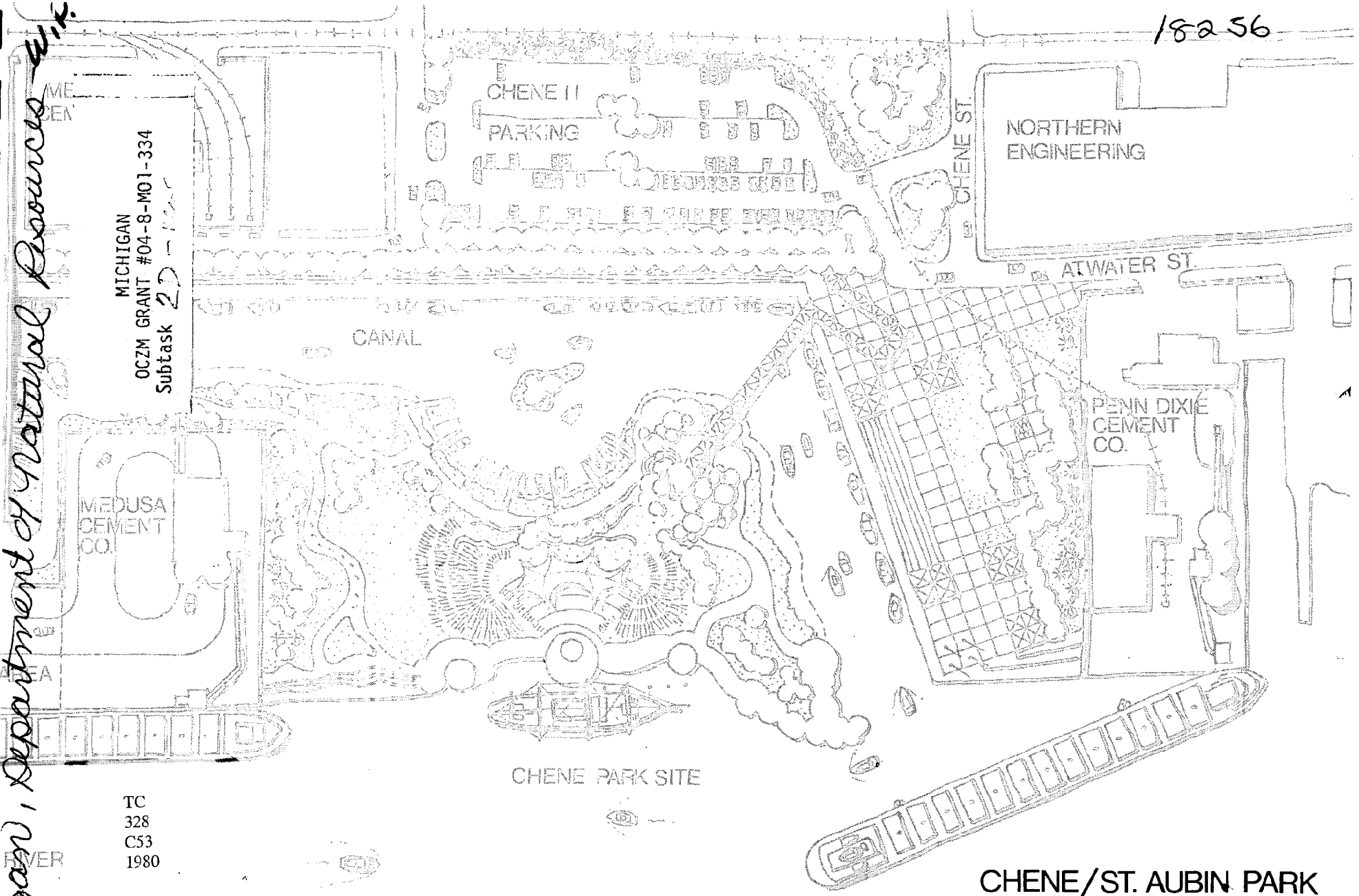


CHENE/ST. AUBIN PARK

MARINA/CANAL FEASIBILITY

SCHERVISH, VOGEL, MERZ, P.C.

CITY OF DETROIT, RECREATION DEPARTMENT

CHENE/ST. AUBIN PARK MARINA/CANAL FEASIBILITY

CITY OF DETROIT
Coleman A. Young, Mayor

RECREATION DEPARTMENT
Daniel Krichbaum, Director

Prepared by:
SCHERVISH, VOGEL, MERZ PC
Architects/Landscape Architects/Planners
1452 Randolph
Detroit, Michigan 48226

Engineering Consultant:
SNELL ENVIRONMENTAL GROUP
Engineering/Planning/Research
1120 May Street
Lansing, Michigan 48906

this report was funded in part through financial assistance provided by the Office of

COASTAL ZONE MANAGEMENT
National Oceanic and Atmospheric Administration
United States Department of Commerce
through funds provided under the
Coastal Zone Management Act of 1972 (PL 92-583)
and administered by

MICHIGAN DEPARTMENT OF NATURAL RESOURCES
Division of Land Resources Program
Chris Shafer, in charge, Coastal Zone Management Unit
David Warner, Project Representative

September, 1980
Rev. October, 1980

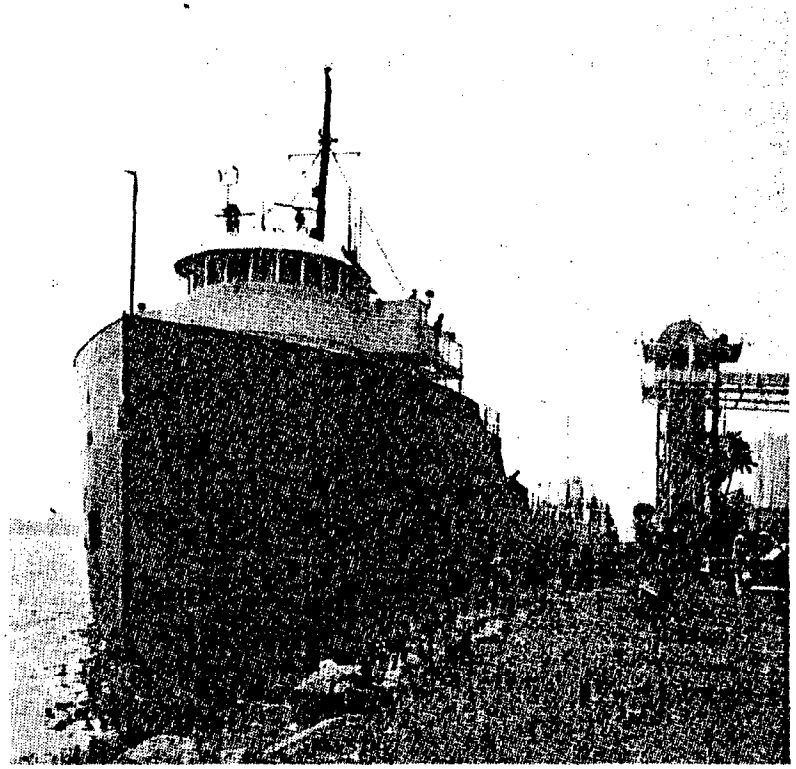


TABLE OF CONTENTS

Chapter

1.0 INTRODUCTION
- 1.1 Scope
- 1.2 Alternative Marina/Canal Configurations

2.0 TECHNICAL MARINA/CANAL CONFIGURATION
- 2.1 Introduction
- 2.2 Wave Action Concerns
- 2.3 Canal Hydraulics
- 2.4 Construction Beyond Harborline
- 2.5 Summary, Conclusions and Recommendations

3.0 RESOLUTION OF POTENTIAL INDUSTRIAL/RECREATIONAL/ TRANSPORTATION/UTILITY CONFLICTS
- 3.1 Introduction
- 3.2 Consolidated Docking
- 3.3 Medusa Cement Company
- 3.4 Penn-Dixie Cement Company
- 3.5 Recreation Service and Security Vehicles
- 3.6 Pedestrian/Bicycle Access
- 3.7 Truck Routing
- 3.8 Utility Conflicts
- 3.9 Noise and Dust
- 3.10 Rail Transportation
- 3.11 Summary, Conclusions and Recommendations

4.0 MARINA
- 4.1 Introduction
- 4.2 Marina Program
- 4.3 Design Criteria
- 4.4 Operations and Maintenance
- 4.5 Summary, Conclusions and Recommendations

5.0 ECONOMIC IMPACTS
- 5.1 Introduction
- 5.2 Construction Costs of Marina/Canal Improvement
- 5.3 Construction Costs of Medusa Improvements
- 5.4 Total Construction Costs of Marina/Canal and Medusa Improvements
- 5.5 Marina Revenue
- 5.6 Funding Potentials
- 5.7 Other Economic Developments

6.0 SUMMARY
- 6.1 Feasibility of Marina/Canal
- 6.2 Impact on Chene Phase I Design
- 6.3 Applicability To Other Sites
- 6.4 Recommendations
- 6.5 Conclusion

REFERENCES
PLANNING TEAM
ACKNOWLEDGEMENTS

Introduction 1.0

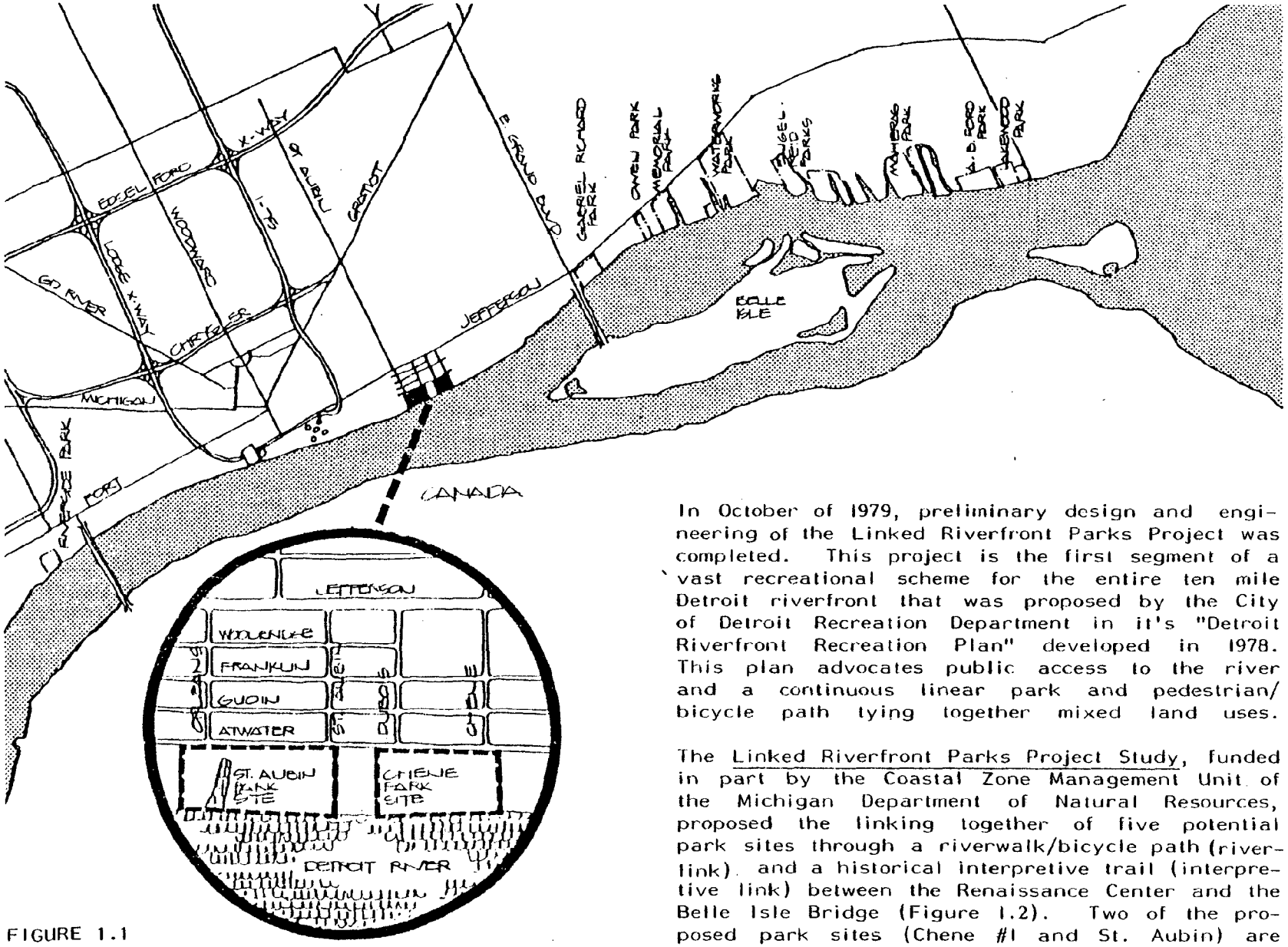


FIGURE 1.1

In October of 1979, preliminary design and engineering of the Linked Riverfront Parks Project was completed. This project is the first segment of a vast recreational scheme for the entire ten mile Detroit riverfront that was proposed by the City of Detroit Recreation Department in it's "Detroit Riverfront Recreation Plan" developed in 1978. This plan advocates public access to the river and a continuous linear park and pedestrian/bicycle path tying together mixed land uses.

The Linked Riverfront Parks Project Study, funded in part by the Coastal Zone Management Unit of the Michigan Department of Natural Resources, proposed the linking together of five potential park sites through a riverwalk/bicycle path (river-link) and a historical interpretive trail (interpretive link) between the Renaissance Center and the Belle Isle Bridge (Figure 1.2). Two of the proposed park sites (Chene #1 and St. Aubin) are

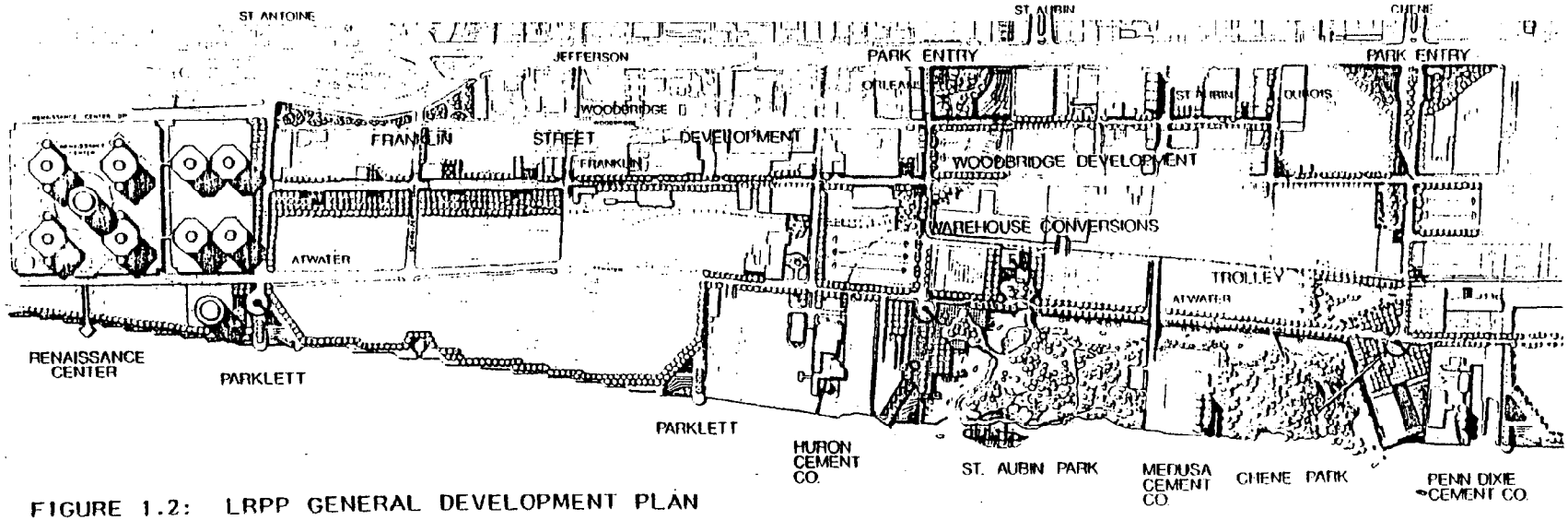
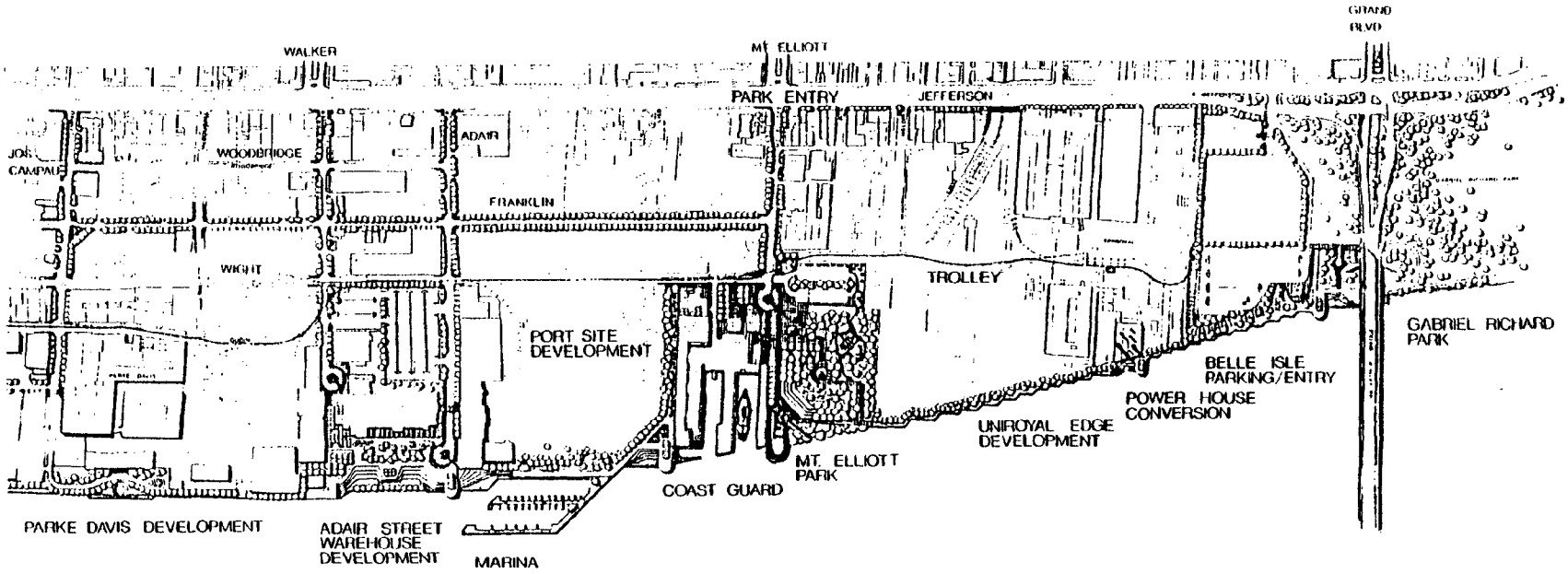


FIGURE 1.2: LRPP GENERAL DEVELOPMENT PLAN

further linked by a proposed transient marina/canal which passes through land privately owned by the Medusa Cement Company. The purpose of the marina/canal is threefold: 1) to create a single entity of two separate park sites; 2) to provide much needed boat access to the downtown area; and 3) to provide a catalyst for private development in the east riverfront area. Since the completion of the LRPP study, design development services have been performed for the total Chene/St. Aubin park and marina/canal (Figure 1.4). In addition to the marina/canal linking the park sites, Atwater Street is proposed to be closed between Orleans Street and Chene Street creating a pedestrian mall parallel to the canal. It is assumed that this mall and canal would spur intense private development north of Atwater including conversion of existing warehouses and building of new commercial, entertainment or residential developments.

Realization of the total park concept relies upon acquisition of various parcels of land (Figure 1.3). The city presently owns the vacant Chene #1 and Chene #2 sites. It does not, however, own the complete St. Aubin site except for a portion at the western edge (referred to as the Waterboard Site). Acquisition of the St. Aubin site, presently a container port, is under negotiation. Finally, to accomodate the canal link between the Chene and St. Aubin sites, a land trade with Medusa Cement Company is required.

Assuming that land acquisition is finalized, design development indicated that complete implementation of the marina/canal relied on the resolution of certain concerns beyond the scope of the LRPP study or the Chene/St. Aubin design development contract. These concerns, which relate directly to the feasibility of the marina/canal, include the following: a) cost impacts; b) impacts



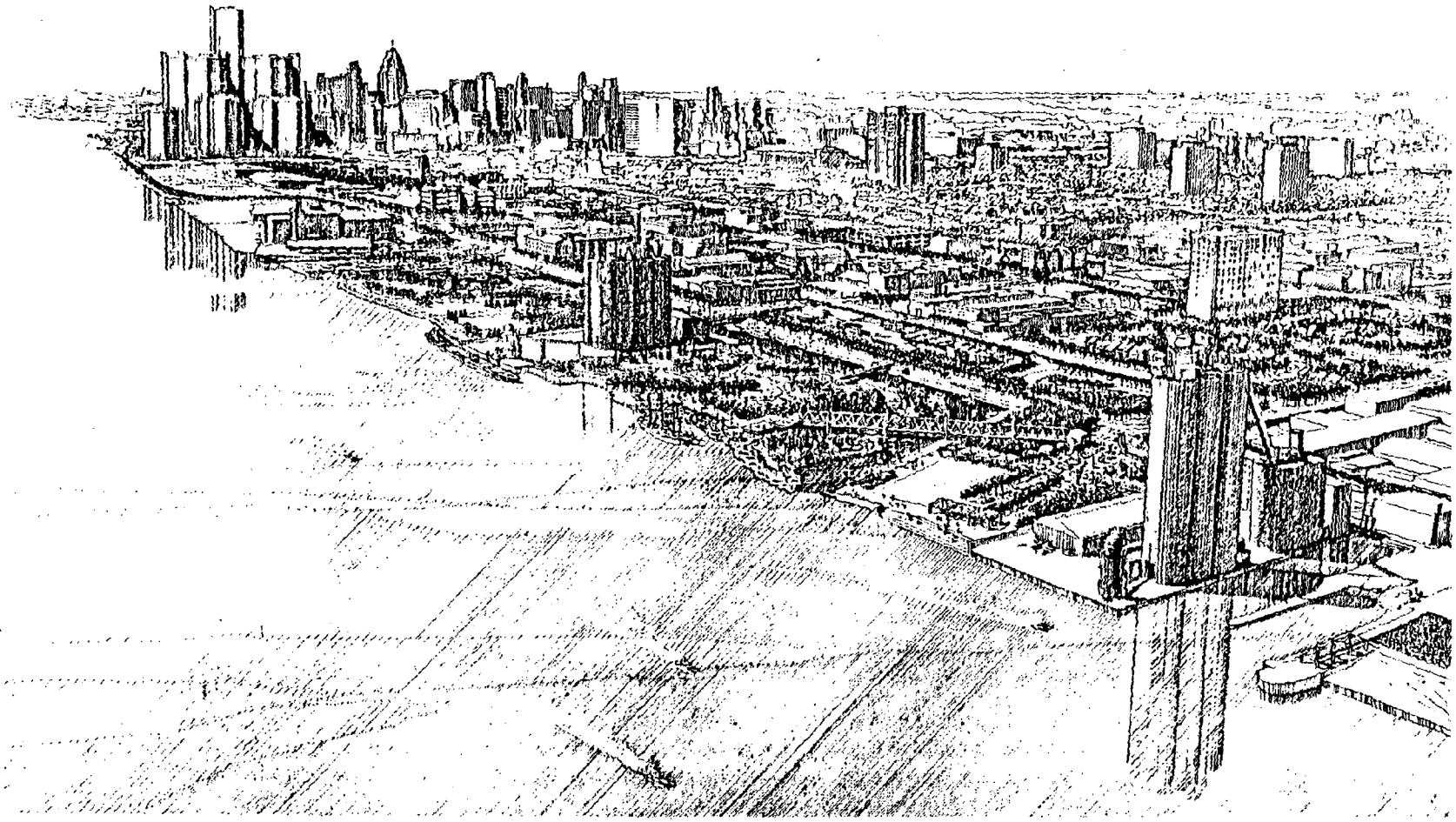
on infrastructure; c) impacts on circulation systems, especially truck transportation; d) technical engineering questions concerning flow, wave action, profile and alignment; e) marina program; f) impacts on surrounding industry; and g) environmental impacts.

The Recreation Department has contracted for an Environmental Assessment Report to address the last concern. The rough draft has been prepared but awaits vital information contained in this study. In February, 1980, the Coastal Zone Management Unit of the Michigan Department of Natural Resources agreed to fund a special emergency grant to address the remaining issues. This study is a result of that grant.

1.1 SCOPE

The purpose of this study is, therefore, to address the Chene/St. Aubin marina/canal issues just described. These issues have been grouped into four major categories: a) the technical canal configuration which includes hydraulic and wave action implications; b) potential industrial, recreational transportation and utility conflicts; c) the content and feasibility of the proposed seasonal transient boat marina; and d) the cost impacts of recommended physical improvements.

This study will build upon previous studies funded by Coastal Zone Management grants including The Linked Riverfront Parks Project, performed by Schervish, Vogel, Merz, P.C.; a sub-report of the LRPP executed by The Snell Environmental Group entitled Hydraulic Study Chene/St. Aubin Park Riverfront Canal; and Riverfront Capabilities Expansion Analysis by Coastal Zone Laboratories of the University of Michigan. This new report will also serve as a support document for the Chene/-



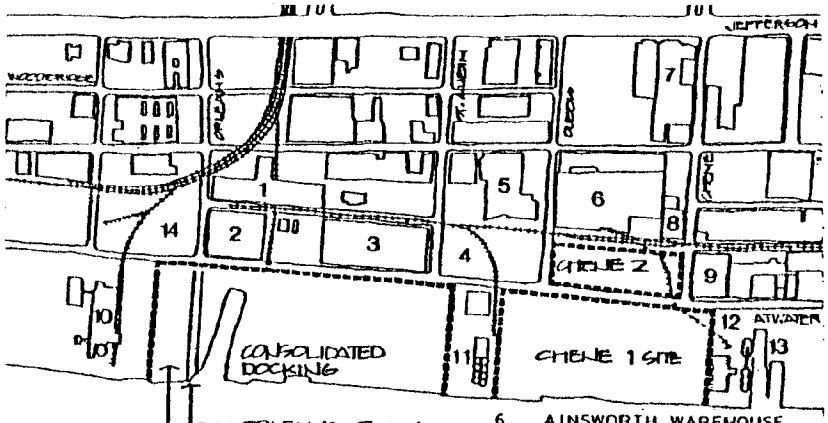
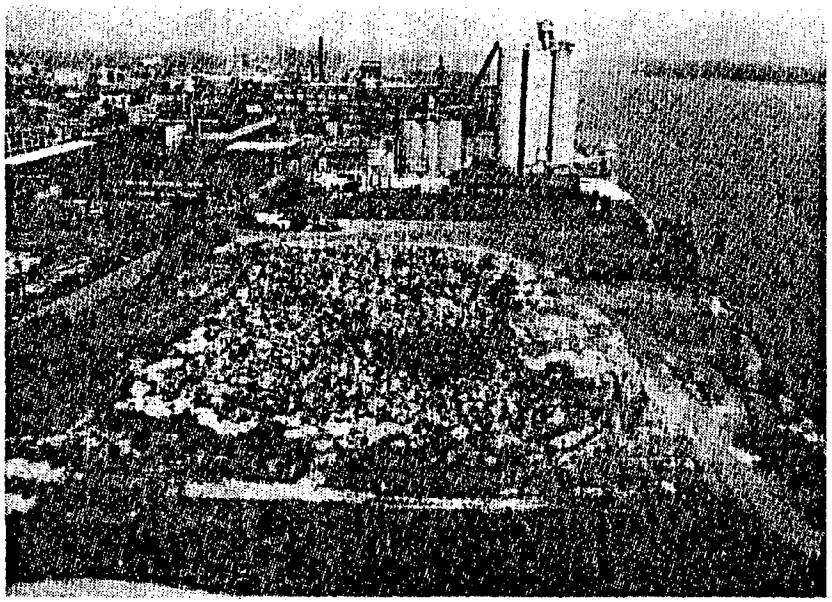


FIG. 1.3

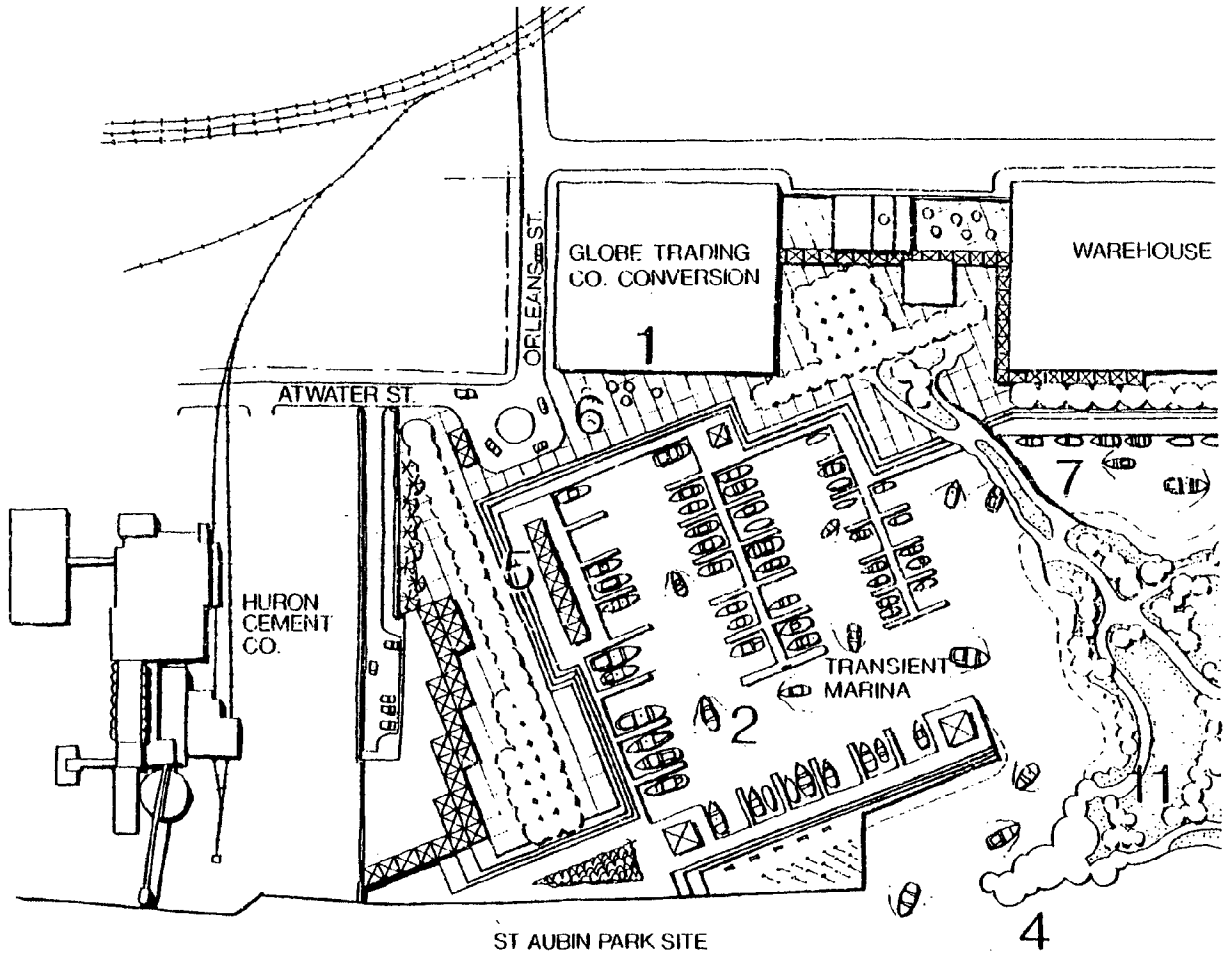


St. Aubin Environmental Assessment Report presently being prepared under a separate contract.

Lastly, information in this report concerning hydrological questions such as wave motion, surge and canal profile that may have applicability to other areas of the riverfront will be so noted and summarized.

1.2 ALTERNATIVE MARINA/CANAL CONFIGURATIONS

For the purposes of this study, and in order to fully investigate the marine aspects of the park complex, two alternative marina/canal configurations were explored. The first alternative, hereinafter referred to as the "Marina/Canal Alternative" assumes a configuration as delineated in the design development drawings for the total Chene/St. Aubin Park (Figure 1.4). The second alternative assumes a delay or inability in acquiring the St.



