies existing riverside industries who would benefit from the new terminal facilities. The practicalities and economics of an associated lighterage system are analyzed and a port master plan is developed to include the possibilities of future expansion.

Areas of possible environmental conflict are identified and general recommendations are presented within the scope of the broad-based planning objectives.

BACKGROUND

The Bay Port area has been considered a suitable site for industrial and marine development since 1921. In 1969 the City Council acquired approximately 600 acres of low-lying land to be reserved for the proposed project.

Inception of the scheme was designated to take place in three phases, the first of which comprised a report to the Brown County of Harbor Commissioners and the Division of Economic Development, Department of Local Affairs and Development of the State of Wisconsin. The report, prepared in May 1971 covered the analysis of waterborne commerce potential, port operations and harbor facilities and established baseline commerce forecasts for the proposed development.

In June 1972 a Phase 2 development study of the project was submitted to the Brown County Regional Planning Commission. The report included schemes and costs for the port and industrial area and discussed dredging and spoil disposal requirements associated with the project and deepening of the main approach channel to serve the new port.

The Brown County Planning Commission then prepared a master land use plan for the area. The report, submitted to the Brown County Board of Supervisors in March 1973 identifies the opportunities, limitations options and priorities of marine and new marine functions in the Bay Port area related to land utilization.

The objectives of the report were later expanded in a study entitled "Port of Green Bay, Marine Related Land Use Study" in March 1979. The report concluded that existing port facilities along the Fox River are underutilized as a result of the navigational constraints and recommended the development of a modern facility in Bay Port in order to enable Green Bay to become a viable and competitive Great Lakes port.

The report further recommended that the facilities should include a lighterage service for transshipment of incoming and outgoing cargoes and indicated that cost savings to major riverside industries could be realized by the barge scheme.

In May 1973 the University of Wisconsin prepared a report entitled Environmental Impact Considerations, Project Bay Port in which the areas of conflict of the proposed scheme were identified.

The study was only able to discuss impacts in overall terms as all of the schemes developed up to that point were outlines and generalized formats. However, the report does provide an extremely useful review of the interactions involved in the project development.

The Green Bay-Brown County Planning Commission published in April 1979, a report covering environmentally significant areas in Brown County, Wisconsin. The study is essentially an inventory of significant areas in the country and extends the horizons of the possible impact of the Bay Port development to include guidelines identifying areas that are more capable of supporting addition al growth. The report also delineates resources and land areas in Brown County which directly contribute to the maintenance of environmental quality, natural productivity and community amenity.

The Bay Port project is now entering Phase III of the planning process where a clear definition of the development strategy is required in order to define the marine facility requirements and identify potential port needs.

CHAPTER 3

PHYSICAL CHARACTERISTICS OF THE FOX RIVER

Navigation in the stretches of the Fox River indicated in Figure 3.1 is restricted by a number of physical constraints which effectively limit the size of vessel able to serve waterfront developers. In addition to which the frequency of bridge openings causes congestion of vehicular traffic and regulations are in force to limit bridge openings to non-rush hour periods.

EXISTING CONDITIONS

Approach Only

The main approach channel to Green Bay is dredged to a depth of 26 feet to Grassy Island and has a depth of 24 feet south to the Fox River entrance.

Dredging of the channel to the St. Lawrence Seaway depth of 27 feet LWD would result in an estimated 4,000,000 cu. yds. of dredged material, containing polluted sediments and requiring a confined, dredged disposal area which could extend to 300 acres.*

Current economic indicators also show that further dredging of the main channel is unlikely to take place unless a major commercial impetus develops in order to upgrade the current cost-benefit ratio.

Fox River Channel

The channel is dredged to its authorized depth of 24 feet over a width of 300 feet from the Fox River seaward limit to 150 feet downstream of the C&NW Rail Road Bridge where the depth reduces to 20 feet to include the turning circle in front of the Ft. Howard Paper Co. wharf. The channel narrows

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* Supplemental Design Memorandum -- U.S. Corps of Engineers (Chicago District).

to 150 feet from the upstream limit of the turning circle and a reduced depth of 18 feet is maintained from 1,700 feet upstream of the bridge to the City of DePere.

The authorized Green Bay project also included dredging to a depth of 24 feet at various widths to a point 1,700 feet upstream of the C&NW bridge and included deepening the turning circle at the bridge to the authorized depth of 24 feet. The main project was completed in 1973 but the additional dredging detailed above was not regarded as economically justified at the time and was not implemented. It was further concluded that deepening of the channel through the C&NW bridge would undermine the pier foundations, at that modifications would be required.

Recent developments* indicate a satisfactory cost-benefit ratio for the deferred works and it seems likely that the necessary permits will be obtained to allow work to go ahead on the additional dredging to the turning circle and channel in the vicinity of the C&NW rail bridge together with the necessary modifications to the bridge pier.

Further deepening of the channel beyond 24 feet would undermine the foundations of a large number of the existing bridges and pose problems of disposal of polluted material which would be extremely difficult to resolve.

Three turning circles are located in the Fox River; The upper limit at the City of De Pere, a second as discussed above, directly upstream of the C&NW Rail Road Bridge, and a third at the mouth of the East River. Consideration of the DePere basin is not taken further as it is outside the scope of this study.

East River Turning Basin

The basin at the mouth of the East River is of triangular form with cross-river width of approximately 1,000 feet.

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* Green Bay Harbor Wisconsin, 1962 Modifications, Supplemental Design Memorandum, U.S. Army Corps of Engineers, February 1980.

River currents of up to 3 knots can cause delays of 1-2 hours to vessels using the turning circle.

Turning Basin at the C&NW Bridge/
Ft. Howard Paper Plant

The turning basin is currently dredged to 20 feet from 150 feet downstream of the railroad bridge. It is of triangular form and has a cross river width of 933 feet. Large vessels calling at the C. Reiss Coal Company wharf do not transit the bridge to use the turning circle due to its draft limitations and the restricted horizontal clearance, preferring to use the East River basin. This necessitates the transit of four bridges astern in either entry or exit to the coal berth.

Road and Rail Crossings

The river is crossed by a total of 3 rail and 4 road bridges between the river mouth and the turning basin in front of the Ft. Howard wharf. The tower bridge under construction at the mouth of the river has been designed to permit the passage of large vessels and has a vertical clearance of 120 feet.

Vertical and horizontal clearances for all bridges downstream of the Ft. Howard Paper Company wharf are indicated in Table 3.1.

It is seen that all the bridges upstream of the new Tower Drive Bridge are either of swing or bascule configuration. The minimum horizontal clearances are 75 feet at the C.M. St. P. and P and C&NW railroad bridges and the minimum vertical clearance when closed is 7.5 feet at the Green Bay & Western RR Bridge.

In the past, several minor collisions have occurred, mainly with the CB&W RR bridge and the Walnut St. bridges, both of which have been out of service for a period of hours following the accidents.

TABLE 3.1

BRIDGES ACROSS THE FOX RIVER CHANNEL
GREEN BAY

	Location, Mile	Type	Clearance (feet) Horizontal	Clearance (feet) Vertical*
Tower Drive	0.07	fixed	-	120.0
Green Bay & Western RR	1.02	swing	85.6	7.5
Main Street	1.57	bascule	87.3	12.3
Walnut Street	1.80	bascule	78.0	9.0
Tilleman Memorial (Mason Street)	2.26	bascule	124.0	30.0
Chicago, Milwaukee, St. Paul & Pacific RR	2.60	swing	75.0	8.3
Chicago & North Western RR	3.30	swing	75.0	31.0

* Vertical clearance in closed position referred to mean low water datum for Lake Michigan.

VESSEL LIMITATIONS IN THE FOX RIVER

Draft

The maximum loaded vessel draft in the river channel is limited to 22.5 feet which allows 1.5 feet for squat and under-keel clearance over a soft bottom. The draft then reduces effectively to 18.5 feet at the C&NW bridge and the turning circle upstream of the bridge.

The majority of the vessels wishing to navigate the channel are likely to be carrying out coal in bulk and accordingly, a review has been made of the dimensions and availability of self-unloading bulk carriers at present operating in the Great Lakes. It is seen in Figure 3.1 that a summer draft of 22.5 feet would indicate a maximum coal carrying capacity of 12,000-14,000* tons per vessel dependent on the density of the coal. This would increase to approximately 18,000 tons if advantage is taken of seasonal variations in lake levels.

The review also indicated that self-unloading vessels of drafts of less than 20 feet are not generally available in the Great Lakes and hence, any vessel wishing to call at the Ft. Howard Paper Co. must either offload part of the cargo at the C. Reiss wharf or arrive part loaded in order to deliver to terminals above the C&NW bridge.

Turning Basins

The two main turning basins are not of sufficient size to enable maneuvering without tugs of any but the smallest vessels.

Based on present standards acceptable to the marine industry the East River basin is of sufficient size to accommodate a vessel of approximately 210 feet in length maneuvering under its own power or up to 425 feet with tug assistance.

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* Greenwoods guide -- coal capacity calculated on the basis of 42 cu. ft./ton.

This would then represent bulk carrier vessels of 7,000 and 12,000 tons capacity respectively.

Bridge Constraints

The most important constraint on navigation in the Fox River arises from the number and physical limitations of the road and rail bridges. Horizontal clearances vary from a minimum of 75 feet on the C.M. St. P & P. and C&NW railroad bridges to 124 feet on the Mason Street road bridge.

The Main Street bridge has a clear opening of 87.3 feet but navigation through the draw is hampered by a 23^{o} angle in the channel at the opening, effectively reducing the usable horizontal clearance.

It is usual to allow a minimum clearance between vessel and bridge pier of three feet per side unless a ship is guided through by land-based equipment and hence, it is seen that a 69-foot beam vessel is the largest craft that can safely transit the minimum bridge opening in ideal conditions.

Ship dimensions vary significantly for vessels having similar cargo capacity but in general terms the present horizontal bridge clearances restrict lake vessels to a maximum capacity of 20,000 tons.

CRITICAL LIMITATIONS

It is seen from the foregoing that further dredging works in the 24 ft. channel are not likely to increase the size of vessel able to call at terminals on the Fox River as the turning circle and bridge clearance restrictions would then become critical and large capital outlay would be then required to modify bridge piers and foundations.

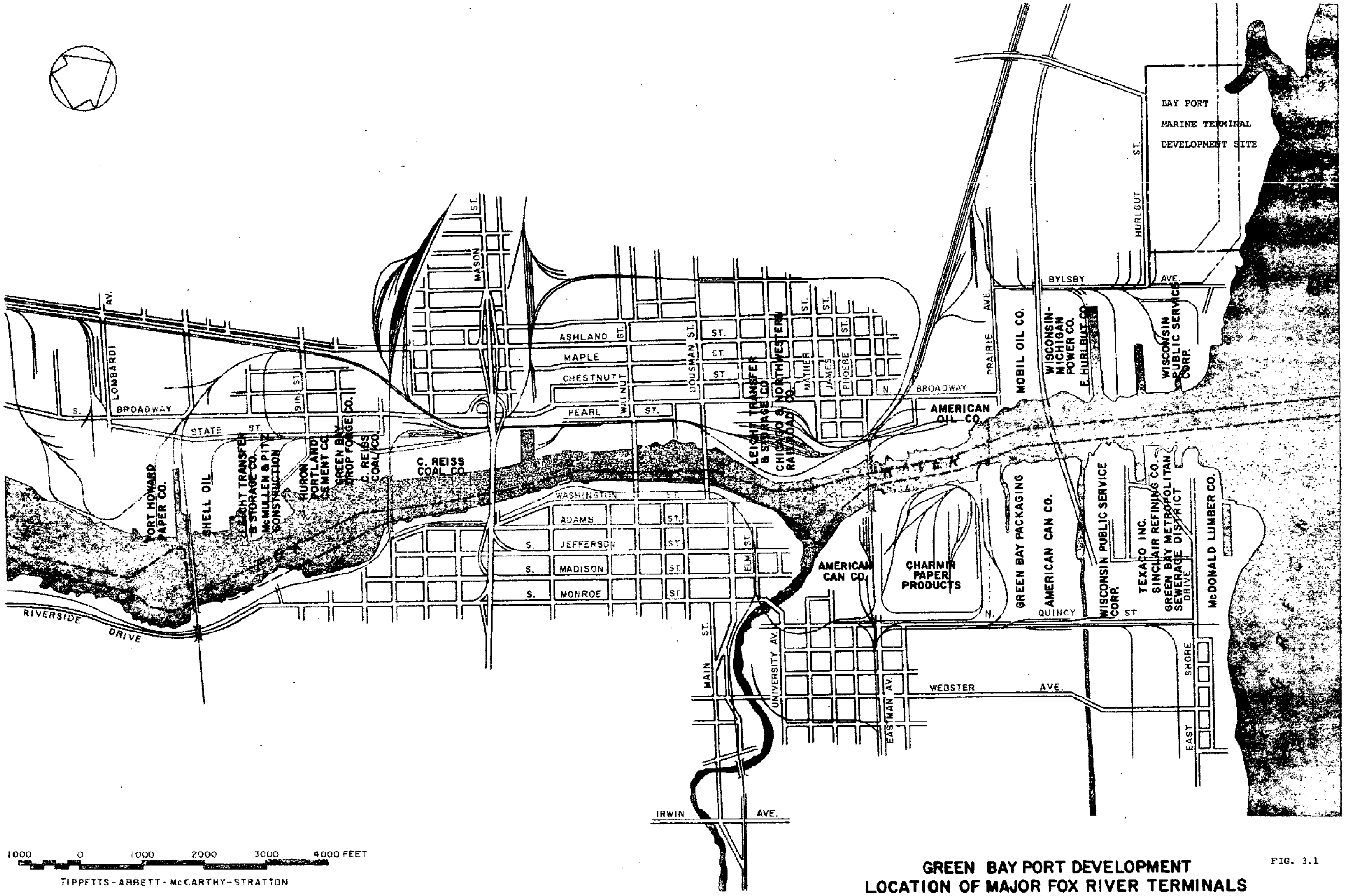
The depth of water at the C&NW bridge is, however, a severe restriction to the Ft. Howard Paper Co. operations in that very few self-unloading vessels are able to enter a 20-foot channel in a fully loaded condition.

The combination of constraints on the river effectively limit the size of vessel to an absolute maximum of 18,000 dwt.

Figures 3.2 and 3.3 indicate that the typical dimensions of an existing self-unloading Great Lakes bulk carrier having the above capacity will be:

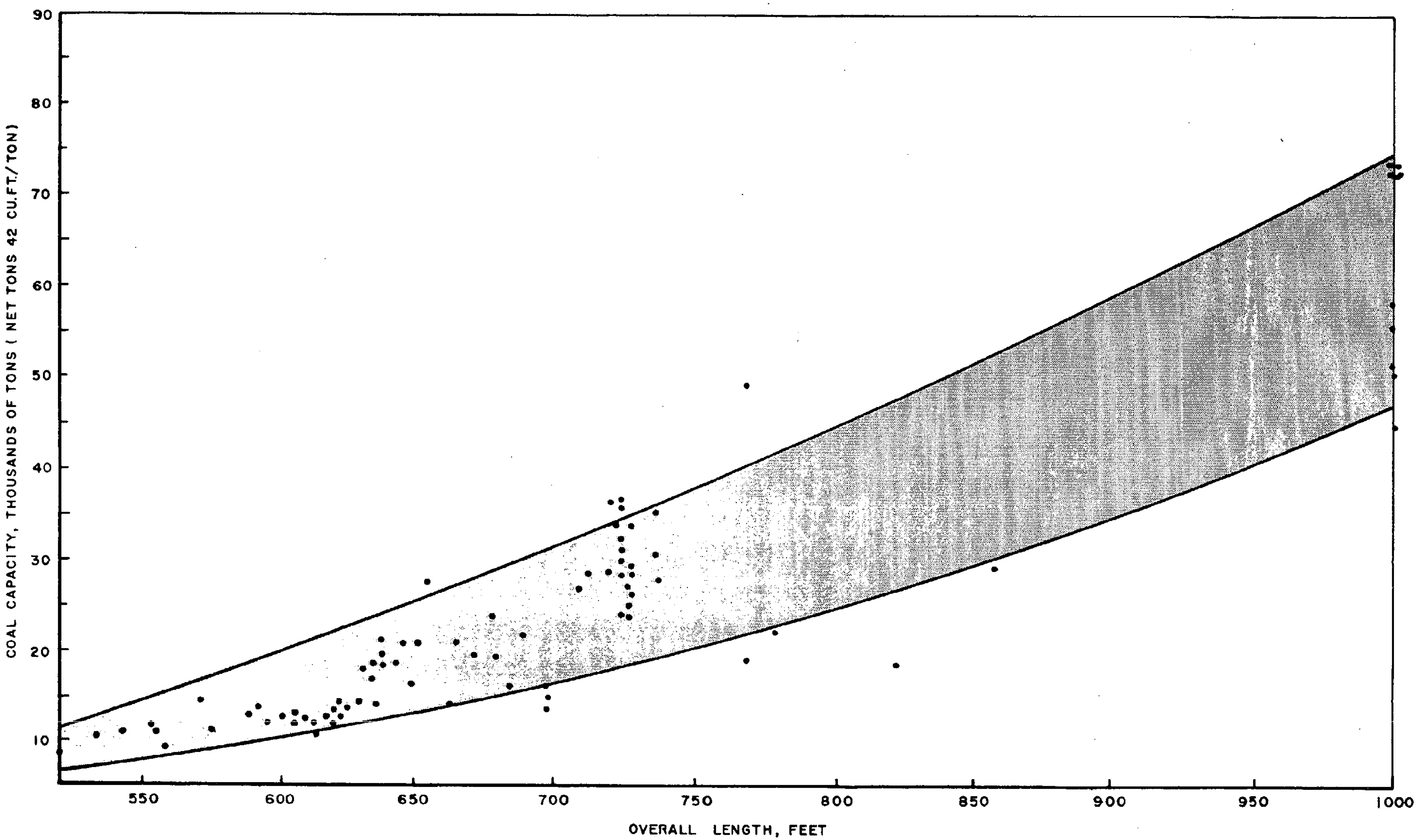
Length	635 feet
Beam	70 feet
Loaded Draft	25 feet* (Intermediate).

* Assumes the vessel takes advantage of increased seasonal lake levels and lightens cargo by approximately 7,000 tons before transiting C&NW bridge.