LEGEND

1. ATWATER MALL
2. TRANSIENT BOAT PARKING
3. AMPHITHEATER
4. OVERLOOK/SCOOP
5. TOILET FACILITIES
6. PLAZAS
7. PEDESTRIAN BRIDGES
8. TRUCK SERVICE BRIDGE
9. TOUR BOAT
10. CONVEYOR
11. OPEN SPACE

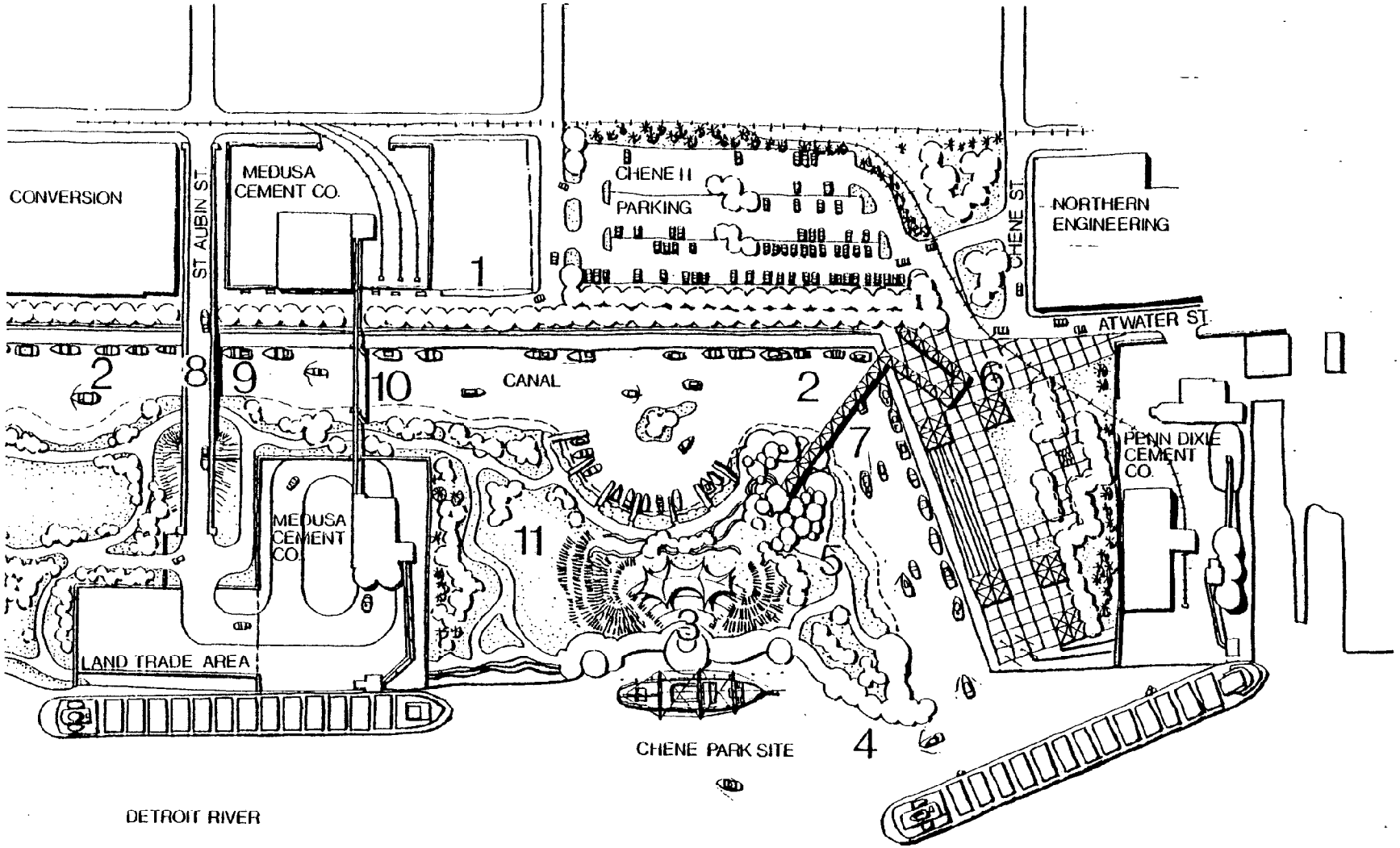


FIGURE 1.4: MARINA/CANAL ALTERNATIVE

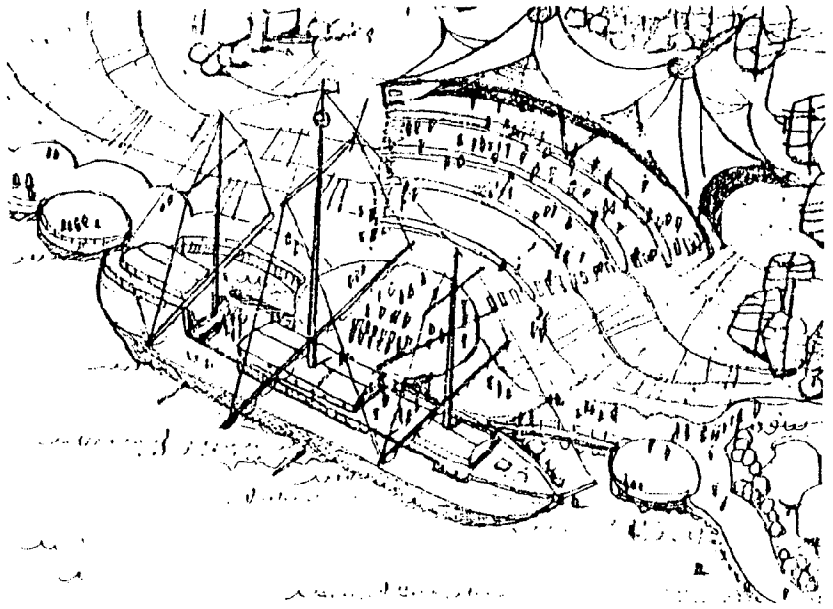
Aubin site. This alternative, hereinafter referred to as the "Marina/Lagoon Alternative", proposes a canal which terminates in a marina/lagoon on the Chene site only (Figure 1.5). In the event that acquisition of the St. Aubin site is delayed or funding of the Chene Park continues before acquisition of St. Aubin the Marina/Lagoon Alternative can also be viewed as first phase construction of the total eventual Marina/Canal Alternative. These alternatives are described more fully below.

Marina/Canal Alternative

In this alternative a 1700 foot long canal is proposed. In order to maximize it's length, it begins at a point nearest the east property line of the Chene Park site that design and physical restraints will allow and likewise ends at a point nearest the west property line of the St. Aubin Park site. The canal angles across the Chene site to Atwater Street (the angle maximizes flow) and parallels Atwater through the Chene site and the proposed Medusa land trade area and into the St. Aubin site. Transient boat parking aligns the canal and the adjoining Atwater mall. At the St. Aubin site the canal broadens into a larger basin where additional transient boat parking is accommodated in a major marina.

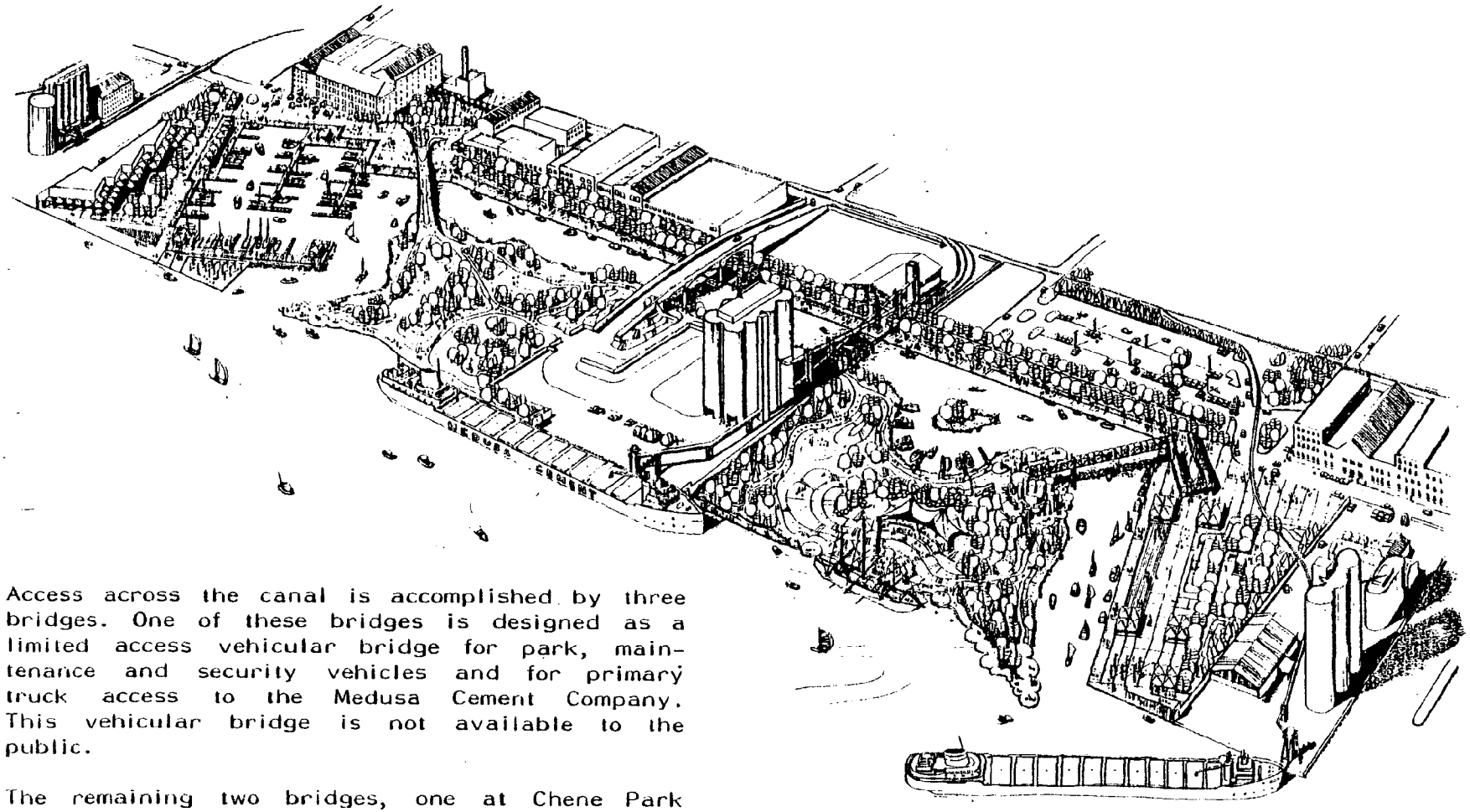
The marina is proposed to accept 30 ft., 45 ft. and a few 60 ft. berths. Depending upon the extent of excavation determined feasible, sixty to one hundred slips are accommodated in the St. Aubin marina. The remaining canal accommodates approximately 50 slips. Proposed marina facilities include a water supply system, litter receptacles, toilet facilities, pump-out facilities, sewage receiving units, shops offering marina supplies, and a possible marina gas station.

The inlet to the canal on the Chene site requires hydrological devices to encourage flow into the



canal. These devices include a land extension beyond the harbor line which acts as a "scoop" as well as a wave mitigating mechanism. This same land extension also functions as an overlook viewing area for park users. Likewise the entrance to the St. Aubin marina, which also acts as an exit for the canal, requires surge and wave mitigating devices that extend beyond the harbor line and function as an overlook. Alternative configurations of both the entrance and exit to the canal are investigated further in this study.

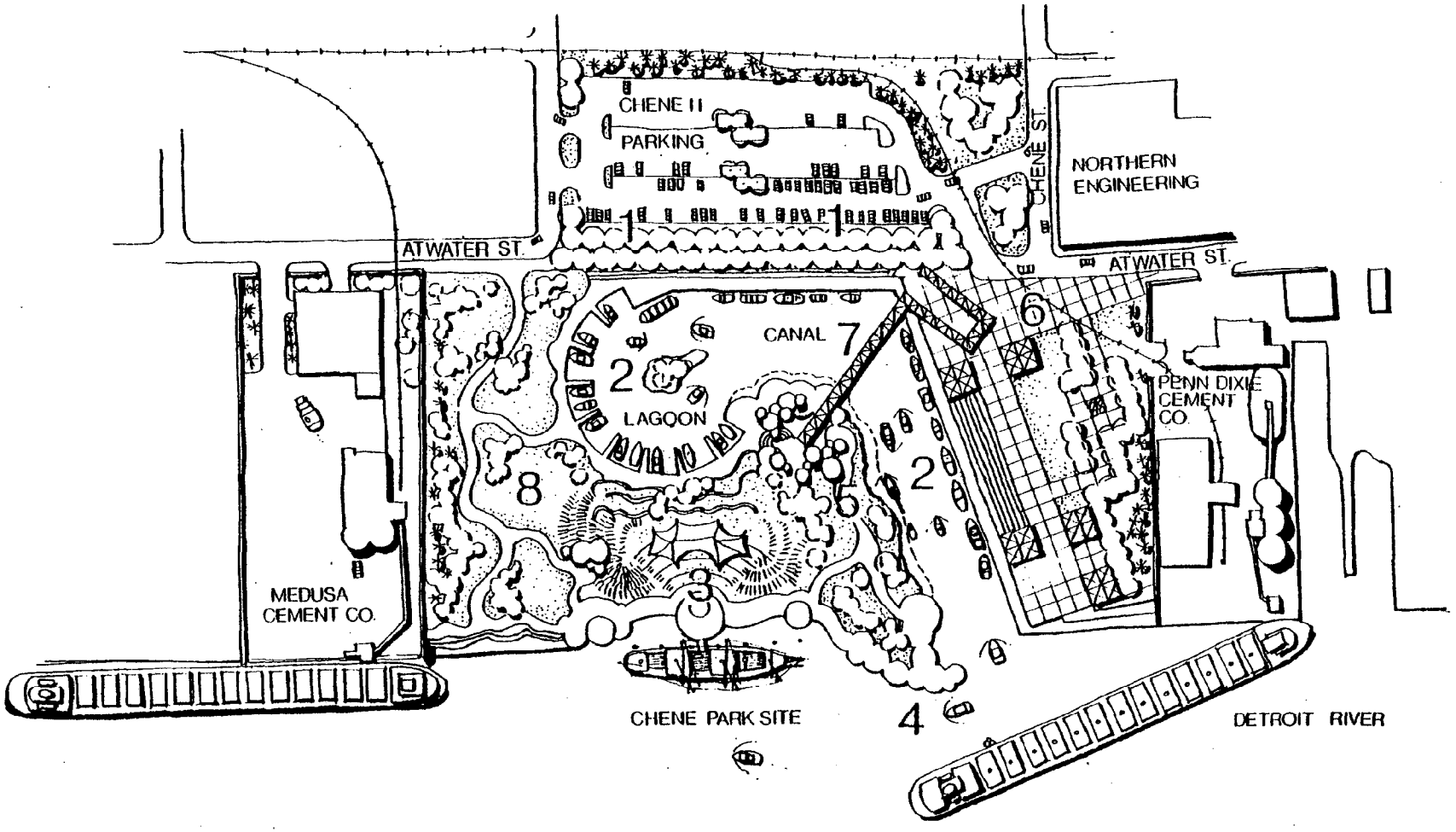
In addition to boat parking for pleasure craft, the canal accommodates a proposed tour boat concessionaire at a point approximately midway along its length. The tour boat is proposed to travel through the canal at regular intervals and may connect to Belle Isle, points downtown and to Windsor.



Access across the canal is accomplished by three bridges. One of these bridges is designed as a limited access vehicular bridge for park, maintenance and security vehicles and for primary truck access to the Medusa Cement Company. This vehicular bridge is not available to the public.

The remaining two bridges, one at Chene Park and one at St. Aubin Park, accommodate pedestrian users. Both bridges are ramped for bicycle and handicapped use and provide direct access to the Atwater Mall.

The consequence of this alternative configuration is to add approximately one mile of accessible river edge to the parks project while at the same time linking two diverse sites in an exciting and functional way.



LEGEND

1. ATWATER MALL
2. TRANSIENT BOAT PARKING
3. AMPHITHEATER
4. OVERLOOK/SCOOP
5. TOILET FACILITIES
6. PLAZA
7. PEDESTRIAN BRIDGE
8. OPEN SPACE

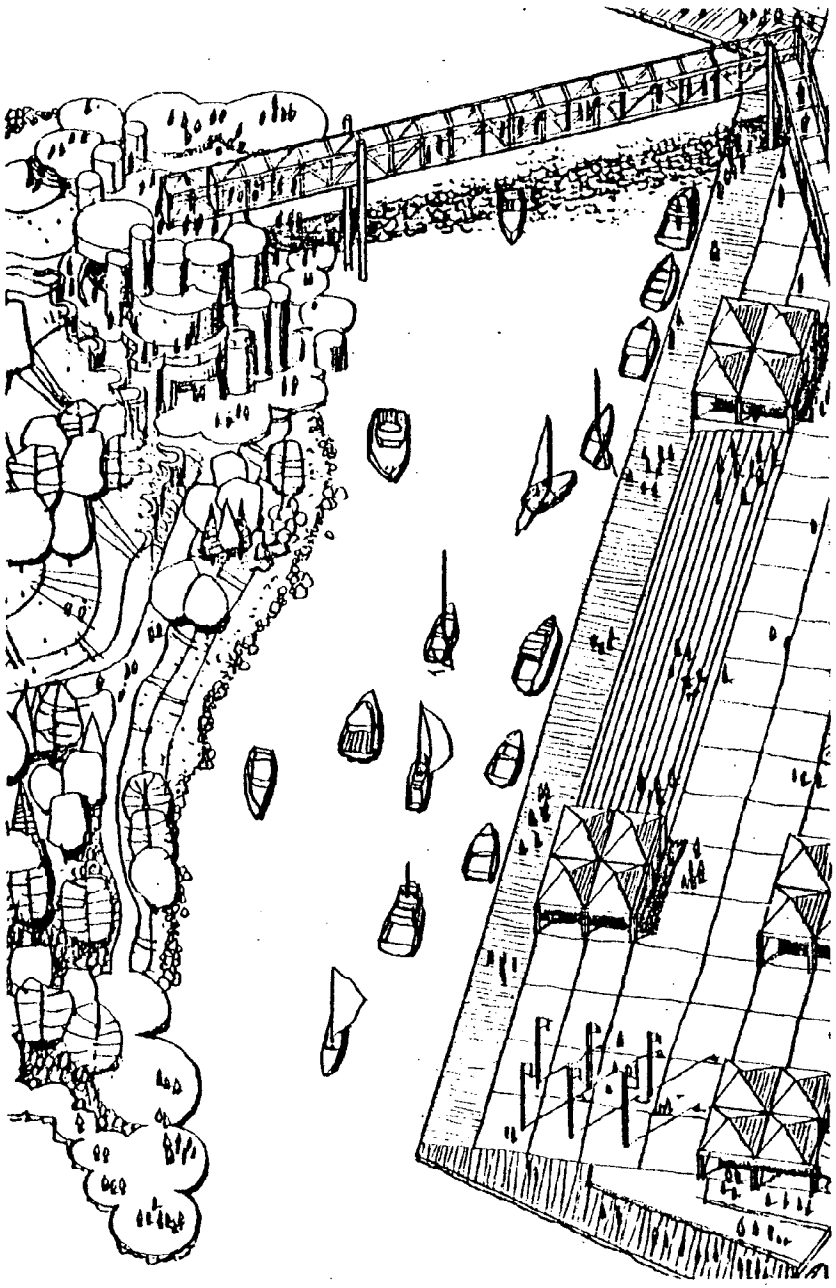
FIGURE 1.5: MARINA/LAGOON ALTERNATIVE

Marina/Lagoon Alternative

This alternative assumes the St. Aubin Park site is not acquired or acquisition is delayed. In this instance the configuration of the Chene Park is the same except that the canal terminates in a lagoon area at the west side of the site and Atwater is closed between Dubois and Chene Streets only. The lagoon permits limited transient boat parking, but the boaters enter and exit at the same point. Because the entry and exit are combined, flow is restricted which potentially causes stagnation. This problem is investigated further in this study. The tour boat would have facilities similar to those in the Marina/Canal Alternative except that they are provided at the west side of the lagoon adjacent to the Atwater Mall.

This alternative does not require a land trade with the Medusa Cement Company and consequently the truck, maintenance and security vehicle bridge is not required. The pedestrian bridges are likewise reduced from two to one. The remaining bridge on the Chene site would create immediate access to the center of the park rather than requiring people to travel completely around the lagoon to gain access.

The consequence of this alternative configuration is to add approximately 2,000 feet of accessible river edge to the parks project. It does not, however, link the park sites nor does it have the extensive boat parking capacity of the first alternative.



Technical Marina/Canal Configuration 2.0

2.1 INTRODUCTION

This chapter investigates the marina/canal configurations from three technical viewpoints: 1) wave action impacts upon navigation and boat mooring; 2) hydraulic concerns for prevention of stagnation; and 3) impacts of constructing beyond the harbor line. These concerns are analyzed individually for each of the two marina/canal configuration alternatives.

2.2 WAVE ACTION CONCERNS

This phase of the report deals with the feasibility of the proposed canal and marina in terms of the impact of wave action upon navigation and mooring. Proper navigation in the canal and at the entrances requires that waves in the canal be no larger than waves in the Detroit River and that wave reflections inside the canal be suppressed. Wave reflections result in crossing wave patterns which reduce maneuverability. Small craft marina requirements specify that wave heights be no greater than 1.5 feet and preferably less than 1.0 feet where boats are to be moored (Reference 1).

Concern over wave action at this step of the project is due largely to problems encountered with floating docks installed at the shoreline of the Detroit River near Cobo Hall. Although no documentation could be found regarding this problem, it was the opinion of Detroit Harbormaster, Sargent B. Jiminesh, that problems occurred because the docks were unprotected from incoming waves and the waves were reflected by vertical walls behind the docks (Reference 2).

Marina/Canal Alternative

Wave action concerns in this report examine both the St. Aubin canal entry and the Chene Street canal entry. The marina/canal alternative requires that both entering locations be analyzed for feasibility; whereas the second alternative, terminating in a lagoon, only requires the Chene entry to be analyzed. Since the proposed Chene Street entry configuration alternatives are the same for both canal alternatives no separate wave action analysis was conducted. The wave action results presented for the Chene Street entry, therefore, apply equally to both marina alternatives.

In order to evaluate the feasibility of the proposed canal and develop design criteria to mitigate wave action it was necessary to conduct a harbor model study. The use of model studies for designing harbors has been well established such that it would be unusual to design a new harbor without the aid of a model study (Reference 3). Preliminary design criteria for the

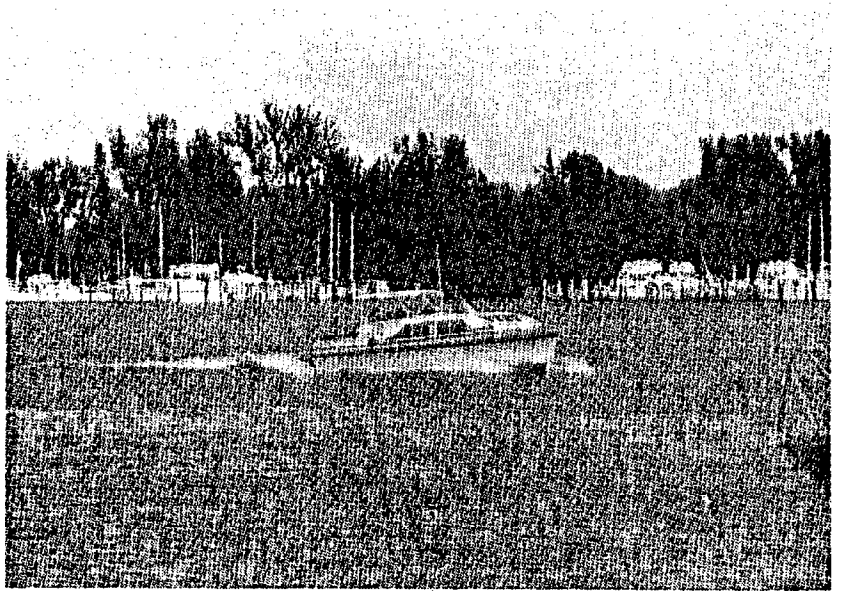


TABLE 2.1
COST COMPARISION OF ALTERNATIVE EDGE TREATMENT

EDGE TREATMENT ALTERNATIVE	CANAL WALL[1] $/LINEAL FOOT	RIVER SHORE-LINE WALL[2] $/LINEAL FOOT
A - TWO LAYERED RUBBLE MOUND WALL WITH 0.5' CONCRETE CAP	901	945
B - TWO LAYERED RUBBLE MOUND WALL WITH 5' CONCRETE CAP	920	978
B (MODIFIED) - HEAVY RIP RAP ONLY	896	NOT FEASIBLE
C - RIP RAP	126	NOT FEASIBLE
D - VERTICAL WALL W/ CONRETE CAP	852	1275
E - VERTICAL, CURVILINEAR WALL W/ CONCRETE CAP	988	1442
F - VERTICAL, ZIG ZAG WALL WITH CONCRETE CAP	1230	1810
G - RIP RAP, GRADE BEAM, STEPS AND WOOD DECK	641	NOT FEASIBLE
O - OVERLOOK EDGE, VERTICAL WALL W/ CONCRETE CAP	NOT APPLICABLE	1230
Tr - TRANSITION EDGE, RUBBLE CANAL EDGE TRANSITION TO VERTICAL RIVER EDGE	NOT APPLICABLE	1000

canal entrances at St. Aubin and Chene Street was determined by Dr. E.F. Brater, professor at the University of Michigan, Dr. D.C. Wiggert, professor at Michigan State University and personnel of Snell Environmental Group, Inc. This information was forwarded to Schervish, Vogel, Merz, P.C. and incorporated in the canal layout so that alternative canal entrances could be developed and analyzed in the model study.

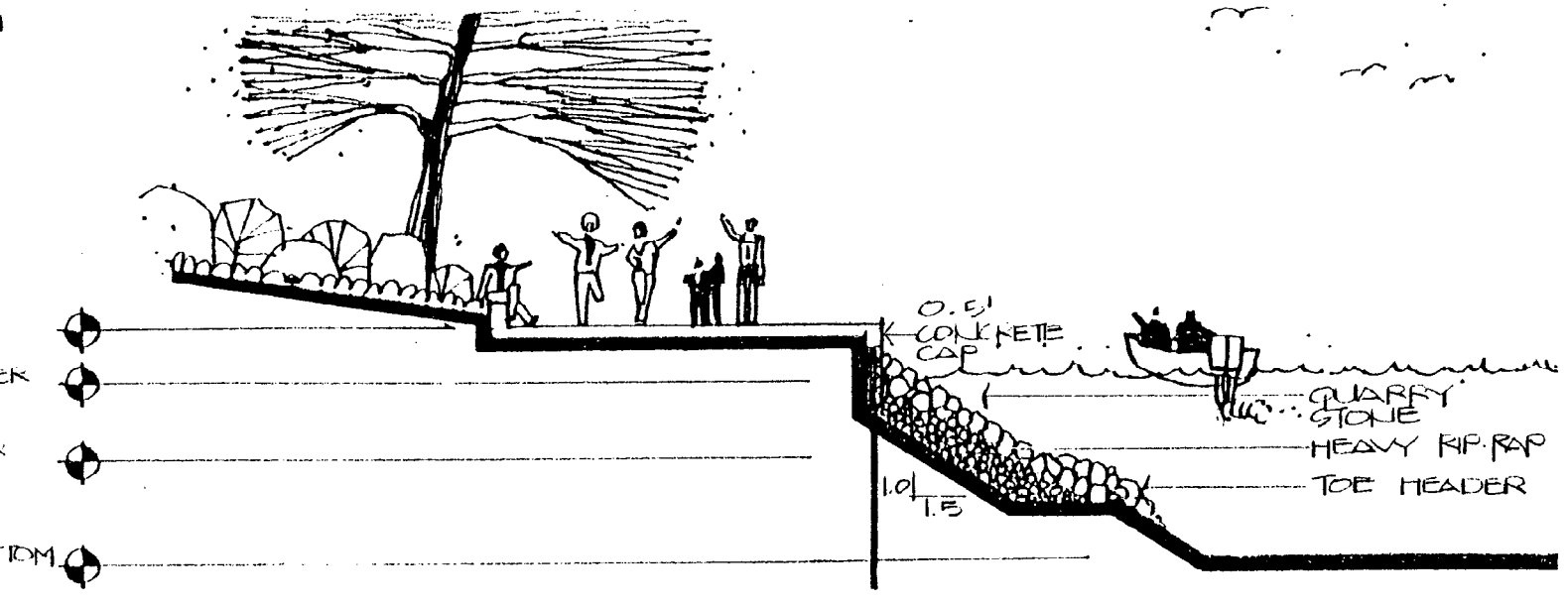
Alternative edge treatments are presented in Figure 2.1. Present day estimates, including materials, construction and excavation, for the wall are given for each edge alternative in Table 2.1. Alternatives A or B are considered necessary only for the canal entrances where wave action is of concern. Alternative C is not considered to be feasible for canal walls at the entrances exposed to high wave action. Alternatives A and B are identical except that the rubble of Alternative A begins 0.5 feet below the surface instead of 5.0 feet as in Alternative B. Alternative A thereby affords more wave protection and can be expected to function adequately for low, average and high water conditions. Alternative B is expected to provide sufficient protection only during low and average water conditions; at high water the vertical wall will not absorb wave action.

[1] Includes materials, construction, and excavation assuming vertical height of 14.5' from canal bottom to top of wall.

[2] Includes materials, construction, and excavation assuming vertical height of 29' from river bottom to top of wall.

NOTE: Costs are present day costs.

FIGURE 2.1



EDGE ALTERNATIVE A

Edge Alternative A is a two layered rubble mound wall with a 0.5 foot concrete cap formed on steel sheet pile. The bottom of the rubble wall is composed of heavy rip-rap with the top layer of boulders and quarry stone for aesthetic reasons. The wall reduces the depth the sheet pile must be driven and simplifies its construction.

Application: use where edge construction requires hard surfaces along edge and where rip rap is needed to dissipate wave action. Proposed locations are at the St. Aubin entrance and at the water play fountain.

Maintenance: minimal maintenance. Boulders may require periodic adjustment. Litter and debris clean-up will be required.

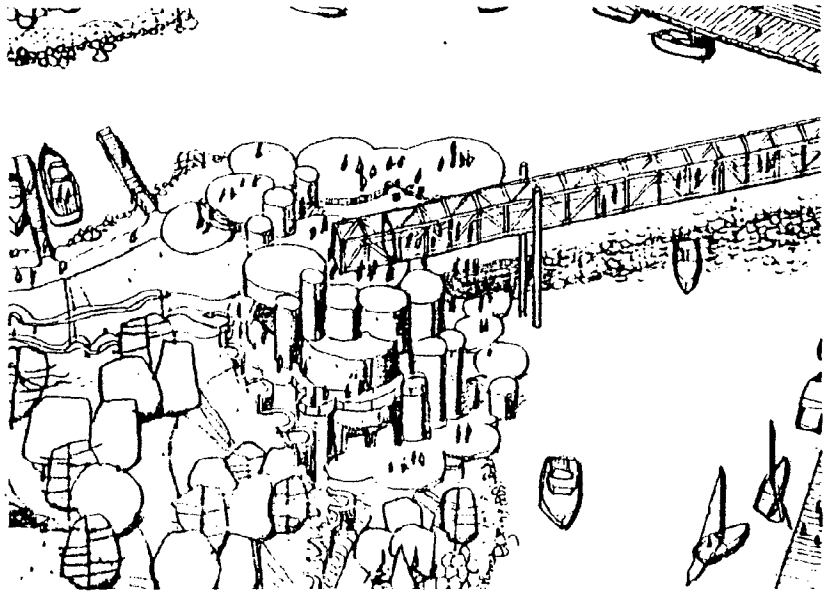
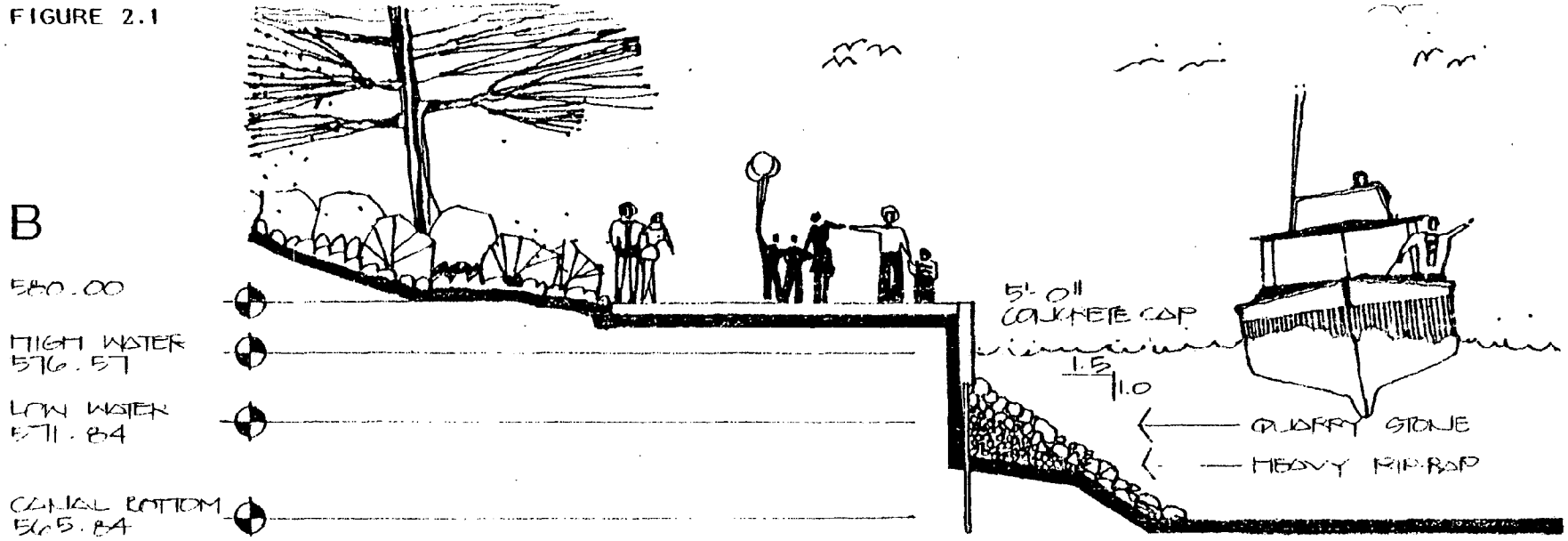


FIGURE 2.1



EDGE ALTERNATIVE B and B (Modified)

Edge Alternative B is similar to Alternative A except that a 5 foot concrete cap is used. This limits the distance required for the slope of the rubble wall. The bottom layer of the wall is composed of heavy rip-rap and the top layer of boulders and quarry stone for aesthetic reasons. B (Modified) eliminates the boulders and quarry stone when not visible.