GREEN BAY PORT DEVELOPMENT
LOCATION OF MAJOR FOX RIVER TERMINALS

FIG. 3.1

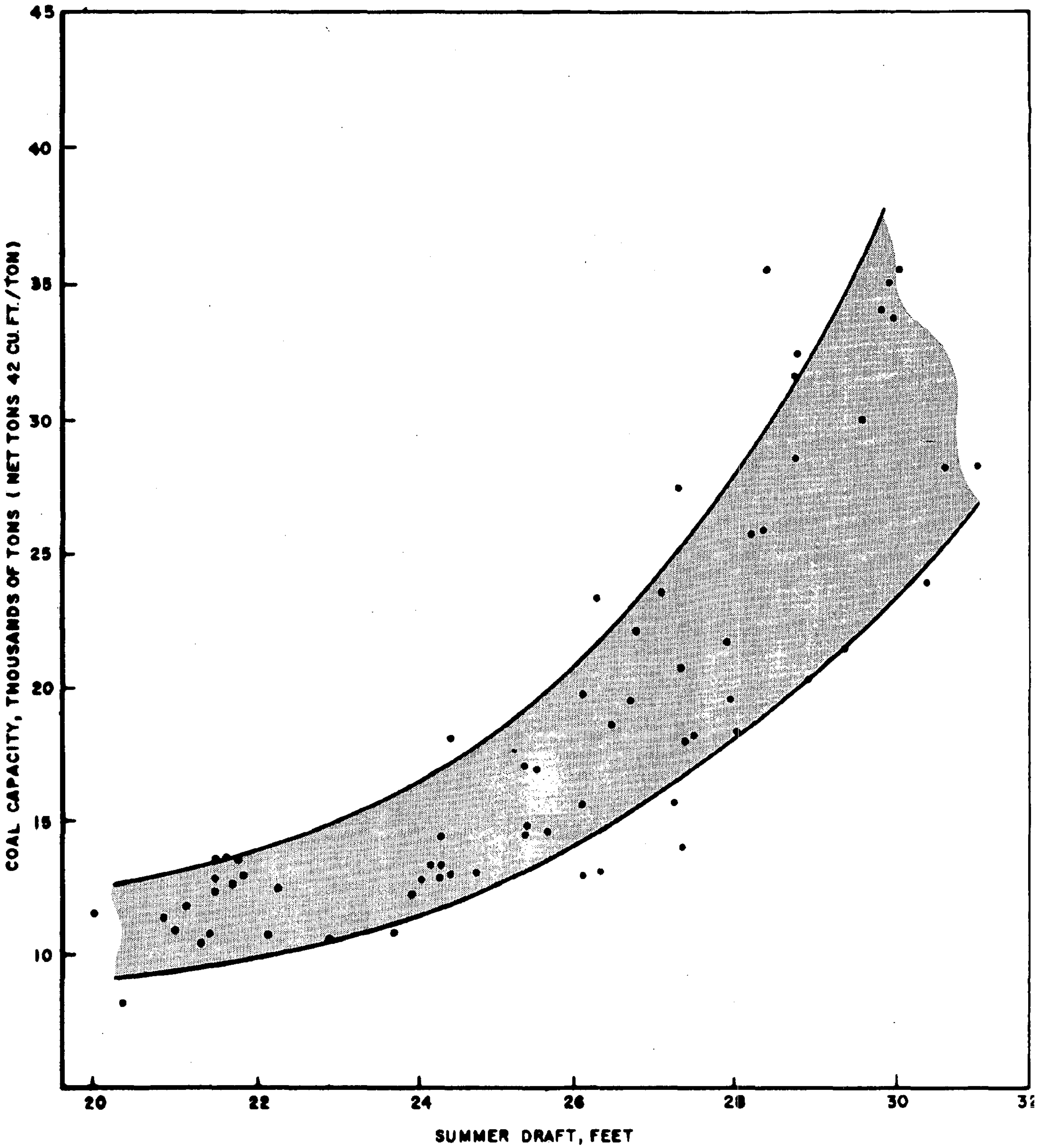


GREAT LAKES BULK CARRIERS

LENGTH VS COAL CAPACITY

SOURCE: GREENWOODS GUIDE 1980

FIG. 3.2



NOTE: "SUPER LAKERS" ABOVE 45,000 DWT NOT SHOWN

GREAT LAKES BULK CARRIERS

DRAFT VS COAL CAPACITY FIG. 3.3

SOURCE: GREENWOODS GUIDE 1980

CHAPTER 4

TRAFFIC PATTERNS AND SHIPPING TECHNOLOGY

SHIPPING TRENDS ON THE GREAT LAKES

In recent years the Great Lakes region has undergone major changes in shipping. The package freight trade has virtually disappeared, together with the Great Lakes passenger vessel and many small vessels have been scrapped through obsolescence and have not been replaced by similar size ships.

The trend is towards fewer but larger vessels with emphasis on automated cargo handling systems to ensure optimization of vessel utilization. Self-unloading vessels are now common and the "straight deckers" of the past are being phased out.

Development of the 1,000-foot super bulk carrier vessel is a recent phenomenon and studies are being made of a future breed of 1,300 and 1,500-foot vessels which would require further expansion of the limits of locking systems between the lakes.

Navigation between the Great Lakes and in much of the St. Lawrence River involves transiting confined channels that place serious limitations upon the drafts of vessels. The standard seaway depth is 27 feet, and most of the major Great Lakes harbors have been dredged to the same depth, which generally allows for transit of vessels up to 25.75 feet draft. All of the locks except the newest one at Sault Ste. Marie limit the length of vessels to 730 feet, with beam limited to 75 feet. The Poe lock at Sault Ste. Marie allows vessels of 1,000-foot length and 105-foot beam to transit.

Within these dimensional constraints, there are significant differences between the carrying capacities of lake vessels and of ocean-going ships that are able to transit the Great Lakes-St. Lawrence Seaway system. A typical "laker" is flat-bottomed, with blunt bow and stern; its high "block co-efficient" enables it to carry more cargo than could an ocean-going ship of similar basic dimensions.

Table 4.1 summarizes the physical characteristics and functions of vessels in the major categories of Great Lakes vessels.*

For Green Bay Harbor, an entrance and river channel 24 feet deep and 300 feet wide exists from Grassy Island to a point about one-half mile upstream from the mouth of the Fox River; the channel continues at a depth of 24 feet with varying widths to a point 1,700 feet upstream from the C.& N.W. railroad bridge, and then at a depth of 18 feet and width of 150 feet to the City of DePere, with a turning basin at the end. There are two turning basins within the Port: one, 24-feet deep at the mouth of the East River and the second, 20-feet deep, downstream of the C.& N.W. railroad bridge.

These channel and turning basin dimensions limit the size of the vessels that can navigate within the Port of Green Bay.

Table 4.2 provides a summary of all inbound and outbound vessel movements from Green Bay Harbor during 1977, by vessel draft; both self-propelled and non-self-propelled vessels are shown. As can be seen in the table, of the total of 1,285 vessels inbound, 1,013 had drafts of 12 feet or less, and the vast majority of the remaining vessels were in the 20-23 foot range.

The U.S. Corps of Engineers recently completed a study of the feasibility of deepening the Fox River an additional four feet, from 150 feet downstream of the C.& N.W. railroad bridge through and to 1,700 feet upstream of the bridge.**

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* Eric Schenker, Harold M. Jayer, Harry C. Brockel. The Great Lakes Transportation System. University of Wisconsin Sea Grant College Program. 1976.

** U.S. Corps of Engineers, Chicago District. Green Bay Harbor, Wisconsin, Supplemental Design Memorandum (Draft). February 1980.

TABLE 4.1

CHARACTERISTICS OF MAJOR GREAT LAKES VESSEL TYPES

Vessel Types	Length (ft)	Beam (ft)	Draft (ft)*	Cargo Tonnage	Employment
Pre-Seaway "Canaller" (Lake service)	258	43.5	14.00	3,000	Great Lakes-St. Lawrence[1/] Pre-Seaway Canal System
Pre-Seaway "Canaller" (Lake-Overseas Service)	258	43.5	14.00	1,600[2/]	Great Lakes-Overseas Direct via Pre-Seaway Canal System
Cuyahoga River Laker	630	68.0	25.75	18,000	Great Lakes, St. Lawrence[3/]
"Maximum Laker" (pre-1970; post-1959)	730	75.0	25.75	28,000	Great Lakes, St. Lawrence west of Sept. Isles, Quebec
"Maximum Laker" (post-1970)	1,000	105.0	25.75	57,500	Great Lakes, west of Welland Ship Canal
Typical Great Lakes-Overseas General Cargo Liner	500	75.0	24.0	9,000	Great Lakes-Overseas Direct
Typical Lake-Ocean Bulk Carrier	600	75.0	25.75	25,000	Irregular Great Lakes-Ocean Service

* Maximum draft normally allowed for transit of lock system.

1/ Obsolete since opening of enlarged Seaway System in 1959.

2/ On Seaway draft; additional 1,000 tons on 18-foot draft east of Montreal.

3/ Dimensions limited by Cuyahoga River at Cleveland, Ohio.

Source: University of Wisconsin Sea Grant College Program. The Great Lakes Transportation System. January 1976

TABLE 4.2

GREEN BAY HARBOR
TRIPS AND DRAFTS OF VESSELS
(during 1977)

Type of Vessel	Draft (Feet) 28	27	25	24	23	22	21	20	19	18	17	16	15	14	13	12 & Less	Total
INBOUND																	
Self-Propelled Vessels																	
Passenger & Dry Cargo	1	1	2	15	28	62	46	28	11	4	21	6	1	-	-	962	1,188
Tanker	-	-	-	-	3	10	5	2	5	-	-	-	-	-	-	45	70
Towboat or Tugboat	-	-	-	-	-	-	-	-	-	-	1	10	5	-	-	-	16
Non-Self-Propelled Vessels																	
Tanker	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	6	11
TOTAL INBOUND	1	1	2	15	31	72	51	30	16	4	27	16	6	-	-	1,013	1,285
OUTBOUND																	
Self-Propelled Vessel																	
Passenger & Dry Cargo	-	-	-	2	5	9	14	22	26	34	40	12	2	1	12	1,009	1,188
Tanker	-	-	2	3	-	3	-	2	1	8	2	2	-	-	-	46	69
Towboat or Tugboat	-	-	-	-	-	-	-	-	-	-	-	10	5	-	-	-	15
Non-Self-Propelled Vessels																	
Tanker	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	11
TOTAL OUTBOUND	-	-	2	5	5	12	14	24	27	42	42	24	7	1	12	1,066	1,283

Source: U.S. Corps of Engineers

This reach of the river represents the uncompleted portion of the Green Bay Harbor project which was authorized in the 1962 River and Harbor Act. Since this portion of the project would have a major impact on the operation of the Fort Howard Paper Company, the vessel types that were used to transport coal to Ft. Howard were identified. These vessel types are summarized in Table 4.3.

The American Steamship Co. presently provides the shipping services for the Fort Howard Paper Co., the Pulliam Plant of the Wisconsin Public Service Corporation and for the C. Reiss Coal Co. The vessels that serve the Wisconsin Public Service Corporation are slightly larger than those serving the Fort Howard Paper and C. Reiss Coal companies. American Steamship is one of the only companies that are bringing new bulk vessels in the intermediate size category, i.e., the vessels that are not in service in the Port of Green Bay, into service.

FUTURE PATTERNS

Discussions with shipping agents and marine-related industries indicate that vessels at present serving Green Bay terminals are replaced on a one for one basis as the older ships are scrapped. Hence, overall supply is likely to remain constant as traffic volumes increase, both within the Port of Green Bay and in the Great Lakes area as a whole. As a result, the level of shipping service provided to the port may gradually decline although it is not anticipated that this will alter the baseline forecasts of waterborne commerce.

If the approach channel were dredged to 27 feet, service to Bay Port by bulk vessels in the 1,00-foot, 50-60,000 dwt range would be needed to realize the economies inherent in operation at that depth. At the present time, there are 13 vessels in this category in service on the Great Lakes. Discussions with shipping company representatives have indicated that the supply of these vessels will increase in response to

TABLE 4.3

CHARACTERISTICS OF PRIMARY VESSELS WHICH WERE USED OR TO BE USED IN TRANSPORTING COAL TO FORT HOWARD

Vessel 1/	Gross Regular Tons	Length 2/	Beam	Grain Cubic 3/ Space	Mid-summer Capacity 4/	Mid-summer Draft
A 1943	9,775	620' 0"	60' 0"	578,475	14,500	24' 6"
B 1943	9,876	620' 6"	60' 3"	510,975	14,750	24' 7"
C 1977 6/	11,619	634' 10"	68' 0"	748,455	18,500	23' 9" 5/
D 1975	11,619	634' 10"	68' 0"	748,455	18,500	23' 9"
E 1927	8,217	605' 0"	60' 0"	469,505	12,600	22' 0"
F 1917	8,409	600' 0"	60' 0"	480,000	12,600	21' 7"

1/ Date of vessels original construction.

2/ Extreme length of the vessel.

3/ Represents the total area of the hold that is available for the storage of cargo and is expressed in cubic feet.

4/ Capacity is measured in net or short tons (2,000 lbs.) for coal. Capacities for vessels A, B, C and D were furnished by the transport operator.

5/ The draft level listed for vessels C and D are the load levels reached at the mid-summer net tonnage coal capacity for those vessels. That draft level is below the lowest seasonal draft level (winter) for those vessels.

6/ The dimensions for vessel C were assumed based on the fact that it is a sistership to vessel D and built at the same dimensions as vessel D.

(Source: Unless otherwise noted, Greenwood's Guide to Great Lake Shipping, 1977.)

the demand for their service. It is judged herein that if sufficient cargo volumes were generated to justify the construction of a transshipment facility at Bay Port and to dredge the channel to a depth of 27 feet, vessel availability would not likely be a constraint for the operation.

CHAPTER 5
WATERBORNE TRAFFIC FORECAST

INTRODUCTION

The objective of the waterborne traffic forecast for Bay Port in Green Bay, for selected years through 2010, is to provide a basis for evaluation of the potential for new or relocated bulk commodity handling facilities for coal, and for agri-commodities and bulk aggregates. Consideration was given to cargoes that would originate or be destined to local, statewide and regional locations.

Coal is the principal commodity that presently moves through the Port of Green Bay, accounting for about 67 percent of the total cargo moving through the Port in 1979. The feasibility of developing port facilities in the Bay Port area is directly related to the role that Bay Port will play in local, statewide and regional coal movement in the future. In light of the critical role of coal, the waterborne commerce forecast focuses upon its movement. In addition, forecasts were prepared for agri-commodities and bulk aggregates.

The principal objective of the coal analysis is to determine if a transshipment facility in Bay Port could serve as the basis for a coal brokerage operation for western and/or eastern/midwestern coal. For western coal, the demands of various utilities and industries would be aggregated and served through a single facility, thereby permitting the economies achievable through unit train service from the west. Coal users with demands too small to justify unit train service individually, could realize the savings associated with large volume shipments. In the case of eastern/mid-western coal, a facility at Bay Port has the potential for serving as a distribution point for the coal that arrives at the Port of Green Bay via lake vessels from Lake Erie as indicated in Figure 5.1.

TABLE 5.1

THE PORT OF GREEN BAY
WATERBORNE COMMERCE STATISTICS
(1,000s of tons)

Cargo Type	1979		1978		1977		1976		1975		1974		1973		1972		1971		1970	
DOMESTIC	I/B	O/B	I/B	O/B	I/B	O/B	I/B	O/B	I/B	O/B	I/B	O/B	I/B	O/B	I/B	O/B	I/B	O/B	I/B	O/B
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Machinery	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-*	-	-	-
Cement	313	-	374	-	290	-	246	-	270	-	299	-	295	-	252	-	216	-	206	-
Coal	1,898	-	1,516	-	1,619	-	1,440	-	1,589	-	1,648	-	1,670	-	1,887	-	1,746	-	2,123	
General Cargo	-*	-*	-*	-*	-*	-*	-*	-*	-*	-*	-*	5	-*	6	-*	2	-	-	-*	7
Petroleum Products	131	3	201	4	192	4	248	11	182	3	202	3	334	19	287	-	382	-	352	-
Limestone	167	-	174	-	144	-	136	-	119	-	119	-	114	-	115	-	144	-	182	-
Salt	10	-	10	-	21	-	36	-	58	-	30	-	13	-	48	-	26	-	23	-
Limestone Sand	13	-	19	-	42	-	21	-	22	-	24	-	-	-	-	-	-	-	-	-
Calcium Stone	12	-	3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
Calcium Sand	22	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coke	47	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pig Iron	-	-	19	-	14	-	13	-	-	-	9	-	29	-	39	-	12	-	23	-
Garylite Aggregate	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Materialite	-	-	-	-	8	-	9	-	9	-	18	-	9	-	-	-	-	-	-	-
Asphalt	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
Sinter Sand	-	-	-	-	-	-	-	-	-	-	17	-	12	-	10	-	-	-	-	-
Yankee Dryer	-	-	-	-	-	-	-	-	-	-	-	-	-*	-	-	-	-	-	-	-
Papermill Dryer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-*	-	-	-	-	-
Inland Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
Inland Stone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	10	-	-	-
Sand	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-
Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-
Total Domestic	2,613	3	2,342	4	2,330	4	2,149	11	2,249	3	2,372	8	2,491	25	2,653	2	2,536	2	2,908	7
Total Domestic I/B & O/B	2,616		2,346		2,334		2,160		2,252		2,380		2,516		2,655		2,539		2,915	
INTERNATIONAL	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports
Woodpulp	27	-	44	-	64	-	62	-	53	-	38	-	30	-	32	-	45	-	55	-
Salt	106	-	54	-	22	-	61	-	26	-	43	-	62	-	14	-	51	-	18	-
Tallow	-	19	-	20	-	29	-	31	-	17	-	27	-	14	-	9	-	7	-	7
Bulgin	-	14	-	9	-	19	-	7	-	20	-	8	-	8	-	5	-	22	-	13
Wheat Soy Blend	-	2	-	5	-	12	-	1	-	2	-	3	-	11	-	22	-	1	-	-
Flour	-	6	-	1	-	4	-	13	-	10	-	13	-	14	-	26	-	36	-	11
Plywood	-	-	-	-	-	-	-	-	29	-	22	-	-	-	-	-	-*	-	-	-
Other	25	19	10	14	1	13	38	8	18	9	20	6	18	3	13	6	6	14	8	17
Total International	158	60	108	49	87	77	161	60	126	58	123	57	110	50	59	68	102	80	81	48
Total International Imports & Exports	218		157		164		221		184		180		161		129		181		129	
TOTAL INTERNATIONAL AND DOMESTIC CARGO	2,845		2,504		2,498		2,382		2,436		2,560		2,677		2,784		2,720		3,044	

* Less than 500 tons

Source: Port of Green Bay

Future volumes of coal and other cargoes through a proposed facility at Bay Port are despendent upon numerous factors, some of which are beyond the control of Brown County planning officials. National energy and environmental policies will have a major impact upon the movement of coal in the future and long-term projections of these policies involve a high degree of speculation. These policies will affect programs for channel deepening and dredging, winter navigation, rail and truck regulation, the intermodal transportation balance, and other aspects of energy production and transportation, thereby influencing the role of coal and, of the Port of Green Bay, in satisfying the nation's energy demand.

In light of these exogenous factors, the waterborne commerce forecast was prepared in two phases. First, waterborne commerce movements were projected assuming commodity flows will not be constrained by physical conditions or by cargo handling capacity at Green Bay. Then, the potential impact of physical and administrative constraints upon the development of the Port are evaluated. Technological changes in cargo handling methods and the evolution of vessel design on the Great Lakes will have a major impact on the movement of bulk commodities and are considered an integral part of the waterborne commerce forecast.

Considering the range of issues involved in projecting cargo for Bay Port, maximum use was made of recent and ongoing studies of transportation in the Great Lakes. In particular, An Analysis of Brokerage Feasibility for Unit Coal Train Shipments to the Midwest, prepared by the Argonne National Laboratory for the U.S. Department of Energy (January 1980), and Improving Productivity for Bulk Commodity Transfer Facilities in the Great Lakes Trade Area, U. S. Maritime Administration, (April 1979), were reviewed carefully, and pertinent base data and information in those studies were used in this study.

Existing and Historical Waterborne
Commerce Through the Port of Green Bay

Table 5.1 summarizes annual waterborne traffic volumes, by cargo type, through the Port of Green Bay for the years 1970 through 1979. Throughout the period, inbound coal was by far the highest volume cargo moving through the Port, varying from almost 1.5 million tons (61 percent of total cargo) in 1978 to 1.9 million tons (67 percent of total cargo) in 1979. Coal, along with cement, petroleum products and limestone accounted for more than 88 percent of total cargo movements in 1979.

THE TRAFFIC FORECAST

The Forecast Methodology

The waterborne commerce forecasts were developed in four distinct but related steps:

(1) Existing users of the bulk cargo transfer facilities in the Port of Green Bay were identified and a preliminary identification of potential users of the proposed Bay Port facilities was carried out.

(2) An order-of-magnitude demand for coal and other bulk commodities for these users was projected through the year 2010. Projections of future demand were based on evaluations of industrial outlooks and their relationships to past levels of commerce, projections of demand prepared by governmental agencies, and the judgment of the consultant after discussions with industrial and utility representatives.

(3) Analyses of alternative transportation modes and routes were made and cases where a Bay Port

facility might offer a cost advantage for the above users were defined and the resultant traffic was estimated. Steps 1, 2, and 3 served to define a baseline forecast.

(4) Additional factors which could alter the baseline forecast were explored.

In the sections that follow, waterborne commerce forecasts are presented initially for coal, and then for bulk-aggregates and agri-commodities. The coal forecast was prepared for two cases: (1) with a major coal transfer and blending station at the Bay Port facility, and (2) without a major coal transfer and blending station at the Bay Port facility.

Coal

Existing and Potential Users

The coal that presently moves through the Port of Green Bay is used by either paper plants located in the Fox River Valley or by the Wisconsin Public Service Corporation. Discussions with industry and utility representatives indicate that of the approximately 1.9 million tons moving through the port of Green Bay in 1979, approximately 0.95 million was used by the Wisconsin Public Service and the remainder, 0.95 million tons, by the paper plants. Of the 0.95 million tons consumed by the paper plants, about 350,000 tons annually is used by the Fort Howard Paper Company, which is located within the Port of Green Bay, and about 600,000 tons is transshipped by two coal companies within the Port by truck to plants located throughout the Fox River Valley.

The coal that is delivered to the Wisconsin Public Service Corporation is used to operate the coal-fired Pulliam plant in Green Bay. Most of the coal arrives via Lake Erie, with about 60 percent originating in Kentucky, Pennsylvania and western Virginia; less than ten percent of the Pulliam plant's coal is from Montana, while the remainder originates in Indiana, Illinois and Ohio.

The paper plants use the coal for their process heat requirements and, in some cases, to generate their own electrical power. The coal arrives via the ports of Conneaut or Toledo, Ohio in Lake Erie and originates in mines located in West Virginia, Pennsylvania and Ohio.

An evaluation of the role of a coal transshipment facility in north-eastern Wisconsin was prepared by the Argonne National Laboratory of the U.S. Department of Energy.* The preliminary economic investigation presented therein revealed that potential users of a facility in Green Bay would include industries and utilities in the Green Bay region (i.e., within an approximate 50-mile radius of Green Bay) and utilities in the lower peninsula of Michigan, along the shore of Lake Michigan.

Eastern vs. Western Coal Usage for Utilities and Industries: Some General Considerations

According to the United States Department of the Interior, the total demonstrated coal reserves in the western United States total about 234 million tons or slightly more than 50 percent of the total U. S. reserves.** The western coal is located principally in the states of North Dakota, Montana, Wyoming, Colorado, Utah, New Mexico and Arizona.

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* An Analysis of Brokerage Feasibility for Unit Train Shipments to the Midwest. Prepared by Rita E. Knorr and Kurt Wilkie. The 59th Annual Meeting of Transportation Research Board. Washington, D.C.; January 12 - 15 1980.

** National Energy Transportation, Volume III. Prepared by the Congressional Research Service. March 1978.

In recent years, as the price of petroleum has risen, the role and potential of coal in supplying the nation's energy requirements has increased. Western coal in particular is becoming more attractive inasmuch as: (1) the majority of western coal can be mined by open-pit methods using bulldozers and scrapers, (2) the sulphur content is lower, by weight, than that of the coal reserves east of the Mississippi River, and (3) the western coal is relatively thick-veined, with most coal beds averaging 30 to 40 feet as a opposed to an average of five to six feet in the eastern beds.** Because of the above, western surface mines have lower overall production costs.

With the exception of reserves of low-volatile metallurgical coal in southern West Virginia, the average sulphur content, by weight, of western coal is lower than that of eastern coal. The advantage of western coal in this respect is diminished, however, when the sulphur content is expressed in terms of British thermal units (Btu's). In any case, the provisions of the Clean Air Amendments Acts of 1977 and subsequent revisions have significantly lessened the impact of sulphur content upon the choice of coal source. The best-available-control-technology (BACT) criteria requires that all utilities install scrubbers to mitigate the effects of sulphur, leaving primarily Btu and ash content as the critical characteristics of the coal. This legislation has removed one of the potential advantages of western coal.

In the section that follows, the future demand for coal for utility and industrial use is estimated. A critical question in evaluating the relative economics of eastern vs. western coal is the capability of existing plants that are presently using eastern coal to convert to partial or complete use of western coal.

** National Energy Transportation, Volume III. Prepared by the Congressional Research Service. March 1978.

The experience of Detroit Edison, which has received western coal via the Superior Midwest Energy Terminal since 1976, indicates that unless a plant is specifically designed for western coal, a maximum of only 20 percent western coal may be blended with eastern or mid-western coals if serious operational problems are to be avoided.* The boiler modifications that are required to permit exclusive use of western coal are expensive and time consuming; the necessary changes require approximately one year to implement.

Overall Industrial Demand for Coal

As noted earlier, the demand for coal by the paper mills located in the Green Bay region, principally in the Fox River Valley, amounted to about 0.9 million tons during 1979.

Future paper mill consumption was derived from projections of consumption for Green Bay presented in the Green Bay Harbor, Wisconsin, 1962 Modification, Supplemental Design Memorandum prepared by the Chicago District of the U.S. Corps of Engineers (February 1980), the projections prepared in An Analysis of Brokerage Feasibility for Unit Coal Train Shipments to the Midwest, prepared by the Argonne National Laboratory, and through discussions with paper industry representatives and an evaluation of the overall industry outlook as presented in the U. S. Industrial Outlook, prepared by the U.S. Department of Commerce.

Coal consumption will increase due to the following factors: (1) new plant construction; (2) conversion of existing plants from gas and oil to coal; (3) expansion of existing plant capacity, and (4) possible decreases in efficiency in existing plants and equipment.

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* The National Research Council. Critical Issue in Coal Transportation Systems. The Western Coal Project. National Academy of Sciences, Washington, D.C. 1979.

Both the Corps of Engineers' and the Argonne Laboratory Study projected that coal demand for paper mills in the Fox River Valley would increase at an annual average rate of about two percent per year. Discussion with industry representatives tend to confirm this figure and it has been adopted herein as the long-term potential for overall consumption. Table 5.2 summarizes projected coal requirements.

TABLE 5.2

PROJECTED ANNUAL COAL CONSUMPTION
IN GREEN BAY REGION PAPER MILLS
(Thousands of Tons)

Year	Volume
1979	900
1985	1,010
1990	1,120
2000	1,360
2010	1,660

Overall Utility Demand for Coal

The Argonne Laboratory report indicates that existing utilities that might benefit from a major coal transshipment facility in Green Bay are:

(1) The Pulliam plant in Green Bay, Wisconsin, and
(2) The Holland, Muskegon, and West Olive plants in Michigan.

Several coal burning utilities are presently under construction and are considered potential users of a coal transhipment facility, i.e., plants in Grand Haven and Jackson, Michigan. A review of the 1979 Steam Electric Plant Factors, prepared by the National Coal Association revealed that various other utilities are planning to construct plants in Wisconsin. In light of the relatively high volumes of coal that are used by utilities, locations other than those along the waterfront would not be able to take maximum advantage of the unit train to lake vessel transshipment service offered by a Bay Port facility, and are not considered potential users.

Existing and projected demand for coal at those utilities considered candidates for use of a transshipment facility in Green Bay were estimated in the Argonne National Laboratory study of brokerage feasibility for the northeast Wisconsin area, and are summarized in Table 5.3.

TABLE 5.3

UTILITY COAL DEMAND: 1978-2000
(Thousands of Tons)

	Projected Volumes				
Plant Location	1978	1980	1985	1990	2000
Green Bay, Wisonsin	767	767	767	767	767
Holland, Michigan	146	146	146	146	146
Muskegan, Michigan	1,366	3,308	3,308	3,308	3,308
West Olive, Michigan	1,416	1,416	1,416	1,416	1,416
Grand Haven, Michigan (under construction)	0	0	212	212	212
Jackson, Michigan (under construction)	0	0	1,000	1,000	1,000

The Muskegan plant is expected to add additional generating capacity that will double its present coal consumption, as indicated; plant capacity and coal consumption at plants in Green Bay, Wisconsin and Holland and West Olive, Michigan is expected to remain constant through the year 2000.

COST ANALYSIS FOR COAL TRANSPORTATION

The objective of the cost analysis presented in the section that follows is to determine the cases for which a Bay Port facility might offer a cost savings for the utilities and industries that have been identified previously as having potential for using a coal transshipment facility in Bay Port.

First, western coal mining and transportation costs per ton of coal that would be incurred via a Bay Port transshipment facility are presented for the different existing and projected coal consumers. These western coal costs are then compared to eastern/mid-western coal mining and transportation costs, under the existing transportation system, to determine when western coal via Bay Port might offer a cost savings. The comparison was made on a cost per million Btu basis so that western and eastern/mid-western coals might be compared in an equitable fashion. (Note: eastern and mid-western coals generally have a significantly higher Btu content per ton of coal than do western coals.) In comparing western and eastern/mid-western coals, consideration was also given to the impact of boiler conversion costs.

After the coal demand that could be most economically satisfied by western coal via Bay Port was determined as described above, an analysis was made to determine whether Bay Port, as opposed to existing coal facilities in Green Bay, might offer more economical service for the remaining demand that would be satisfied by eastern/mid-western coal.

All costs presented herein are in constant 1980 U.S. dollars. The potential effects of inflation are indicated in the conclusion of the analysis.

Western Coal Costs

As noted earlier, there are several broad categories of users of a proposed coal transshipment facility in Bay Port: (1) existing and proposed utilities in Michigan along the shore of Lake Michigan; (2) existing and expanded paper mills in the Fox River Valley; (3) the Pulliam plant of the Wisconsin Public Service Corporation, which is located in Green Bay adjacent to the Bay Port site; and (4) proposed utilities in north-eastern Wisconsin.

The trip to the utilities in Michigan would involve: a rail leg by unit train from the western mine to Green Bay; transshipment in Green Bay from rail to stockpile to Great Lakes vessel, and on to the utilities which are located along the Lake Michigan shoreline.

For the paper mills in the Green Bay area, or in the case of the plant within the Port of Green Bay itself, after transportation by train to Bay Port, the coal would be delivered locally by truck or rail.

Coal would be delivered directly by unit train from western mines to the Pulliam plant in Green Bay. If other utilities in north-eastern Wisconsin were to use western coal, they could have coal delivered locally from the Bay Port facility by truck or rail; in some cases, it is conceivable that barges could be used to effect the local deliveries to utilities.

In the following sections, the cost components involved in each trip "leg" are estimated.

Freight-on-Board Rail Car

The cost for the coal mining and loading onto unit trains was derived from experience at the Decker mines in Montana; those mines provide the coal that is transshipped to the Detroit Edison utility via the port facility in Superior, Wisconsin. With a minimum volume of four million tons per year, the FOB mine cost would total about $10.00/ton;* it is judged that this figure is representative of the cost that would be incurred for the proposed Bay Port Facility.

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* Estimate based upon discussion with general manager of Superior Midwest Energy Terminal, April 1980.

Rail Cost

The rail rates that would be in effect for unit train shipments of coal from the western mines to Green Bay depend upon the annual tonnage, distance traveled, loading and unloading requirements, rail car ownership and the outcome of recent legislation regarding rail-rate deregulation.

At present, the Burlington Northern Railway provides unit train service for coal movements form the Decker mines in Montana to the Superior Midwest Energy Terminal in Superior, Wisconsin, a distance of approximately 1,030 miles. A rate of about eight mills per ton-mile was originally negotiated between Detroit Edison and the railway and is still in effect, although Burlington Northern attempted to increase the rate to about ten mills per ton-mile during 1979. The rail cars are provided by Detroit Edison and it is estimated that their costs account for an additional 1.5-2.0 mills per ton-mile.

If the Decker mines were used as a source of coal for transshipment via a facility in Green Bay, the coal would likely move via the Burlington Northern Railway from Decker, Montana to Winona, Minnesota, and then via the Green Bay and Western Railway or the Chicago and North Western Railway on to Green Bay, Wisconsin, a total of about 1,300 miles.

Discussions with railway industry representatives have indicated that structural and administrative improvements might be required to allow the Green Bay and Western or the Chicago and North Western Railways to accommodate 100-car unit trains; for purposes of the analysis presented herein, it has been estimated that unit train service between Decker, Montana and Green Bay could be provided at a cost somewhat higher than that along the Decker-Superior route, and is estimated at about 1.3¢ per ton-mile, totaling $16.90 per ton for the journey.

Transshipment Facility Costs

Coal handling costs, including unloading, storage and transfer to lake vessels, depend upon the capacity and competitive position of the transshipment facility under consideration. Interviews with operators of major, high volume coal transshipment facilities throughout North America, including the Superior Midwest Energy Terminal in Superior, Wisconsin, and facilities in Pride, Alabama and Roberts Bank, Vancouver, B.C., revealed that costs in the range of $2.50 - $3.50 per ton are presently experienced; $3.00 per ton has been adopted herein.

Great Lakes Vessel Costs

For coal moving from Green Bay to Michigan utilities located along the shoreline of Lake Michigan, it is estimated that costs will amount to about six mills per ton-mile for an average trip length of about 185 miles, or a total of about $1.10 per ton.* This estimate is considered to include unloading of the Great Lakes vessel at the utility to which it is destined.

Local Rail/Truck Costs

Coal may be moved locally by rail, truck or barge to paper mills or utilities located in the Green Bay area.

Rail tariffs are estimated to range from $1.68 per ton for a local switch by the Green Bay and Western line to $2.84 for a 30-mile movement. The local truck tariff is estimated at about $1.00 per ton for a two to three mile haul and 5¢ per ton-mile for a truck haul in the 30-mile range.*

* Source: Rita E. Knorr and Kurt Wilkie, "An Analysis of Brokerage Feasibility for Unit Coal Train Shipments to the Midwest", Fifty-Ninth Annual Meeting of the TRB. Washington, D.C. January 1980.

Barge Transportation Costs

Detailed barge costs are presented as part of the lightering analysis included in Chapter 6 and Appendix B of the report. For the purpose of the cost comparisons presented herein, it is estimated that barge transportation costs to local paper mills or utilities would be in the range of $1.50-$2.50 per ton, depending upon the type of barge used. These barge costs are estimated to be higher than the truck costs for a comparable distance inasmuch as barge loading/unloading times represent a relatively high proportion of total barge trip time, and the barges are, therefore, unable to operate in a highly efficient manner.

Table 5.4 presents the individual cost components previously described and summarizes total costs per ton for western coal for the four categories of coal users, i.e., the Michigan utilities, local paper plants, local utilities, and the Pulliam plant. As shown therein, estimated costs vary from a low of $28.40 per ton for the Pulliam plant, to $32.74 for delivery by rail to local paper mills.

Western versus Eastern or Mid-Western Coals

In order to make an equitable comparison of the costs of using western and eastern or mid-western coals, two additional factors must be taken into consideration: (1) eastern or mid-western coals have, on the average, a significantly high Btu content per pound than do western coals--about 12,500 Btu's per pound versus 9,600 Btu's per pound,* and (2) before existent utilities or paper plants that are using eastern or mid-western coals may convert to exclusive use of western coal, extensive boiler modifications are generally required.

In Table 5.5, the previously estimated costs per ton

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* Source: Rita E. Knorr and Kurt Wilkie, Analysis of Brokerage Feasibility for Unit Coal Train Shipments to the Midwest.

TABLE 5.4

ESTIMATED MINING AND TRANSPORTATION COSTS
OF WESTERN COAL FOR POTENTIAL USERS
OF BAY PORT COAL TRANSFER FACILITY
(1980 U.S. Dollars per Ton)

Component	Cost
Freight-on-Rail Car (incl. mining)	10.00
Unit Train	16.90
Bay Port Transshipment	3.00
Local Transport	
- Rail	1.68-2.84
- Truck	1.00-1.50
- Barge	1.50-2.50
Lake Vessel	1.10
Total Costs	
MICHIGAN UTILITIES	31.00
LOCAL PAPER MILLS	
- Rail	31.58-32.74
- Truck	30.90-31.40
- Barge	31.40-32.40
LOCAL UTILITIES	
- Rail	31.58-32.74
- Truck	30.90-31.40
- Barge	31.40-32.40
PULLIAM PLANT (W.P.S.)	28.40*

* Transshipment cost for Pulliam plant is estimated at $1.50.

for western coal were converted to cost per MBtu and compared with cost estimates per MBtu for eastern/mid-western coals mined and transported to the same destinations, with the existing transportation system.