Application: use where hard surfaced edge is required, but limited space is available. Dissipation of waves is reduced due to lower rubble wall elevation. Proposed locations on the island are at the St. Aubin pedestrian bridge and truck bridge.

Maintenance: minimal maintenance. Boulders may require periodic adjustment. Litter and debris clean-up will be necessary.

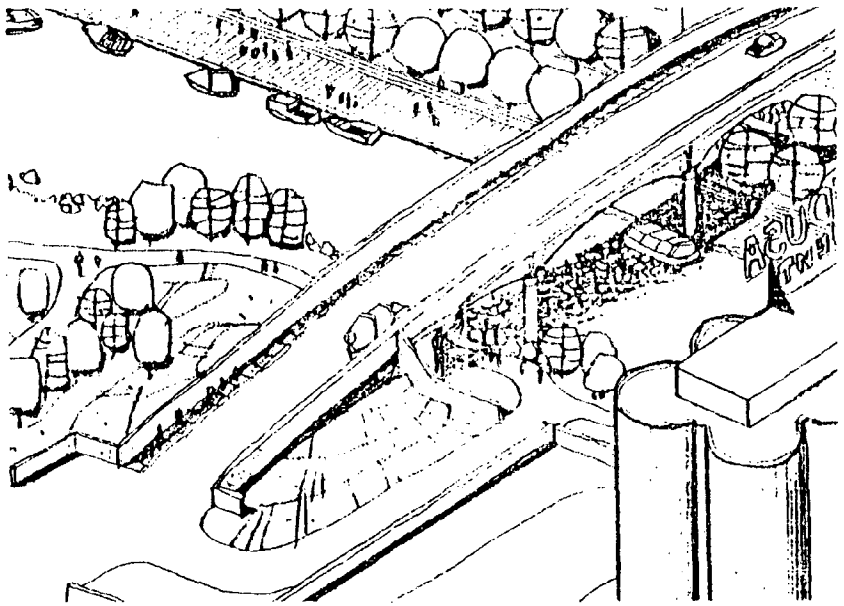
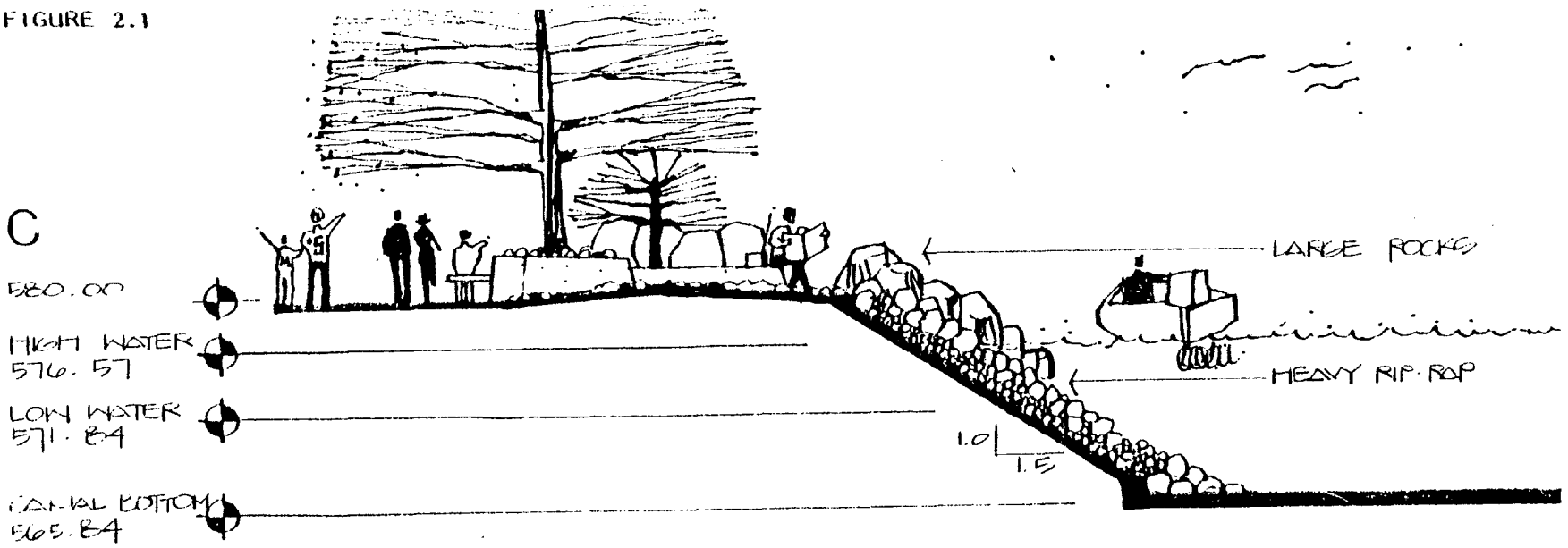


FIGURE 2.1



EDGE ALTERNATIVE C

Edge Alternative C is a rip-rap wall on a sloping bank with large 4-5 foot boulders above the water line for visual reasons.

Application: use where wave dissipation is required, but heavy near shore structural support is not necessary. This edge is not recommended near the Detroit River edge. It is to be used on the island side as the predominant edge where special conditions do not exist.

Maintenance: a moderate amount of maintenance will be required to adjust boulders and to clean litter and debris from between boulders.

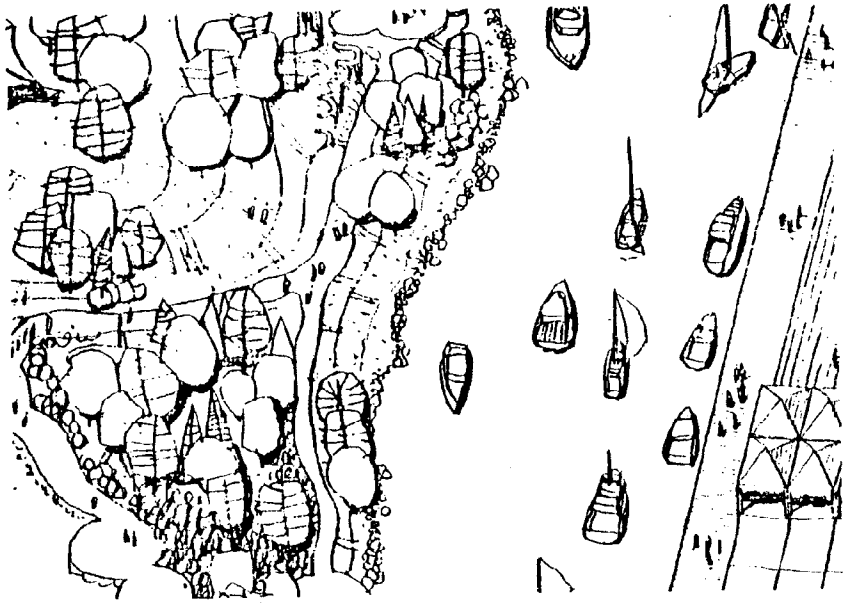
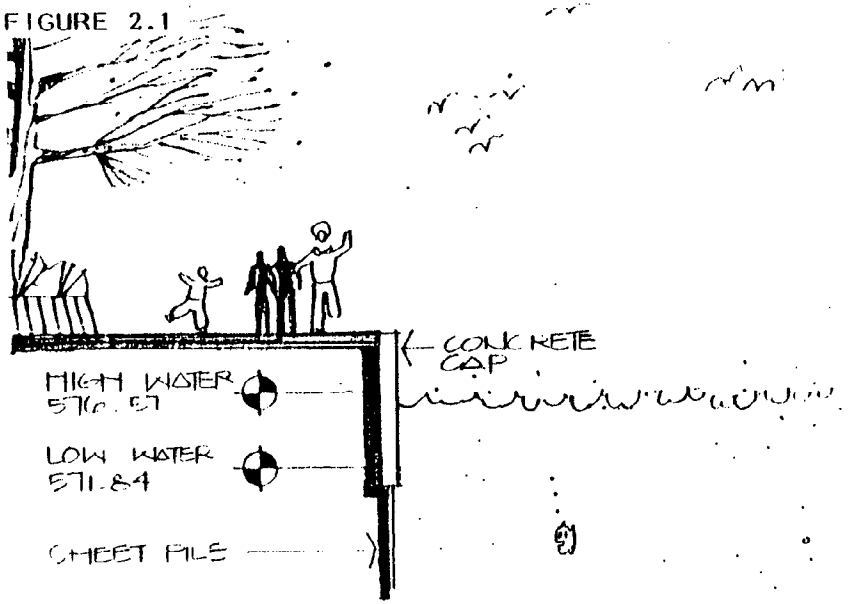
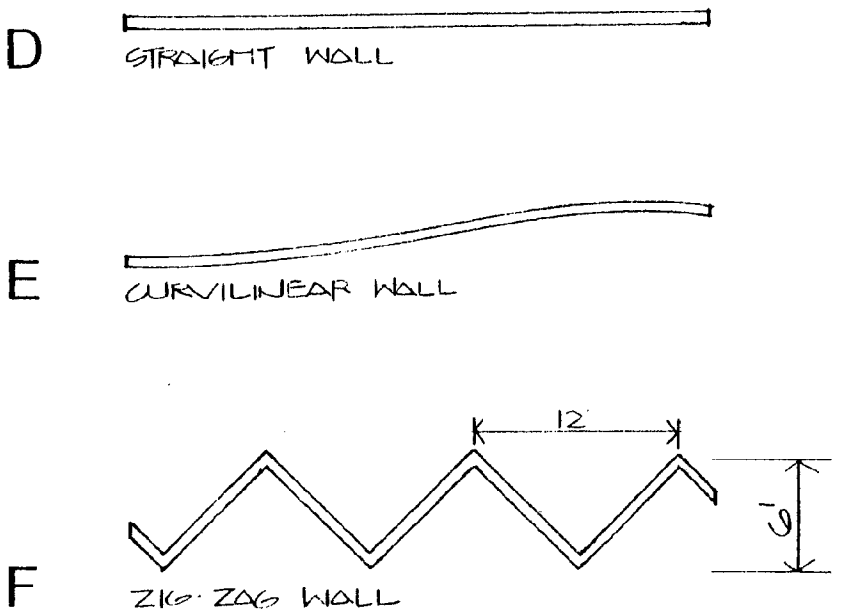


FIGURE 2.1





EDGE ALTERNATIVES D, E, F, AND O

These edge types are all similar in section, but different in plan configuration. All are vertical steel sheet pile edges without rubble mound walls.

Applications: use these edge types where high edge stability and vertical walls are necessary or where sloping rubble walls are impractical. Use of edge type F, zig zag construction, dissipates wave action, but is not used since preference is given to rip-rap edge variations. Edge type D is used at the small island in the canal at Chene Park; under the pedestrian bridge at St. Aubin Park on the Atwater side; and at the straight wall between the Chene entry and Penn-Dixie Cement Company. Edge type O is used only at the overlook land extensions at the canal entries.

Maintenance: very minimal maintenance.

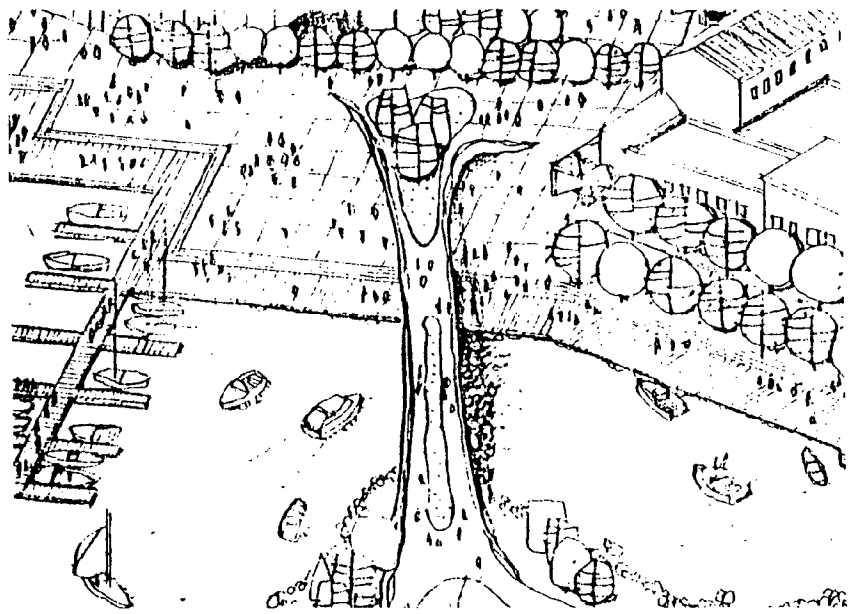
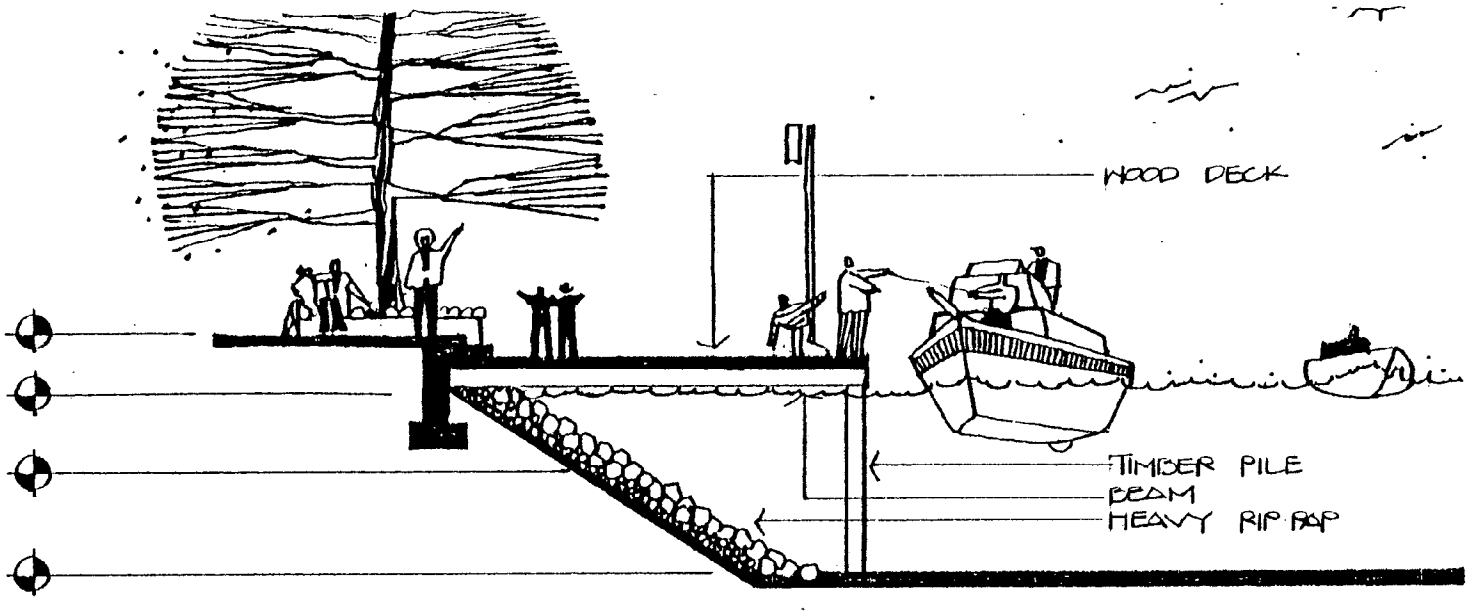


FIGURE 2.1

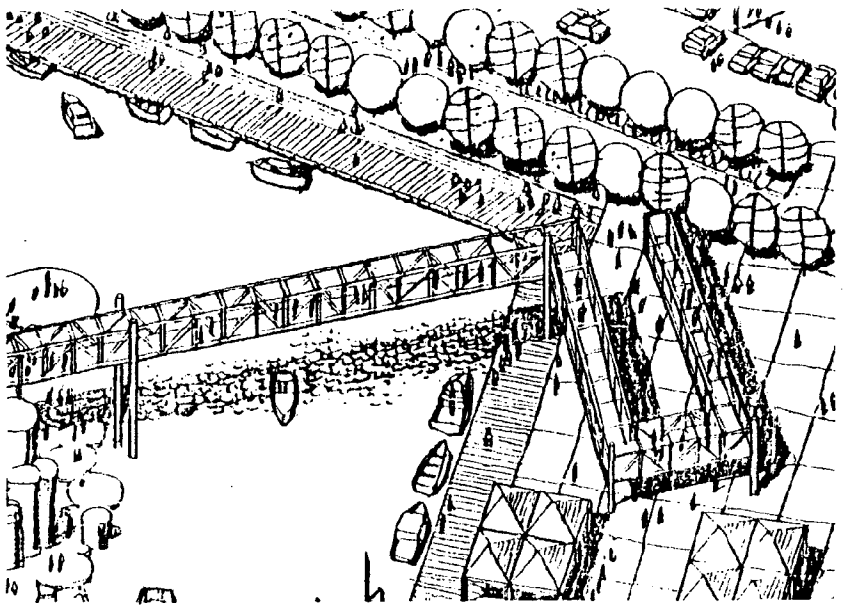


EDGE ALTERNATIVE G

Edge Alternative G is composed of a heavy rip-rap wall with a wood deck structure extending over the rip-rap to allow for boat parking. In some instances it is used in conjunction with a floatation docking system.

Application: use wherever boat parking is desired. Steps down to the boardwalk allow for easier access to boats. The rip-rap wall mitigates wave and wake action in the canal.

Maintenance: the rip-rap walls may require adjustment of the boulders and the docking system will be subject to periodic maintenance and repair. Piling may require adjustment to keep erect.



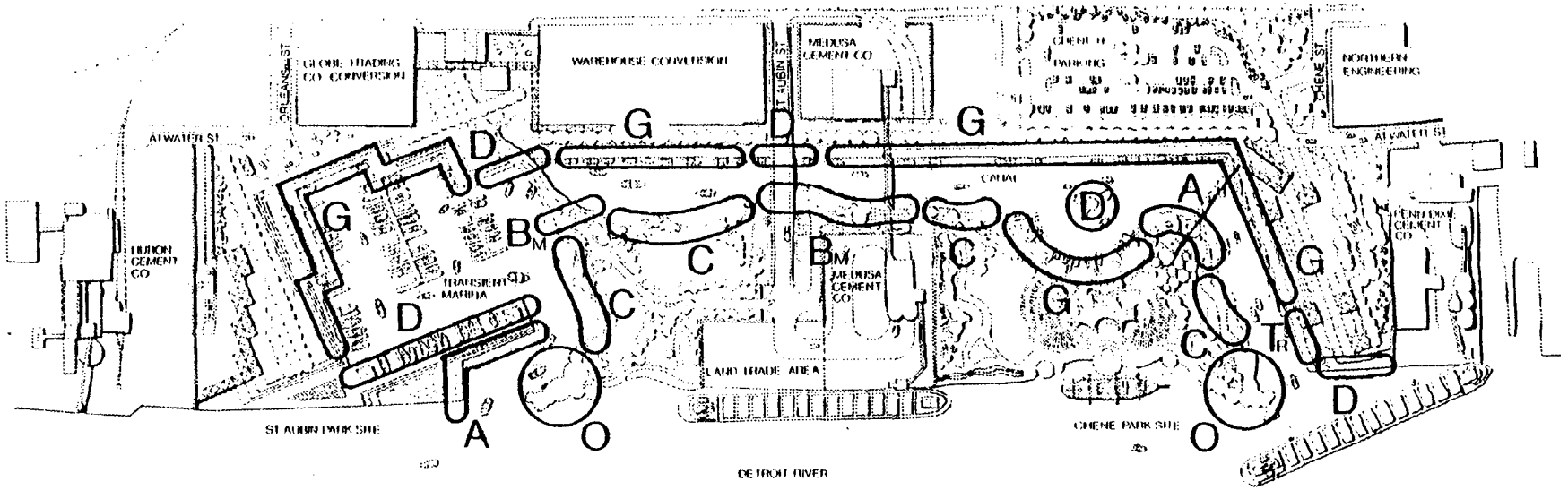


FIGURE 2.1A: MARINA/CANAL ALTERNATIVE: EDGE TYPE LOCATIONS

The selection of edge conditions for the Marina/ Canal Alternative were based upon edge function, wave dampening characteristics, aesthetics and cost. Due to the variety of functions, configurations and hydraulic requirements the edge conditions selected vary considerably from place to place. Figure 2.1A shows the variety of edge conditions required for the Marina/Canal Alternative. Edge type G is used most often because of the favorable wave dampening characteristis of the rip rap and its wood deck construction, which allows for boat dockage. Edge type C, rip rap construction, is the predominant edge along the island because of its- aesthetic appeal, wave dampening ability and its low cost. The edge type O, used only in the overlooks, is sheet pile construction and has the same characteristics as edges D, E, and F, but because it is the transition between the canal and the river it is unique. The other edge types along the canal

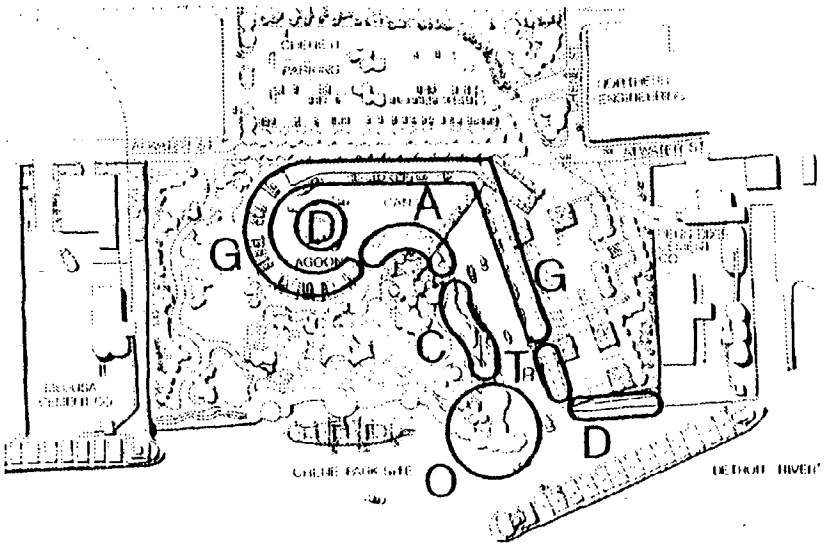


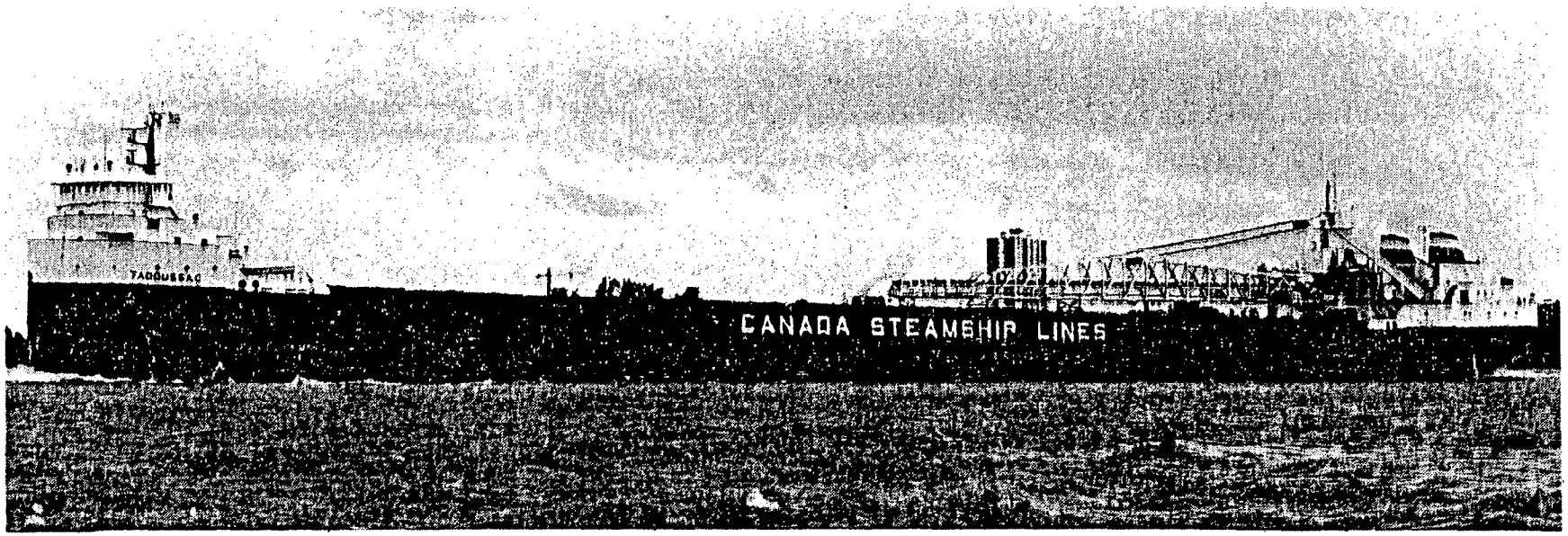
FIGURE 2.1B: MARINA/LAGOON ALTERNATIVE: EDGE TYPE LOCATIONS

were selected for their various properties and clearance requirements because space did not permit for a sloping rip rap edge. Figure 2.1 gives the advantages and disadvantages of the various edges and their applicability.

The Marina/Lagoon Alternative, shown in Figure 2.1B, likewise has several edge conditions. These were selected on the same basis as the Marina/ Canal Alternative. As above, edge type G is the predominant edge used.

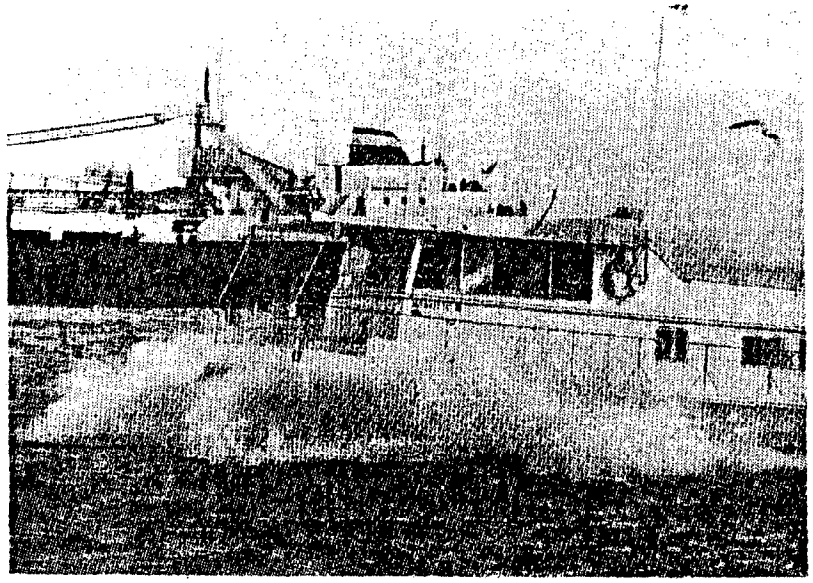
Waves on the Detroit River at the proposed canal site are caused from freighters, small craft vessels and wind. Time and financial constraints did not permit wave measurements, hence existing information and personal observations had to be relied on for wave information. The only wave records uncovered were found in a "Wyandotte Wave Study" report (Reference 4) by the Waterways Division of the Michigan Department of Natural Resources. A wave gage was installed near the Bob-Lo Dock, beside the Trenton channel at Wyandotte, approximately 17 miles downstream from the proposed canal site. The gage recorded 1476 wave periods of five minute durations between September and November, 1969. A maximum recorded water height by the gage was 1.2 feet. Recorded wave periods were on the order of two to four seconds.

Two types of waves are thought to be generated by freighters. The most common, and the type that occurs at the proposed canal site in the Detroit River, are bow waves. The second type of wave that freighters can generate is a surge wave resulting from the displacement of water in a restrictive channel. Surge waves are not expected in the Detroit River at the proposed canal site because the river is relatively large in com-



parison to the volume of water displacement by freighters.

Personnel of the U.S. Coast Guard and the Detroit Harbormaster feel that freighters can be expected to generate waves up to a maximum of 4 feet, (References 2 and 5). It is the opinion of experts at the University of Michigan, however, that freighter generated waves will not impact the proposed canal site as much as wind waves because wave dampening due to friction and energy transmission will occur between the shipping channel and the Detroit River shoreline (References 6 and 7). Energy transmission is the phenomenon where a train of waves will generate a new wave every wave period and the wave energy will be transmitted over the longer wave train, resulting in lower wave heights. Three unloaded freighters observed by SEG staff on April 13, 1980, at Belle Isle, generated waves approximately 1 foot high and 20 feet in length. On June 1, 1980, SEG staff observed waves from Hart Plaza between 3 p.m. and 7 p.m. A west wind on the order of 20 mph generated two foot waves in the River and no larger waves were observed at the shoreline when freighters passed.



Small craft waves up to 3 feet can be expected at the proposed canal site according to U.S. Coast Guard personnel. Because of the numerous small craft vessels operating in the vicinity of the canal site, small craft waves may have a more significant impact on the canal than freighter waves.

Wind wave estimates were determined based on the Sverdrup-Munk Bretschneider method as outlined in the Shore Protection Manual, Volume I, assuming sufficient wind duration to produce a fully arisen sea (Reference 8). With this assumption, wave heights and periods are dependent on wind speed and the effective fetch.

The strongest one minute winds recorded for Lake St. Clair since 1940 were 70 mph from the south (Reference 9). It is not expected that wind in excess of 60 mph would blow for a sufficient duration to develop fully arisen conditions at the site of the proposed canal.

Gravity waves can be classified as deep water, transitional or shallow water waves. Since the relative depth (depth/wave length) is greater than one-half for the Detroit River, deep water conditions occur and the waves are independent of water depth. The following two empirical equations were used to determine wave heights and periods for deep water conditions (Reference 8):

$$\frac{gH}{U^2} = .283 \tanh\left[0.0125 \left(\frac{gF}{U^2}\right)^{0.42}\right]$$

$$\frac{gT}{2U} = 1.20 \tanh \left[0.077 \left(\frac{gF}{U^2} \right)^{0.25} \right]$$

Where: H = Significant wave height in feet
T = Significant wave period in seconds
F = Effective fetch in feet
U = Wind speed in feet/seconds
g = Gravitational constant = 32.2 feet/second^2.

The significant wave height is defined as the average height of the one-third highest waves. It is about equal to the average height of the waves as estimated by an experienced observer. The significant wave period is defined as the average of 10 to 15 successful prominent waves.

Wave estimates at the proposed canal site, computed for south, southeast, and east winds of 40, 50 and 60 mph are given in Tables 2.2 and 2.3. Table 2.2 is based on a 1.1 mile effective fetch while 2.3 is based on a 0.5 mile fetch. In reference to the proposed canal site, an east wind would be a wind blowing downriver parallel to the shoreline while a southeast wind would be a wind blowing upriver and a southeast wind would blow across the river from Canada. The wave heights listed below agree well with opinions of U.S. Coast Guard personnel who feel wind waves up to 3 feet can be expected on the Detroit River at the proposed canal location.

Facilities at the University of Michigan Lake Hydraulics Laboratory were used for the model study. Work was done under the direction of Dr. D.C. Wiggert, Associate Professor of Civil Engineering, Michigan State University, with assistance from Dr. E.F. Brater, Professor of Hydraulic Engineering, University of Michigan. Dr. Brater suggested that the model study focus on the canal entrances so that a suitable entrance could be de-

TABLE 2.2
WIND WAVE DATA FOR SOUTH AND EAST WINDS

WIND SPEED (MPH)	WAVE HEIGHT (FT)	WAVE PERIOD (SEC)	WAVE FREQUENCY (CYCLES/SEC)	WAVE LENGTH (FT)
40	2.3	3.0	.33	46
50	2.9	3.4	.28	59
60	3.6	3.7	.27	70

TABLE 2.3
WIND WAVE DATA FOR SOUTHEAST WINDS

WIND SPEED (MPH)	WIND HEIGHT (FT)	WAVE PERIOD (SEC)	WAVE FREQUENCY (CYCLES/SEC)	WAVE LENGTH (FT)
40	1.5	2.3	.43	27
50	1.9	2.6	.38	35
60	2.4	2.9	.34	43

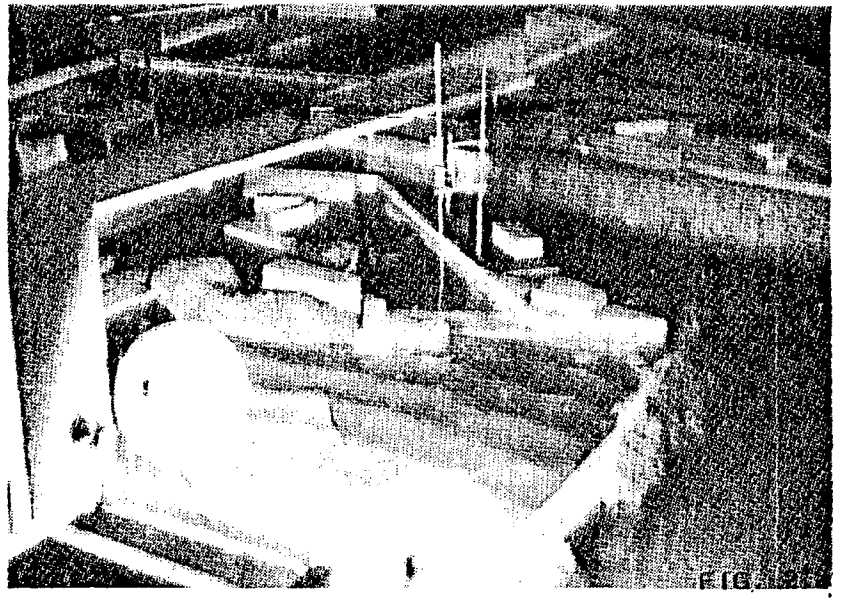


FIG. 2.4

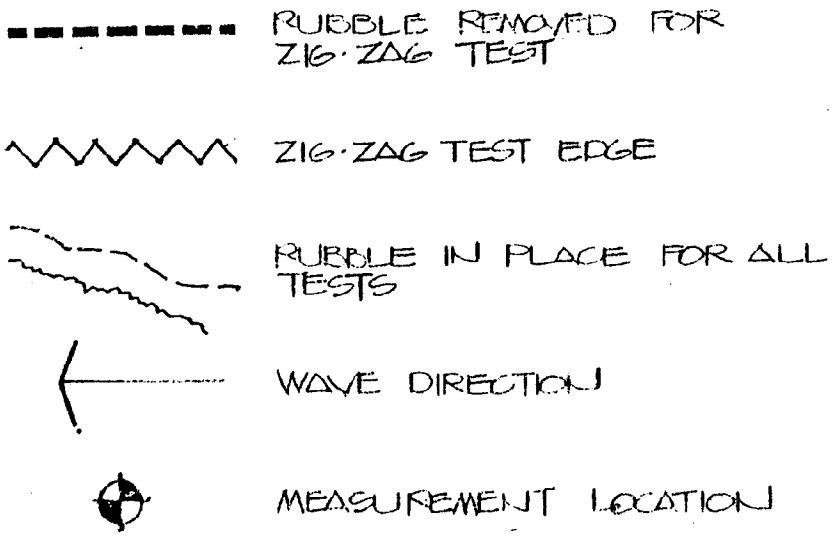
signed to prevent significant wave action inside the canal. Only the harbor entrances were examined in the model study on the basis that it would not be necessary to model the entire canal if waves could be suppressed when initially entering the canal. This allowed for a much larger model scale to be used than if the entire canal were modeled.

A tank, 8 feet by 8 feet, shown in Figure 2.2 was used for the study. The scale ratio of the model was 100 to 1. This scale provided the largest model that could be built while still providing room to maneuver the models into various positions to stimulate different wave directions. A total of four entry configurations were modeled. Two harbor entrances, shown in Figures 2.3 and 2.4 were constructed to model the St. Aubin entry while one model, shown in Figure 2.5 was built for the Chene entrance. The Chene entry model was built such that an entrance wall could be removed to simulate a second alternative entrance shown in Figure 2.6. The models were constructed of wood. Rubble mound walls were simulated by tacking strips of mat material to canal walls. Wave absorbers were installed around the walls of the tank to prevent waves reflecting from the tank walls.

The wave height and wave frequency produced by the wave machine were regulated according to Froude model scaling. A prototype depth of 10 feet, representing average water conditions, was maintained in the canal entrances during testing and seawalls were modeled to a prototype height 4 feet above water. Prototype wave heights, wave periods and wave lengths of 4 feet, 3.4 seconds and 60 feet were simulated in the model. Corresponding values used in the model were 0.04 feet, 0.34 seconds and 0.6 feet. Dr. Brater suggested that if conditions in the canal entrances are satisfactory for a steady train of these waves, the canal will perform satisfactorily for other wave conditions as well.

The four entry configurations were each tested for south (S), southeast (SE) and east (E) waves as shown in Figures 2.3 through 2.6. Figures 2.7 through 2.9 show harbor Alternative B of the St. Aubin entrance under the three wave directions. Visual observations, photographs, and measurements were taken for each model configuration and wave orientation. Harbor modifications such as rubble, zig zag walls and reduced entrance ways were also tested in order to seek optimum harbor conditions.

LEGEND



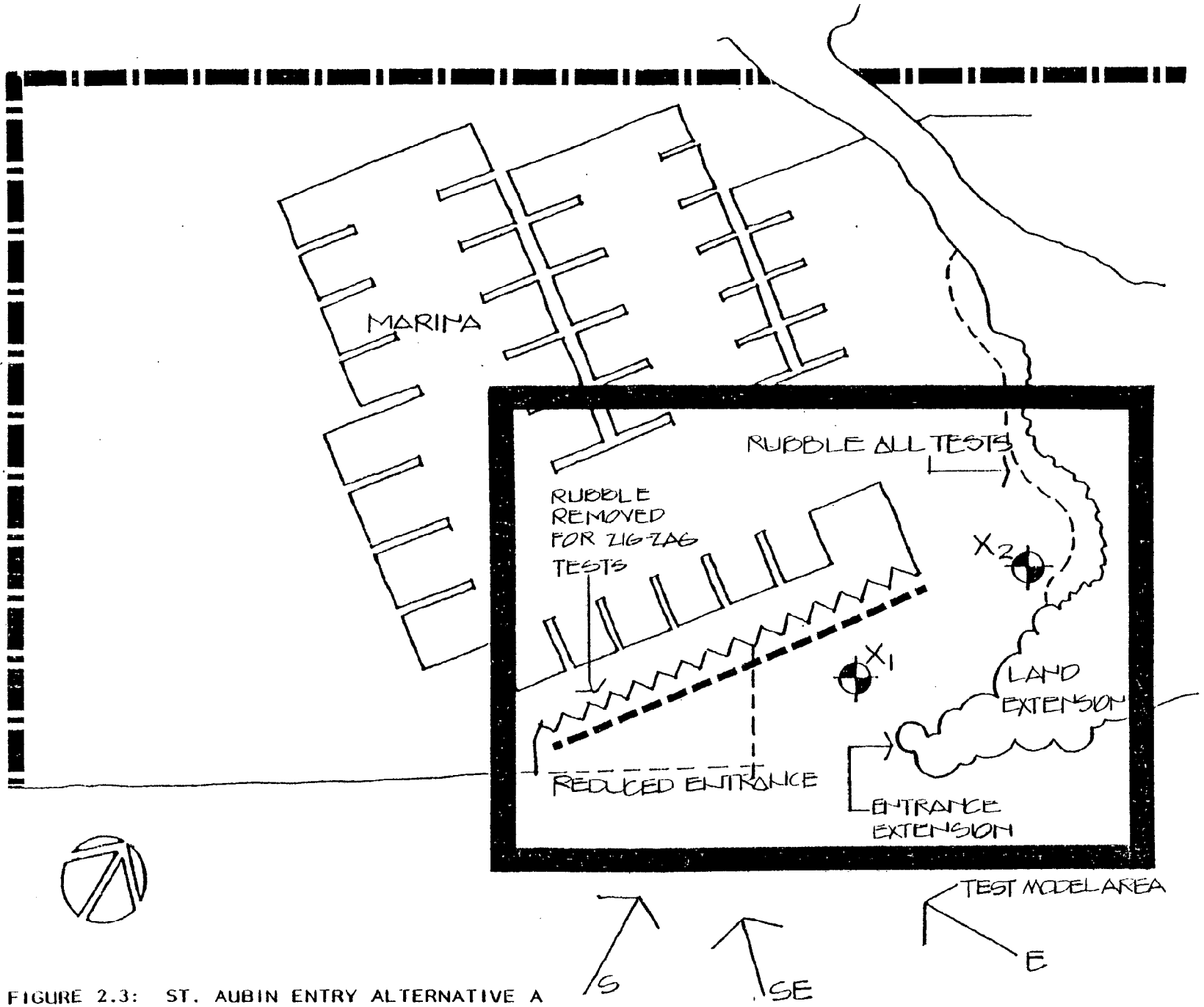


FIGURE 2.3: ST. AUBIN ENTRY ALTERNATIVE A

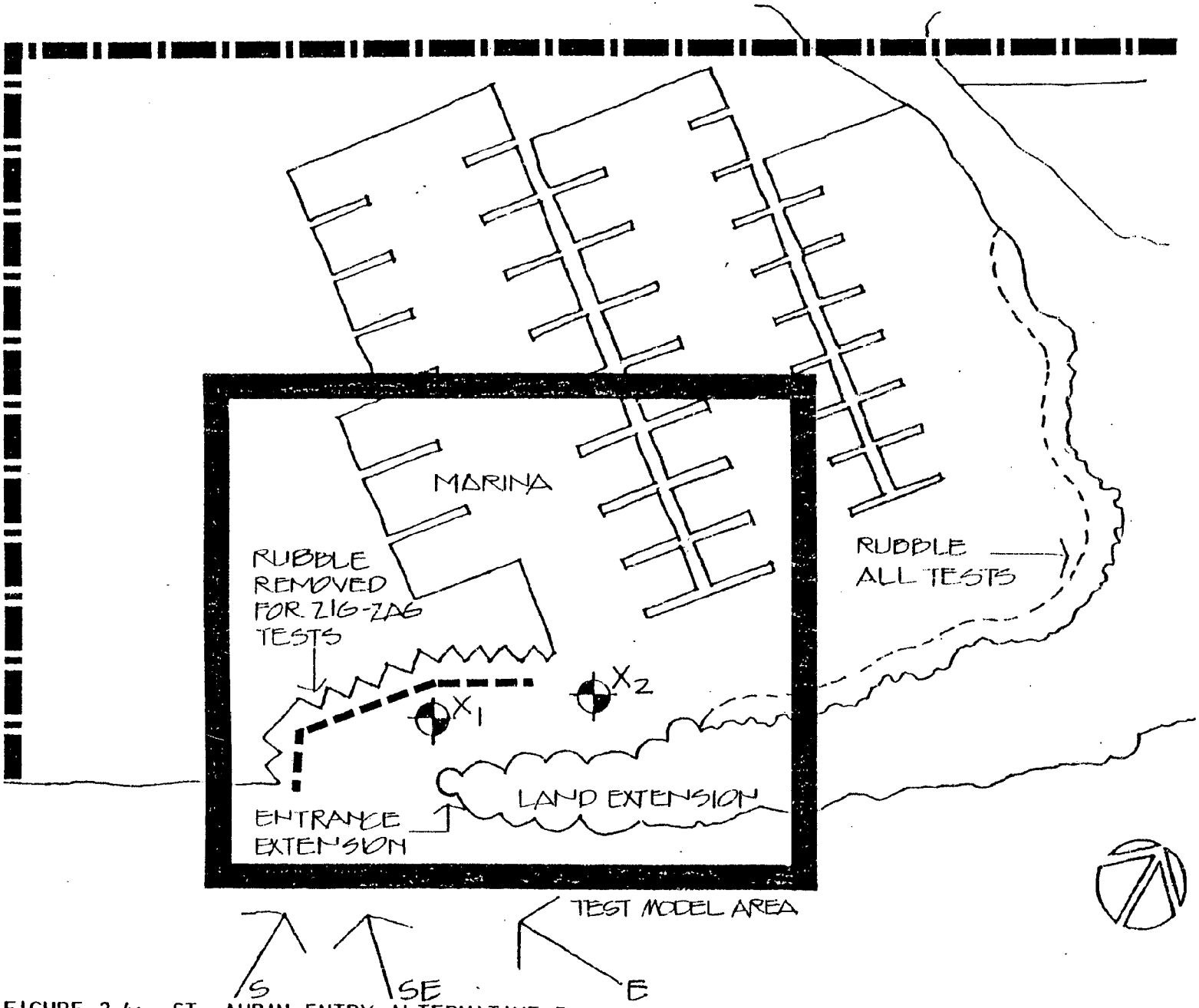


FIGURE 2.4: ST. AUBIN ENTRY ALTERNATIVE B

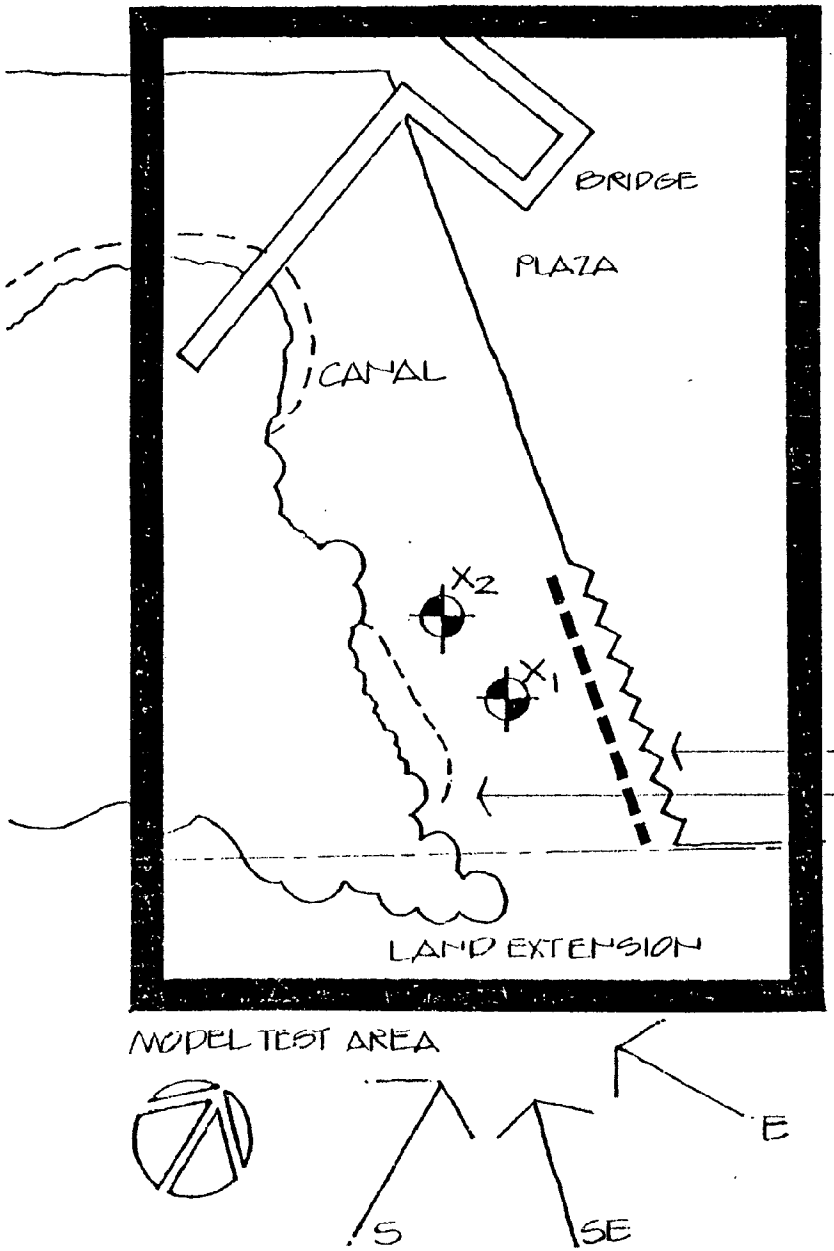


FIGURE 2.5: CHENE ENTRY ALTERNATIVE A

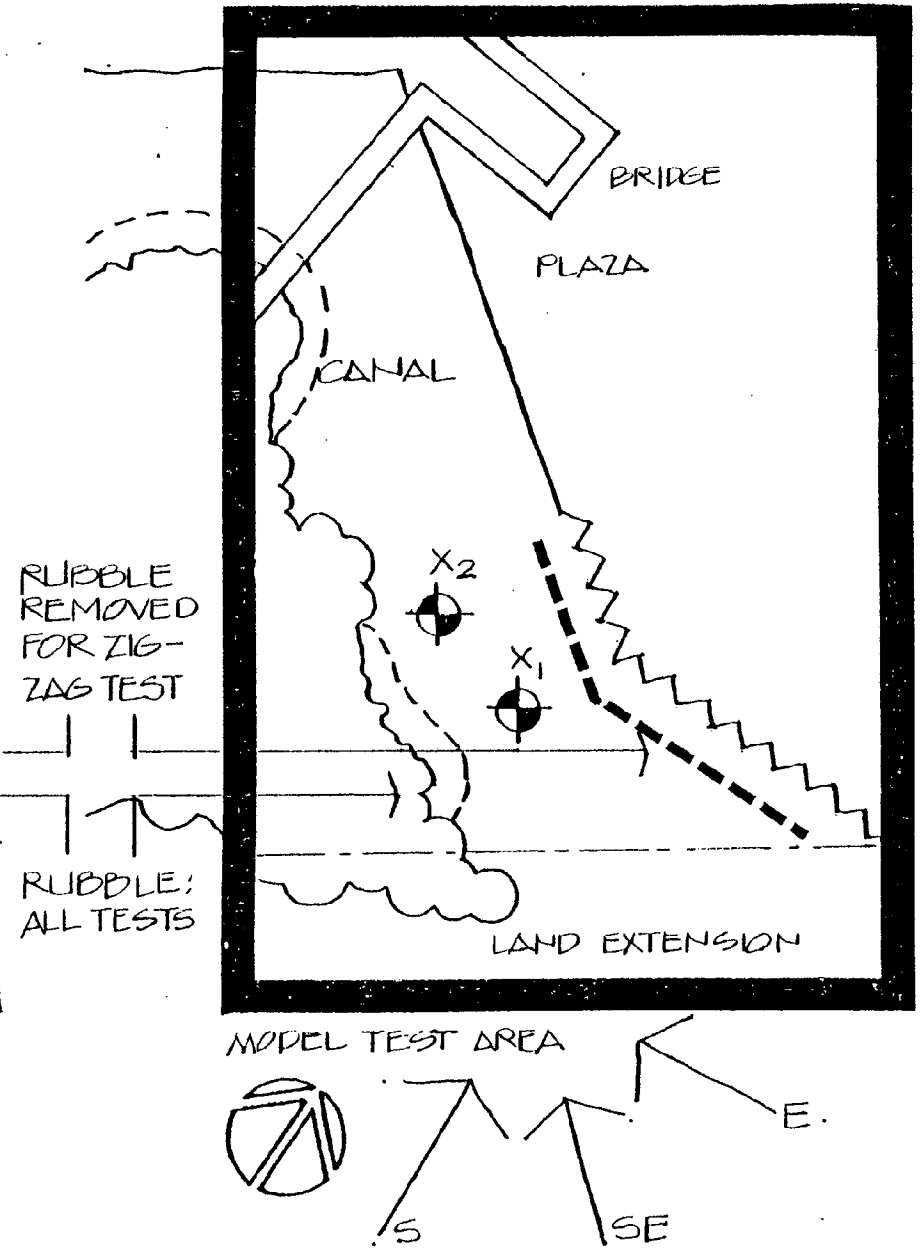


FIGURE 2.6: CHENE ENTRY ALTERNATIVE B

Measurements were taken using a point gage with a vernier scale, capable of measuring to the nearest 0.001 feet. Wave heights were determined by measuring the still water level and wave crest for a train of ten to twenty waves and multiplying the difference by two. By measuring the first ten to twenty waves generated by the wave machine, reflections inside the harbor could be accounted for without including the resonance effects produced from waves reflecting from the shoreline of the model. Although no analysis was conducted to define experimental error, on the basis of repeated observations, it is assumed to be about $\pm$ 20%. The experimental error is due largely to the fact that the wave peaks measured at a particular location were not at all the same height. Therefore, the recorded wave peak was somewhat subjective on the part of the observer. Measurements were repeated several times to ensure consistency.

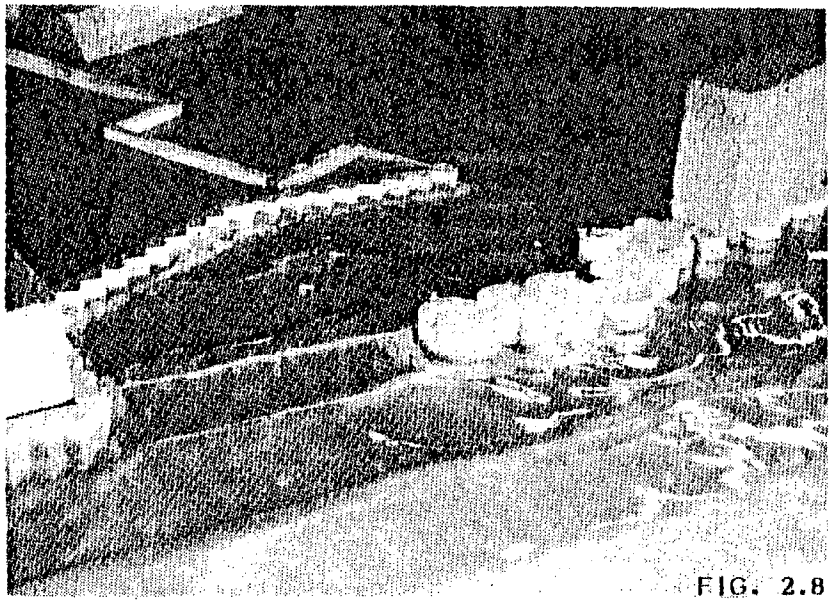


FIG. 2.8

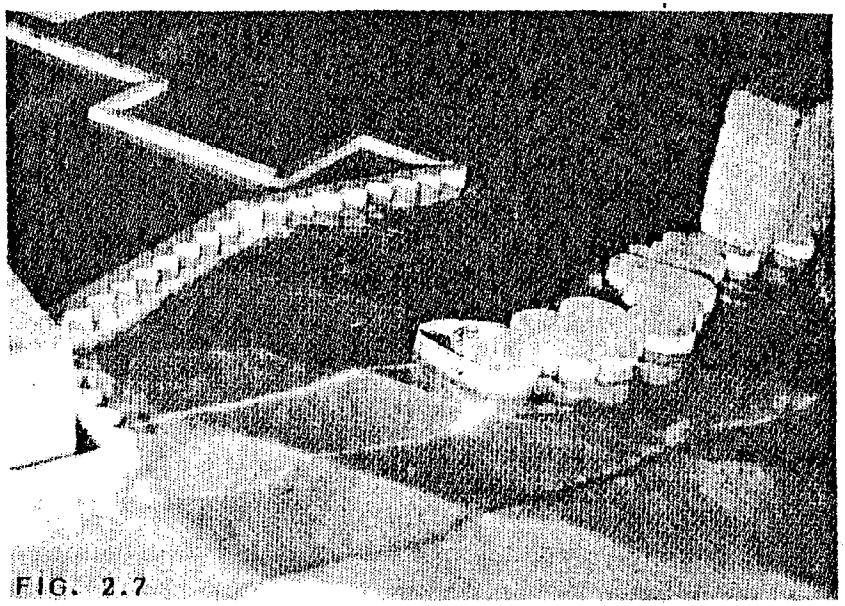


FIG. 2.7

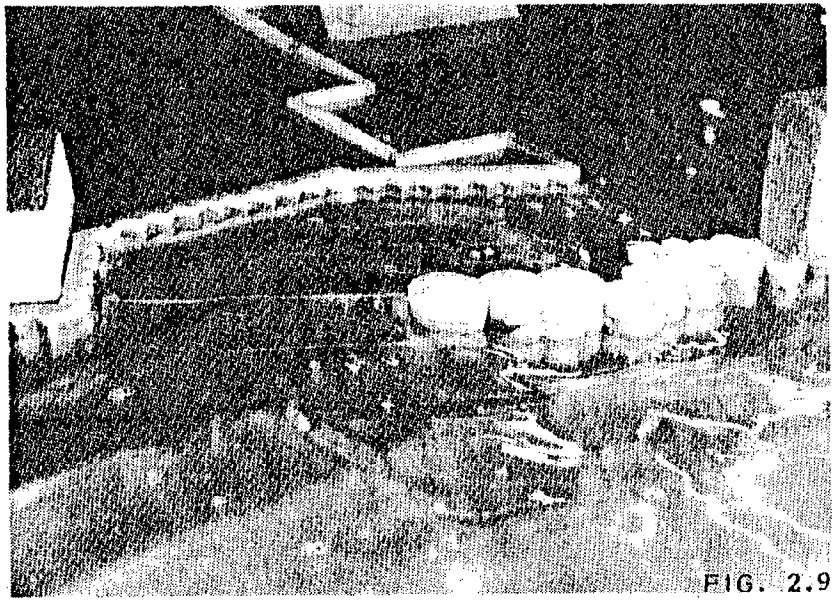


FIG. 2.9

TABLE 2.4
ST. AUBIN ENTRY WAVE MEASUREMENTS
(Relative to Deep Water Wave)

	ENTRANCE MODEL MODEL AND WAVE ORIENTATION	ALTERNATIVE A S	SE	E	ALTERNATIVE B S	SE	E
PT. 1	ZIG ZAG	-	-	.39	.33	.39	-
	RUBBLE	-	-	.22	.50	.50	-
	ZIG ZAG ENTRANCE EXTENSION	.78	.61	-	-	.39	.33
	RUBBLE ENTRANCE EXTENSION	.61	.56	-	.33	.39	.33
	RUBBLE ENTRANCE EXTENSION REDUCED ENTRANCE	.33	-	-	.39	-	-
PT. 2	ZIG ZAG	-	-	.11	-	.11	-
	RUBBLE	-	-	.11	-	-	-
	ZIG ZAG ENTRANCE EXTENSION	.33	.22	-	.17	-	.11
	RUBBLE ENTRANCE EXTENSION	.44	.06	-	.11	.11	.11
	RUBBLE ENTRANCE EXTENSION REDUCED ENTRANCE	.17	-	-	-	-	-

Wave height measurements were taken at two locations for each model test. The measurements are summarized in Tables 2.4 and 2.5 as the ratio of the measured wave height to the wave height of the incoming deep water wave. Location of measurements are shown in Figures 2.3 through 2.6. Selected photographs are given in Figures 2.7 through 2.17 of this report. Additional measurements and photographs are on file are Snell Environmental Group, Inc. in Lansing, Michigan.

Visual observations of the model tests were used in conjunction with photographs and wave measurements to evaluate the performance of the canal entrances. Whereas the measurements were limited to specific locations, the observations enabled one to assess the effects of reflection, diffraction, refraction and dampening upon the harbor as a whole. It was deemed not necessary to employ more sophisticated recording instrumentation to de-

TABLE 2.5
CHENE ENTRY WAVE MEASUREMENTS
(Relative to Deep Water Wave)

	ENTRANCE MODEL MODEL AND WAVE ORIENTATION	ALTERNATIVE A S	SE	E	ALTERNATIVE B S	SE	E
PT. 1	ZIG ZAG	.23	.69	.38	.23	.85	.77
	RUBBLE	.23	.54	.69	.23	.92	.54
	ZIG ZAG ENTRANCE EXTENSION	-	-	-	-	-	.54
	RUBBLE ENTRANCE EXTENSION	-	-	-	-	-	.69
PT. 2	ZIG ZAG	-	.31	-	-	.62	-
	RUBBLE	-	.46	-	-	.77	-

termine the exact magnitudes of the wave heights since the models served to show which arrangement was the most desirable from among several alternatives.

Waves are reflected from straight walls so that the angle of incidence equals the angle of reflection and nearly 100% of the wave energy is reflected. Zig zag walls tend to have the same effect as straight walls except waves are reflected in multi-directions scattering the wave energy. When the reflected waves from straight or zig zag walls combine with waves entering the harbor, wave peaks and troughs are attenuated and standing waves can develop. Reflection patterns observed for straight walls and zig zag walls differed as expected. At some locations, lower wave lengths were observed in the harbor for straight walls than for zig zag walls while at other locations the opposite effect was seen. Rubble mound walls are constructed so that wave energy is absorbed by porous rock structure and wave reflections are suppressed. This was similated and observed in the models by using a porous mat material. Rubble mound walls were found to be most effective when the direction of the incoming wave was perpendicular to the wall.

Wave heights in the proposed St. Aubin marina were found to be on the order of one-tenth the deep wave heights occurring in the Detroit River for both St. Aubin entry alternatives. On this basis, maximum prototype wave heights on the order of 0.5 feet are expected, which is well within acceptable wave height criteria for small craft marinas.

Wave height measurements given in Tables 2.4 and 2.5 show waves measured in the harbors are smaller than waves in the river for all canal entries tested. Neither rubble walls nor zig zag walls are significantly better in terms of re-

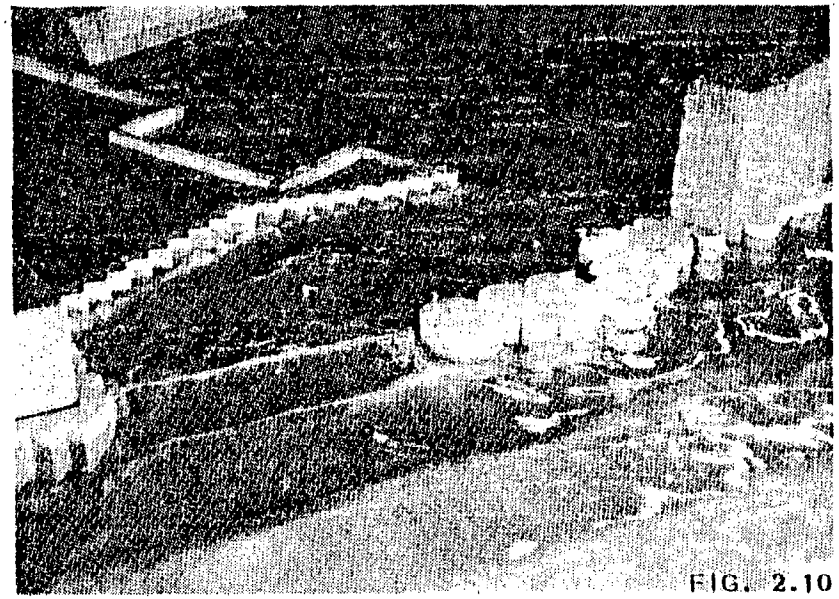


FIG. 2.10

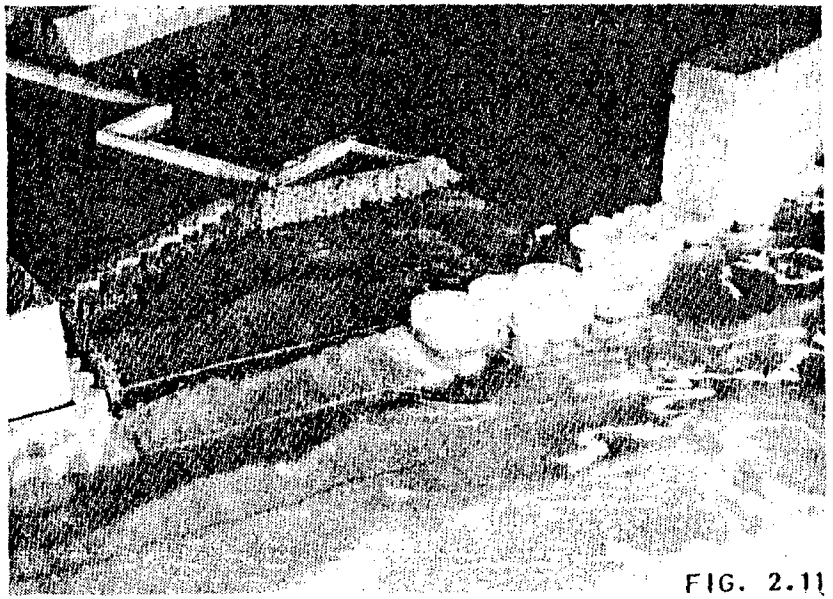


FIG. 2.11

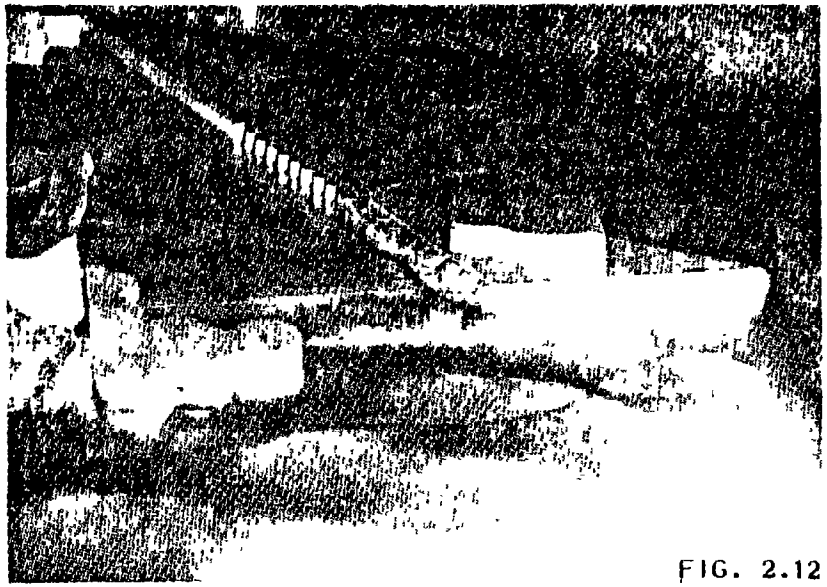


FIG. 2.12

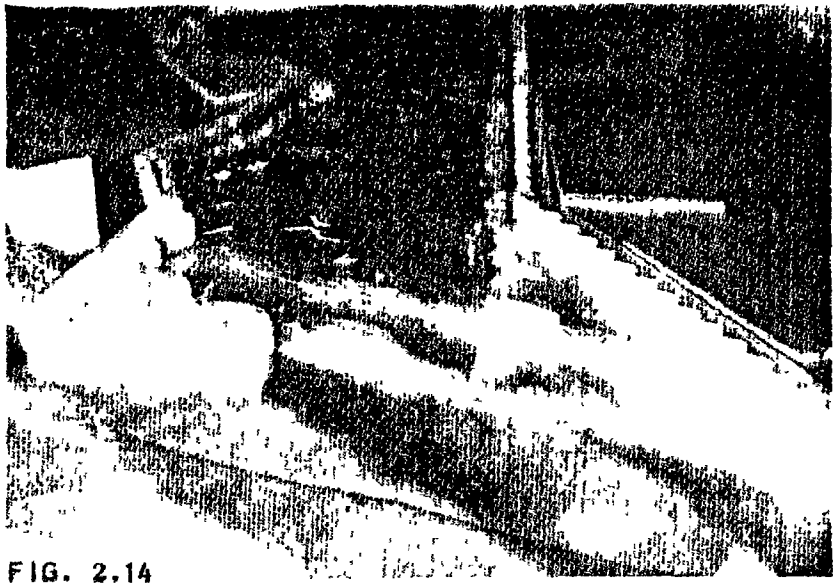
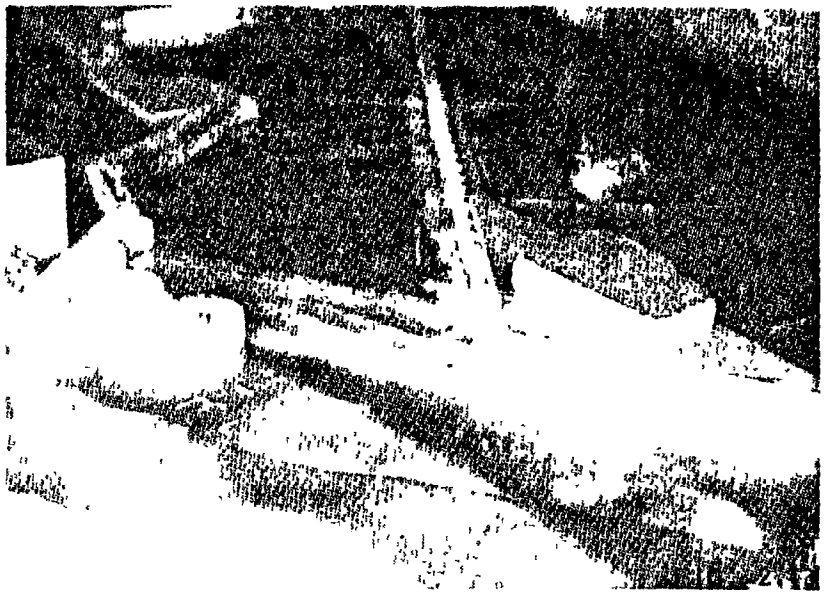