TABLE 5.5

ESTIMATED MINING AND TRANSPORTATION COSTS
OF WESTERN AND EASTERN/MID-WESTERN COALS
FOR POTENTIAL USERS OF BAY PORT FACILITY
(1980 U.S. Dollars per MBtu)

Potential Users	Western Coal*	Eastern/Mid-Western Coal**
MICHIGAN UTILITIES	1.61	0.99-1.70
LOCAL PAPER MILLS	1.61-1.71	1.68-2.10
PULLIAM PLANT	1.48	1.23-1.34
LOCAL UTILITIES	1.61-1.71	1.26-1.37

The estimates in Table 5.5 show that of the potential users of a coal transshipment facility in Green Bay, only the local paper mills in the Fox River Valley might realize a significant savings through the use of western coal. Western coal does not offer a clear cost advantage for Michigan or local utilities, and the costs clearly favor eastern/mid-western coal in the case of the Pulliam Plant in Green Bay.

As noted earlier, those utilities or paper plants that are presently using eastern or mid-western coals would have to convert their boilers if they intend to use primarily western coal. The experience of Detroit Edison, for example, is that "the modification requires that the boiler be shut down for a year to make the adjustments and to add soot blowers.*** The actual time and costs that will be incurred in making the necessary adjustments depend upon the particular boiler involved,

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* With a Bay Port transfer facility in operation.

** Estimates based on rates presently paid with the existing transportation system. Source: Analysis of Brokerage Feasibility for Unit Coal Train Shipments to the Midwest, and discussions with Green Bay industry and utility representatives.

*** Henry Tauber, "The Western Coal Project," p. 254.

but it is clear that a significant investment is required. The boiler adjustment costs have not been included in the estimates shown in Table 5.5, but their inclusion would contribute to the economic advantage enjoyed by the eastern and mid-western coals for the existing Michigan utilities and the Pulliam plant in Green Bay.

Since western coal would offer a savings for local paper mills, it is likely that some of the existing paper plants would convert to western coal usage, and that some of the new or expanded plants would use western coal. For purposes of the forecast presented herein, it is estimated that one-half of the overall industrial demand (as estimated earlier in Table 5.2) will be satisfied by western coal. This estimate is considered to include the possibility of using a blend of western and eastern/mid-western coals for some plants. This projected demand (Table 5.6) comprises the entire western coal potential that is foreseen for the proposed Bay Port facility, i.e., the western coal baseline forecast. As described earlier, the basline forecast assumes that commodity flows will not be constrained by inadequate cargo handling capacity or by physical conditions at Green Bay (other than those conditions such as lock dimensions which limit the dimensions of great Lakes vessels in general).

TABLE 5.6

PROJECTED WESTERN COAL POTENTIAL
FOR BAY PORT FACILITY
(Thousands of Tons)

Year	Tonnage
1985	500
1990	560
2000	680
2010	830

The remainder of the overall industrial coal demand will be satisfied by eastern or mid-western coal. For the paper mills in the Fox River Valley (other than the Fort Howard Paper Co. which is located within the Port of Green Bay), the movement of eastern/mid-western coal through a Bay Port facility would be at least as efficient as their present transferral through the two coal terminals within the Port; there is no inherent advantage at the existing terminals.

The majority of the coal that is used by the Fort Howard Paper Co. is deposited adjacent to their paper mill via self-unloading vessels; the remainder is off-loaded at a dock just north of the Don Tilleman Bridge and transported by truck to the paper mill. Inasmuch as most of the coal is handled only once under the existing system, it appears unlikely that a cost savings for this coal could be realized via the Bay Port facility, and it has been projected herein that Fort Howard Co. would not use the Bay Port facility for eastern/mid-western coal. (A cost comparison between the existing system and the proposed Bay Port facility are presented in section of this study, i.e., the lighterage analysis.)

Table 5.7 summarizes the eastern/mid-western coal potential that is projected for the proposed Bay Port facility.

TABLE 5.7

PROJECTED EASTERN/MID-WESTERN COAL POTENTIAL
FOR BAY PORT FACILITY
(Thousands of Tons)

Year	Tonnage
1985	160
1990	210
2000	330
2010	480

The potential identified in Table 5.7 assumes that the Pulliam plant in Green Bay will continue to receive its coal as it presently does.

Aggregates

During 1979, the principal aggregates that moved through the Port of Green Bay were: cement (312,669 tons), limestone (166,969 tons), and salt (115,915 tons); in addition, 13,223 tons of limestone sand, 12,198 tons of calcium stone, and 21,669 tons of calcium sand were handled (Table 5.1).* In the sections that follow, an evaluation of the potential of these commodities for movement through Bay Port is presented.

Limestone

Approximately two-thirds of the limestone that presently moves through the Port is used by the paper mills in the Fox River Valley. The limestone is received by the Western Lime and Cement Company at their dock along the river and is treated at their plant which is located adjacent to the dock; the hydrated lime is subsequently sent to the paper mills.

Approximately one-third of the limestone that presently uses the Port is used to produce animal feed or fertilizer. This limestone is received by F. Hurlbut Co. at their dock along the river; the limestone is dried, pulverized and screened, and then shipped to local consumers by truck.

Since, in both cases, the limestone is processed at dockside before shipment to consumers, it would not be economical for the limestone movement to divert to the proposed Bay Port facility unless the plants were moved or larger ships could be used to serve Bay Port than those that serve the plants directly. Otherwise, the additional costs of transshipment from Bay Port to the plants would not be justified.

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* Source: Port of Green Bay.

For purposes of the forecast presented herein, it is projected that there would not be any limestone movements through the Bay Port facility.

Salt

Most of the salt presently moving through the Port of Green Bay is used for ice-control by the Wisconsin State Highway Department and is received by F. Hurlbut Co., although about 25,000 tons are used by the Fort Howard Paper Co. Unless environmental constraints restrict the use of salt for ice-control purposes, it is judged that future volumes moving through the Port will remain constant throughout the study period, and that the salt would potentially divert to a Bay Port facility where it would be stockpiled for subsequent distribution directly to users.

Cement

Cement movements through the Port are handled by the Huron Cement Co. Bulk cement is transferred from self-unloading vessels at their dock and then moved, primarily by truck, to destinations throughout Wisconsin. It is expected that cement movements will grow at a moderate rate of about two percent per year throughout the study period.

The cement is a potential candidate for diversion if suitable storage facilities were provided at the Bay Port site.

Agri-Commodities

The agricultural produce that presently moves through the Port of Green Bay is related to the Agricultural Trade Development Act of 1954, Public Law 480 (P.L. 480). Under Title 1, the law provides for the sales of U.S. agricultural commodities to eligible foreign countries and foreign private trade entities, and for financing the purchase and exportation of such products through loans granted by the U.S. Government. Under Title 2, provision is made for the donation of USAID foods to foreign governments, voluntary relief agencies, or intergovernmental organizations.

The P.L. 480 movements through the Port of Green Bay are shipped in bags, however, and would not be suitable for diversion to a Bay Port bulk handling facility.

Bulk grain from Wisconsin moves through the ports of Milwaukee and Duluth-Superior. In light of the frequency of shipping service and the tributary areas of these ports, they are able to provide more economical service for the movement of agricultural products; these cargoes would not be expected to divert to a facility in Bay Port.

Miscellaneous Bulk Cargoes

In addition to the coal, aggregate and agri-commodities that have been previously analyzed, there are cargoes related to the proposed industrial development in Bay Port that may have potential for movement through the proposed terminal facilities.

The types of industries that are attracted to sites adjacent to navigable waterways generally are those that are likely to utilize barge, lake or ocean vessel transportation for their receipts and/or shipments, or require large volumes of cooling or processing water. The leading types of installations that have located or expanded near navigable waterways throughout the United States in recent years have been those associated with chemical processing and petroleum refining, metal production, and paper and wood production.

In order to assess the waterborne commerce that might be generated by the proposed industrial park, an analysis would have to be made of the supply of and demand for industrial space in the Green Bay area, potential environmental constraints to industrial development and of the industrial recruitment policy that will be pursued in Bay Port, e.g., to what extent will industrial recruitment be restricted to industries that require waterborne transportation?

Based on the waterborne commerce generated by similar types of industrial development elsewhere, it is estimated that on the order of 100,000 tons of bulk aggregates per year will be generated by the industrial district by the year 2010.

The Baseline Forecast Summary

Table 5.8 summarizes the bulk commodities that have been previously identified as having potential for movement through the proposed terminal facility in Bay Port.

TABLE 5.8

ESTIMATED POTENTIAL ANNUAL CARGO MOVEMENTS THROUGH A BAY PORT PORT FACILITY (Thousands of Tons)

Cargo Type	1985	1990	2000	2010
Western Coal	500	560	680	830
Eastern Coal	160	210	330	480
Cement	345	380	465	515
Salt	100	100	100	100
Misc. Bulk Aggregates	60	70	80	100

Additional Factors that Affect the Forecast

The baseline forecast presented in the previous section assumes that commodity flows will not be constrained by inadequate cargo handling capacity or by physical conditions at Green Bay (beyond those conditions such as lock dimensions which limit the size of Great Lakes vessels in general).

For the movement of western coal to utilities in Lake Michigan, it was assumed that the approach channel to

Bay Port would be dredged to 27 feet and that the larger lake vessels capable of taking maximum advantage of this depth will be available. Under this assumption it was found that it is more economical for these utilities to continue using eastern/mid-western coal than to receive western coal through Green Bay.

In addition, it was assumed that there would not be any environmental constraints associated with provision of the required terminal facilities.

The U. S. Army Corps of Engineers has recently completed a study of the potential of winter navigation in the Great Lakes.* The report analyzed the feasibility of extending the navigation season in terms of economic, engineering, environmental and social considerations. The recommendations presented therein will be acted upon by the legislative branch of the Federal government pending further evaluation of possible negative environmental impacts.

Of the 30 harbors throughout the Great Lakes system that were evaluated in that study for extended navigation, Green Bay, with the benefit/cost ratio of 1.3 (at an interest rate of 7-1/8 percent), was ranked 24th. Although the funds that will be available for these projects are not known at this time, Green Bay harbor is not one of the higher priority projects. If, for example, the Duluth-Superior harbor extension were implemented (with a B/C ratio of 3.7), the Superior Midwest Energy Terminal which is located there would enjoy an advantage over sites where winter navigation is not possible. The Superior facility has an estimated annual coal handling capacity of about 11 million tons and is presently moving only about four million tons.** The facility operators are interested in "third party use", and could offer strong

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* U.S. Army Corps of Engineers, Detroit District. Final Survey Study for Great Lakes and St. Lawrence Seaway Navigation Season Extension. August 1979.

** Based on conversation with John A. Ethen, General Manager of the Superior Midwest Energy Terminal.

competition for other coal transshipment facilities in the Great Lakes.*

In sum, at the present time there are no identifiable factors or trends that might alter the conclusions of the forecast presented herein.

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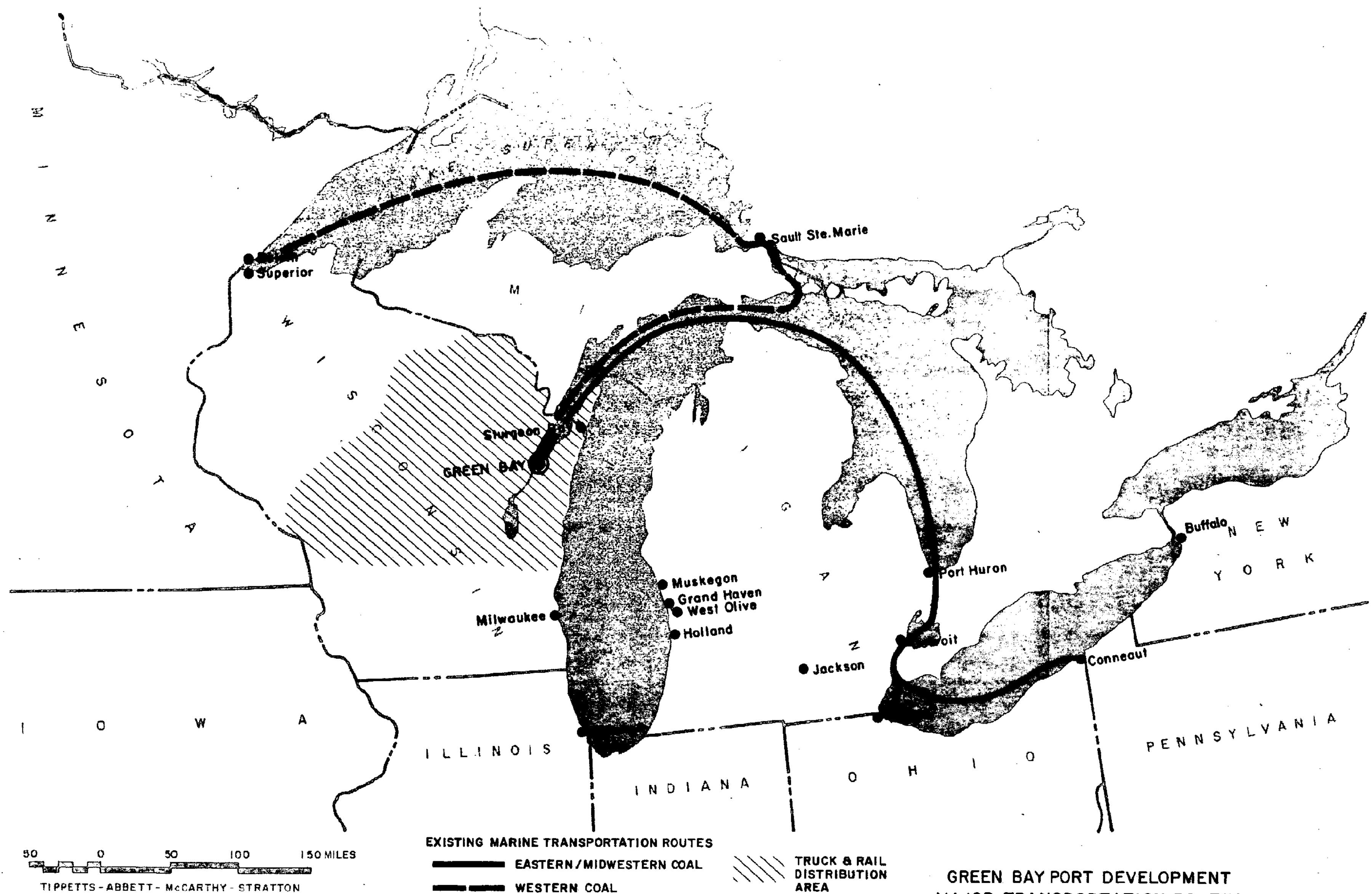
* "Thrid-party use" implies clients other than Detroit Edison.



GREEN BAY PORT DEVELOPMENT
MAJOR TRANSPORTATION ROUTES

FIG. 5.1

CHAPTER 6

TRANSSHIPMENT MODES

The waterborne commerce forecasts show that Bay Port will initially function primarily as a bulk commodity distribution center.

Possible alternative bulk transfer modes from storage areas to consumers are:

- Barge transshipment
- Distribution by truck or rail.

BARGE TRANSSHIPMENT

The port will have insufficient cargo throughput to justify deepening the main approach channel to allow the passage of vessels larger than those at present calling at the Fox River terminals. The unit cost of transshipment by barge from Bay Port to the existing industrial areas must then be offset against the vessel delay time in negotiating bridges and the economic consequences of traffic congestion and occasional bridge damage.

The average reduction in turnaround time of a 12,000 ton vessel using Bay Port will be in the order of 12 hours, representing a saving of approximately $6,000, equivalent to $0.50 per ton.

The cost of barge transportation is shown in Appendix B to vary between $3.26/ton and $5.29/ton dependent on barge size and total tonnage handled, exclusive of the cost of providing and maintaining unloading equipment.

The current cost of shipping coal from Conneaut or Toledo to Green Bay averages $3,87/ton and hence it is clear that transshipment from Bay Port to Fox River terminals by barge cannot be justified under the present circumstances.

TRANSPORTATION BY TRUCK OR RAIL

Bulk commodities handled through the existing Fox River terminals are currently distributed by truck or rail to destinations generally within the Wisconsin area. Transfer patterns through the Bay Port bulk transshipment facility will, therefore, remain unchanged and the major distribution mode from stockpile to customer will continue to be by truck or rail.

LIGHTERAGE

The present limitations of the Fox River do not allow local port-orientated industries to take advantage of cost savings generated by large bulk carriers .

The provision of a lighterage service from deep water to the existing river terminals has been suggested as a possible means of obtaining these benefits.

The use of barges as lighters normally arises from a situation whereby a vessel is unable to enter a port due to limited draft or insufficient port facilities. The ship will anchor in deep water and transfer cargo to barges of approximately 600-1,000 ton capacity. Tugs then transport a string of barges to the shoreside facilities.

In the case of Green Bay, lighterage from a large vessel would, therefore, be carried out from a vessel anchored beyond the limits of the existing approach channel, approximately 12-15 miles from the Fox River entrance.

In order to show any savings in unit freight rate, the vessel would require an unloading time comparable to that of other ports of call. A turnaround time of 10-15 hours is considered acceptable indicating that an average unloading rate of up to 5,000 tph could be required for a 50,000 dwt vessel. Since the barge round trip would exceed 10 hours it would be necessary to provide a lighterage capacity at least equal to the vessel capacity, say a fleet 5 barges, each capable of carrying 10,000 tons.

Studies have been carried out of the relative economies of large vessels and a guideline unit freight rate reduction of 25 percent has been postulated for an increase of 100 percent in vessel capacity (see Appendix A).

Based on the current cost of coal transportation to Green Bay, this would indicate a probable maximum saving of $1.00 per ton. The capital recovery cost of a fleet of five, 10,000 ton barges would be equivalent to a unit cost of $1.20 per ton based on the most optimistic traffic forecasts, operational costs would further increase the figure by at least 100 percent.

It is evident that no savings would be realized by the use of a lighterage service to vessels unable to enter the existing approach channel to Green Bay.

CHAPTER 7
BAY PORT MASTER PLANNING

FIRST PHASE DEVELOPMENT

The development of waterfront facilities and the Bay Port site represents a further step in the establishment of a revitalization policy for the marine service and port-orientated industries in the Green Bay area.

The reservation of the Bay Port area for the development of waterfront facilities and port-orientated industries provides the opportunity to relieve the navigational problems on the Fox River and offers the potential for increasing demand for industry in the area.

The site selected for development is a wetlands area known as Atkinsons Marsh, a large proportion of which has now been filled by dredged materials from harbor maintenance works and flyash from the nearby W.P.S. power plant.

COMMODITY FORECASTS

Early development is expected to involve the transfer of existing Fox River terminals to the new site where a higher level of service can be offered unhindered by the present physical and navigational constraints of the river channel and bridge systems.

Table 7.1 summarizes the potential annual cargo movements through a new facility at Bay Port as developed in Chapter 5 of this report.

TABLE 7.1

TOTAL POTENTIAL CARGO MOVEMENTS
THROUGH BAY PORT
(tons x 1,000)

	Coal	Salt	Cement	Misc. Bulk Cargoes	Total (tons x 1,000)
1985	660	100	345	60	1,165
1990	770	100	380	65	1,315
2000	1,010	100	465	80	1,655
2010	1,310	100	515	100	2,025

FUNCTIONAL REQUIREMENTS

The development plan for Bay Port is formulated on the basis of three basic principles.

- Provision of facilities that will provide an adequate level of service to accommodate the identified commerce potential.
- The development will permit future expansion to keep pace with Great Lakes shipping technology and attract industrial development to Green Bay.
- The industrial waterfront area should benefit the community and result in the lowest practicable environmental conflict.

Vessel Size and Type

The first stage development is planned to accommodate those vessels now employed on routes to Green Bay, but will also have the capacity for expansion to accommodate future larger sized lake vessels.

The authorized dredged depth of the approach channel is 24 feet, from which 2 ft. must be subtracted to allow for underkeel clearance, squat, accumulation of sediment between maintenance dredging periods, etc. Lake vessels vary both seasonally and also over a period of years, however, 22 ft. represents a mean acceptable vessel draft for planning purposes.

The minimum width of channel is 300 ft. It is usual to apply a ratio of vessel beam to total channel width of 4.0-7.5 to allow two vessels to pass; the wide variation being due to channel orientation, vessel size, sea conditions, etc. Based on the present traffic forecast, two-way traffic of vessels of equal size in the approach channel simultaneously would rarely occur and the lower value is considered to be acceptable; vessels with 75 foot beam could be accommodated, therefore, even under those conditions.

A sample plot of the relationship between the draft, length and tonnage of bulk carriers at present operating in the Great Lakes was shown previously in Figures 3.1 and 3.2.

It is seen that 22 ft. draft bulk carrier will have a capacity of 10,000-15,000 tons, and a length of 600-650 ft. From Figure 7.1 it is seen that vessels of the above capacity represent more than 30 percent of the total bulk carrier tonnage at present in service on the Great Lakes excluding ocean-going ships visiting Lake ports.

The first stage development of Bay Port should be planned to accommodate a 15,000 dwt vessel having a length of 650 ft., and draft of 22 ft.

The traffic forecasts summarized in Table 7.1 indicate a total cargo movement of 1.16 million tons in 1985 rising to 2.02 million tons in 2010.

The average number of vessel calls will then be as shown in Table 7.2 below.

TABLE 7.2

VESSEL CALLS TO BAY PORT

Year	Calls/Year	Calls/Month	Occupancy of Single Berth (%) 1/
1985	95	12	48
1990	110	14	56
2000	140	18	72
2010	170	21	84

1/ Assumes a 12-hour turnaround time for bulk carriers.

Materials Handling

Coal

Management of the coal distribution terminal could be by one or a number of operators. At this level of study it is necessary to make certain assumptions in order to calculate stockpile areas, handling systems, etc. The basic criteria for planning the bulk handling facility are as follows:

Management:	-Single operator
Distribution Pattern:	-Multiple needs - blending required
Secondary transportation:	-Truck -Rail -Possible future barge transportation
Annual tonnage:	-660,000 tons rising to 1,310,000 tons
Operating year - vessels:	-8 months
Operating year - land distribution:	-12 months
Vessel size:	-15,000 tons self-unloader - present -50,000 tons - possible future
Coal density:	-37 cu ft/ton - 42 cu ft/ton in vessel hold or stockpile.

The first phase development of the coal distribution facility will include the following major elements:

- Primary conveyor system from dockside to stockpile
- Ground storage
- Stacker
- Secondary distribution system to rail or truck
- Blending facilities
- Administration center.

Primary Conveyor System

The system would handle self-unloading bulk vessels and hence no unloading tower will be required. A fixed hopper would be provided at the dockside with a primary covered conveyor to the main storage area.

A 15,000 dwt vessel would be expected to discharge its cargo in 10 hours and hence require a materials handling system capable of moving 1,500-2,000 tons per hour.

Ground Storage

Ground storage areas are classified as "live" or "dead" according to their location relative to fixed or rail-mounted bulk handling equipment. Live storage areas are those within reach of a stacker or reclaimer and coal in the dead storage areas is generally moved by mobile equipment to or from the live storage area.

Coal will be moved into the storage area for 8 months each year but distribution will take place over a 12-month period. It is considered that acombined live and dead storage capacity of 500,000 tons represents the maximum requirements within the study forecast period.

Coal Blending

A multiple customer outlet implies that a large proportion of the outgoing coal will be blended before distribution and hence facilities should be provided for stockpile areas of blended coals.

Distribution

Distribution initially will be by truck or rail. Unit train facilities will not be required at the first stage of development but long-term planning should include the provision of a unit train loop, thaw sheds, etc.

Bulk Cement Handling

Movement of bulk cement will reach 345,000 tons p.a. by 1985 increasing to 515,000 tons in 2010. The cost of providing silos is high and storage to cover the port closed season cannot be justified. Capacity would be related to the size of vessel shipments and vary between a factor of 0.75-2.00 dependent on the secondary distribution method operated.

The current storage capacity of the Huron Plant is 15,336 tons, roughly equivalent to 1.5 times a single vessel shipment.

Unloading would be through sealed pipelines so dust levels are generally low. However, low velocity exhaust vents are required to relieve excess air pressure in silos and hence, the operation is environmentally sensitive and requires close control.

Distribution is primarily by bulk trucks or special rail cars and a facility for bagging may also be required.

Salt

Salt is at present delivered to the Hurlbut, Reiss or Leicht docks by self-unloading vessels to open stockpile areas. Tarpaulins or plastic sheet covers are used for protection from the elements and distribution is by truck to Wisconsin highway authorities.

Since the port is closed during the winter months when salt is required, a storage capacity approaching the total winter demand will be required.

However, both the use and storage of salt raises environmental concerns in several areas. It is unlikely that the current practice of open storage will be permitted due to contamination of ground water from runoff (the use of salt for highway de-icing may also be restricted in the future).

Miscellaneous Bulk Commodities

Storage areas will be required for miscellaneous products. Materials compatible with the movement of bulk coal may be handled through the main bulk handling berth and conveyor system.

Summary of Bay Port Functional Requirements

Vessels

First stage	- 15,000 dwt, self-unloading bulk carrier - draft: 22 ft. - length: 650 ft. - beam: 75 ft.
Future development	- 50,000 dwt, self-unloading bulk carrier - draft: 27 ft. - length: 1,000 ft. - beam: 105 ft.

Vessel Calls

At first stage development level:

1985 - 12 per month
1990 - 14 " "
2000 - 18 " "
2010 - 21 " "

Bulk Handling Terminal

Coal

Storage - up to 500,000 tons

Handling - self-unloading vessel to conveyors 1,500-2,000 tph

Distribution - rail or truck.

Cement

Storage - silos

Handling - sealed pneumatic system from self-unloading vessels

Distribution - primarily truck, possibly rail.

Salt

Storage - covered, capacity up to 100,000 tons

Handling - conveyor from self-unloading vessels

Distribution - truck.

Miscellaneous Bulk Commodities

Storage - adjacent to coal storage where compatible

Handling - by coal conveyor where compatible alternatively from dockside by mobile equipment

Distribution - truck and rail.

EXISTING SITE CONDITIONS

The site selected for the development of a waterfront terminal and industrial area comprises a parcel approximately 586 acres in size bordering the south shore of Green Bay.

Geotechnical

The area is generally classified as a wetlands zone, much of which has been filled to a depth of 6-11 ft. with dredge tailings, flyash or a mixture of both materials.

Underlying the fill is a layer of organic material and topsoil varying from 1 ft. to 6 ft. in thickness.

Below the organic materials, layers of silts, clayey silts and silty clays overly slightly softer clay deposits which are encountered at elevations +80 - +90, i.e., at depths of 20 ft. below existing ground level.*

* Subsurface investigation for Project Bay Port, Soil Testing Services of Wisconsin, March 1972.

A transition zone appears to exist at the southwesterly portion of the site where softer clays and some silty sands are encountered.

Ground water elevation is close to the lake level in the bay.

No rock was encountered in the offshore area where 3 borings were taken down to an average elevation +62.00 in silts, clays, clayey silts and some trace gravel deposits.

The average depth of water offshore is stated to be 6 ft. based on a sounding grid of 80 stations measured in February 1972.

Access Highway

The site is well served by highways, principally the new Interstate 43 and Tower Bridge link passing to the south of the proposed development area. An internal distribution road system exists to serve developments to the area at the Fox River mouth.

Rail

At present, rail service is provided in Brown County by the Chicago and Northwestern Railway Company (C&NW), the Green Bay and Western (GB&W) and the Chicago, Milwaukee, St. Paul and Pacific (Milwaukee Road). The Minneapolis, St. Paul and Sault St. Marie (Soo Line) is nearby in Shawano and Appleton and connects to the three in Green Bay.

Bay Port is served primarily by the C&NW Railroad although the GB&W has a line which approaches from the east side and crosses North Broadway with the C&NW where a transfer track is used between the two railroads. The C&NW serves a generally northerly/southerly direction, the GB&W a generally easterly/westerly area. Since Green Bay is a transfer and maintenance complex for all three lines, considerable versatility is afforded rail customers in Brown County.

Utilities

The site is well served by public utilities as below.

Electricity

The site is traversed by the main high voltage transmission lines to the Wisconsin Public Services Pulliam Plant which are not available for local supply. A new local service line is available to augment the northwest area of Green Bay including Bay Port.

Water

10" and 12" water mains run alongside Bylsby Avenue and Hurlbut St. Fire hydrants and laterals are installed.

Sewers

A 54" sanitary sewer traverses the site from west to east, and follows a route to the north of Hurlbut St., crossing the Fox River to the treatment plant south of the Green Bay Yacht Club.

Surface Water Drainage

Surface runoff is now conveyed to the Bay via drainage ditches, or by a storm water sewer to the Fox River.

Telephone

A telephone service is available to the east and western limits of the development site.

INITIAL DEVELOPMENT PLAN

Marine Terminal Facilities

The proposed first phase of development at Bay Port is structured to minimize capital investment and provide a basis for attracting port-oriented industries to the area. The following facilities are considered to comprise the first stage of the project.

- Dredging - Channel
  - Turning basin
  - Berth area
- Wave protection
- Berth for self-unloading bulk vessel
- Berth for tug and harbor launches
- Handling system for coal and miscellaneous bulk commodities
- Highway access and paved areas
- Extension of utility network
- Port Administration center

Space is also allocated for the following facilities regarded as potential first stage developments:

- Cement storage and bagging plant
- Salt storage and distribution area
- Rail spurs and loop track
- Service industries.

Dredging

Bay Port will be served by the existing main approach channel to the Fox River.

Access from the existing channel is maintained at a depth of 24 ft. over a 300 ft. channel width.

A turning basin is required either at the intersection with the main channel or within the port area. The required diameter for a vessel maneuvering under its own power would be 2,600 ft. However, it may be assumed that tug assistance will be made available and a turning basin of 1,400 ft. diameter is provided at the first stage of development.

Based on soundings taken in 1972 it will be necessary to dredge 2.5 million cu. yds. of sediments to provide marine access to the minimum level of port development.

In 1977 the U.S. Environmental Protection Agency classified the sediments in the proposed project area as heavily polluted, and unsuitable for open-lake disposal.

Sediments from the Fox River were primarily brown silt having an earthy odor. The bulk sediment chemistry results showed particularly high concentrations of volatile solids, COD, TKN, oil and grease, lead, zinc, phosphorous, ammonia, arsenic, chromium and copper. The elutriate test using river water showed high releases of ammonia, phosphorous, phenols and manganese. PCB and pesticide contamination levels were stated to be moderate. The sampling data showed the Fox River to be a highly stressed polluted environment with low species numbers and diversity. Pollutant levels will decrease with distance from the river mouth but it must be assumed that no dredged spoil within the study area will be suitable for open water disposal.

Past policy with respect to disposal of dredge spoil has involved the identification of suitable confined disposal sites. 3 million cu. yds. of material has been dumped in the Bay Port area and a new offshore disposal site has recently been set up to the east of the Fox River mouth.

The Bay Port site has also been selected as a designated disposal area for a further 150,000 cu. yds. of material resulting from the project to complete dredging of the turning basin in front of the Ft. Howard plant in the Fox River.

The results of previous studies indicate that there is no local land-based site outside the project area suitable for the disposal of the 2.5 million cu. yds. of spoil that would result from the first phase capital dredging works.

The geotechnical data obtained by the Brown County Regional Planning Commission in 1972 indicates a characteristigh high percentage of fine grained silts and clays in the subsurface deposits. Such soils are not normally suitable for near-term land reclamation purposes, in particular in areas having a high water table, as compaction is inhibited by high pore water pressures, poor drainage and excessive settlement of structures may result.

Disposal sites within the project area are thus restricted to those outside the first stage development sector.

The existing dike area covers approximately 400 acres and has been reclaimed to an average level of +102 ft., i.e., approximately 9 inches above the designated 100 yr. flood level for Green Bay. The addition of 2.5 million cu. yds. of fill to the area would raise the level by a 3.50-4.00 ft. to an average elevation of +106 ft. which is above the level of existing highways surrounding the area. A maximum acceptable final elevation would appear to be 103.5 ft., permitting the deposit of up to 1 million cu. yds. of material.

Wave Protection

The alignment of the existing bulkhead line is such that vessels alongside the unloading facility will be exposed to the northeasterly storm direction and wave protection will be required. Alternatively, a pier could be constructed having southwest-northeast orientation and detailed study might indicate that wave protection could be omitted. A major disadvantage of this latter would arise from the fact that any development with its root on the existing bulkhead line would block future expansion in an east-west direction and does not offer the flexibility of marginal berths.

It is seen in Figure 7.2 that the first phase development includes a breakwater located some 1,200 feet from the face of the initial berth. This allows the expansion of the harbor basin to accommodate larger vessels in the future.

Possible construction methods for the breakwater include:

- Sheet pile wall
- Circular caissons
- "Offshore island" from dredged spoil retained by dike and protected by riprap armor
- Precast concrete units.

Construction of a breakwater structure from suitably confined dredge spoil represents a useful solution to the problem of disposal of dredge materials.

The final form of the structure could be insular or peninsular. At this stage of study a land-linked structure is preferred as it would appear that separation of the current regime of Duck Creek from the Fox River would be environmentally desirable and lead to less sedimentation in the port area.

Any construction outside the established bulkhead line is technically illegal and construction of the breakwater would require that lake rights are ceded from the Wisconsin State Legislature to the developing authority, necessitating a detailed study of the environmental, technical and economic implications of the project.

Main Berth and Tug Berth

A marginal wharf is considered to offer the most flexible form of construction for the first phase development.

Possible construction alternatives to be studied at the later detailed design stage include:

- Open piled structure
- Bulkhead or sheet piled wall
- Cellular caisson units
- Individual dolphin structures.

Any piling should be taken down to a depth sufficient to permit dredging to 27 or 29 feet as dictated by future traffic patterns.

The tug berth is essentially an extension of the main unloading area and is constructed in a similar fashion to the main berth.

A fixed hopper is installed for unloading coal and compatible bulk materials. Unloading of any vessel not having self-unloading equipment could be carried out by mobile clamshell equipment discharging into the main hopper.

Coal Storage Area

Stockpiled coal will have a density varying from 42-37 cu. ft./net ton. The height of stacking will vary according to ground conditions and is unlikely to exceed 40 ft. at Bay Port where the subsoil appears to be of medium compressibility. A total of 45 acres is allocated for the main coal storage area and includes space for vehicle circulation, blending, etc.

Coal - Materials Handling

Coal will be moved from the stationary hopper at the dock by a conveyor capable of handling up to 2,500 tons per hour. It will be necessary for the materials handling system to cross the route of transmission lines traversing the site. From a practical viewpoint the conveyor may be sited below the cables which are approximately 25 ft. above ground level. However, Wisconsin Public Service regulations may well prohibit such crossings and early negotiations should be initiated to assess any difficulties raised by the presence of the power lines.

Coal is handled from the primary conveyor by a radial stacker having a 180° operating arc and mounted on rails. No provision is made for an automatic reclaimer system as the throughput does not appear to justify the capital cost at this stage. Movement from live and dead storage areas to truck and rail distribution is by four methods which may be used in combination or independently.

- Directly from vessel to loading hopper and via main conveyor system.
- By front end loader to mobile conveyor onto main conveyor into loading hopper.
- By front end loader into mobile conveyor for loading into truck or railcar.
- Front-end loader directly into truck or railcar.

Cement - Storage and Handling

An area is reserved for cement storage and a small bagging plant. A group of four silos of 40 ft. diameter and an overall height of 50 ft. would be adequate to store approximately 20,000 tons of bulk cement, equivalent to two normal shipments based on existing vessel sizes.

Loading into the silos would be by a sealed pipe systeam which may be controlled from the vessel or via a mobile compressor/suction unit. On completion of delivery the discharge pipes are uncoupled leaving the berth apron clear for use by other classes of vessel.

Salt

Open storage of salt is unlikely to be environmentally acceptable, mainly due to contamination of ground water resulting from runoff.

Contamination by salt can also cause an otherwise good quality coal to be classified as unacceptable hence the discharge and conveyor systems for the two cannot be combined.

The provision of a mechanized bulk handling and storage system for an annual throughput of 100,000 tons is unlikely to be justified and should be carefully studied before any commitment is made. The master plan layout indicates a suitable area reserved for storage of up to 100,000 tons but no development is recommended at this stage.

Highway and Rail Access

The main highway links to the project area are already in existence and give good access both from US41-141 and the new Interstate Highway I-57. The primary rail spur would be taken from the C&NW line running parallel and to the south of Tower Drive. Access is provided to the berth, storage and administration areas and left "open ended" for future extension.

Utilities

No major problems are envisaged arising from the extension of the existing utility networks which ring the site. All main utilities are available within the close proximity of the proposed bulk handling and waterfront areas.

LONG-TERM DEVELOPMENT

The level of development proposed in the preceding section is regarded as adequate for traffic needs until the mid-1990's. During the early years of operation the Bay Port can be expected to act as a focus for regional industrial development thus creating new areas of demand for waterfront and cargo storage facilities.