FIG. 2.14



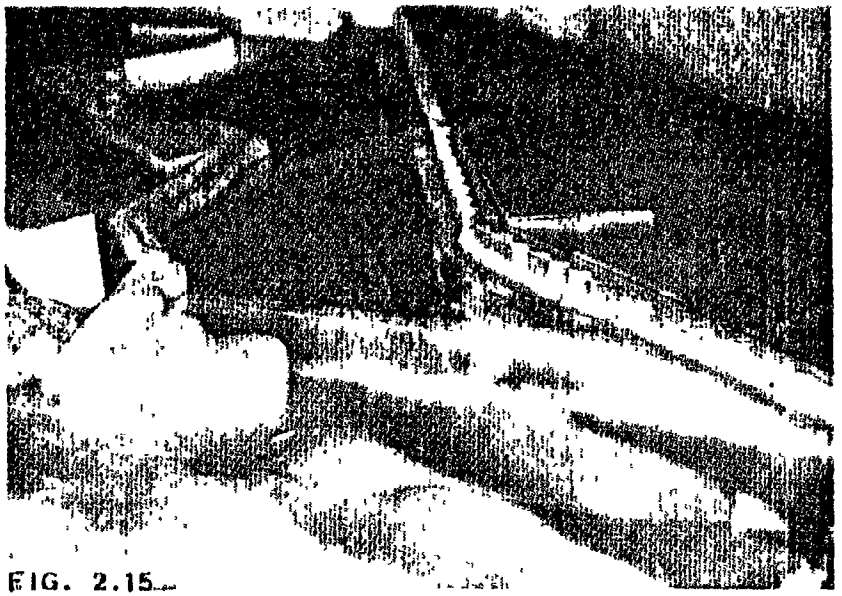
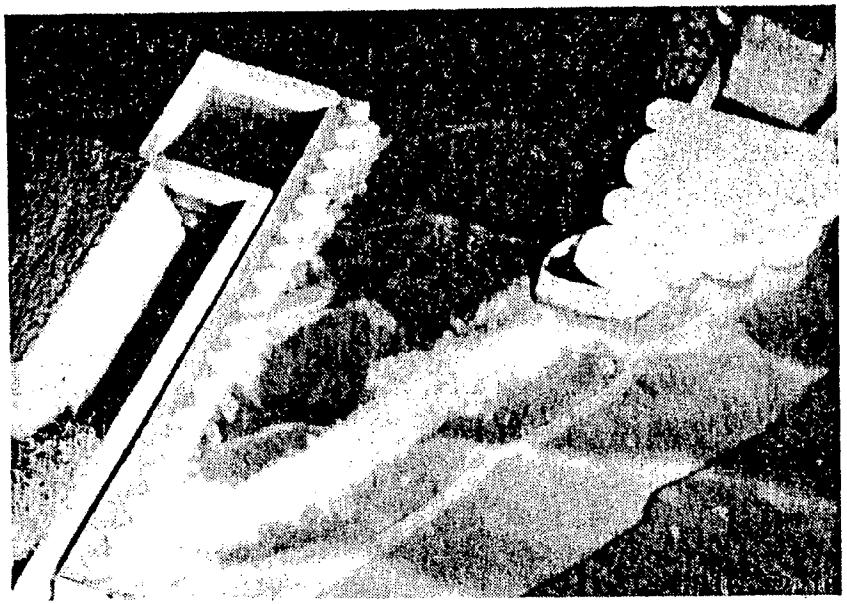


FIG. 2.15



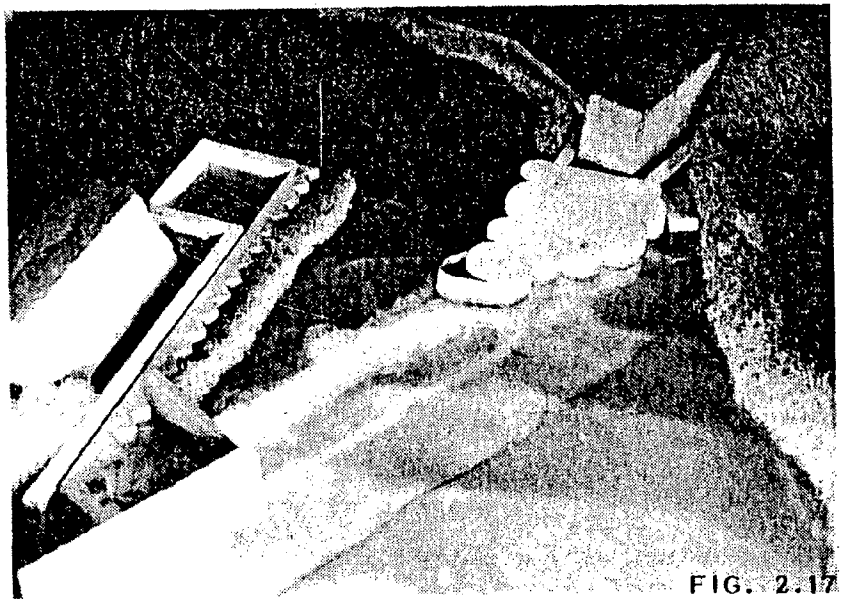


FIG. 2.17

ducing wave heights at the measured locations. Generally, however, rubble walls resulted in much calmer harbor conditions than either zig zag or straight walls, both of which cause cross wave patterns; this effect is apparent in Figure 2.10 to 2.15. Cross wave patterns and unstable conditions can be seen in the photographs of zig zag models, while fewer reflections are apparent in the models with rubble walls. The lack of cross wave patterns in Figures 2.11, 2.13 and 2.15 indicates the rubble mound walls have absorbed the waves and prevented reflections. Cost estimates given in Table 2.1 indicate the vertical concrete capped wall is slightly lower than the cost of the rubble mound wall. However, because the rubble wall affords more wave protection, it is recommended for locations exposed to high wave action.

Wave overtopping, if prolonged, can cause soil erosion and possible sidewall structural failure as well as interfere with the social functions of the riverfront edge. While wave overtopping of circular and zig zag walls was observed at the Detroit River shoreline for extreme conditions (four feet waves simulated in the model) overtopping is not expected to occur frequently enough to conflict with recreational activity or cause structural damage. The potential for wave overtopping can be reduced by increasing seawall freeboard or using rip rap to absorb wave energy while the potential for soil erosion or structural failure can be avoided by providing adequate drainage for overtopping and surface run-off. Overtopping is more noticeable at locations where wave energy is focused, such as the deep v-shaped notches formed by circular walls. For this reason, straight walls have less potential overtopping problems than zig zag or circular notched walls. As the overtopping was particularly severe at the deep circular wall notches, design modification to avoid deep notches is recommended. Figure 2.18 shows one manner in which the circular

wall design can be used with modifications to alleviate wave overtopping.

Wave diffraction is the changing in wave direction as waves pass the end of a breakwater. This phenomena was observed in the models at circular wall breakwaters as shown in Figures 2.10 and 2.11. In the figure, waves follow the curvature of the circular wall upon entering the harbor. This allows additional wave energy to enter the harbor causing unstable conditions near the circular walls. Experimental observations revealed diffraction at circular walls can be minimized by designing the circular wall breakwater with a more pointed end tip as shown in Figures 2.3 and 2.4 and photograph, Figure 2.7. Alternatively, a series of smaller circular walls can be used to form a more pointed end tip.

The effects of reducing the harbor entrance width was also examined. Significant improvements were observed when the entrance way was reduced. Test measurements for Chene entry Alternative A and B can be compared to see this effect. Wave measurements for Alternative A, the narrow entrance, are about half the height of the waves in the Alternative B model for incoming waves directed perpendicular to the shoreline (SE test). Similar results were observed when the harbor entrance was reduced for the St. Aubin entries as shown in Figures 2.16 and 2.17. It is recommended, therefore, that the harbor entrances be reduced to minimize the wave energy entering the harbors. However, since reducing the harbor entrance will constrain canal flow and boat traffic a minimum width of 80 feet is suggested.

Alternative A is the recommended Chene harbor entrance. Measurements given in Table 2.5, and observations, support Alternative A as being more effective in reducing wave action than Alternative B. Rubble mound walls are suggested for portions of the east wall as shown in Figure 2.5.

Entry Alternative B with rubble walls and pointed entrance extension, as shown in Figure 2.4, is recommended for the St. Aubin entrance. Wave measurements presented in Table 2.4 are lower for Alternative B than for Alternative A. Although some of the measurements tend to support zig zag walls being more desirable than rubble walls, rubble mound walls are recommended because wave reflections that hinder navigation are suppressed. St. Aubin Alternative A entrance with the reduced entrance, rubble walls and entrance extension shown in Figure 2.3 is recommended in the event entrance B is not acceptable for aesthetic or functional reasons.

Marina/Lagoon Alternative

This alternative has the same entry configuration as the Marina/Canal Alternative. This entry also acts as the exit and, therefore, no separate wave action analysis was conducted.

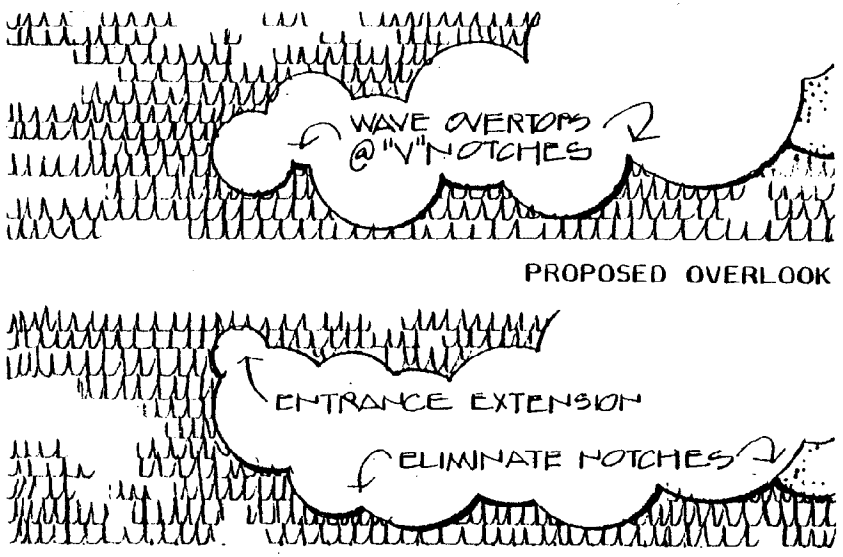


FIGURE 2.18

2.3 CANAL HYDRAULICS

Canal hydraulics is addressed because of concern over stagnation which could cause weeds, algae, foul odors, muck and fish kill. These problems can be avoided by providing sufficient oxygen exchange to minimize nutrients, pollutants and decayed matter. Oxygen can be exchanged with the atmosphere either by mixing that which occurs from the natural flow process or by artifical means such as fountains and aerators. The exchange mechanisms reduce organic deposits by diffusing ammonia, carbon dioxide and other nutrients into the atmosphere, oxidizing iron and manganese and keeping phosphate precipitated.

Marina/Canal Alternative

The hydraulic concern for this alternative is that there be sufficient flow in the canal to avoid stagnation. Previous information contained in a preliminary report by SEG is included in this report, noting that the canal design has changed only slightly (Reference 10). Results of a computer analysis of canal flow under low, average, and high flow conditions for both trapezoidal and rectangular cross section shapes, as shown in Figure 2.19, are presented in Table 2.6. The analysis indicated flow would be slightly greater for a rectangular shaped channel than a trapezoidal channel, however, either would provide enough flow to avoid stagnation. The higher flow for the rectangular channel is due to lower wetted perimeter and frictional effects. Travel time for water flowing through the canal would range between 1.7 and 3.3 hours depending on the channel shape and water depth condition.

Design criteria for the inlet at Chene Street and canal outlet at St. Aubin is selected based primarily on wave action concern and secondly, on hy-

TABLE 2.6
CANAL FLOW
RESULTS OF COMPUTER ANALYSIS

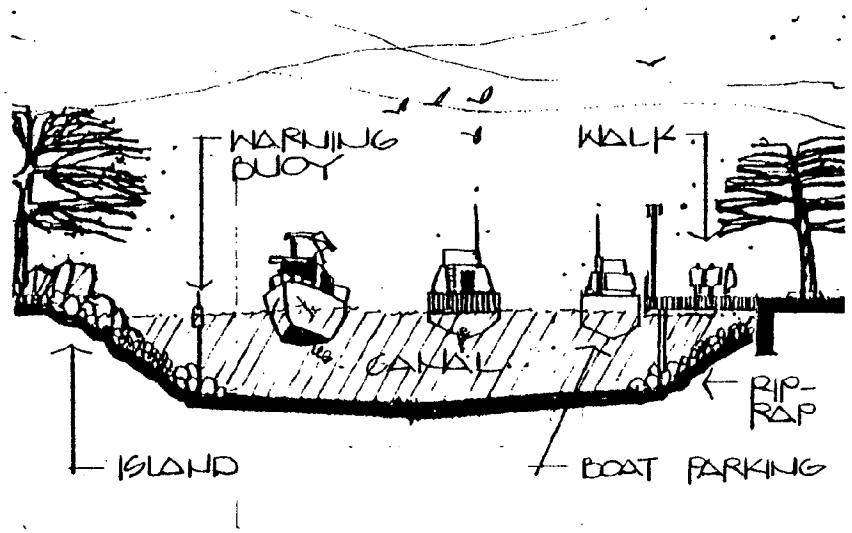
CROSS SECTION TYPE	FLOW CONDITIONS	CANAL FLOW CFS	AVERAGE VELOCITY IN CANAL FT./SEC.	MAXIMUM VELOCITY IN CANAL FT./SEC.	MAXIMUM VELOCITY IN CANAL FT./SEC.	TRAVEL TIME THROUGH CANAL (HOURS)
TRAPEZOIDAL	LOW	75	.20	.74	.10	3.3
TRAPEZOIDAL	AVERAGE	125	.24	.75	.12	2.7
TRAPEZOIDAL	HIGH	175	.24	.83	.13	2.6
RECTANGULAR	LOW	150	.34	.83	.18	1.9
RECTANGULAR	AVERAGE	200	.34	.85	.18	1.9
RECTANGULAR	HIGH	300	.39	.96	.21	1.7

draulic flow consideration. The recommended canal entrances mentioned in Section 2.2 of this report are acceptable in terms of hydraulic effects on the proposed canal.

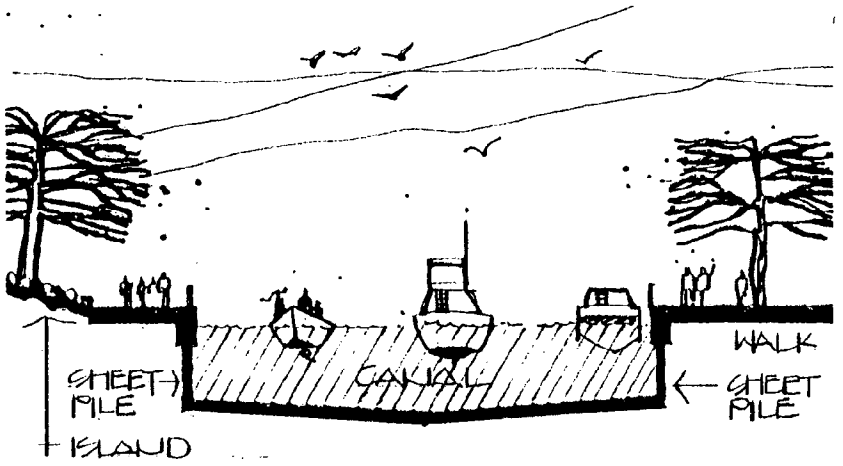
Proposed alternative edge treatments and costs are given in Figure 2.1 and Table 2.1, respectively. Cost estimates for the sloped , rip rap walls are much lower than verticle wall costs, however, the sloped wall requires more space and does not permit boat docking. The recommended edge treatment configurations are given in Figures 2.1A and 2.1B. Since the hydraulic performance of the alternatives edge treatments is relatively the same, design is based on the local physical conditions, the planned function and activities of the perimeter and cost.

Aeration may be required in the marina where flow is expected to be low. Design of the canal should include aeration design of the marina, however, the aeration system can be phased for construction and installed only in the event stagnant conditions occur. Bottom diffusers are recommended for reasons given in Section 2.4 of this report.

Sedimentation is likely to occur in the canal, but is difficult to predict. Provisions, therefore, should be made for the access of maintenance machinery. National Oceanic and Atmospheric Administration (NOAA) records indicate the maximum monthly water surface elevation fluctuated by 4.7 feet for gages near the proposed canal site during the boating season since 1901. A 5 foot difference between high and low water is recommended for design. To accommodate small craft and maintenance vessels a minimum depth of 7 feet is required. According to NOAA records the canal bed should be designed at elevation 565.4 (USGS datum) to maintain a depth of at least 7 feet during the boating season. No hydraulic advantage would be gained by designing the channel with a sloping bed, therefore, to minimize construction



TRAPAZOIDAL SECTION



RECTANGULAR SECTION

FIGURE 2.19

costs a horizontal slope of 0% is recommended. The transition between the canal and the Detroit River should be designed at a slope of 1:2 to insure stable channel conditions and avoid potential erosion.

Marina/Lagoon Alternative

A number of circulation methods can be employed for the Marina/Lagoon Alternative. These methods include the use of culverts, pumping water from the lagoon into the river, surface aeration and bottom aeration. Connection of the lagoon to the river by culvert will not provide adequate circulation due to the small head available and large wetted perimeter to area ratio of the culvert. Pumping water from the canal to the river, although feasible, is not recommended because of high capital and operational costs. The estimated capital costs for a complete pump and piping system is approximately $60,000. Surface aeration is accomplished by means of a fountain while bottom aeration entails bubbling air upwards from the bottom. Essentially, both processes function similarly turning over water once or twice a day absorbing oxygen from the atmosphere. Bottom aeration is recommended for this canal alternative because of the lower operational cost and noninterference with navigation. The bottom diffuser is more efficient because bubbles rising to the surface drag water upwards through surface tension thereby moving a maximum volume of water with minimum power. Preliminary investigations indicate 4 diffusers, a 1 Hp compressor and electrical facilities would be required and would cost approximately $10,000. Operational costs are expected to be $30.00 per month plus chemicals, if required. Construction of the bottom circulation system can be phased so that the system is implemented only if found to be required. The system, however, should be designed at the time of final canal design.

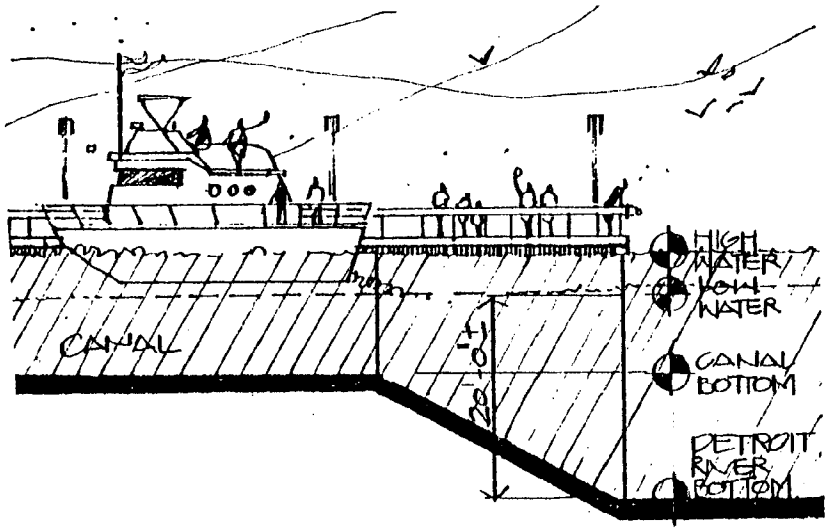


FIG: 2.20: CANAL TRANSITION TO RIVER BOTTOM

Collection of surface debris is also a potential problem with the Marina/Lagoon Alternative. Bottom diffusers will dispurse water to the canal edge, thereby moving surface debris to a location where it can be collected by hand.

2.4 CONSTRUCTION BEYOND HARBOR LINE

The alternative canal and marina configurations include expansion beyond the harbor line. This expansion, at both the Chene and St. Aubin entries, was done for three reasons: 1) to create wave dampening chambers; 2) to encourage flow into or out of the proposed canal; and, 3) to add a scenic overlook function into the park for viewing up and down the river's edge. These extensions, for functional reasons explained below, are a maximum of 75 feet beyond the harbor line. The extensions were examined for impact on Detroit River flow, Detroit River navigation, and

cement boat docking.

Marina/Canal Alternative

This alternative has extensions beyond the harbor line at both the Chene Park (canal entry scoop) and the St. Aubin Park (canal exit and marina entry). The Chene extension is a maximum of 75 feet beyond the harbor line; while the St. Aubin extension is approximately 45 feet.

The impact on river flow of filling into the Detroit River for expansion was examined in Riverfront Capabilities Extension Analysis, by Coastal Zone Laboratory (Reference 9). The study has determined that there would be little or no change in the river hydraulics if the fill does not exceed more than 200 feet offshore of the present riverbank. A HEC-2 computer analysis of the Detroit River by CZL found filling a distance 200 feet offshore would raise the water level by only 0.01 ft. and increase average velocities in the river at the fill site by 0.16 ft./sec. The proposed Chene/St. Aubin riverfront park may require filling 75 feet into the Detroit River. On the basis of results presented in the above mentioned report, this filling would have no significant impact on flow in the Detroit River.

The proposed construction beyond the harbor line would impact small craft navigation in as much as it would necessitate increased awareness on the part of boaters. Lighting and visibility (height, color) would play significantly in reducing potential hazards. Flashing lights, defining the entry points on both sides, in conjunction with red lights along the river side will increase visibility with a bright color, such as white, for the construction material.

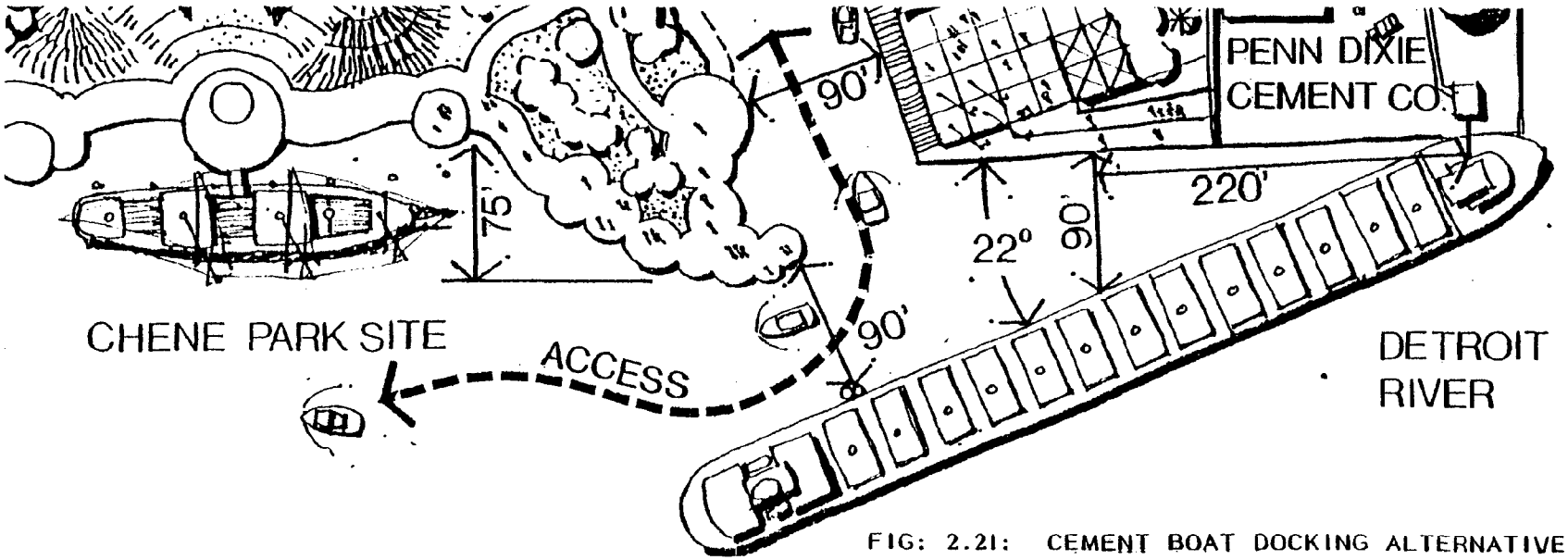


FIG: 2.21: CEMENT BOAT DOCKING ALTERNATIVE

Other than visibility, the extensions should have no impact on the navigation of small boats on the Detroit River. They also do not affect larger shipping vessels since the shipping channel is approximately 1600 feet away from the proposed extensions. The location of the Chene inlet will, however, impact the navigation of freighters docking at the Penn-Dixie Cement Company. If a freighter was docked parallel to the shore at Penn-Dixie, the land extension would be in its path and the canal entry would be blocked to small craft. This potential problem was solved through conversations with the cement companies where it was considered feasible to angle the freighter to the shore and thereby allow access to the canal. This angle poses no difficulty to loading and unloading operations and, in fact, enhances security since the vessel would not be directly against the shore and within reach of the public. To maintain a minimum canal entry width of 80 feet and utilizing angle dimensions as provided by the cement companies (equal to approximately 22 degrees) limits the Chene entry extension to 75 feet beyond the harbor line.

Marina/Lagoon Alternative

This alternative as presently configured has identical impacts as the Marina/Canal Alternative except that there is no land extension proposed at the St. Aubin site. The Chene entry extension is not as critical in promigating flow since the proposed aeration process in the lagoon minimizes this need. Therefore, an extension of smaller distance into the river is considered possible although the scenic overlook and wave dampening functions are still considered necessary.

2.5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter dealt with the technical hydraulic and wave concerns of the proposed marina/canal as well as with the impacts of land extensions beyond the harborline. Wave analysis was conducted using 1:100 scale models of the canal entrances. Hydraulic concerns were examined using a HEC-2 computer model of the proposed canal. The analyses indicate the canal as proposed is technically feasible. Land extensions beyond the harbor line beneficially impact wave action concerns and canal flow. The extension at the Chene entry requires a realignment of freighter docking at the Penn-Dixie Cement Company.

Conclusions of this chapter are as follows:

(1) Waves affecting the canal will be generated from freighters, small craft vessels and wind. Freighter wave heights are not expected to have a significant impact at the canal site because of wave dampening due to friction and energy transmission. Small craft vessels can be expected to generate waves up to 3 feet at the canal site. The maximum wind wave expected at the proposed canal site is 3.6 feet occuring from a 60 mph wind.

(2) Wave action in the proposed marina at St. Aubin is minimal and would not be a hindrance to moored boats.

(3) Wave reflections inside the canal entrance result in cross-wave patterns and should be avoided for navigation purposes. The use of rubble mound walls is the most effective means to reduce wave reflections inside the canal entrance. Vertical and zig zag canal sidewalls produce undesirable reflections inside the canal entrance. Generally the zig zag will disperse the waves more than the vertical wall, but both walls create cross-wave patterns.

(4) Significantly less wave action is observed in the canal when the canal entrance is narrowed.

(5) Potential for wave overtopping at the river shoreline is observed for zig zag walls and v-shapped notches formed by circular walls.

(6) A HEC-2 computer analysis revealed there would be sufficient canal flow to avoid stagnation. Travel time through the canal would range between 1.7 and 3.3 hours, depending on the flow in the Detroit River. Circulation is required for the second canal alternative which terminates in a lagoon-like pond.

(7) The maximum difference in average monthly water surface elevations during the boating season since 1901 is 4.7 feet.

(8) No hydraulic advantage would be gained by designing the canal with a sloping bottom.

(9) Any of the proposed canal cross section and edge treatment alternatives is acceptable from a hydraulic flow standpoint. In protected areas of the canal, where wave action is of no significance, channel cross section and edge treatment design is based on local physical conditions, planned functions and activities of the perimeter and cost. Rip rap walls are far less costly than vertical sheet pile walls, but require more space and cannot be constructed where boat mooring is to be provided.

After consideration of the analyses, recommendations are made as follows:

(1) Alternative A is the preferred alternative for the Chene canal entrance. Alternative B is preferred for the St. Aubin canal entrance; however, Alternative A with a narrower entrance would be as acceptable.

(2) If aesthetically and economically acceptable, the canal entrances should be narrowed to reduce wave action. A width of at least 80 feet however, is necessary for navigation.

(3) Rubble mound walls should be used for seawalls inside the harbor entrances where incoming waves would be reflected. The rubble walls should be constructed of two rock layers, on a 1:1.5 slope. The rock armor should extend down to a point 2 feet below mean low water level. The outside rock layer should be placed and consist of 3.7 cubic foot size quarry stone while the underneath layer should be 3 feet thick and composed of multi-size heavy rip rap. Toe headers of the larger stones should be placed along the lower underwater edge.

(4) In order to suppress wave overtopping, deep, v-shaped notches formed by circular walls should be either avoided or filled with rubble.

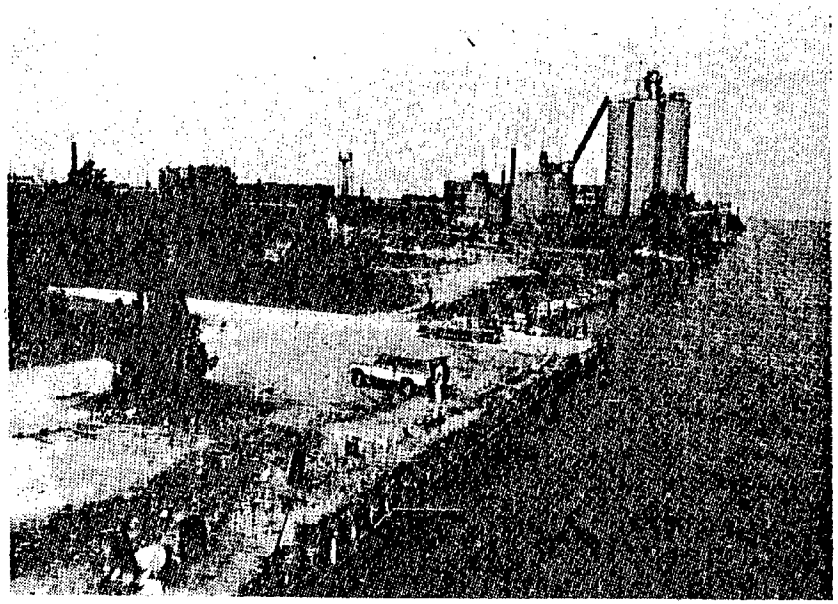
(5) Drainage facilities should be provided behind seawalls adjacent to the river shoreline to minimize soil erosion, to prevent hydraulic head build-up behind the walls, and to prevent surface water run-off over the exposed end face.