Future space and berth requirements can best be ascertained after a pattern of cargo movements has developed. The development plan shown in Figure 7.3 provides the flexibility to handle possible unforeseen future developments.

The following discussion evaluates the capacity of the proposed development to absorb future expansion.

Vessel Size

Development at Bay Port should be planned to permit an expansion program to accommodate the "Super Laker" vessel should the demand arise.

The location and planning of breakwater, channel and bulkheads should be such as to accommodate a vessel of at least 1,000 ft. length and 25.5 ft. maximum draft. A development of multiple marginal berths will permit a flexible berthing arrangement able to accommodate vessels of varied length.

Berths

Assuming that the main approach channel and harbor basin were dredged to permit the passage of larger vessels as above the port has the ultimate capability to accommodate up to six vessels of sizes ranging from 15,000 dwt-50,000 dwt.

It is anticipated that occupancy of the single first stage berth will increase by 2.5 percent per year indicating that a second berth will be required in the mid-1990's when congestion would approach a significant level.

Expansion of Bulk Handling Terminal

Coal

The cost differentials arising from the use of western coal against eastern/mid-western coals were seen in Table 5.5 to be at marginally in favor of the latter at this time. However, long-term projections of national energy and environmental policies are subject to a high degree of speculation and it is possible that the role of Bay Port as a western coal distribution center could be enhanced in the future.

Future expansion of coal open storage area could be to the south or east of the first phase development.

The area required for coal stockpiling and miscellaneous bulk commodities will be in the order of 40 acres per million tons of annual throughput. The area provided in the initial phase of development is sufficient for demands until the mid-1990's when expansion into land due west or south of the existing storage area will be required. It follows, therefore, that the above area of the site should be kept free from industrial development.

General Cargo

The provision of waterfront facilities at Bay Port will attract commerce to the adjacent industrial area and it can be assumed that imports and exports of general cargo will increase proportionately.

The rate of absorption of industrial land will depend to a large extent upon development policies. If use of the area is to be restricted to port-related industires, the acquisition of clients will be slower than if all types of industry were to be encouraged.

On the basis of the performance of other industrial parks which are adjacent to inland water ports Bay Port would be expected to attract new industry to the area at a rate of 30-50 acres per year.

The annual throughput of general cargo generated by the port-related industries will be subject to large variation dependent upon the nature of business of the concern. However, an assembly type facility could be expected to generate up to 1,000 tons of general cargo per year per acre. Assuring that 60 percent of the industrial park was reserved for port-oriented industries, this would indicate an ultimate annual throughput of 150,000 tons of general cargo by the year 2000.

Specialized Cargo Handling Facilities

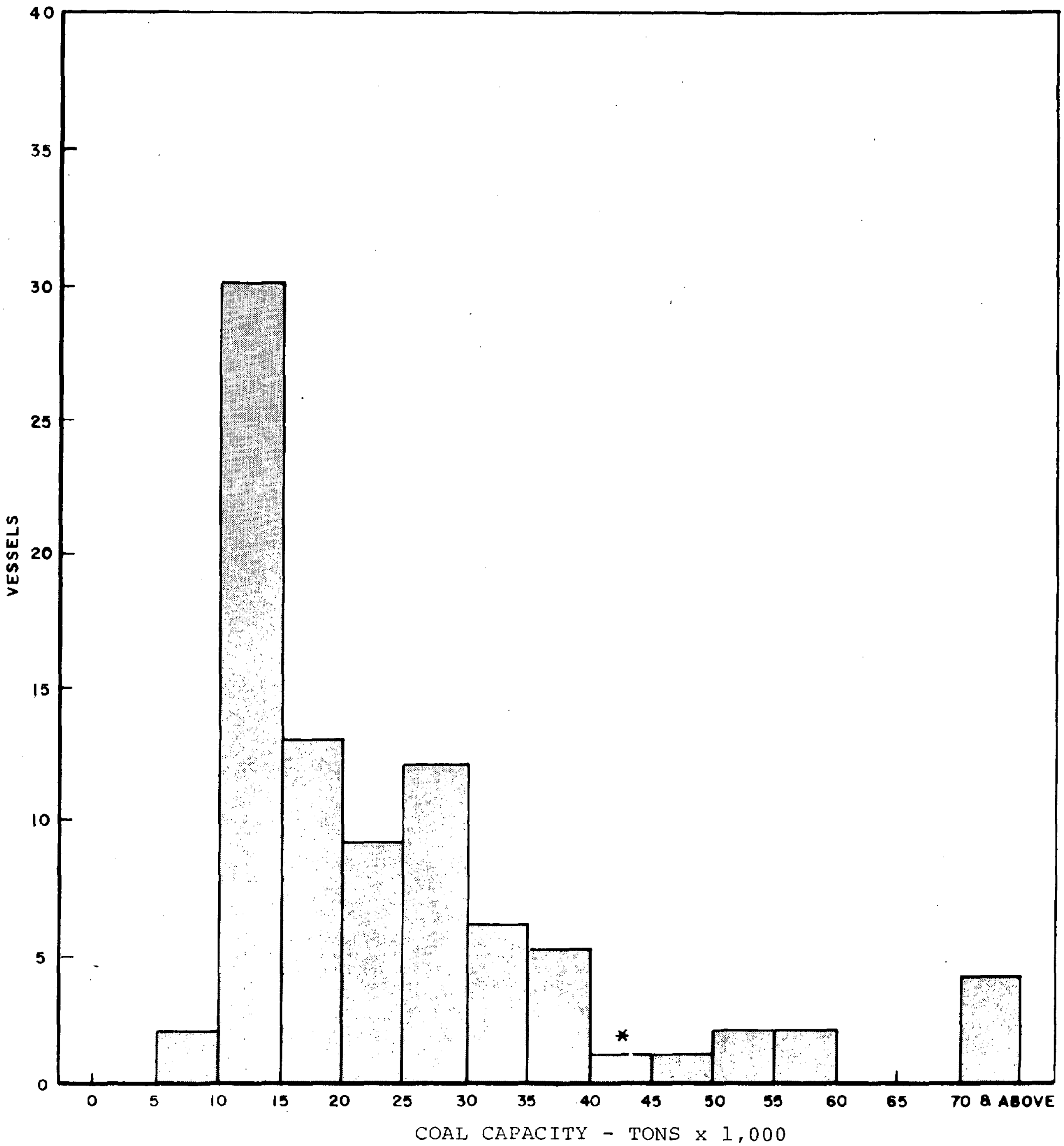
Containers, RO/RO

No requirement for container storage or handling facilities is envisaged until large vessels are able to enter the port. Future movements could include import or export of containerized cargoes from the industrial area in which case the designated open storage area could be utilized. Alternatively the peninsular dredge disposal area could be used for container storage assuming that adequate time were allowed for natural compaction of the fill material.

Any future requirement for a RO/RO berth is likely to be associated with ocean-going vessels or container ships. Should a demand develop, a RO/RO platform could be incorporated in the construction of one of Berths 2, 3 or 4 shown in Figure 7.3

SUMMARY

The future demand for waterfront and port-related facilities at Bay Port will depend very much on a series of exogenous factors, a number of which are not subject to local control. The existence of a modern port facility will be a major factor in the future growth of the region, however, and increased demand for both bulk and general cargo facilities should follow. The layout of the first stage development is such that adequate capacity for rapid expansion is provided both at the waterfront and in the landside. An active promotional effort of Bay Port will serve to further reinforce the position of Green Bay as a regional growth center.

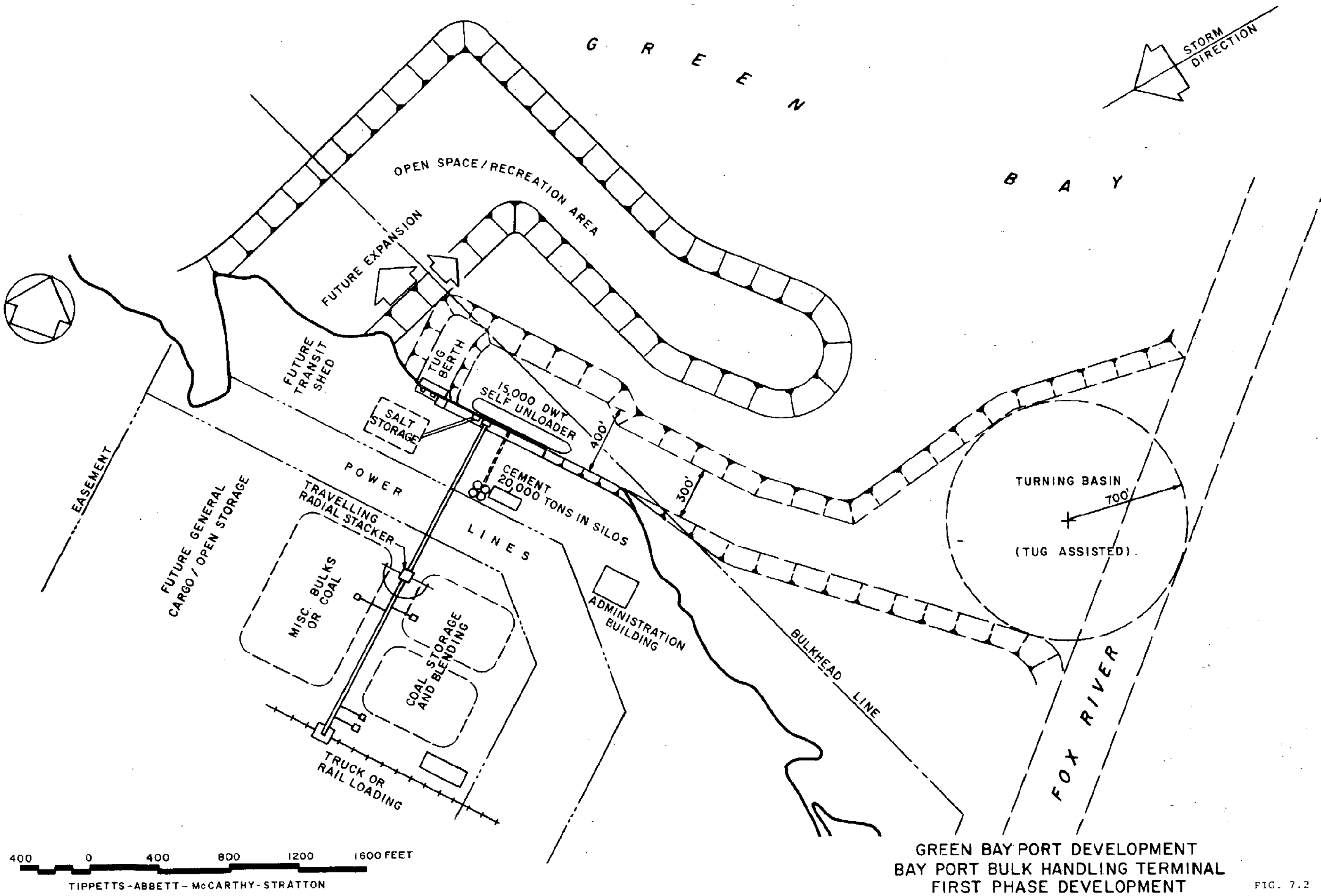


GREAT LAKES BULK CARRIERS

DISTRIBUTION BY VESSEL TONNAGE

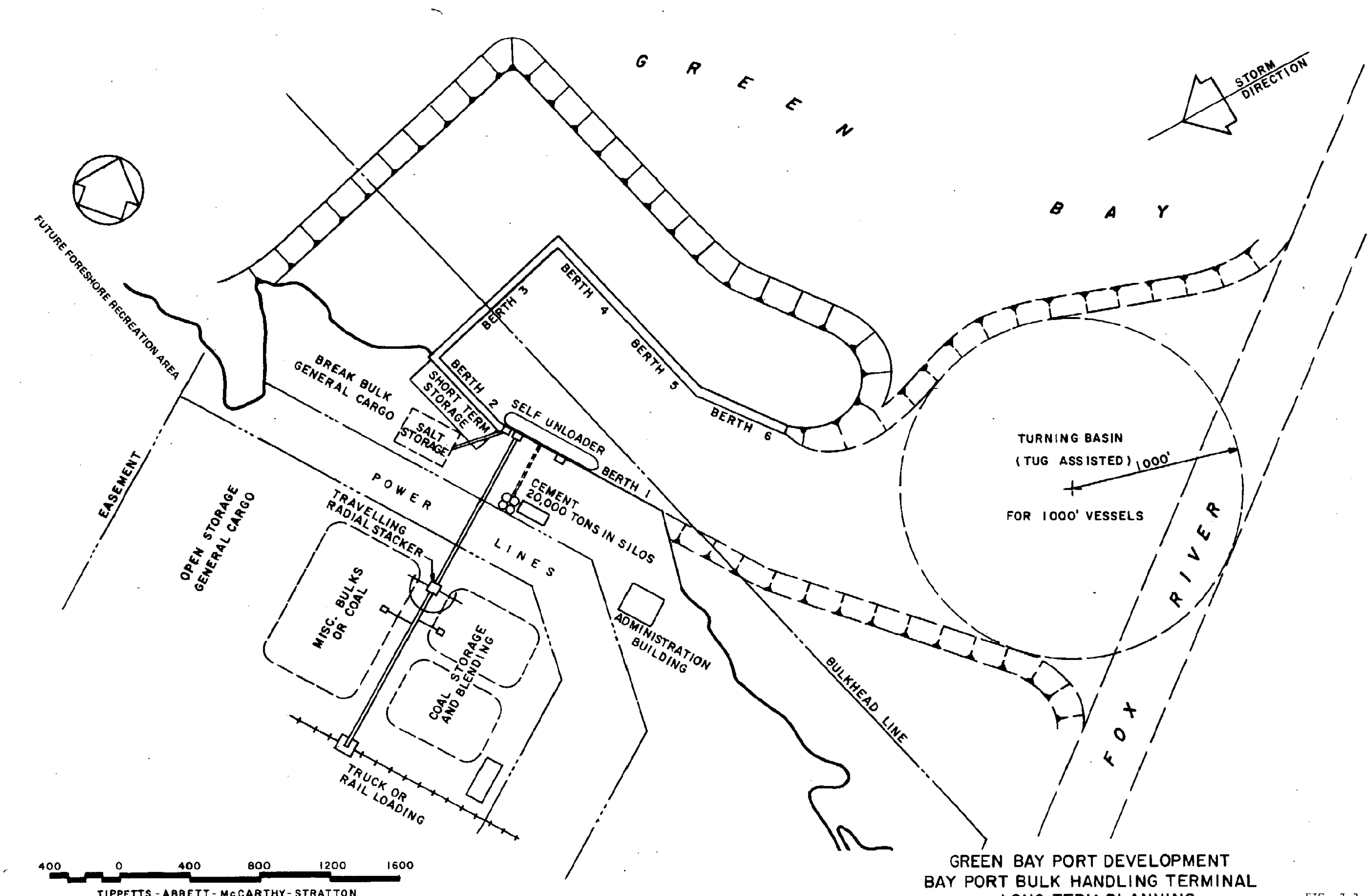
SOURCE: GREENWOODS GUIDE

FIG. 7.1



GREEN BAY PORT DEVELOPMENT
BAY PORT BULK HANDLING TERMINAL
FIRST PHASE DEVELOPMENT

FIG. 7.2



GREEN BAY PORT DEVELOPMENT
BAY PORT BULK HANDLING TERMINAL
LONG TERM PLANNING

FIG. 7.3

CHAPTER 8
ENVIRONMENTAL EFFECTS

A preliminary discussion of the environmental effects of the major elements of the first phase of development is presented hereinafter. The discussion is based on existing available data.

DREDGING

Water Quality and River Regime

Increased turbidity will occur in the lower Green Bay area in the near term, having low to moderate effect on biological conditions. In the longer term the presence of the dredged channel may lead to a modification in the current and sedimentation pattern in the vicinity of the Fox River mouth.

Shipwreck Sites

It is understood that no survey work has been carried out to register any magnetic anomalies that might indicate the presence of possible shipwreck sites. Such survey should be undertaken before dredging is performed to insure that any sites of archeological value will be protected.

Flora and Fauna

Dredging would eliminate the waterfowl habitats which are lately being reestablished on the shoreline in the port area following the recovery of aquatic plant life in shallow water. Loss of wildlife habitats resulting from the dredging operations is not considered significant.

DISPOSAL OF DREDGED SPOIL

The major environmental conflict associated with dredging works arises from problems of disposal of about 2½ million cu. yds. of dredged spoil. All of the dredged material could be placed in the breakwater structure. Alternatively, up to 1 million cu. yds. could be placed in the existing disposal area to the west of the designated industrial site.

The disposal of 1 million cu. yds. of material would cause a permanent loss of the remaining 75 acres of wetland wildlife habitat in the dike area. The degree of impact of the reclamation work generally would follow the same pattern as detailed in the Green Bay Harbor Modification supplemental design memorandum prepared in February 1980 by the U.S. Army Corps of Engineers.

Flora and Fauna

Loss of the remaining wetland environment will result in a change in vegetation succession. The existing flyash deposit areas do not appear to readily support vegetation and covering those areas with dredge spoil would provide a medium for pioneer vegetable invasion of a similar form to the upland plant forms now developing on the drier portions of the site.

Since very little of the original wetland area exists within the designated disposal area, further depositing of dredged spoil is not considered to have a significant impact on vegetative cover. In some parts of the site, increased plant growth will follow as previous flyash deposits are covered.

Filling of the existing wetland has almost completely eliminated the habitats of fish, amphibians and some reptiles therein. However, vegetative invasion will rehabilitate the area to a certain extent as small mammals make their homes in the new dryland habitat and establish their level in the modified food and energy web.

The distribution of bird populations will also change as shorebirds and waterfowl are displaced and other species make their homes in the dryland.

Water Quality

The deposit of dredged material would be within an area protected by dikes and having a sand filter. Based on the results of past monitoring by the U.S. Army Corps of Engineers no deterioration of water quality outside the dike area has been noted. It was concluded that continued discharge of dredged materials within the site will not have any significant adverse impacts on the water column or benthos adjacent to the disposal facility.

Recreational Pursuits

The continued infilling of the wetlands has eliminated duck hunting in the area. At the present time the infilled area supports no recreational activities apart from the dikes which are used as walkways. It may be assumed that development of the area as an industrial site will not take place immediately and a degree of care taken during the filling operation could make the open space suitable for a temporary sports field which could serve local workers employed in the area.

Archeological Sites

No known archeological sites are stated to exist within the disposal area.

Cultural Status

Continued use of the site for dredge spoil disposal will not adversely affect the cultural status of the area.

Conclusion

The major issue of concern relative to the disposal of dredged spoil arose from the original decision to reclaim the wetland area, that work now being virtually completed. The disposal of a further 1 million cu. yds. would essentially fill in low-lying areas and level the site. The resultant environmental impact is marginally negative in terms of the present status of the site. A degree of care taken during filling operations would permit the use of the area for sport or recreational purposes until such time as it is required for industrial use.

The Wisconsin Department of Natural Resources have expressed an interest in retaining approximately 40 acres in the northwest sector of the site. No conflicts are envisaged arising from the modification.

BREAKWATER STRUCTURE

A peninsular type breakwater structure would absorb the dredged spoil from the navigation channel. The disposal area will be completely enclosed by a retaining dike having sand filters at regular intervals and rip-rap armour to the outer faces to prevent erosion. The land area generated has low priority for port or industrial development in the short term and offers possibilities as a refuge for small mammals and birds or a recreational and scenic area.

Flora and Fauna

Construction of the breakwater will destroy some aquatic plant life although it is understood that very few species are established in the shoreline zone.

The major spawning grounds for perch are in the shoreline shallow water area and insufficient data is available at this time to fully assess the impact on the commercial and sport fisheries.

It is concluded that construction of the proposed spoil disposal area will affect local conditions to a limited degree and may be beneficial to bird and small mammal populations once vegetation cover is developed.

Water Quality

With filters and dike of the breakwater structure constructed to Corps of Engineers standards, water quality will not be adversely affected.

Sedimentation Patterns

The peninsula would alter the features of the Bay and almost certainly disrupt the current regime in the lower Bay. At this stage it is considered that diversion of the water flow of Duck Creek would have no significant effect on the marshlands and might even lead to a minimal improvement of water quality as the outflow from the Fox River will be altered by the breakwater. Insufficient data exists at this time to accurately predict sedimentation and flow patterns resulting from the construction.

Land Use

The proposed action will cause loss of open water space. The potential beneficial use of the area as a wildlife habitat and recreational area mitigates the negative environmental impact to a degree and the resultant impact of the altered land form is considered to be low.

Scenic Views

The presence of a flat, man-made peninsula will have a negative visual impact on the lower Bay. Allocation of funds to encourage vegetative encroachment and a program to plant hardy shrubs and small trees would reduce the impact on the aesthetic environment.

Conclusions

Construction of the wave-break structure from dredged spoil represents a means of resolving two engineering problems at one time -- a site for disposal of dredged spoil and a means of constructing a protected harbor. The negative impacts can be mitigated to a certain extent by careful planning.

The impact of the diversion of Duck Creek is regarded as being of primary importance and further study is necessary before a firm conclusion can be made.

WATERFRONT CIVIL ENGINEERING WORKS

Establishment of a new bulkhead line and shoreline protection works will prevent erosion of the bank by wave action and stabilize the shoreline. Negative impacts will result from the loss of aquatic plant life and elimination of habitat of shallow water faunal forms and bottom organisms. At a local level the impacts will be of moderate to severe magnitude. In regional terms the importance of the change is considered to be small.

BULK STORAGE AND HANDLING AREAS

Coal

The initial phase of development provides for the open storage of up to 500,000 tons of coal and miscellaneous bulk commodities. Environmental impacts are considered to be as follows:

Water Quality

A preliminary review of the geohydraulic conditions in the project area indicate that an impervious layer will be required under stockpiles to control leachates. This may be achieved by the installation of a blanket protected against damage by a cushion layer of fine material.

A drainage system would be integrated with the impervious layer and a settlement pond would be required for collection and disposal of leachates.

It is considered that the impact of the coal stockpiles on water quality would be of low magnitude if the above precautions are followed. Storage without leachate control would have a moderate to severe impact on water quality within the project area. Impact outside the retaining dikes would be minimal as the sand filter can be expected to control loss of polluted materials into the lower Bay.

Air Quality

Wind-blown dust can cause a local reduction in air quality under certain conditions. The effective impact may be of moderate magnitude within the industrial area at times of unloading or loading and dust control apparatus should be included in the materials handling equipment. Regional impact of the reduction in air quality is of low magnitude as the new stockpile will replace one or more of the existing storage areas along the Fox River bank, all of which are located in the urban residential and industrial areas.

Visual Impact

Coal stockpiles are often visually unattractive. The location of the stockpile adjacent to the Wisconsin Public Service power plant will give some aesthetic relief. The relocation of the storage areas from the riverside area will have a beneficial effect at a regional level and hence the overall visual impact is not considered to be of importance within the context of the site development strategy.

Cement

It is proposed that bulk cement will be stored in four silos approximately 50 ft. high and 30 ft. diameter. The resultant impacts are considered to include the following:

Water Quality

Small quantities of fine cement power will accumulate in the area of the silos, particularly following loading operations. The discharge process is pneumatic via enclosed pipelines but it is impossible to avoid losses when hoses are coupled and uncoupled. If drainage systems are installed with interceptor chambers. The local impact on water quality will be marginally negative.

Air Quality

Silos and vessels will be equipped with low velocity exhaust vents to relieve excess pressure and a local reduction in air quality is difficult to avoid. The impact of the cement storage area on air quality is considered to be moderate to severe at a local level and minimal at a regional level. Transfer of the facilities from the Fox River is considered to be beneficial to the region.

Visual Impact

The silos will be installed in a group, partially hidden from the land side by the coal storage and handling systems. Visual impact is considered to be minimal from the shore area and moderate from the waterside.

Salt

It is not likely that the current practice of open storage for salt will be permitted at Bay Port. However, in the absence of regulations to the contrary, the impact of both closed and open storage methods are presented.

Water Quality

No reduction of water quality is envisaged if salt is stored in a purpose-built structure. Open storage would have a severe impact and it would be difficult to devise an effective method for collecting dissolved salts resulting from precipitation runoff.

Air Quality

No reduction of air quality is likely from either open or shed storage.

Visual Impact

Construction of the storage shed or stockpile is considered to be compatible with development policies and of low visual impact.

Materials Handling and Distribution

Most actions involved with the handling of bulk materials will have an adverse effect on the existing local natural environment. The primary impacts will affect the aesthetic environment, reduction of open space and a decrease in air quality.

The level of the negative impacts can be reduced by proper planning and the enactment of stringent pollution control systems both at design stage and during operation of the facility.

Bulk commodities will be moved away from the storage areas by truck or rail and minor adverse effects are envisaged. The local highway and rail network has adequate capacity to absorb the traffic and congestion in the urban areas should be slightly reduced.

INFRASTRUCTURE

Drainage

The increased surface water runoff from the paved areas is likely to have a slight negative effect on water quality at a local level.

Sewage and Industrial Waste Products

Sewage from the area will be treated at the new Metro Plant in the east bank of the river. State regulations prohibit discharge of industrial wastes into the Bay and hence no reduction of water quality will result from the development.

SUMMARY

Green Bay historically has had a strong focus on marine transportation, which has served to attract industries and related activities to the area. The Bay Port project, therefore, would be an important feature of Green Bay's continuing efforts to maintain and improve its role as a regional economic center.

The main area of environmental conflict will arise from the disposal of dredge spoil.

State and Federal regulations will require that an exhaustive environmental and technical study be implemented before the necessary permits can be issued.

The overall impact of the waterfront development, bulk handling and storage facilities is compatible with the development of Bay Port as an industrial area and marginal improvements to the regional environment should follow the transfer of certain Fox River terminals to the new site.

CHAPTER 9

FINANCIAL ANALYSIS AND ECONOMIC BENEFITS

FINANCIAL ANALYSIS

The object of this analysis is to present a comparison of anticipated port revenues and annual costs for the first phase development of the bulk cargo terminal.

A common practice at many U.S. ports is to lease handling and storage facilities on a long-term basis, each lessee being responsible for the provision and maintenance of its equipment. The terminal companies then negotiate charges with shipping interests normally subject to approval by the port operating authority. The allocation of annual costs and revenue in the following analysis is based on the assumption that bulk handling facilities at Bay Port will be constructed and operated by one or more private companies on a similar basis.

ANNUAL COSTS

Debt Service

Subject to the necessary construction permits and approvals, the Port Commission will be required to finance only part of the total construction cost of the Port.

Major areas of financial responsibility will be:

Dredging and channel maintenance works	- U.S. Army Corps of Engineers*
Bulk handling equipment and storage requirements	- Private operators
Dredge disposal, berths, site preparation and infrastructure.	- Port Commission

The total capital cost of the first phase development of the project is indicated in Table 9.1 to be $27.8 million

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* Subject to a favorable economic feasibility and environmental impact study.

TABLE 9.1

FIRST PHASE PORT DEVELOPMENT
CAPITAL EXPENDITURE
(1980 dollars)

Item	Description	Cost ($x1,000)
Dredging	2.5 million cu. yards	9,600
Dredge Disposal	30% in diked area; 60% in offshore structure; 10% as site infill	2,500
Duck Creek Diversion	Training works	135
Site Preparation	General leveling	180
Wharf and Apron	800 ft. total length	2,550
Access and Pavings		300
Administration Building	3,000 sq. ft.	145
Utilities	Within the port area	350
Mechanical Handling Equipment	Coal--conveyor, hoppers, stackers, etc.	3,520
	Cement--Pipeline and pumps	710
	Salt--conveyor and hopper	730
Bulk Storage Facilities	Coal (impermeable layer)	175
	Cement--silos	400
	Salt--covered storage	700
Navigation Aids		260
Contingencies and Engineering Costs		5,560
TOTAL COST EXCLUSIVE OF LAND ACQUISITION		$27,815

expressed in 1980 dollars. The Port Commission would be required to finance $7.7 million of the total cost of construction at a local level.

Financial assistance may be available to the Port Commission in the form of state or Federal grants or loans. The Coastal Management Program, Economic Development Association and the Community Development Block Grant Program are all considered to be possible sources of funding. For the purposes of this study it has been assumed that 20 percent of the initial development costs would be covered by a grant and the Port Commission portion of the capital construction cost would be financed over a period of 20 years at an interest rate of 8.5 percent.

An annual cost of $650,000 will, therefore, be required to service the capital expenditure attributable to the Port Commission.

Maintenance

Funds will be required for periodic maintenance costs and other measures to prevent deterioration of those items under Port Commission jurisdiction. It is estimated that an annual allowance of $70,000 would be adequate.

Administration

The Port Commission will require funds to provide for the service of a port executive director, engineering, legal and accounting personnel, secretarial services, promotional and travel expenses. It is considered that administration costs are likely to be in the order of $180,000 per year.

Summary of Annual Costs

The average annual cost to the Port Commission for the construction and maintenance of the first phase of development is estimated to be $900,000. No payments have been included to cover the cost of land acquisition as the site is now under public ownership.

Port Revenues

The revenues generated by the marine terminal will be obtained from charges levied on the private operators by one of three basic forms:

- Annual fixed charge
- Fixed charge plus a fee per ton moved
- Fee per ton moved with a minimum annual charge.

A review of bulk handling charges for ports operating on a similar basis to the proposed Bay Port terminal indicates an equivalent fee range of $0.075-$0.12 per ton for dry bulks and $0.05-$0.10 per ton for liquid bulk cargoes. A charge of $0.10 per ton for dry bulks and $0.075/ton for liquid bulk including cement is regarded as reasonable and would yield a revenue expressed in 1980 dollars of $111,000 in 1985 rising to $206,000 by the year 2010.

Summary

The annual revenue generated by the first phase development of the port terminal is unlikely to exceed $111,000 during the first years of operation against a net annual cost of $900,000.

Public marine terminals are usually marginal enterprises in the sense that their direct earnings are very rarely sufficient to cover capital charges, maintenance, operation and administration expenses. Generally, funds from other sources are necessary to supplement earnings.

ECONOMIC BENEFITS

The economic benefits resulting from the proposed Bay Port bulk handling terminal would accrue almost entirely from the income generated by the development of the adjacent industrial area. No definitive method for evaluating the portion of such income that can be attributed to water transportation and port facilities.

Other benefits would be:

- Savings in shipping costs
- Savings in truck and rail distribution costs
- Indirect savings as a result of reduced vehicle congestion and train delay at bridges.

Savings in Shipping Costs

The total trip time for a vessel calling at Bay Port as compared with the Fox River terminal would be reduced by approximately 8 hours and it may be assumed that this time saving can be used to earn revenue. Current bulk coal freight rates are in the order of $3.80 per ton for a trip averaging four days hence the resultant saving would be in the order of $0.16/ton to $0.33/ton.

Truck and Rail Costs

The travel time for trucks conveying bulk products from Bay Port is likely to be marginally reduced due to the improved access to the major highway links. A saving of approximately $0.05/ton would appear likely for hauls in the 30-mile range. Rail costs are unlikely to be reduced as a result of the new development as freight rates are less sensitive to minor variations in haul length.

Vehicle Congestion from Bridge Openings

The transfer of vessel movements to Bay Port would reduce bridge openings and lead to minor savings in fuel costs to vehicle owners and reduced bridge operation costs. These benefits have not been quantified herein.

Annual Savings

When applied to the 1985 traffic forecasts the resulting direct economic benefit to be attributed to the analysis of dredging works will be $240,000 annually expressed in 1980 dollars.

Direct and Indirect Economic Effects

Very few modern ports are financially viable and considerable study has been devoted to the economic benefit of a port to the local community. Data applicable to Green Bay may be developed from analysis of other ports. Benefits may be stated to be direct or indirect; direct benefits are considered to arise from activities directly connected to the port operation such as steamship agencies, stevedoring, rail and trucking services, etc. Indirect effects arise from the economic activity generated by the existence of the port such as purchases made by port workers and purchases made by port supply or service industries.

A number of recent studies indicate that bulk products may be expected to generate a direct economic activity in the order of $8.00 per ton handled and that a regional economic multiplier of 2.0 may be applied to assess the indirect effects, giving a value of $16.00 to the community for each ton of bulk cargo handled. This would equate to a figure of more than $18 million per year based on the 1985 waterborne traffic forecasts.

SUMMARY

The financial analysis indicates that a large discrepancy exists between the annual expenditure required to operate the port and service the locally attributable debt portion of the capital cost of construction and the revenues that would be generated.

However, it is also clear the concentration of port activity and consequent development of an industrial area at Bay Port is an attractive development from a transportation viewpoint and would give added impetus to the status of Green Bay as a regional industrial growth center.

It is not possible to put a dollar figure on the economic effect of the port in terms of the development of the adjacent industrial park. However, the presence of both good highway and rail links combined with a modern waterfront facility is a powerful incentive to a prospective industrial developer and would thus lead to a more rapid rate of absorption of industrial land than would be the case if port facilities were not provided.

The significant economic impact of a port on the region is evidenced by the foregoing analysis of economic effects and the impact of any loss of future waterborne traffic that could result from the physical inability of the port to handle present and future traffic would be to the detriment of the community.

APPENDIX A
THE ECONOMIES OF LARGE VESSELS

The operation of large vessels on the Great Lakes has many significant effects on the coastal region. The economic aspects of these effects cannot be separated from engineering requirements which in turn are related to environmental and social considerations.

The purpose of this analysis is to provide an estimated order of magnitude of freight rate savings that may be generated as vessel size increases, hence, giving a basis for the analysis of any future proposal to expand port facilities to accommodate larger vessels.

The saving in unit rates generated by the use of large vessels will vary according to commodity value, length of trip, type of cargo and annual tonnage carried. However, considerable study has been devoted to the question and several useful indicators have been established.

Vessel Operating Costs

Revenue potential and hence freight rates are derived from vessel operating costs and debt service of equipment plus an additional cost to cover overheads, profit, and fees, payable by the vessel operator.

As vessel size increases, operating costs will also rise but components of the overall cost will increase at differing rates, certain items remaining essentially unchanged.

A typical breakdown of the major elements of operating costs for a Great Lakes bulk freight is shown in Table A.1, together with an indication of the relative importance of each item and its proportionate rate of increase related to increase in vessel size.

It can be seen from the table that a 100 percent increase in vessel capacity will lead to a rise of 80 percent in maintenance and insurance costs but a 60 percent increase in fuel costs.

TABLE A.1

OPERATING COSTS OF MIDSIZE VESSELS

	Percent of Total	Multiplication Factor Per 100% Increase in Relative Vessel Size
Capital Recovery Cost	40-60	0.6
Fuel	10-20	0.6
Crew, Stores, Supplies	6-10	0.2
Maintenance and Insurance	7-12	0.8
Overheads	15-20	0.1
Misc. Port Fees, etc.	2-4	1.0

Required Freight Rates

This generalized case can be applied to vessels calling at Green Bay in order to forecast a likely freight rate for a range of vessel sizes. Operating costs for a typical bulk carrier of 20,000 dwt are shown in Table A.2 below.*

TABLE A.2

DAILY OPERATING COSTS FOR TYPICAL
20,000 DWT GREAT LAKES BULK CARRIER

Item	Cost ($/Day at Sea - 1980)	
Fuel	5,000	(Assumes Bunker "C""
Wages and Stores	3,500	
Maintenance	820	
Insurance	370	
Miscellaneous	110	
	$9,800	
Add Capital Recovery Cost	8,250	
Profit and Overhead	2,400	

TOTAL DAILY COST = $20,450, i.e. $1.02/ton/day**

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* MarAd Statistics 1978 figures uprated 20 percent.

** (Present rates for Green Bay -- $0.98-1.07/ton/day). Supplement Design Memorandum February 1980 U.S. Army Corps of Engineers.

Using the proportional increases in operating costs as detailed in Table A.1, a typical required freight rate for a range of vessel sizes is shown in Table A.3.

TABLE A.3

VARIATION OF REQUIRED FREIGHT RATES
GREAT LAKES BULK CARRIERS ($ 1980)

	Bulk Vessel Capacity (tons)			
Component of Freight Rate	20,000 DWT	30,000 DWT	40,000 DWT	50,000 DWT
Capital Recovery Cost	8,250	10,725	13,200	15,675
Fuel	5,000	6,500	8,000	9,500
Crew, Supplies	3,500	3,850	4,200	4,550
Maintenance & Insurance	1,190	1,670	2,140	2,620
Miscellaneous	110	165	220	275
Overhead	1,100	1,200	1,300	1,400
Profit	1,300	1,350	1,400	1,450
Required Freight Rate/Ton	1.02	0.85	0.76	0.71

It is seen that use of a 50,000 dwt vessel would reduce the current freight rates by some 30 percent. This can then be considered as a direct benefit resulting from the employment of the larger vessel.

APPENDIX B

ANALYSIS OF BARGE TRANSSHIPMENT

TRANSSHIPMENT

The economies of large vessels arise from their use for a particular commodity on a regular run with a minimum turnaround time in port. As a result very high unloading rates are now common on Great Lakes bulk carriers and a rate of 5,000 tph is not unusual for a large vessel.