(6) The circular wall breakwater of the St. Aubin entrance should be designed with a pointed end tip to minimize wave diffraction inside the harbor.

(7) The channel bottom transition between the canal and the Detroit River should be a maximum slope of 1:2. A horizontal slope of 0% is acceptable in the canal between the canal inlet and outlet.

(8) The canal bottom should be constructed at elevation 565.4 (USGS) to provide the 7 foot minimum canal depth at extreme low water condition required for small craft and maintenance vessels. A 5 foot difference between low and high water should be considered for the design.

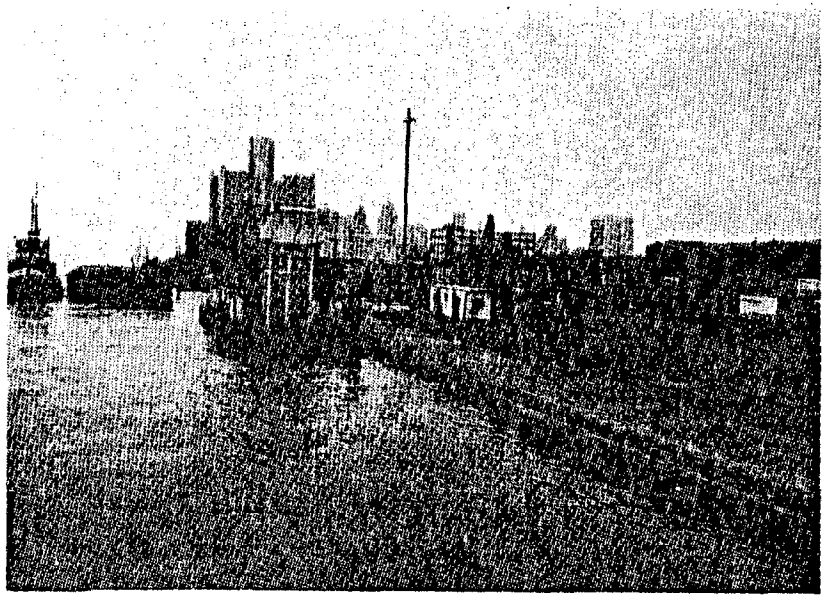
(9) Bottom aeration is recommended to avoid stagnation for the Marina/Lagoon Alternative. The capital cost of the aeration system is approximately $10,000 while operational costs are expected to be $30 per month plus any required chemicals.

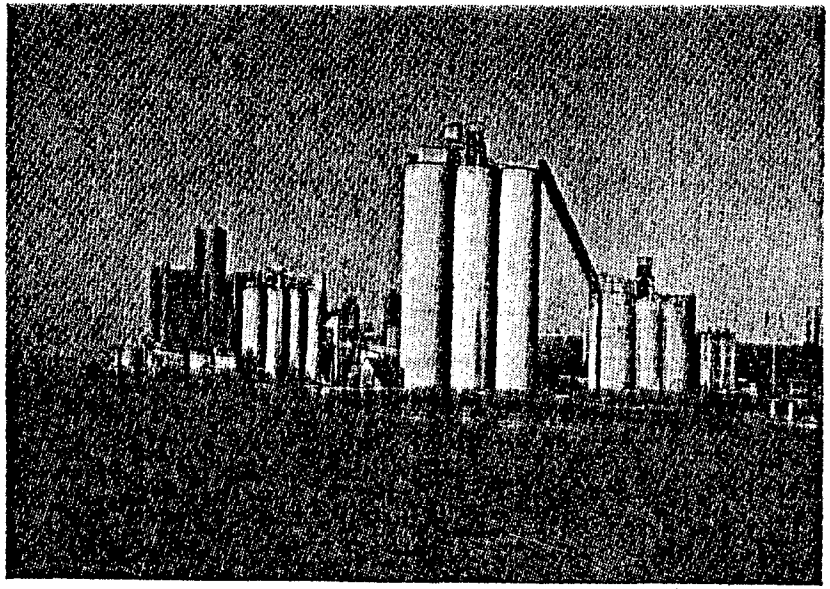


Resolution of Potential Industrial/ Recreational/Transportation/Utility Conflicts 3.0

3.1 INTRODUCTION

This chapter investigates the potential conflicts between the proposed marina/canal configurations, with their related recreational uses and adjoining industrial uses, transportation systems and utility infrastructure. The operations of three industries will be specifically analyzed: Consolidated Docking, Medusa Cement Company and Penn-Dixie Cement Company. Truck, rail and shipping operations to these companies and the routing needs of the Rex Trucking Company will be investigated as well as pedestrian/bicycle, park maintenance and security vehicle circulation. The proposed marina/canal configurations also conflict with underground utilities. These conflicts will be itemized and solutions proposed. Lastly, general concern with noise and dust and their impacts on recreational use will be investigated.





3.2 CONSOLIDATED DOCKING

Consolidated Docking is the present owner of the majority of the proposed St. Aubin Park site. Its present use is to receive containerized bulk material from river barges originating in Windsor, Canada and transmitting them to trucks which carry the material to Jefferson Avenue and the state highway network. A boat slip has been recut into the site for barge access. The total area of this container port is 12.41 acres with an approximate employment of twenty.

Marina/Canal Alternative

Acquisition of this site is necessary for the development of this alternative. Negotiations for this acquisition and relocation are presently underway. The acquisition of Consolidated Docking will greatly reduce the amount of truck traffic originating

from this area of the east riverfront.

If acquisition of this site does not occur, both the concept for a canal and an Atwater mall will have to be abandoned and the major developments proposed in the original Linked Riverfront Parks Project study will have to be re-analyzed.

Marina/Lagoon Alternative

This alternative is premised on not acquiring, or delay in acquiring, the Consolidated Docking site. In this instance the primary impact will be from the extensive truck traffic generated by Consolidated Docking near the Chene Park site. This traffic will have to be re-routed to St. Aubin Street and north to Jefferson Avenue as opposed to its present routing to Dubois Street.

3.3 MEDUSA CEMENT COMPANY

The Medusa Cement Company is a division of Medusa Corporation with main offices located in Cleveland, Ohio and with regional offices in Southfield, Michigan. The information in this section was gathered from direct conversations with representatives of Medusa, from the site visits of the operations, and from data and diagrams supplied by the Medusa Cement Company.

The terminal on Atwater is used as a temporary storage unit for bulk cement brought in by ship and rail. The cement is transferred to trucks in bulk or bag form for shipping.

The Medusa Cement Company utilizes two sites in the area. One is south of Atwater, the other directly north across Atwater. The site south of Atwater, located between the two park sites, is 2.43 acres in area with 221.35 feet of frontage on the Detroit River. This site contains the entire operations and facilities of Medusa. The second site, north of Atwater, is approximately 1.2 acres

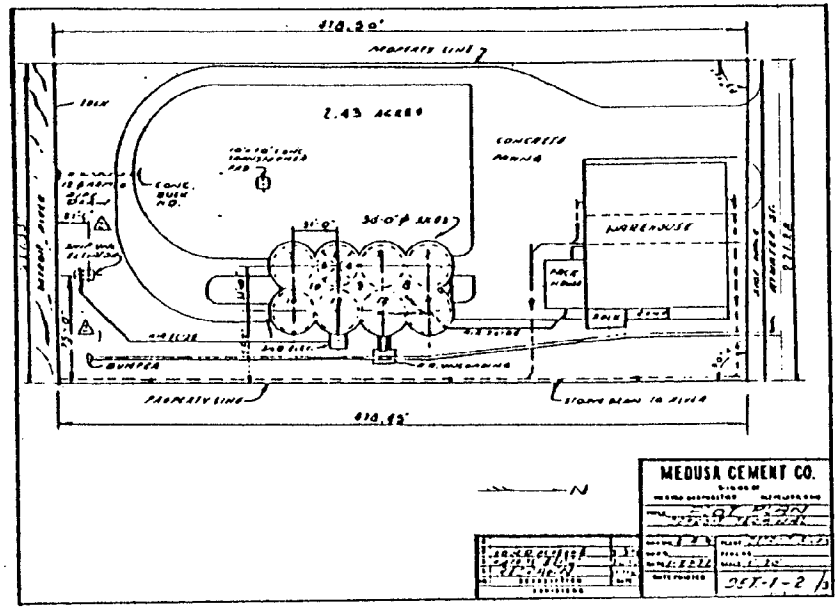


FIGURE 3.1: MEDUSA SURVEY

and has approximately 265 feet of frontage on Atwater Street. This site is minimally used for storage and is primarily vacant except for a Grand Trunk Railroad siding which crosses it for access to the site south of Atwater.

The facilities on the south Atwater site consist of eight silos divided into 14 storage compartments. The silos, built in 1967, are approximately 143 feet high and are constructed of reinforced concrete. The trucks to be loaded are able to drive directly below the silos onto a scale. Trains side up adjacent to the silos for unloading. Ships dock parallel to the harbor line and unload by means of an air slide elevated conveyor system.

One additional structure on the site is a metal warehouse building approximately 16 feet high and 100 feet square built in 1974. This building is connected to the cement silos by an air slide

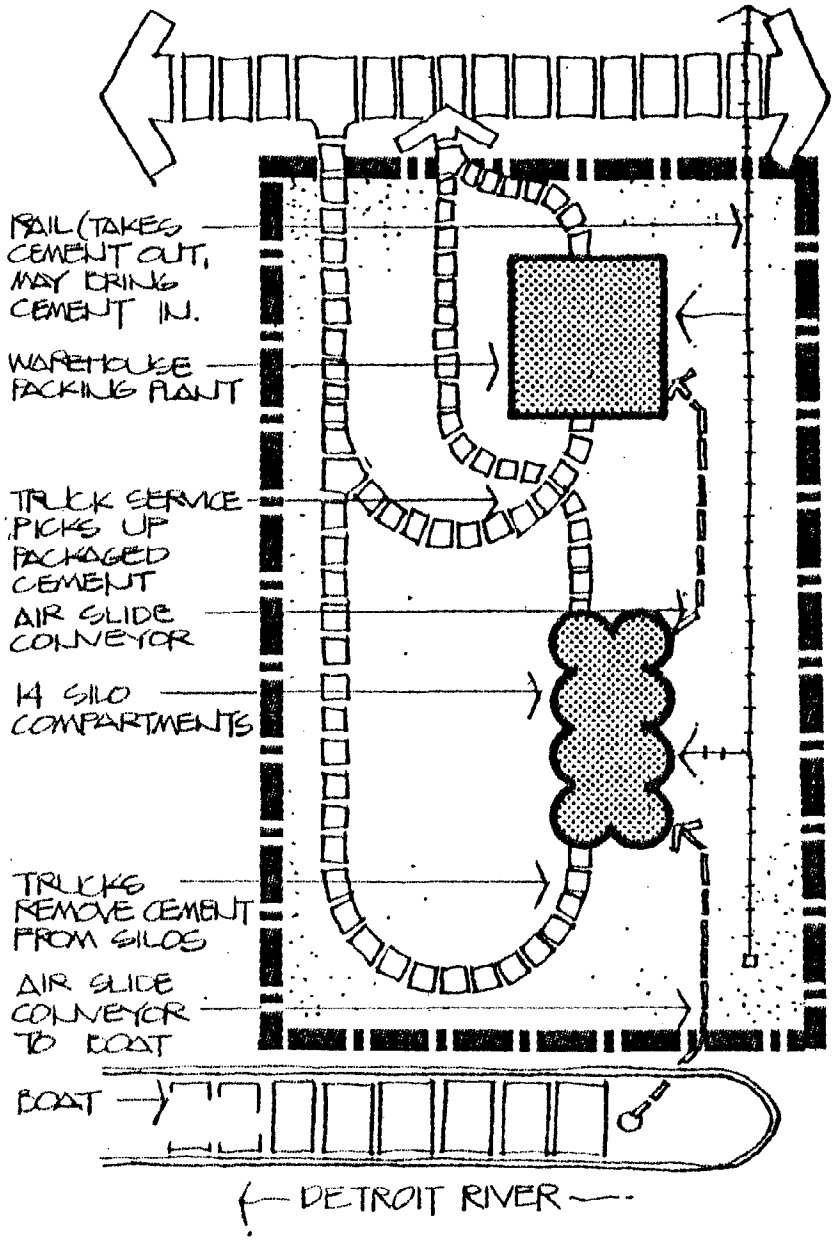


FIGURE 3.2: MEDUSA OPERATIONS RELATIONSHIPS

conveyor and is used for the packaging of cement into bag portions and for storage.

The terminal operates year around due to the rail access which allows cement to be brought in when the shipping season is closed on the Detroit River. The peak periods of operation are May through October when an average of 52,000 tons of cement are shipped per month.

Marina/Canal Alternative

In order for the canal in this alternative to connect Chene Park with St. Aubin Park a 135 foot wide section of the north portion of the Medusa site south of Atwater must be acquired. This portion is approximately .68 acres and contains the warehouse and packing building. There are two proposed land trade alternatives for acquiring this portion and one sub-alternative.

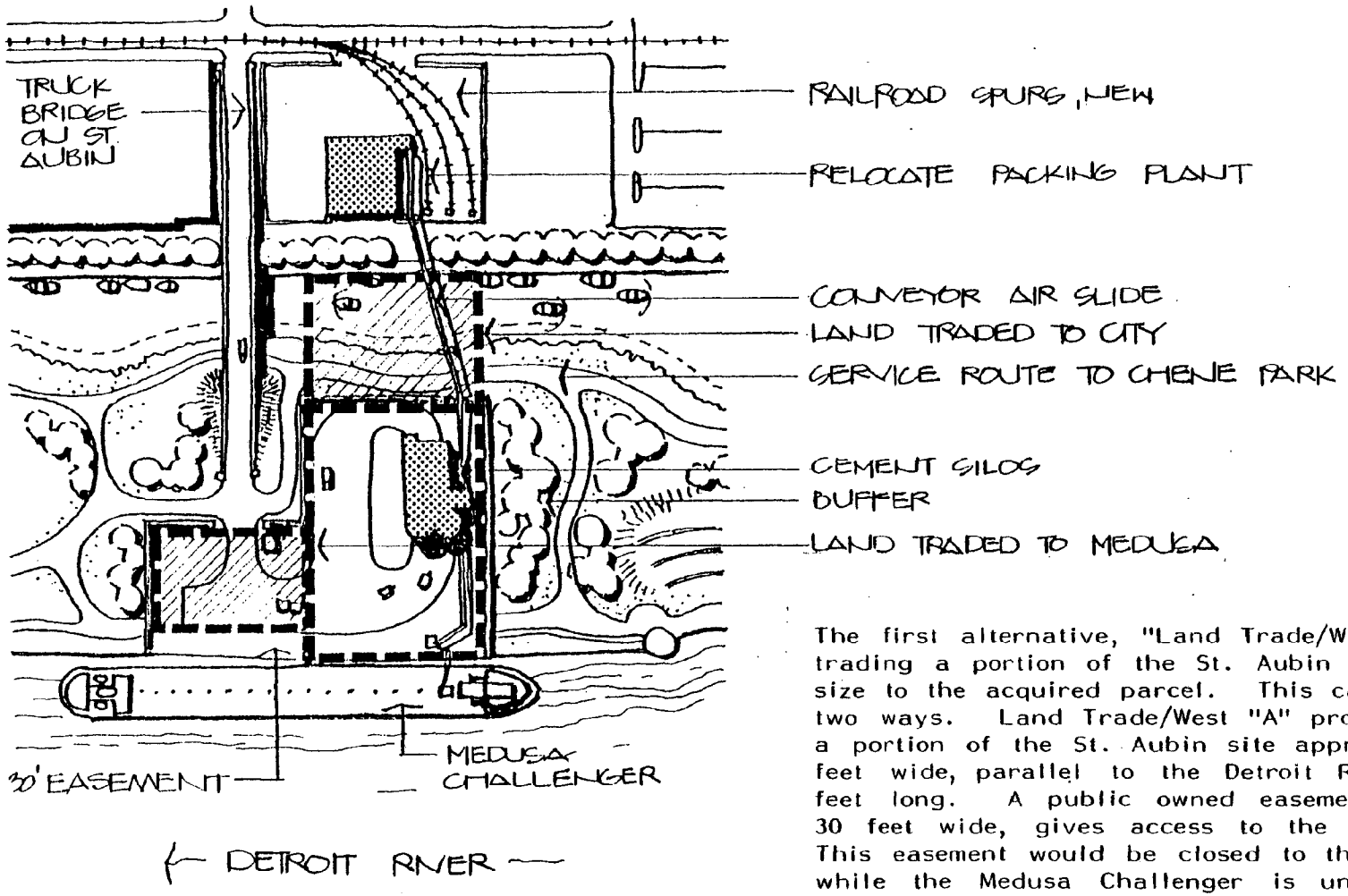
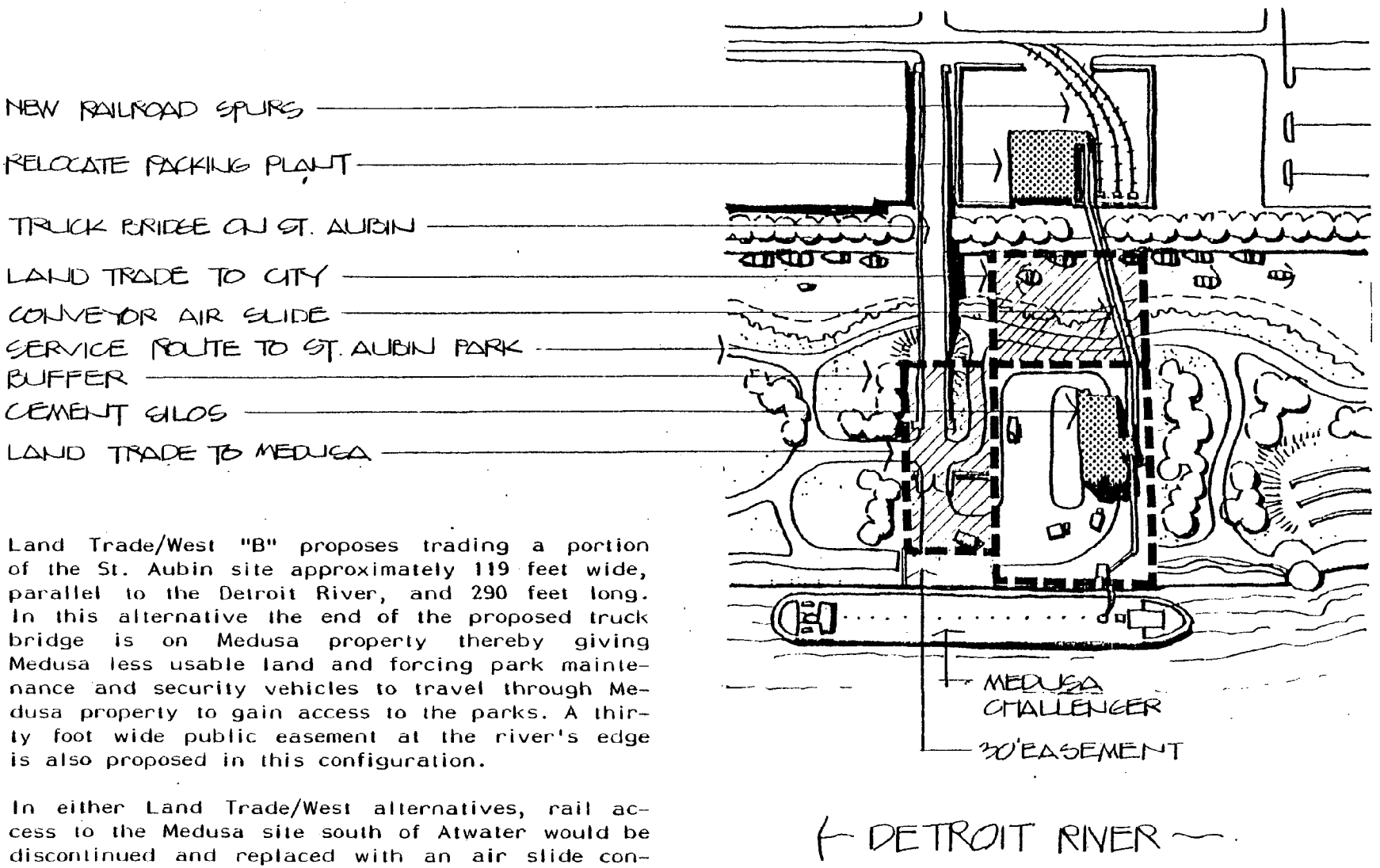


FIGURE 3.3: LAND TRADE WEST "A"

The first alternative, "Land Trade/West", involves trading a portion of the St. Aubin site equal in size to the acquired parcel. This can be done in two ways. Land Trade/West "A" proposes trading a portion of the St. Aubin site approximately 288 feet wide, parallel to the Detroit River, and 120 feet long. A public owned easement, minimally 30 feet wide, gives access to the river's edge. This easement would be closed to the public only while the Medusa Challenger is unloading. In this way the public would have access to the maximum amount of edge while Medusa would gain, during unloading, access to land at the river's edge adjoining their ship. For truck access to Medusa operations a new truck bridge is proposed. In this alternative the bridge is on public property and also gives maintenance and security vehicles access to the parks without traversing Medusa property. This bridge is discussed in more detail later in this chapter.



Land Trade/West "B" proposes trading a portion of the St. Aubin site approximately 119 feet wide, parallel to the Detroit River, and 290 feet long. In this alternative the end of the proposed truck bridge is on Medusa property thereby giving Medusa less usable land and forcing park maintenance and security vehicles to travel through Medusa property to gain access to the parks. A thirty foot wide public easement at the river's edge is also proposed in this configuration.

In either Land Trade/West alternatives, rail access to the Medusa site south of Atwater would be discontinued and replaced with an air slide conveyor to the Medusa site north of Atwater. Investigations showed that this conveyor is much more feasible than building a train bridge across the canal since this bridge would require a prohibitive length of ramp for maintaining clearance over the canal. Likewise, the packing building

FIGURE 3.4: LAND TRADE WEST "B"

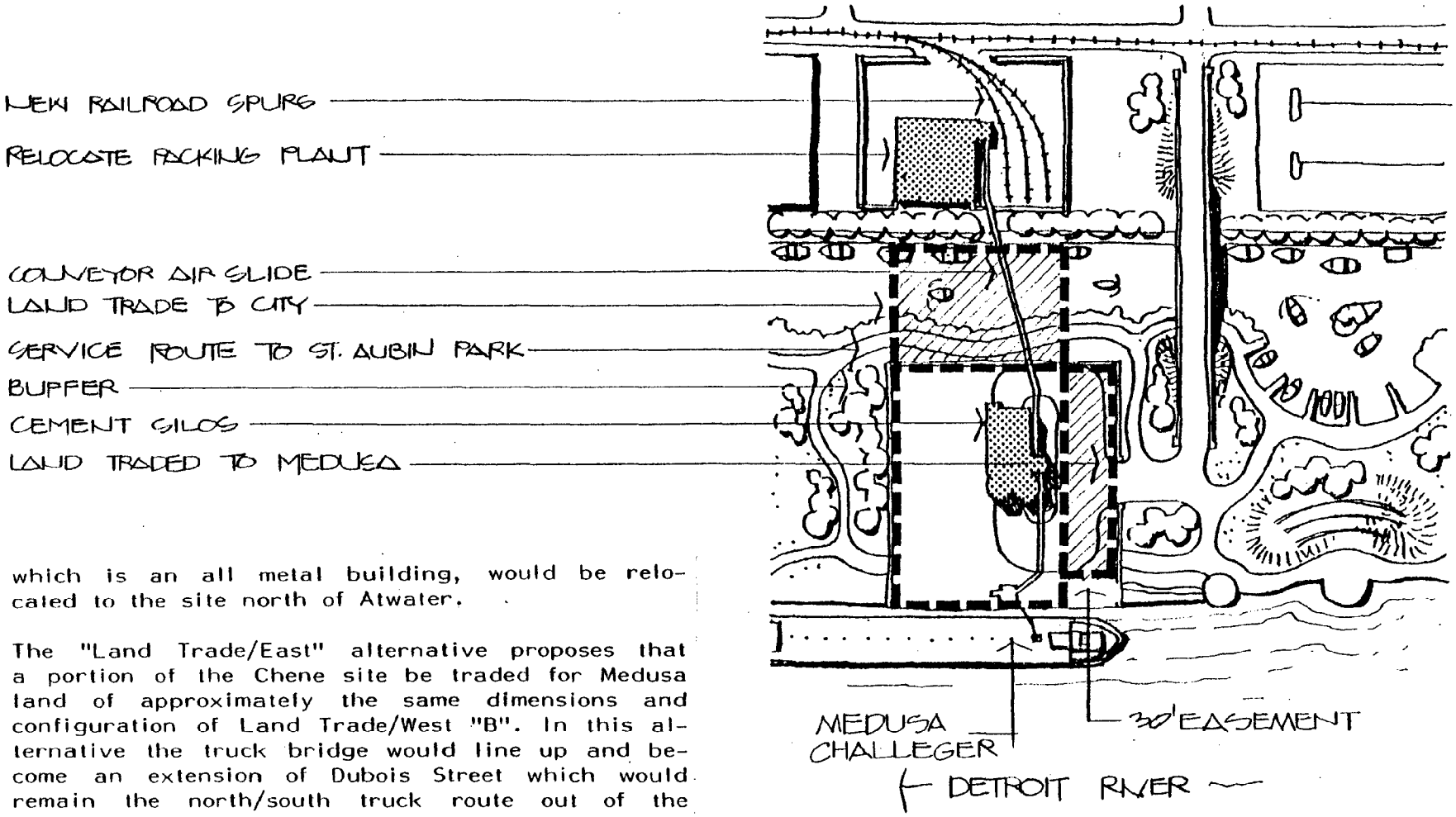


FIGURE 3.5: LAND TRADE EAST

which is an all metal building, would be relocated to the site north of Atwater.

The "Land Trade/East" alternative proposes that a portion of the Chene site be traded for Medusa land of approximately the same dimensions and configuration of Land Trade/West "B". In this alternative the truck bridge would line up and become an extension of Dubois Street which would remain the north/south truck route out of the area.

Land Trade/West "A" is the recommended alternative because it provides more equitable and useable land for the Medusa Cement Company; because it trades a portion of the St.Aubin site which is the larger of the two park sites; because it keeps the proposed truck route on St. Aubin which has less impact on proposed new development of the Chene #2 and ajoining sites;

and because Land and Water Conservation funds have already been utilized to purchase the Chene site while the St. Aubin site has not yet been purchased.

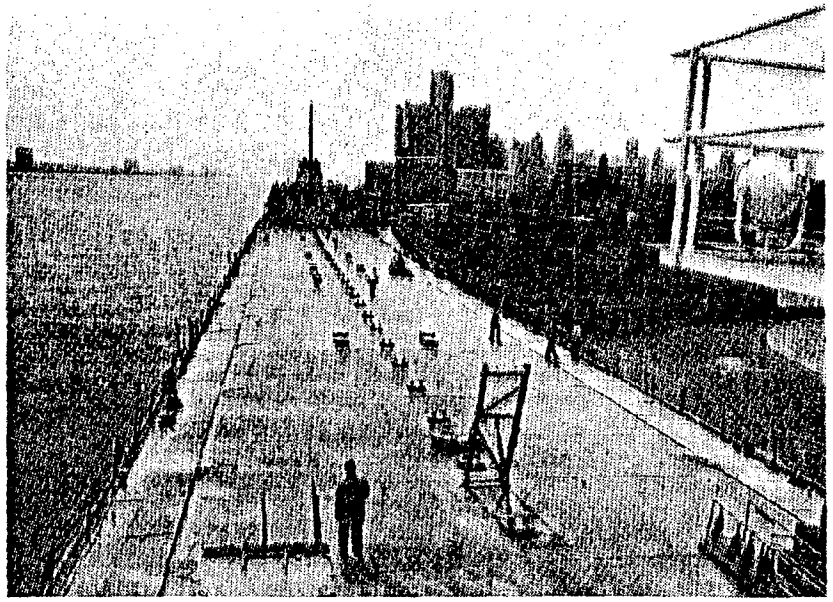
Site improvements to Medusa Cement Company after the recommended land trade occurs include a truck bridge over the canal, relocation of the packing plant, an air slide conveyor to the site north of Atwater, rail spur realignment, fencing and landscape buffering.

The truck bridge is proposed to provide access to the Medusa Cement Company's loading facilities, primarily heavy truck traffic, and to provide service vehicles access to the island park. There is no additional right-of-way or easements required for the Land Trade/West alternatives since the existing 72-foot right-of-way of St. Aubin Street is sufficient to accept the northerly retained approach roadway. An additional 10 feet of right-of-way on the east side and 15 feet of right-of-way on the west would be required for the Land Trade/East alternative due to the limitation of the existing 42-foot right-of-way on Dubois Street.

The nature of the anticipated vehicular types utilizing the proposed structure would mandate a live load design criteria of HS-20, the standard Michigan Department of Transportation loading for State trunklines.

The typical bridge section as illustrated provides for two 12-foot traffic lanes with 3-foot curb clearances for a total of 30 feet face-to-face of curb. A 5-foot sidewalk is proposed on the east side of the structure for Land Trade/West and on the west side for Land Trade/East to provide pedestrian access to the island park for Medusa Cement Company personnel and park service employees. A 2-foot 6-inch safety curb is called for on the opposite side of the structure. A traffic designed concrete railing is designated on both sides of the bridge. For economic and aesthetic reasons, the type of superstructure selected is a variable depth, reinforced concrete T-beam arrangement continuous over 3 spans and cast-in-place. The substructure units are reinforced concrete founded on either spread footings or piles as the soil conditions dictate. Reinforced concrete retaining walls are shown on the north approach to eliminate requiring additional right-of-way in the case of Land Trade/West or to minimize acquiring additional right-of-way in the case of Land Trade/East. The concrete retaining walls on the north approach will also highlight the urban aspects of the Detroit side of the park whereas the sloping sidefills of the south approach will be treated to blend with the natural flavor of the island side.

The roadway vertical alignment, or grade, was established to facilitate the required 16-foot mini-



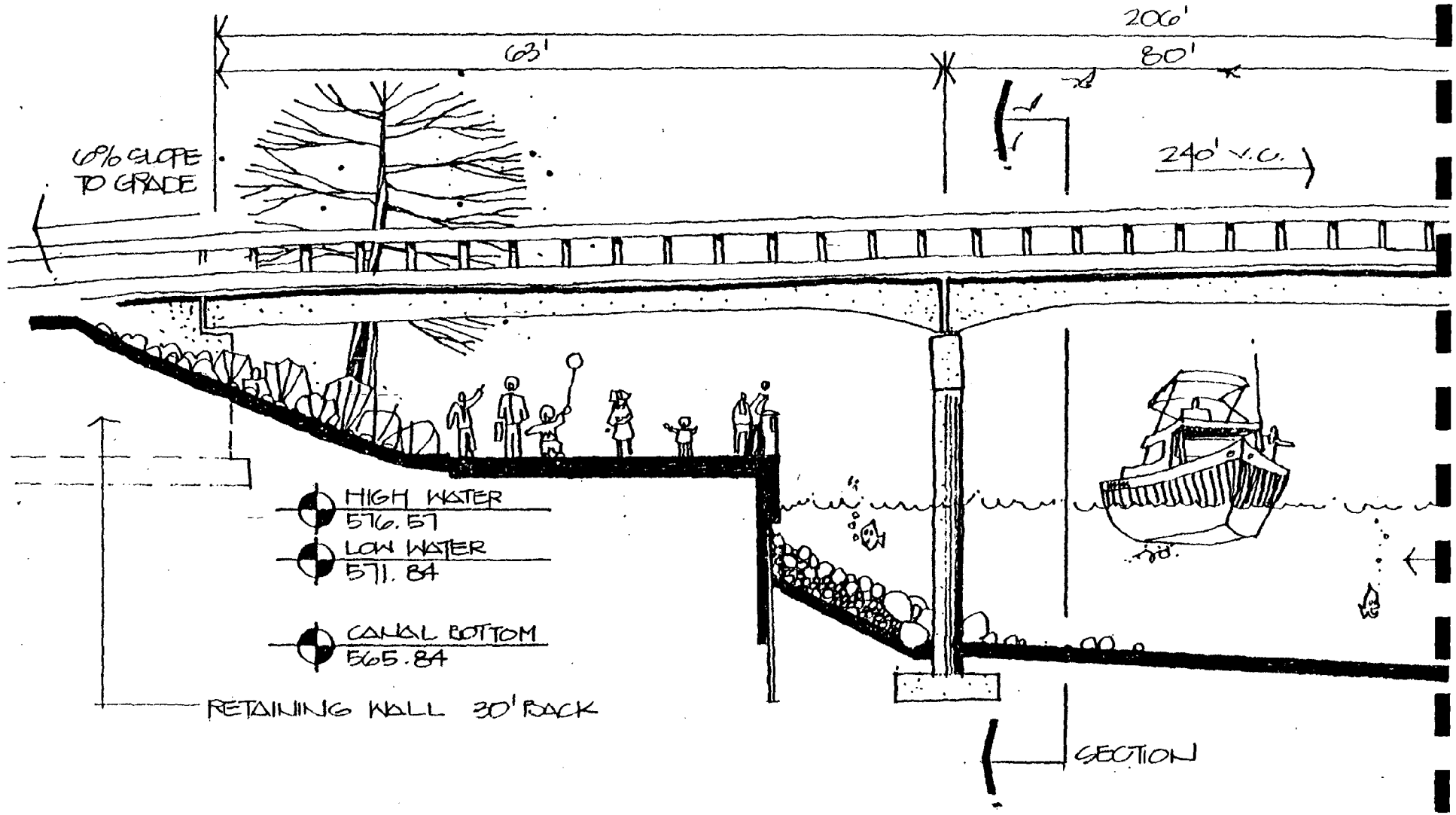
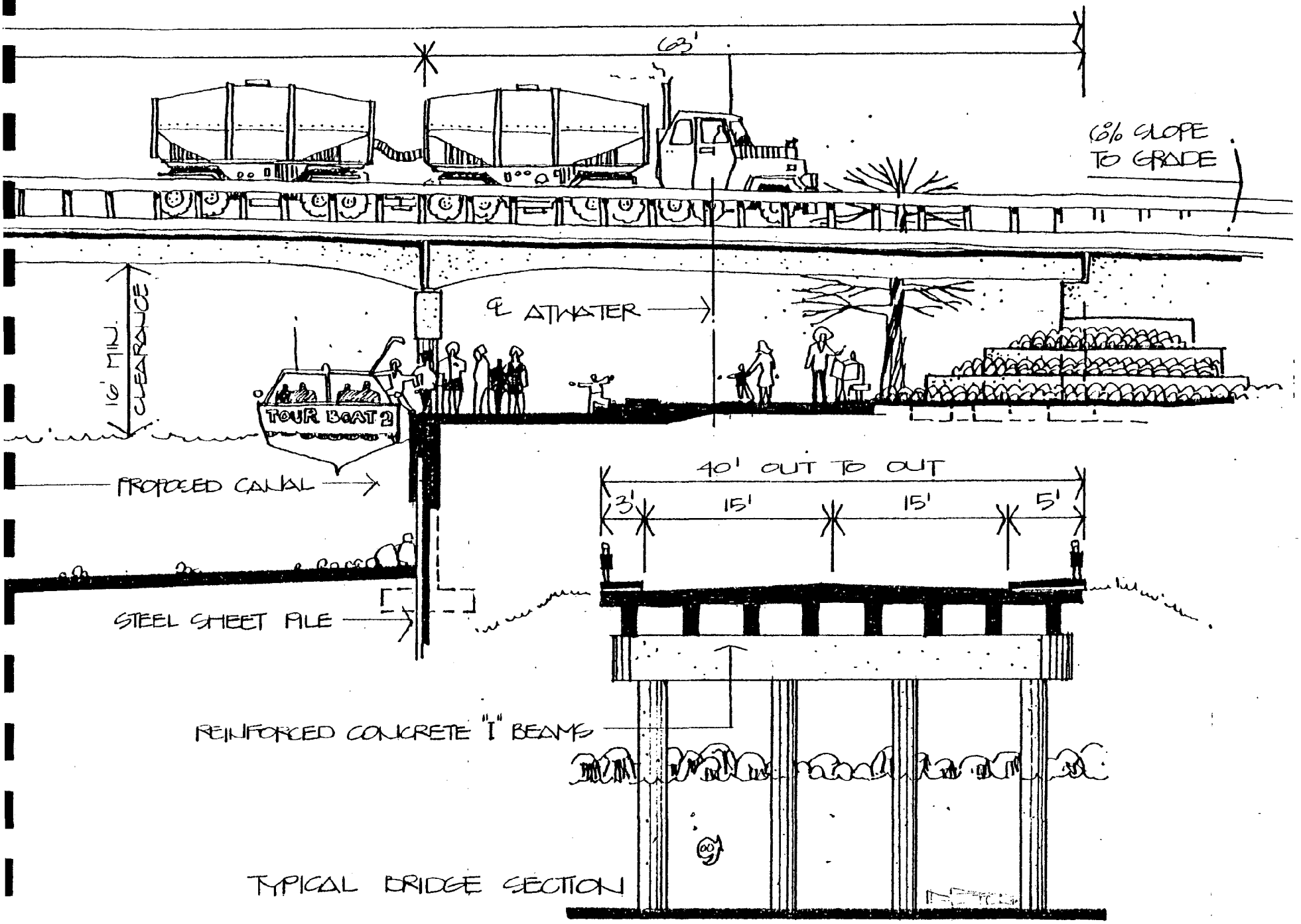
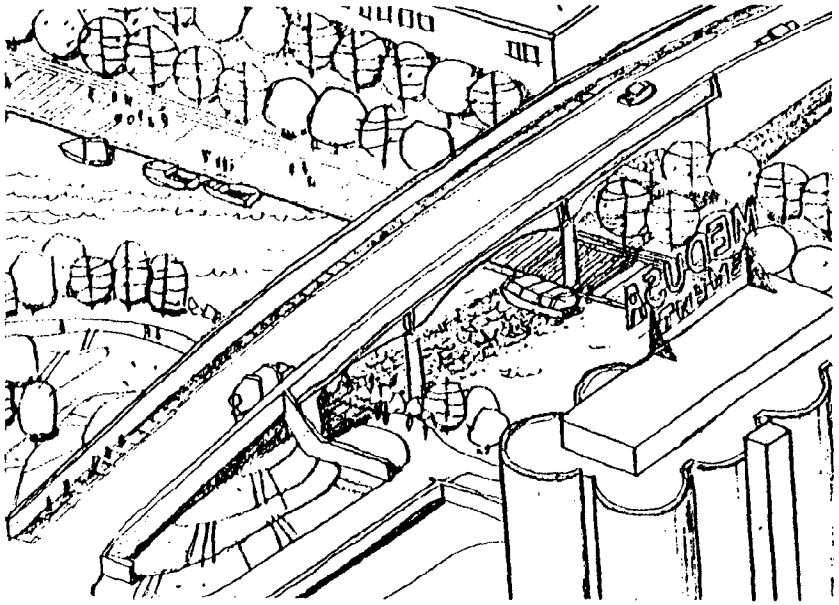


FIGURE 3.6: TRUCK/SERVICE BRIDGE ELEVATION



TYPICAL BRIDGE SECTION

mum underclearance for boat traffic on the proposed canal. A design speed of 25 miles per hour (mph) was selected. The critical grade considerations occur on the north approach to meet the existing roadway elevation at the existing railroad crossing, approximately 250 feet north of the Atwater Street centerline, due to the cost involved in adjusting railroad grades. A six percent (6%) grade on the north approach was necessary to meet the 16-foot minimum underclearance at the proposed canal. The crest vertical curve at the bridge provides a stopping sight distance of 167 feet which is adequate for a 25 mph design speed. The 6% grade on the south approach was chosen to minimize approach fill and to maintain the lowest profile possible. The south approach grade could be flattened if deemed advisable since it is the upgrade for loaded cement trucks. The south approach alignment is tied to the existing ground elevation at the cement silos of the Medusa Cement Company operation. Drives for the park service vehicles intersect the south approach approximately 360 feet south of the Atwater Street centerline. The service drive alignment and grades will be adjusted to fit the constraints of any land trade arrangements, and to blend with the natural terrain of the park sites.



Construction costs of $640,000 for the proposed structure and approaches will be essentially the same for either land trade. However, cost of additional land acquisition along Dubois Street must be added to the total costs of the Land Trade/East.

The Medusa land trade alternatives dictate that the existing railroad service to Medusa Cement Company's operation be discontinued from the existing cement silos north to the north right-of-way line of Atwater Street. Removal of this portion of the spur track is necessary since providing a railroad structure over the proposed canal would negate the value of the canal due to the lack of vertical underclearance between such a structure and the canal water surface. Adjusting the railroad grades to accommodate acceptable underclearance would be extremely impractical if not impossible. Since rail transportation is a major part of the Medusa Cement Company's operation at this site, it is imperative that a method of transporting cement between the existing cement silos and a new rail unloading facility north of Atwater Street be provided. It is proposed that either the existing rail unloading operations and the existing warehouse and packing building be relocated to the Medusa Cement Company's property immediately north of Atwater Street or that new facilities to accomplish the same functions be constructed on that site, whichever is most cost effective. The most viable method of transporting cement between the existing silos and the facilities north of Atwater Street is the utilization of cement air slides such as those presently being used

to unload cement boats south of the existing cement silos. Mr. Howard L. Simpson, Marine Manager of Medusa Cement Company, stated that the air slide operation is very efficient and could handle the quantities of cement involved in their operations. He also stated that the air slides are cost effective in containing cement dust during transport. The minimum effective slope for air slides is limited to seven degrees (7^{o}). Since cement has to be transported to and from the cement silos, two (2) air slides are required with vertical conveyor towers at each end. The conveyor tower at the site north of Atwater Street will be approximately 48 feet tall and attached to the warehousing and packing building. The conveyor tower to the south is the same height and can be attached to the existing cement silos. Adequate vertical underclearance is provided under the air slide at Atwater Street north of the proposed canal and at the service drive immediately south of of the proposed canal. It should be noted that

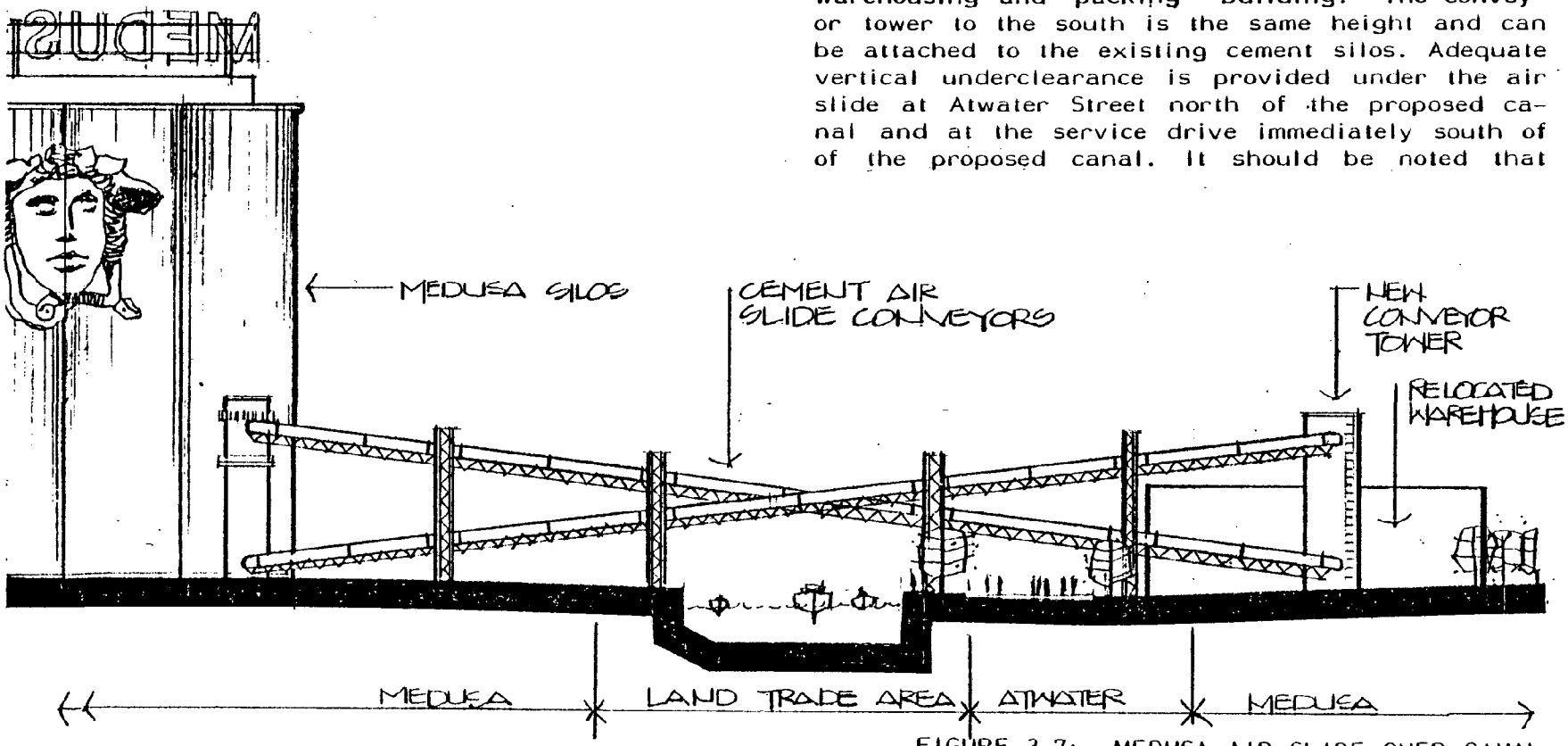


FIGURE 3.7: MEDUSA AIR SLIDE OVER CANAL

vertical water-edge treatment is required on the south side of the proposed canal to accommodate the service drive and pathway.

Mr. Simpson indicated that railroad tracks for storage of at least five (5) railroad cement transport cars, approximately 70 feet long, must be provided at the site north of Atwater Street. In order to meet this requirement, it is recommended that two additional spur tracks be installed parallel to and connecting with the existing spur at the northerly edge of the site.

The three tracks would lie adjacent to and parallel with the east side of the relocated warehousing and packing building and would allow undertrack cement unloading operations to be conducted with minimum of railroad car switching. We feel this unloading operation would be superior to the existing facility.

The relocation or construction costs of the warehousing and packing building, railcar unloading facility, and air slides would be essentially the same for either land trade alternative.

The machinery and equipment would be replaced. The total estimated cost for this operation is $80,000.

The new plant would be connected to the silos by an air slide conveyor system. This would involve approximately 360 lineal feet of slide and the structure to carry it across the canal. The estimated cost for this is approximately $200,000.

The rail spur, fencing, landscaped buffer and other general improvements such as building clean up, access roads, site circulation and painting graphics on the silos should cost approximately $256,000.

Total relocation and adjustment costs for the Medusa Cement Company are outlined below:

Site Improvements	$336,000
Conveyor Systems	200,000
Truck Bridge	640,000
Total	$1,176,000

Marina/Lagoon Alternative

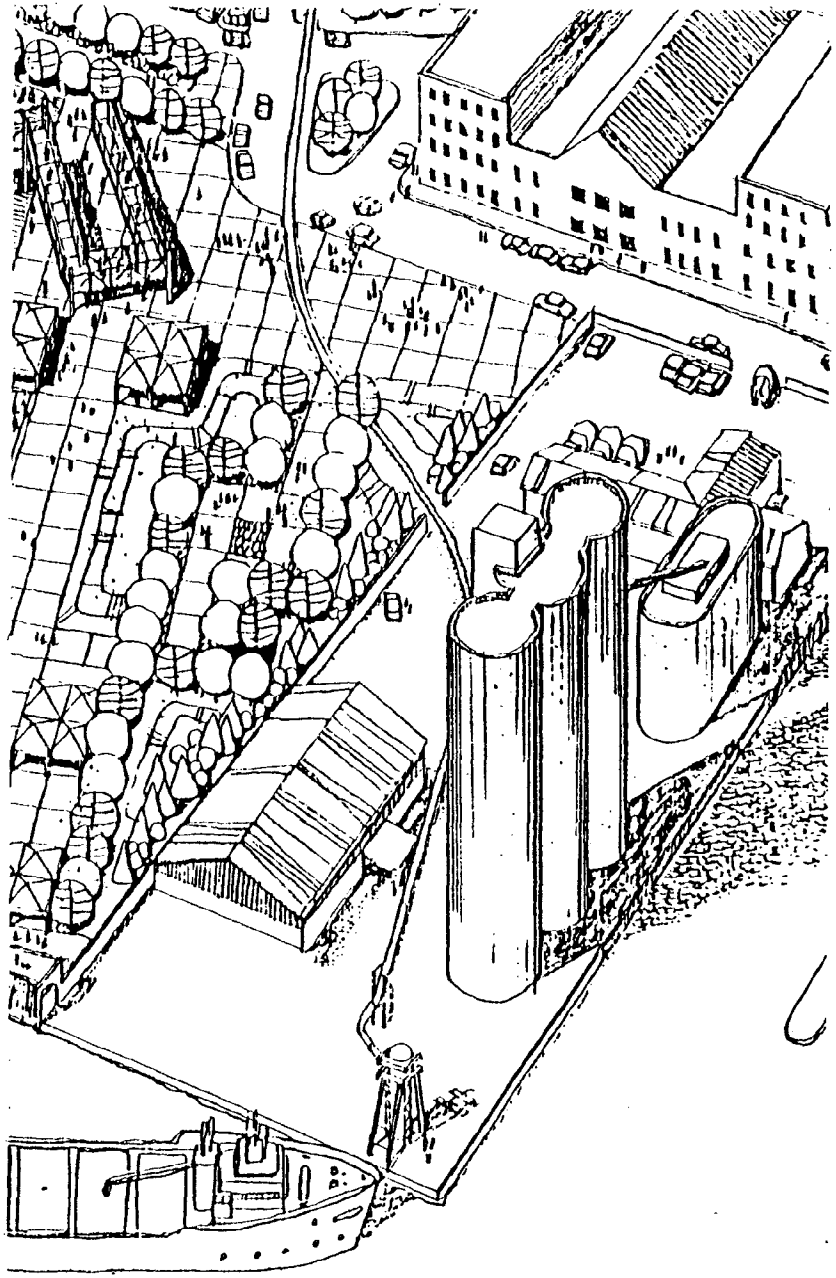
Because the canal does not cross Medusa property in this alternative no land trade is required. Hence, no major relocation costs are incurred. Site improvements including site clean-up, fencing, landscaped buffer and painting the cement silos are still recommended for compatability with the proposed park. These improvements are estimated to cost $75,000.

3.4 PENN-DIXIE CEMENT COMPANY

Penn-Dixie Cement Company is located east of Chene Park south of Atwater on the Detroit River. Penn-Dixie operations are affected minimally with the development of the park sites. The operations for shipping and storage of bulk cement are generally similar to those at Medusa. The major impacts on Penn-Dixie involve their railroad spur, ship loading operations, and truck routes.

Marina/Canal Alternative

The railroad spur to Penn-Dixie is currently not in use, is in a dilapidated condition and would require extensive improvements to use. Since representatives of Penn-Dixie expressed a desire to maintain this line in case the future demands its use, the rail spur poses a particular problem. The alignment of the canal places the entry plaza and drop-off to Chene Park at the foot of Chene Street. Because the spur crosses through this



area, conflicts may arise for pedestrian and vehicular crossing. If the rail did come into use, however, the traffic would be so light that only minor precautions would be necessary, such as signage and special paving to increase awareness of the rail spur. Inconvenience to park users would be for a very short period of time while freight cars are moved into position.

Ship loading operations would be affected because the ship overhangs the canal entry. Through conversations with the cement companies, it was determined feasible to angle the ship out into the Detroit River. This frees the canal entry for small craft and gives added security to the ships at Penn-Dixie by being away from the shore and out of the reach of the public using the park.

The truck routes to Penn-Dixie would be affected from the closing of Atwater Street between Orleans and Chene Street. The trucks would be rerouted up Jos. Campau Street directly to Jefferson Avenue with no serious interference to business.

Marina/Lagoon Alternative

This alternative would involve identical consideration as the Marina/Canal Alternative since the only land changes are on the west side of Chene Park and are not related or adjoining Penn-Dixie operations.

3.5 RECREATION, SERVICE AND SECURITY VEHICLES

According to Mr. Carl Ackerman of the Forestry and Landscape Division of the Recreation Department, the largest service vehicle used for park maintenance is $10\frac{1}{2}$ feet high and 8 feet wide weighing 17,000 pounds. Utilizing this design standard, the proposed truck bridge across the canal in the Marina/Canal Alternative will be more than adequately designed for this load since it accommodates larger and heavier cement trucks. Ser-

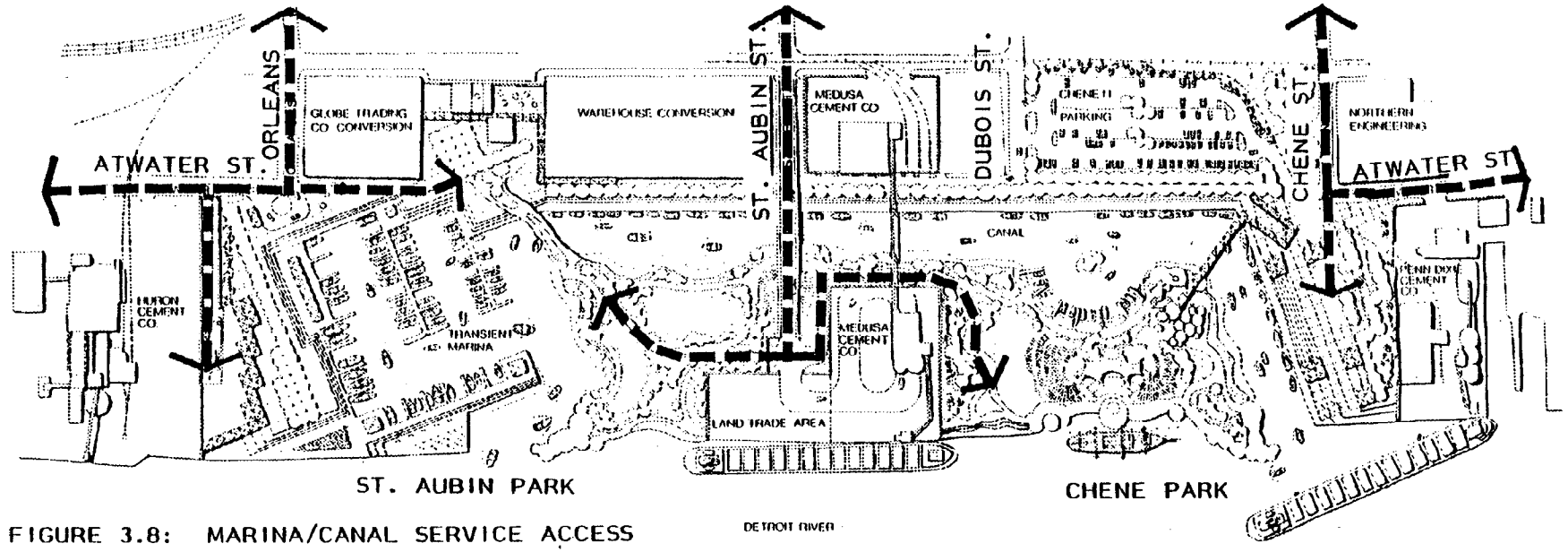


FIGURE 3.8: MARINA/CANAL SERVICE ACCESS

vice vehicles will be able to gain access to all points in the park. The bridge will not require service/security vehicles to pass under it because the proposed design allows access off the bridge in both directions.

The Marina/Lagoon Alternative allows for service vehicle access on grade. This route will primarily be a pedestrian route with a chain/bollard device preventing vehicles other than maintenance vehicles from access to the Chene Park site.

3.6 PEDESTRIAN/BICYCLE ACCESS

The Linked Riverfront Parks Project proposed creation of two major pedestrian/bicycle circulation systems. The Riverlink follows the river's edge wherever possible and the Interpretive Link winds through the existing streets of the east riverfront area and includes access to Jefferson Avenue and

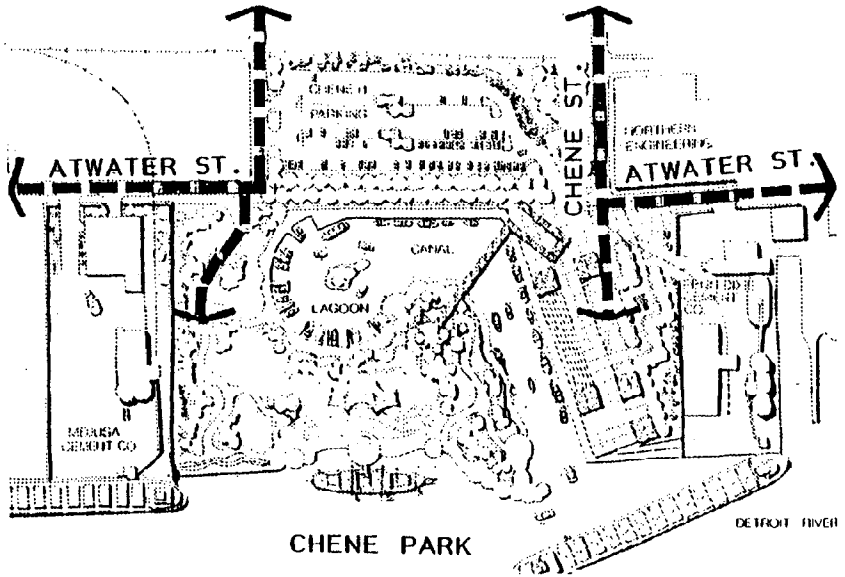


FIGURE 3.9: MARINA/LAGOON SERVICE ACCESS

residential areas to the north. At the proposed Chene and St. Aubin park sites the Riverlink and Interpretive Link come together at the Atwater Mall. Access to the Mall from the north is proposed to follow Chene Street and Orleans Street. Vehicular parking for the park sites would lie on these north/south access routes north of Atwater Street with auto drop-off points occurring at each park site.

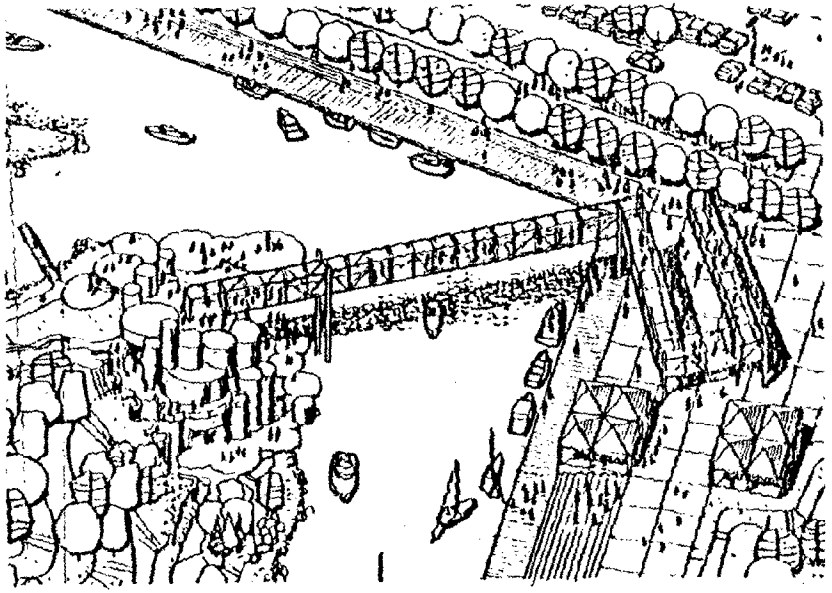
Either of the proposed marina/canal alternative configurations will affect the movement of pedestrians and bicyclists from the Atwater Mall or auto drop-off areas into the parks.

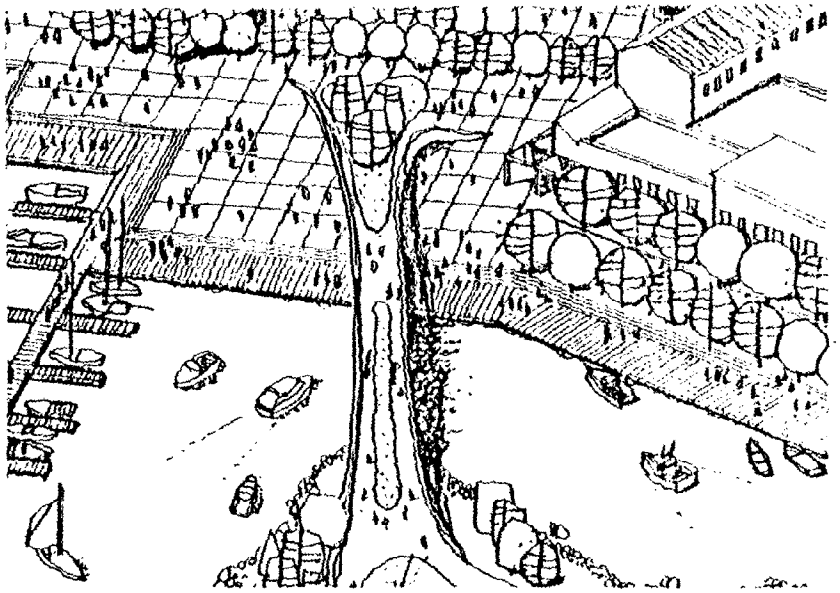
Marina/Canal Alternative

The canal, in this alternative, completely blocks pedestrian and bicycle access to the major portion of the parks. To accommodate access, two pedestrian bridges are proposed: a ramped, steel truss bridge at the Chene Park and a free form concrete bridge at the St. Aubin Park. Both bridges accommodate bicycles and handicapped access. The Chene bridge is estimated to cost $111,250 and the St. Aubin bridge is estimated to cost $74,000.

Marina/Lagoon Alternative

One pedestrian bridge - the Chene Park ramped, steel truss bridge - is proposed for this alternative. This bridge will connect the entry plaza to the proposed water play feature on the east end of the Chene Park peninsula. This will eliminate the need to walk the distance around the boat lagoon to gain access to the peninsula and will also create a high viewing area to look at the entire park site. The bridge cost is the same as in the previous alternative.





3.7 TRUCK ROUTING

One of the primary issues identified by the Linked Riverfront Parks study was the potential conflict between industrial truck traffic and new land uses such as commercial or residential. This is especially true in the area of the Chene/St. Aubin parks. Presently trucks move east and west along Atwater and move north along Rivard, St. Aubin, Dubois, Chene and Jos. Campau Streets. Although Dubois is presently the designated north/south truck route, lack of signage and enforcement minimizes the confinement of trucks to this route.

The primary generators of truck traffic in the parks area are Consolidated Docking, Huron Cement Company, Medusa Cement Company and Penn-Dixie Cement Company. Truck traffic is also generated by industries north of Atwater, but this traffic is not directly affected by the proposed Marina/Canal.

Marina/Canal Alternative

Truck traffic in this alternative is affected in three ways: 1) the closing of Atwater between Orleans and Chene removes a complete segment of the major east/west truck route; 2) the canal configuration and recommended land trade alternative requires a truck bridge to Medusa and moves the north/south truck route from Dubois to St. Aubin; and 3) the acquisition of Consolidated Docking drastically reduces the number of trucks generated in the area.

Because Consolidated Docking is relocated, the primary concern is with truck access to the cement companies. The primary transporter of bulk cement from these companies is the Rex Trucking Company. This company is located adjacent to the Huron Cement Company on Atwater and also parks their trucks on a site north of Atwater and west of Orleans.

Conversations were held with representatives of Rex Trucking Company to discuss the impact of the closing of Atwater. The primary criteria expressed by this company is that any new route be within a maximum distance of one mile from their present location to the farthest cement company, (Penn-Dixie).

An alternate routing system was presented to Rex Trucking which proposed east/west travel along Jefferson and north/south travel along Riopelle, St. Aubin and Jos. Campau. This route was proposed for the following reasons: 1) traffic signals at Jefferson facilitate in turning large cement trucks; 2) other east/west routes (Franklin, Woodbridge) do not have adequate right-of-ways for truck routes and do not provide enough clearance for the minimum turning radii of cement trucks; 3) any east/west route south of Jefferson would conflict with proposed new developments in the east riverfront area including the planned Interpretive Link; 4) the straightest possible path is desirable to minimize turns; and 5) this route is within the one mile maximum distance criteria. This route, as well as the proposed Medusa truck bridge, was found acceptable to the Rex Trucking Company. Costs incurred would be minimal for new signage and a new traffic signal light at Jefferson and Riopelle.

Marina/Lagoon Alternative

This alternative proposes the closing of Atwater between Dubois and Chene only. It is still recommended that St. Aubin replace Dubois as the primary north/south route to keep greater distance between the extensive truck traffic at Consolidated Docking and the users of Chene Park. Jefferson to Jos. Campau would remain the primary access to Penn-Dixie Cement Company.