Transshipment to a barge system can be considered as a means of distribution of bulk cargoes only if adequate marine and shoreside facilities can be developed to handle the larger craft. The subsequent analysis is developed on the assumption that those facilities would be available.

Commodities likely to divert to Bay Port are identified in Section 5 as those cargoes which are essentially transshipped by truck or rail and involve no manufacturing or conversion process.

Candidates for a barge transshipment service based on Bay Port are then limited to the following:

1. Fox River terminals having associated manufacturing process.
2. Waterfront developments not physically able to handle vessels capable of navigating the Fox River.

POTENTIAL TRAFFIC

Coal

Coal consumers in Wisconsin and Michigan will not realize any significant economies from the use of western coal at this time and are more likely to continue to receive eastern/mid-western coal by existing transportation systems.

Imports through Green Bay to the public utility companies are likely to remain static while demand for coal for the paper industry will increase at two percent per annum. Table B.1 then indicates a breakdown of all coal imports to Green Bay for the period 1980-2010.

TABLE B.1

TOTAL COAL IMPORTS TO GREEN BAY, 1980-2010
(tons x 1,000)

	DESTINATION			
Year	W.P.S. Pulliam Power Plant	Ft. Howard Paper Co.	Other Paper Companies	Total
1985	767	396	660	1,823
1990	767	438	770	1,975
2000	767	533	1,010	2,310
2010	767	605	1,310	2,682

Not all importers will benefit from a waterborne distribution system and must, therefore, be excluded from the forecasts of potential tonnage. The Pulliam Power Plant and F. Hurlbut docks are both sited at the river mouth and hence would derive no benefits from a barge system.

Provision of a transshipment facility would necessarily require a mechanized conveyor system and adequate stacking area, i.e., facilities similar to the coal distribution center at present operated by the C. Reiss Coal Company at their existing location. Since distribution by truck or train could just as easily be carried out from the first point of offloading, the C. Reiss operation is also excluded from consideration.

The Ft. Howard Paper Company remains as the only major coal importer likely to utilize barge transshipment. Potential movements of coal that could be offloaded at Bay Port for subsequent transshipment to barges are as indicated in Table B-2.

TABLE B.2

POTENTIAL MOVEMENT OF COAL
TO FT. HOWARD PAPER CO.
1985-2010

Year	Tonnage
1985	396,000
1990	438,000
2000	533,000
2010	605,000

Aggregates

The principal bulk aggregates moving through the Port of Green Bay are salt, limestone and cement.

Salt

At least 50 percent of the annual tonnage of salt passing through Green Bay will divert to Bay Port and it is considered that the remaining 50 percent will continue to be shipped directly to the Ft. Howard or Hurlbut terminals.

Limestone

The two main importers of limestone process raw materials at dockside before distribution to either the paper industry or to produce fertilizer. Since the diversion of bulk cargoes to Bay Port would also involve movement of the processing plants it was concluded in Section 5 that the limestone companies would not move to a Bay Port facility. It is unlikely that a barge service will be necessary.

Cement

It is assumed that bulk cement shipments would be diverted to Bay Port for distribution by truck, hence there will be no requirement for barged shipments.

Agri Commodities

Agricultural products moving through Green Bay are generally for export and it follows that they are more easily brought directly to the shipment area by truck or rail. A barge service would not, therefore, be required.

Miscellaneous Bulk Cargoes

The establishment of a barge transshipment center at Bay Port may encourage increased use of the upriver waterfront facilities by companies wishing to take advantage of the relative economies of marine transportation.

The waterborne commerce forecasts indicate that up to 100,000 tons of miscellaneous bulk cargoes could be handled through Bay Port and it is considered that up to 15 percent of the potential tonnage could be handled by barge.

Summary of Potential Traffic

It is seen from the foregoing discussion that only those companies unable or unlikely to move to Bay Port can be considered as candidates for a transshipment/barge service.

The principal movement considered is bulk coal to the Ft. Howard Paper Co. together with a small percentage of the total traffic in miscellaneous bulk products to a variety of users.

Total potential movements by barge are summarized in Table B.3 below.

TABLE B.3

POTENTIAL BARGE TRANSSHIPMENT MOVEMENTS
FROM BAY PORT, 1985-2010
(tons x 1,000)

Year	Coal	Miscellaneous Bulk Products	Total
1985	396	9	405
1990	438	10	448
2000	533	12	545
2010	605	15	620

For the purposes of analysis of transshipment operations it is considered that the port will be open for eight months per year.

EXISTING FACILITIES AT THE FT. HOWARD WHARF

No bulk unloading equipment is provided at the Ft. Howard Wharf.

The turning basin in front of the wharf is dredged to 20 ft. and is the subject of a U.S. Army Corps of Engineers study which would increase the depth to the authorized project depth of 24 ft. Present water depth alongside the wharf is 19 ft. and this would be increased to 24 ft. in the event that the turning basin is deepened. The apron length is 1,100 ft. long and found as a solid concrete bulkhead on timber piles.

Open storage is provided for a total of 450,000 tons of coal and salt.

FUNCTION REQUIREMENTS OF BARGE TRANSSHIPMENT SYSTEM

The functional requirements of the barge transshipment system are dictated by cargo throughput, the constraints in unloading and storage at Ft. Howard, the physical limitations of the Fox River and restrictions of bridge openings.

Cargo Throughput

Since 98 percent of the total potential traffic for a barge transshipment system will be received by the Ft. Howard Paper Company, barge requirements will be optimized on a single user.

It was seen in Table B.3 that the Ft. Howard Paper Co. expects to import 396,000 tons of coal per year by 1985, rising to 605,000 tons by the year 2010.

Coal imports can be handled only during the eight-month open navigation season and the above figures then indicate a potential monthly demand of 49,500 tons in 1985 rising to 75,650 tons by 2010.

Total on-site storage at the Ft. Howard plant is quoted as being 450,000 tons of which 25,000 tons is necessary for salt storage. It is not anticipated that any peak demands are likely to occur in the months immediately prior to winter close-down of the port.

Average monthly demand is, therefore, presented in Table B.4 below.

TABLE B.4

AVERAGE MONTHLY DEMAND FOR COAL
TO FT. HOWARD PAPER CO., 1985-2010

Year	Demand (tons)
1985	49,500
1990	54,750
1995	66,625
2010	75,625

EQUIPMENT

Barge Equipment Available on the Great Lakes

A listing of barges currently in service on the Great Lakes is shown in Table B.5. Discussions with marine operators revealed that only the largest barges have self-unloading equipment and that trends do not indicate that future tug/barge fleets will include vessels of less than 15,000 dwt.*

* Source: Greenwoods Guide to Great Lakes Shipping, 1980.

TABLE B.5

BULK CARGO BARGES IN SERVICE ON THE GREAT LAKES
(Hopper barges or bulk carriers)

Owner	Capacity at Summer Draft (T)	No	L Ft.	B Ft.	D Ft.	Equipment & Remarks
Bultema Marine Inc.	3,500		350	56	16'2"	
	1,400	(3)	195	35	8'0"	(3 covered hopper barges)
Lake Transportation Co.	8,900		524	54	21'2½"	Self unloader (converted freighter)
S.C. Loveland	1,000	(2)	195	35	8'2"	
Morton Norwich Products Inc.	2,100		195	35	12'0"	
Will W. Stender	2,800		250	46'8"	15'7"	1 stat. crane 50T
	600		177	38'2"	9'5"	1 mobile crane 35T
Goderich Elevator & Transit Co., Inc.	9,200		500	54'0"	20'11"	
	7,000		436	50'0"	20'5½"	
	12,000		552	58'0"	21'8½"	
McAllister Towing & Salvage Inc.	7,000		343	63	14'8"	
	3,000		265	42'6"	15'4"	Trav. crane 20T
	3,000		261	43'3"	15'6"	Trav. crane 50T
A.B. McLean Inc.	1,685		245	43'0"	10'0"	Trav. crane 5T
	1,075		150	41'9"	8'0"	

Source: Greenwoods Guide to Great Lakes Shipping - 1980.

Specialist Vessels
(LASH, SEEBEE, BOB)

The above class of vessel carries its cargo in barges which are lowered into the water and raised by the ship's own gear enabling a combined deep water, lighterage service to be offered to ports having draft or physical limitations.

They are relatively sophisticated ocean-going vessels and thus costs of construction and operation are generally high, requiring maximum utilization to generate a satisfactory rate of return.

A typical vessel would carry up to 70-100 barges having a total capacity of 40,000-50,000 tons and a draft of 32-38 feet.

It is concluded that the use of specialist vessels would not be practically or economically feasible at Green Bay.

Inland Waterway Barges

Large numbers of barges are operated on U.S. inland waterway systems and those suitable for transportation of bulk products at Green Bay are indicated in Table B.6. All have a draft of 8'9" as dictated by the standard waterway depth of 9 ft. None of the barges are provided with self-unloading equipment.

TABLE B.6

CLASSIFICATION OF INLAND WATERWAY BARGES

Barge Type	Description	Length & Breadth	Capacity (Net Tons)
Hopper	Open	245 x 35	2,400
Hopper	Open Jumbo	195 x 35	1,700
Hopper	Open Standard	175 x 26	1,060
Hopper	Open Small	120 x 30	630
Hopper	Covered Jumbo	195 x 30	1,700

Source: Mid-America Ports Study--U.S. Department of Commerce, June 1979.

Self-Propelled Barges

The possibility of using barges small enough to minimize bridge openings was also considered.

It is not uncommon in Europe to see small self-propelled barges of less than 100-ton capacity passing through tunnels having vertical clearances of 7-12 feet.

Cargoes handled are normally manufactured products or agricultural produce having a high value-volume ratio. It is considered that establishment of a fleet of small barges will not be feasible at Green Bay for low value bulk products.

SELECTION OF ALTERNATIVE BARGE SYSTEMS

The subsequent analysis evaluates the cost of providing and operating barges of varying capacity up to the maximum size able to safely operate over the selected route.

The limiting dimensions for the largest barge are as follows:

Length:	475-500 ft. (not critical)
Beam:	69 ft.
Draft:	18 ft.
Capacity:	8,500 tons

Cost of Marine Equipment

Capital Costs

For the purposes of analysis, estimates are expressed in 1980 dollars as developed from recent equipment purchases and discussions with marine industry representatives.

Capital costs for a range of matched tugs and barges are developed in Table B.7.

TABLE B.7

CAPITAL COST OF INLAND
TUG BARGE EQUIPMENT
($1980 x 1,000)

Barge Capacity (tons)	Cost	Tug Bhp	Cost
1,000 (open standard)*	325	1,000	1,650
1,700 (open jumbo)	520	1,000	1,650
2,400 (open)	750	1,500	1,900
4,000 (purpose built)	1,200	1,500	1,900
6,000 (purpose built)	1,600	2,000	2,150
8,500 (purpose built)	2,200	2,500	2,500

* Inland waterway barge.

Capital Recovery
and Operating Costs

The operator of the barge transshipment system will expect to be reimbursed for all expenses including supporting office and personnel and also obtain a satisfactory rate of return of equity in equipment.

The total cost of marine transportation can be summarized as below:

(a) Capital Recovery Cost (debt service and return on equity).

(b) Operating Costs-
- Crew wages, subsistence and stores;
- Fuel;
- Maintenance, repair and insurance; and
- Overhead and profit.

Capital Recovery Cost

Financial arrangements such as interest rates and repayment periods will vary according to the method of controlling the barge system. The Port Authority could provide and operate the system as part of the overall Bay Port facility and finance the equipment from local or Federal funding as bond issue. Alternatively a marine operator could be granted a concession.

However, as it appears that barge operations would serve one customer only, the most likely operator would be the Ft. Howard Company or a subsidiary.

Marine equipment may be purchased under the federal Maritime Administration (MarAd) Title XI mortgage program. Under this program the government guarantees up to 87.5 percent of the construction costs.

The annual amortization costs are indicated in Table B.8 on the basis of acquisition of a MarAd Title XI 12 percent interest rate over a repayment period of 20 years.

TABLE B.8

ANNUAL CAPITAL RECOVERY COSTS OF MARINE EQUIPMENT ($1980 x 1,000)

Barge Capacity (tons)	Annual Cost ($x1,000)	Tug bhp	Annual Cost ($x1,000)
1,000	45	1,000	230
1,700	73	1,000	230
2,400	105	1,500	265
4,000	170	1,500	265
6,000	225	2,000	300
8,500	310	2,500	345

Operating Costs

The operating cost of marine transportation is composed of a number of factors, certain of which will remain steady over a given period. Others, such as fuel, stores, etc. will be related to operating hours and tonnages of commodity moved.

Coal Movements

Total tonnage of coal moved in a given period will depend on a number of controlling factors as below.

- Shift system of marine operator;
- Permitted working hours at Ft. Howard and Bay Port;
- Restrictions on bridge openings;
- Environmental limitations.

Table B.9 indicates the number of deliveries required per month for the range of barges under study.

TABLE B.9

POTENTIAL MONTHLY BARGE MOVEMENTS
BAY PORT TO FT. HOWARD
1985-2010

Barge Capacity (tons)	Number of Deliveries per Month			
	1985	1990	2000	2010
1,000	50	56	67	76
1,700	30	33	40	45
2,400	21	21	28	32
4,000	13	14	17	19
6,000	9	10	12	13
8,500	6	7	8	9

Cycle Times

The distance from transshipment center to terminal is low, averaging four miles each way and thus the major component of barge cycle time shown in Table B.10 comprises the loading and unloading operations. Handling rates vary from 200 tons per hour to 10,000 tph dependent on the equipment and total tonnage to be handled. The following rates are assumed:

- Load into barge by land-based equipment at Bay Port -- 1,000 tph.
- New unloader at Ft. Howard Paper Co. -- 1,000 tph.

TABLE B.10

BARGE CYCLE TIMES
BAY PORT TO FT. HOWARD PAPER CO.
(Hours)

Barge Capacity	Load @ 1,000 tph	Transit 1/	Unload @ 1,000 tph	Return 2/	Total (hours)
1,000	1.00	3.00	1.00	3.25	8.25
1,700	1.70	3.00	1.70	3.25	9.65
2,400	2.40	3.00	2.40	3.25	11.05
4,000	4.00	3.00	4.00	3.25	14.25
6,000	6.00	3.00	6.00	3.25	18.25
8,500	8.50	3.00	8.50	3.25	23.25

1/ Includes undocking at Bay Port, transit at four knots, bridge openings and docking.

2/ Includes undock and turn, transit at four knots, bridge opening and docking.

Unit Cost of Marine Transportation

The marine components of the cost of the barge service are summarized in Table B.11. It is assumed that no bridge transit will be carried out during the morning and evening rush-hour periods and that unloading will not be permitted at the Ft. Howard wharf after 6 P.M.

Bulk Handling Terminal and Equipment

Transshipment Facility

It is assumed that the civil marine and dredging works at Bay Port will not be discounted against the barge operation and that only such facilities as are necessary for berthing and loading into the barges are included in the analysis.

TABLE B.11

UNIT COSTS OF MARINE TRANSPORTATION
BAY PORT TO FT. HOWARD
(1980 dollars)

Barge Size (tons)	Operational System		Annual Costs $1980 x 1,000						Unit Cost $/ton 1/
	Barges	Tug	Capital Recovery Cost	Fuel	Crew & Subsistence 2/	Maint., Insurance	Overhead & Profit	Total	
1,000	3	2	595	280	570	170	480	2,095	5.29
1,700	2	1	375	170	570 3/	110	380	1,605	4.05
2,400	1	1	370	177	345	105	295	1,292	3.26
4,000	1	1	435	110	345	125	325	1,340	3.38
6,000	1	1	525	100	345	150	360	1,480	3.74
8,500	1	1	655	84	345	190	420	1,694	4.28

1/ Based on 1985 traffic forecasts.

2/ Assumes that crew are employed for 12 months.

3/ Two crews required for shift work.

Attributable costs for a loader and barge berth are then as follows:

	$ 1980
Loading time and conveyor	500,000
Conveyor and gantry	275,000
Access platform and barge berth	300,000
Additional dredging	295,000
Engineering and contingencies	375,000
	$1,745,000

Amortization of the loading equipment and associated works will cost $240,000* per year and operating and maintenance costs will increase the figure by 60 percent giving a total annual payment of $385,000 per year or $0.97 per ton at the 1985 traffic forecasts.

Unloading Equipment

It is not normally feasible to provide self-unloading equipment on barges or less than 10,000 tons due to the high cost of equipment and loss of cargo carrying capacity.

A further capital investment will, therefore, be required to cover the cost of unloading equipment and a primary conveyor system at the Ft. Howard wharf as below:

	$ 1980
Unloading tower, 1,000 tph capacity	2,000,000
Conveyors, gantries, etc.	225,000
Contingencies and engineering	500,000
	$2,725,000

Annual cost of recovery of capital expenditure will be $354,000. Operations and maintenance will cost a further $190,000 per year giving a resultant unit cost of $1.37/ton based on the 1985 forecast.

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* All amortization costs considered to be repaid over 20 years at 12 percent interest rates and incorporate residual value.

Summary of Unit Costs

The total cost of providing and operating a barge system to fulfill the forecasted demand is summarized in Table B.12

TABLE B.12

TOTAL COST OF BARGE TRANSSHIPMENT SERVICE

Description	Annual Cost ($1980 x 1,000)	Unit Cost Based on 1985 Tonnage ($/ton)
Loading tower and barge berth	385	0.97
Marine equipment (Single 2,400 ton barge & tug unit)	1,292	3.26
Unloading tower and conveyor	544	1.37
Total	$2,221	$5.60/ton

SUMMARY

Maritime transportation costs are not subject to regulation and will vary according to a number of modifying factors and hence no fixed scale of charges can be used as a basis for comparison purposes. The present cost of delivery of coal to Green Bay from Conneaut and Toledo, Ohio varies from $3.72-$4.35/ton, dependent on vessel size.

It seems unlikely that barge costs could exceed the total cost of marine transportation from Conneaut to Green Bay, however, the very high unit cost is chiefly due to the low volumes involved and the high redundancy factors for the majority of the tug barge configurations.

In general terms bulk handling installations do not show a satisfactory rate of return at throughputs of less than one million tons. The loading and unloading equipment at Bay Port and Ft. Howard would have a potential in excess of that figure but will be used at levels of less than 50 percent capacity and hence unit rates quoted in this section are distorted.

It is, therefore, concluded that Fox River waterfront developers unable or unlikely to move to Bay Port will not realize any cost advantages from a barge transshipment system.

The particular navigational problems experienced by vessels calling at the Ft. Howard paper company are most easily resolved by the completion of the authorized dredging project to the adjacent turning basin when the need to lighten vessels downstream of the C&NW bridge would be eliminated.

APPENDIX C

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