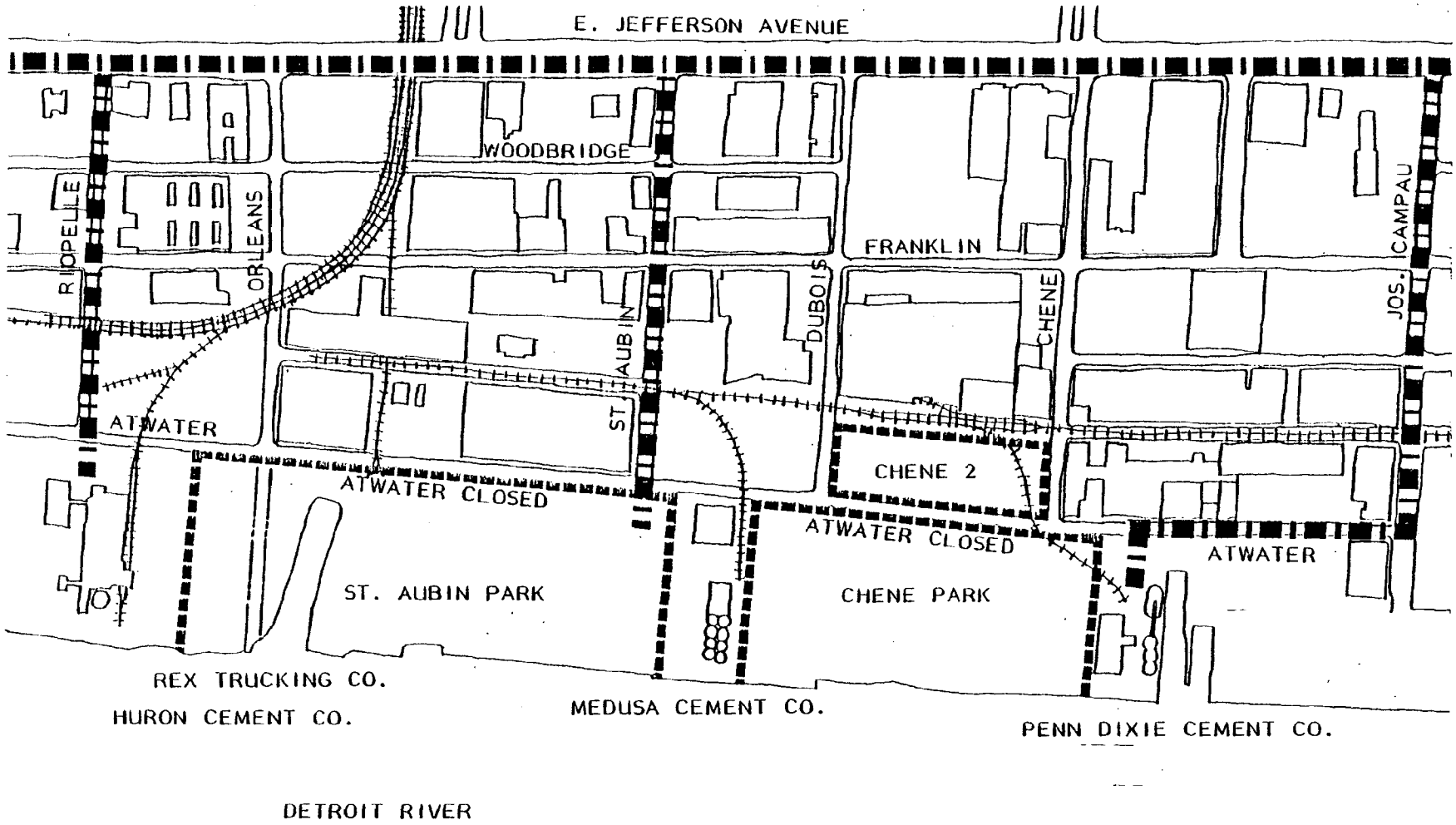


FIGURE 3.10: TRUCK ROUTES

3.8 UTILITY CONFLICTS

The conflicts that arise between construction of the proposed marina/canal and public utilities such as storm sewers, sanitary sewers, water mains, gas lines and leads for each utility that are known to exist on the present site will be addressed herein for each marina/canal alternative. The sizes and locations of the public utilities located on the site were obtained from the City of Detroit engineering records made available to us and their accuracy is not hereby attested to except for that area on Atwater Street between Chene Street and Dubois Street which was surveyed under previous development contracts.

Both the Chene and St. Aubin sites contain major combined overflow sewers. These are located on the Chene Street, Dubois Street and Orleans Street right-of-ways and extend through the park sites to the river. These sewers are activated when major rainfall overloads the city's combined sewer system and its filtering plant. When this occurs stormwater carrying sanitary sewage is discharged directly into the Detroit River creating point source pollution. To mitigate this problem, a storm water retention and/or combined sewer separation study is being conducted for the City of Detroit by the consulting engineering firm of Black and Veatch. Their preliminary findings will not be released until September of 1980. It is known at this time that the report will not recommend total elimination of sewer overflows nor discontinuation of any overflow sewers in the canal study area. However, storm water flows to the area will be greatly reduced by utilizing retention storage basins, quite likely near the present Elmwood Cemetary. This reduced flow data will not be available until March of 1981. Until this data is available, it is preliminarily recommended that these overflow sewers not discharge directly into the canal since they presently carry non-processed sanitary sewage. The estimated construction cost to realign these sewers under the canal assumes the worst condition. These costs could probably be reduced when further data is available next spring.

<u>Marina/Canal Alternative</u>

The resolution of the conflicts that construction of the proposed canal may generate with public utilities will be analyzed at each major street intersection in this area, working from east to west namely Chene Street, Dubois Street, St. Aubin Street, and Orleans Street.

A. Chene Street Utilities at Inlet

Storm Sewers: two 42-inch diameter storm sewers, with flow controls, located within Chene Street right-of-way and extending south of Atwater Street to the Detroit River.

Contact with the City indicates that storm water flow in these sewers are restricted to 75% capacity. Based on sewer invert elevations of 872.6 at Atwater Street and 871.0 at the river, a length of 450 feet and the 75% restriction; the maximum flow is estimated at 30 cubic feet per second (cfs). Since the proposed canal inlet is located west of the storm sewers at the Detroit River's edge, the storm sewers will not cause an interference. However, reconstructed outlets into the Detroit River will be required due to the reworked river edge treatment. It is anticipated that the relatively low flow of 30 cfs will not adversely affect the canal inlet flow or the canal water quality.

Gas Line: one abandoned 4-inch high pressure gas line located within the Chene Street right-of-way extends from Atwater Street an unknown distance.

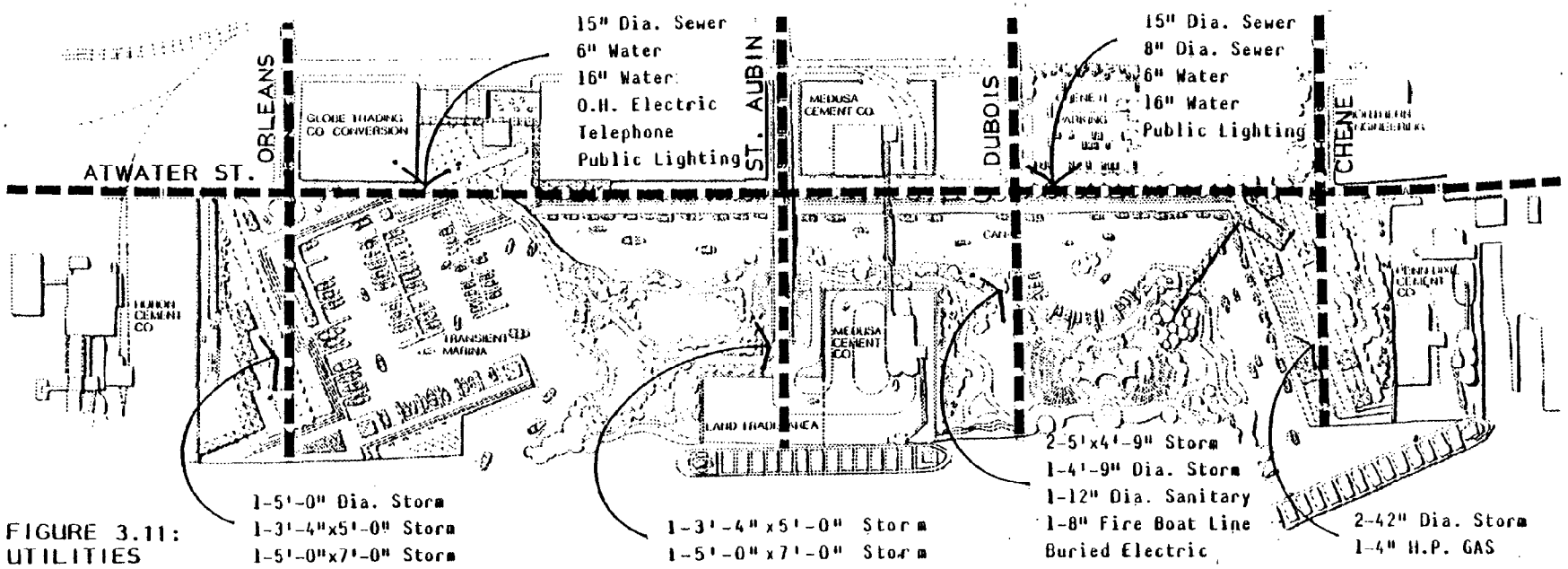


FIGURE 3.11:
UTILITIES

The gas line does not interfere with the proposal canal construction.

B. Utilities at Dubois Street

Storm Sewers: two 5-foot-by 4-foot-9-inch arch sewers and one 4-foot-9-inch diameter sewer, all located in the Dubois Street right-of-way, extending south from Atwater Street to the Detroit River.

Construction of the proposed canal will interfere with these storm sewers. Based on sewers inlet elevations at 873.5 at Atwater Street and 872.0 at the Detroit River, a maximum flow of 330 cfs is anticipated. The following options were investigated as resolutions to the sewer conflict:

Option 1: reconstruct the existing sewers under the proposed canal only as an inverted sewer (siphon). Although this is cost effective, the Detroit Water and Sewer Department does not feel syphons are appropriate due primarily to maintenance concerns. The estimated construction cost is $175,000.

Option 2: construct new sewers along Atwater Street to redirect sewer flows to the intersection of Chene Street and Atwater Street and reconstruct existing sewers from that intersection south to the Detroit River. Reconstruction of the existing sewers south of Chene Street is required to accomodate the increased flow. This option may adversely affect flows and water quality at the proposed canal inlet due to the relatively high volume discharged into the Detroit River immediately upstream of the proposed inlet. Estimated construction cost is $990,000.

Option 3: reconstruct the existing sewer under the proposed canal only with a vertical lift pumping station at the south side of the proposed

canal. This option was eliminated due to the high initial construction costs and the high continual maintenance costs associated with lift stations of the size necessary to handle the anticipated flows. The appearance of a lift station on the island park would also be objectionable.

Option 4: construct new sewers along Atwater Street to redirect sewer flows to the intersection of Orleans and Atwater Street and reconstruct existing sewers from that intersection south to the Detroit River. This option, including picking up the sewer flow from the St. Aubin sewer, is estimated to cost $1,900,000.

Option 5: outlet the sewers directly into the canal. This option involves minimal cost but would have to be studied in much greater depth to determine if the marina area could be adequately flushed of sanitary matter. The canal itself is self flushing.

Option 4 is recommended as presently the most viable solution. Option 5 may have merit but cannot be investigated fully until the Black and Veatch study is complete.

Sanitary Sewer: one 12-inch diameter sanitary sewer within the Dubois Street right-of-way extending south of Atwater Street a distance of 155 feet to a sanitary manhole.

This sewer services the Medusa Cement Company and will also service the proposed park. We recommend reconstructing the 12-inch sewer under the proposed canal from its south edge to the manhole on the south side of Atwater Street and lifting the sewerage to the existing sanitary sewer by means of a manhole type sanitary sewer lift pump. This solution would also provide adequate capacity to discharge other sanitary sewers required for the total park concept. The estimated construction cost is $36,000.

Water Line: one abandoned 8-inch diameter fire boat line within the Dubois Street right-of-way extending south from Atwater Street to the Detroit River. Because it is abandoned this line will not affect canal construction.

Buried Electric Service: an abandoned buried electric service line is located in the Dubois Street right-of-way extending south of Atwater Street an unknown distance. Because it is abandoned this line will not affect canal construction.

C. Utilities at St. Aubin Street

Storm Sewers: one 5-foot diameter storm sewer within the St. Aubin Street right-of-way extending south of Atwater Street to the Detroit River.

Construction of the proposed canal would interfere with the existing sewer described above. Based on an assumed slope of 0.2%, the anticipated flow for the 5-foot diameter storm sewer is 108 cfs. The following options were studied as a resolution to the storm sewer conflict:

Option 1: reconstruct the existing sewer under the proposed canal only utilizing an inverted sewer (siphon) as described in Option 1 at Dubois Street. Estimated construction cost is $70,000.

Option 2: construct a new sewer easterly on Atwater Street to Chene Street and thence southerly to the Detroit River. When this option is considered in conjunction with Option 2 at Dubois Street, i.e. increasing the sewer size from Dubois Street east to Chene Street and from Chene Street south to the river, the anticiapted increase in construction cost is $500,000.

Option 3: reconstruct the existing sewer under the proposed canal only utilizing a vertical lift pump station on the south side of the proposed canal. This option was eliminated for the same reasons given in Option 3 at Dubois Street.

Option 4: same as described at Dubois Street.

Option 5: same as described at Dubois Street.

Option 4 is recommended as at Dubois Street.

D. Utilities at Orleans Street

Storm Sewers: one 3-foot-4-inch by 5-foot box

storm sewer and one 5 foot by 7 foot box storm sewer within the Orleans Street right-of-way extending south of Atwater Street to the Detroit River.

Construction of the proposed canal does not conflict with the storm sewers at this location except at the extreme westerly portion of the canal outlet in the marina area. Based on an assumed sewer slope of 0.2%, the anticipated maximum flow is 330 cfs. Resolution of any storm sewer conflict must be predicated on the final configuration of the proposed canal outlet and marina facilities. However, we feel a minimum amount of sewer relocation would be required at the Detroit riverfront. Estimated construction costs associated with the sewer relocation will be addressed in the cost analysis of the Marina/Canal Alternative. In our opinion, the flow from the existing storm sewers would have a minimal effect on the proposed marina operations and no adverse effect on the water quality.

Marina/Lagoon Alternative

The identification and proposed resolution of potential conflicts between the existing utilities and construction of the Marina/Lagoon Alternative are as follows:

Utilities at Chene Park: identical to the Marina/Canal Alternative.

Utilities at Dubois Street: identical to the Marina/Canal Alternative based on anticipated construction of the proposed boat turnaround lagoon extending west of Dubois Street. Limiting construction of the proposed boat turnaround lagoon entirely east of Dubois Street would result in no conflict with the utilities at this location.

Utilities at St. Aubin Street: the existing utilities will not conflict with proposed lagoon construction.

Utilities at Orleans Street: the existing utilities will not conflict with proposed lagoon construction.

3.9 NOISE AND DUST

The level of background and/or peak noise is a major potential conflict between recreational use and industrial use. The Federal Highway Administration recommended L_{10} design noise level for recreational areas is 70 dBA; the recommended level for outdoor amphitheaters is 60 dBA. It is presumed that noise, per se, does not affect the canal; in fact, the boat traffic in the canal is potentially a major generator of background noise. The noise generated by industry surrounding the parks may adversely impact the park quality. Therefore, noise readings were obtained by the staff of Schimpeler-Corradino Associates, consulting engineering, at two different times of the year, under two different conditions. The first readings were taken in October, 1979 at ten locations. At the time of these readings no cement unloading operations were occuring and, therefore, general background noise from surrounding industry is recorded. The results of these readings are as in Table 3.1.

These readings indicate that even though this urban park cannot be considered quiet, the noise levels can generally be considered acceptable.

There was some concern expressed that unacceptable peak noise might be experienced during cement ship unloading operations. Therefore, on August 8, 1980, additional noise level readings were taken during the unloading of the Medusa Challanger at the Medusa Cement Company - an operation that occurs about once a week. As illustrated below, L10 noise levels ranging from 59 dBA to 79 dBA were recorded. The higher noise levels were associated with conveyor motors, as well as background noise along the river.

TABLE 3.1
NOISE MONITORING
(WITHOUT SHIP UNLOADING OPERATIONS)

Station Location	L_{10} (dBA)	Location
A	69	Center of Chene #2 Site
A	63	
B	64	Northeast Corner of Chene #1
B	63	
C	58	Southeast Corner of Chene #1
C	59	
D	74	Northwest Corner of Orleans & Atwater
D	77	
E	65	North side of Atwater
E	67	
F	71	Northwest Corner of Atwater & St. Aubin
F	74	

These noise levels are, again, generally acceptable except that with or without ship unloading they exceed the recommended L10 level of 60 dBA for amphitheaters. The proposed earth mounding, contouring and landscaping should mitigate these high noise levels to some extent, but the potential to hold certain types of performances at the amphitheater might be limited. The amount of noise specifically generated by the Consolidated Docking operations cannot be separated from the readings.

Staff of Schervish, Vogel, Merz, P.C. stood at the amphitheater loction during ship unloading operations on August 8. Conversations were easily carried on in a normal tone of voice; background noise was not disturbing.

Another potential conflict between recreational and industrial use is from dust. This dust is generated by cement plant operations and by road dust caused by truck traffic. Visual observation of the park sites by SVM staff throughout the past year has indicated that dust does not appear to be a major problem. On August 8, 1980

TABLE 3.2
NOISE MONITORING
(DURING SHIP UNLOADING OPERATIONS)

Station Location	L_{10} (dBA)	Location
1	79	Along river south of amphi-theater
1	65	
1	66	
2	71	Southwest corner of Chene #1
2	62	
2	73	
3	67	Along Atwater
3	72	
4	59	East edge of inlet, St. Aubin site
4	74	
4	70	

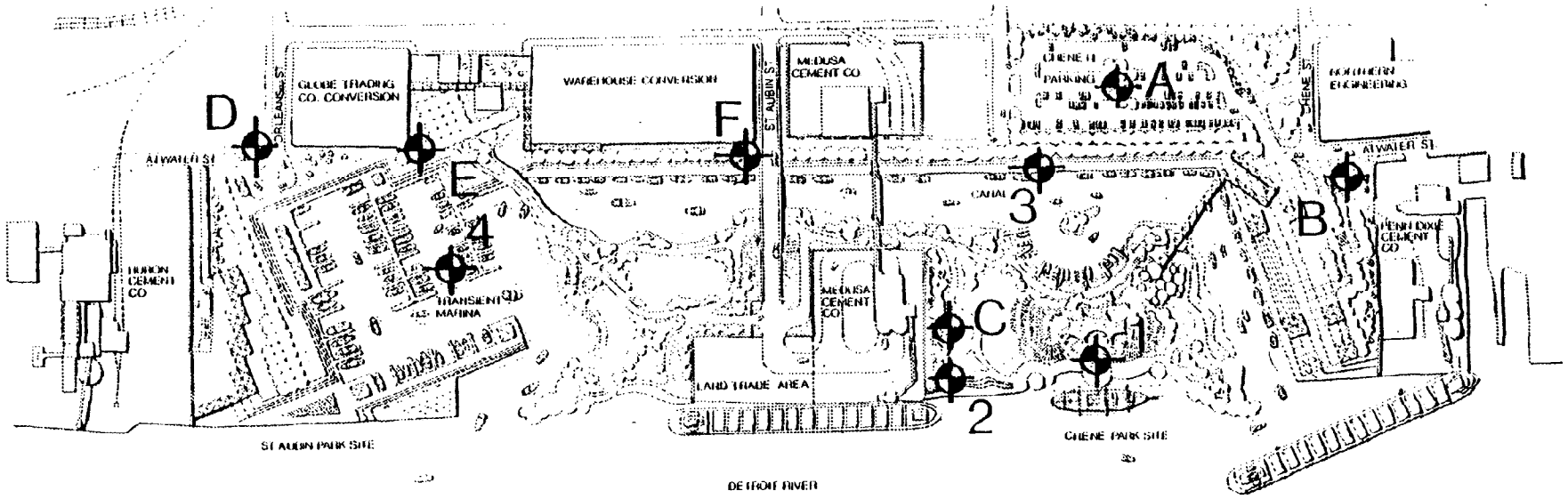


FIGURE 3.12: NOISE MONITORING LOCATIONS

the unloading operations of the Medusa Challenger were observed. The operation is under constant surveillance by an employee of Medusa Cement Company from the top of the cement silos. At one point in the operations a conveyor malfunctioned causing a small cloud of cement dust. The conveyor was shut down immediately; the total duration of dust was less than 60 seconds and in minimal amounts. During the normal course of unloading dust generated was totally controlled and not evident.

Road dust can be easily controlled through a road wetting program. The Medusa Cement Company informed us that their plant in Charlevoix, Michigan is in a recreational area and that they regularly wet the roads for dust. This same program could be utilized on the truck route on St. Aubin Street.

3.10 RAIL TRANSPORTATION

As this report was going to the printers, word was received that Conrail had embargoed rail shipping in the east riverfront area. We assume the reasons for this include the low volume of shipping and the cost of bringing the existing rail up to minimum safety standards (Conrail personnel had to walk in front of the engines when using this track). The elimination of rail service affects the Marina/Canal Alternative in that it assumes the warehouse building must be moved north of Atwater to gain rail service.

Two potential solutions are apparent: 1) replace the low volume rail service with truck service; or 2) run a new spur from the Grand Trunk Western Railroad to Medusa. If the latter is feasible (which is questionable) then the Marina/Canal Alternative would not change. If the former

is feasible then the warehouse/packing building could possibly be relocated on Medusa property south of Atwater. The cost of relocation would probably still remain the same because a new conveyor system to this building would be needed.

Although there is insufficient time to analyze the impact of the Conrail embargo, the cost of Medusa relocation is not drastically changed. It is assumed that this embargo does not affect Medusa operations to the extent that they would have to abandon their operations.

3.11 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter investigated the potential conflicts arising from industrial, recreational, utility and transportation concerns. The investigation determined that all conflicts can technically be resolved. Cost impacts are summarized in Chapter 5. Major conclusions and recommendations are as follows:

1. The Consolidated Docking site must be acquired for development of the Marina/Canal Alternative. The Marina/Lagoon Alternative is premised on delay or inability of acquisition of this site.

2. A land trade with Medusa Cement Company is necessary for the Marina/Canal Alternative. The Marina/Lagoon Alternative requires no land trade.

3. The Medusa Land Trade/West "A" is the recommended land trade alternative.

4. The Marina/Canal Alternative requires a new truck bridge for security and maintenance vehicle access to the park as well as access to the Medusa Cement Company.

5. The Marina/Canal Alternative requires a new air slide conveyor to cross the canal for servicing Medusa Cement operations north and south of Atwater. This conveyor and the relocation of the packing building was considered more feasible than building a railroad bridge over the canal.

6. Two pedestrian bridges are required by the Marina/Canal Alternative. One pedestrian bridge is recommended for the Marina/Lagoon Alternative.

7. No utility alterations are required for the Marina/Lagoon Alternative except for sewer reconstruction at the river's edge.

8. The Overflow sewers at Dubois Street and St. Aubin Street conflict with the canal in the Marina/ Canal Alternative. The recommended resolution is to reconstruct the sewers along Atwater Street to Orleans Street and then south to the Detroit River.

9. The sanitary sewer at Dubois will have to be reconstructed under the canal in the Marina/Canal Alternative.

10. The utilities at Orleans Street require no alterations outside of reconstruction of the outlet at the river's edge.

11. Truck, pedestrian and bicycle circulation concerns can be feasibly resolved for either marina/canal configuration.

12. Industrial noise and dust pose no major conflict with recreational use.

Marina 4.0

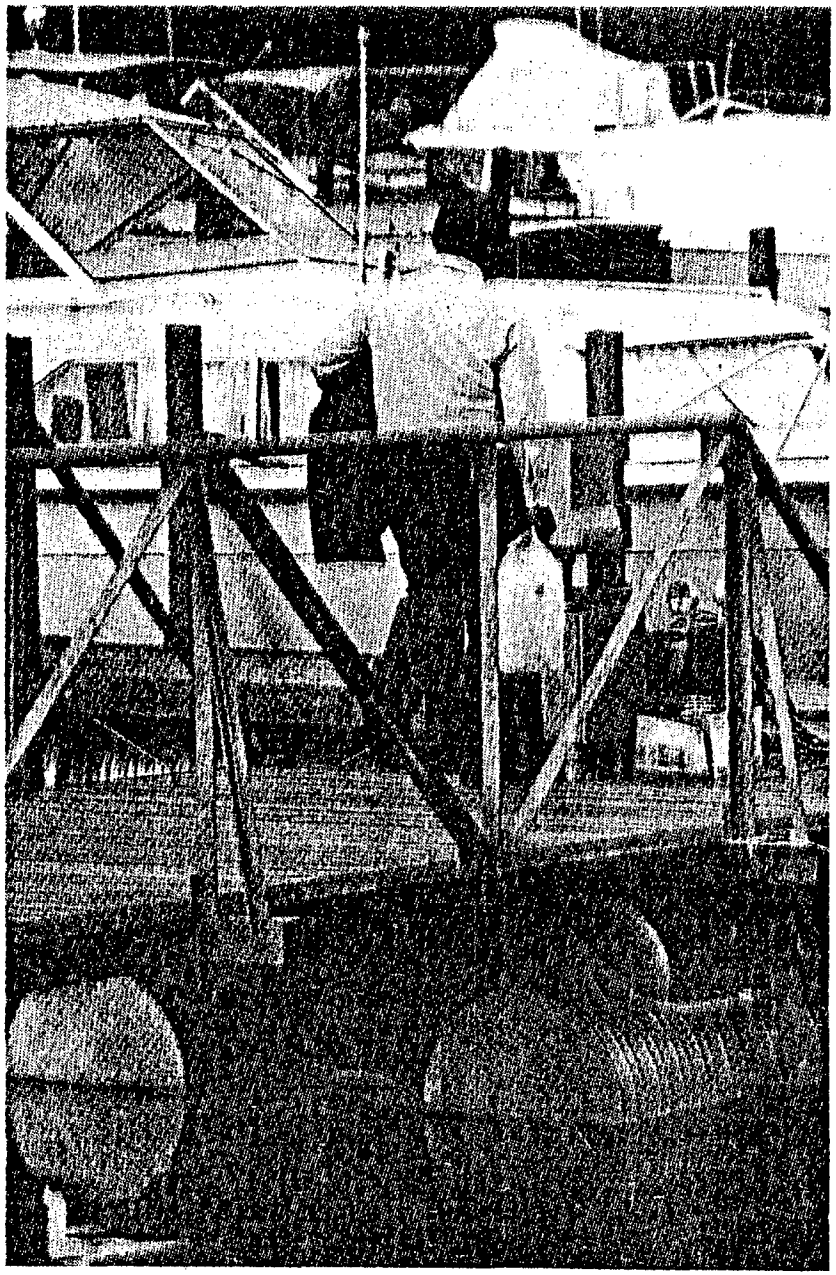
4.1 INTRODUCTION

This chapter investigates the program, design, cost, and operations of the proposed transient boat parking areas represented in the alternative marina/canal configurations. The need for transient boat parking facilities near downtown Detroit was confirmed by a Marina Owners' Conference sponsored by the Detroit Recreation Department. Marina design criteria was gathered from the Michigan Department of Natural Resources. The mix of boat types and operations and maintenance costs were derived from a review of existing State of Michigan and City of Detroit marinas.

4.2 MARINA PROGRAM

The need for marinas with access to downtown Detroit has long been considered. The attempt to install such a marina at Cobo Hall failed because of its inability to deal with wave action concerns. This failure has dampened enthusiasm for other attempts to create a downtown marina, but it has not diminished the need for such a marina. The concept of boats being able to park near downtown and attend restaurants, hockey games, theaters, shopping and other city amenities is an appealing one.

A conference on marina development and operations, sponsored by the Detroit Recreation Department, was held May 29, 1980. Attendance included representatives of local yacht clubs, boating organizations, private and publicly owned marinas, the Waterways Devision of the Michigan Department of Natural Resources, the U.S. Coast Guard, the City Planning Department, the Community and Economic Development Department, Public Services, the Recreation Department, and Schervish, Vogel, Merz, P.C. The focus of this meeting was on present and future development



along the Detroit riverfront and on the concept of a transient marina at the Chene/St. Aubin park sites. The general consensus of this conference was that even though there is a slight downward trend in seasonal marina usage there is a very strong need for transient marina facilities with recreational tie-up in the City of Detroit.

The Chene/St. Aubin park concept proposes a transient marina as opposed to a seasonal marina for several reasons:

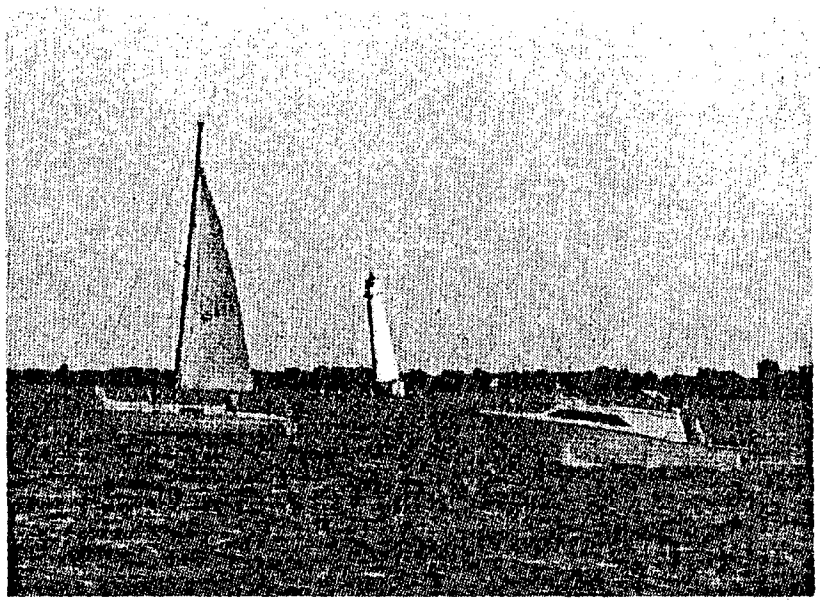
1. Seasonal marinas would serve only a few people while transient marinas would provide, through turn-over, a maximum number of people with access to downtown and the proposed recreational /entertainment center proposed for the East Riverfront.

2. The Chene/St. Aubin sites are not large enough to facilitate a full service seasonal marina.

3. Seasonal marinas are planned by the City or private developers in other locations (Greyhaven, Marina City, Riverfront West).

4. The only designated transient marinas near Detroit are at Wyandotte (12 miles away) and at Metropolitan Beach (21 miles away). Memorial Marina in the City of Detroit makes available transient spaces only if they don't obtain 100% occupancy on a seasonal basis.

The Michigan Harbors Guide of the Michigan State Waterways Commission of the Department of Natural Resources states that commission sponsored harbors have been located in such a way that no boater will ever be more than about 15 shoreline miles from a safe harbor. In the Detroit area there is no lack of safe harbors in which to take refuge, but the nearest transient



marina slips at Wyandotte total only four spaces. The Metropolitan Beach Marina contains 172 transient spaces, but is 100% occupied on all weekends in season.

In order to maximize potential usage, any marina designed for Detroit should accommodate the current trend to sailboats (the present ratio is about 35% to 65% powerboats). It was considered infeasible to accommodate sailboats totally through the canal since most clearances would make the fixed pedestrian bridges improbably high; while pedestrian draw bridges would complicate the ease of boat movement through the canal.

Mr. Keith Wilson of the Michigan Department of Natural Resources further stated that if the marina accommodated 30 foot, 45 foot and 60 foot craft in the ratio of 45/45/10 it would adequately accommodate pleasure craft on the Detroit River.

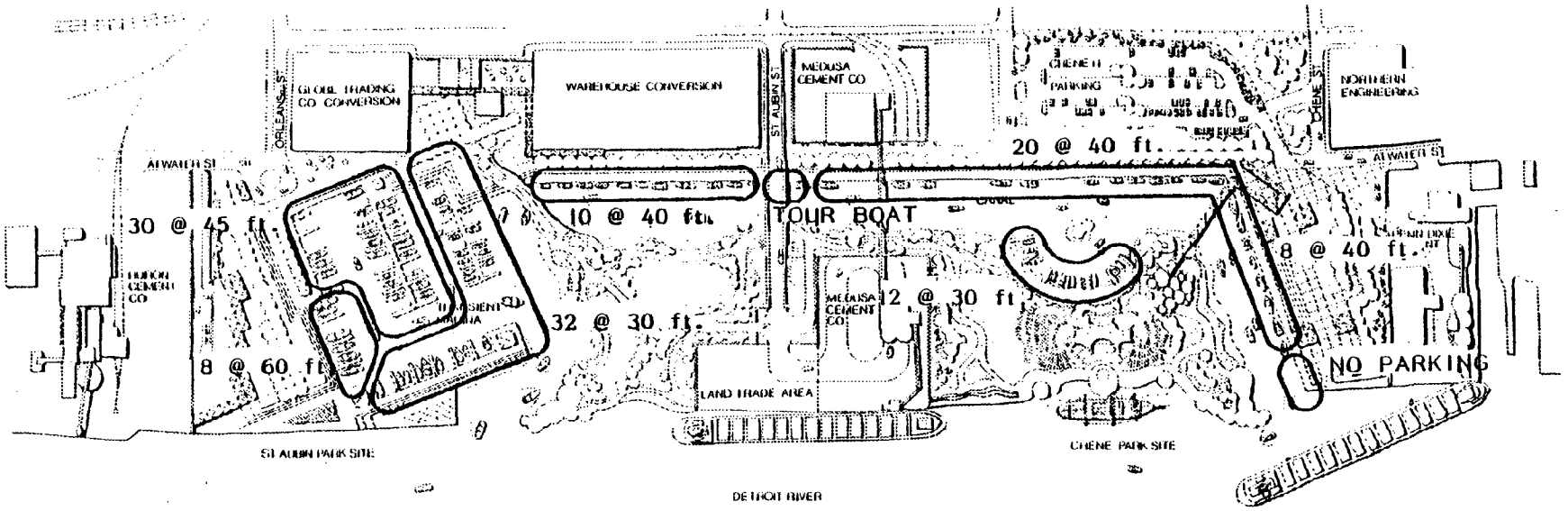


FIGURE 4.1: BOAT SPACES: MARINA/CANAL ALTERNATIVE

The rationale presented above in conjunction with the design criteria presented in section 4.3 was used to program each of the marina/canal configuration alternatives.

Marina/Canal Alternative

The program for boat parking slips in this alternative is based on the assumption that there is a need for transient slips greater than the maximum number of boats that could ever be accommodated on the combined Chene/St. Aubin sites. Therefore, the design assumes that all land area not programmed for other recreational uses would be excavated and used for boat parking. This generated the following table of available parking spaces:

MARINA/CANAL ALTERNATIVE
MAXIMUM BOAT SPACES AVAILABLE

	30'	40'	45'	60'	TOTAL
St. Aubin Basin (slip parking open to sailboats)	32		30	8	70
Chene Basin (slip parking not open to sailboats)	12				12
Canal Edge (open to sailboats)		8			8
Canal Edge (not open to sailboats)		30			30
Total	44	38	30	8	120

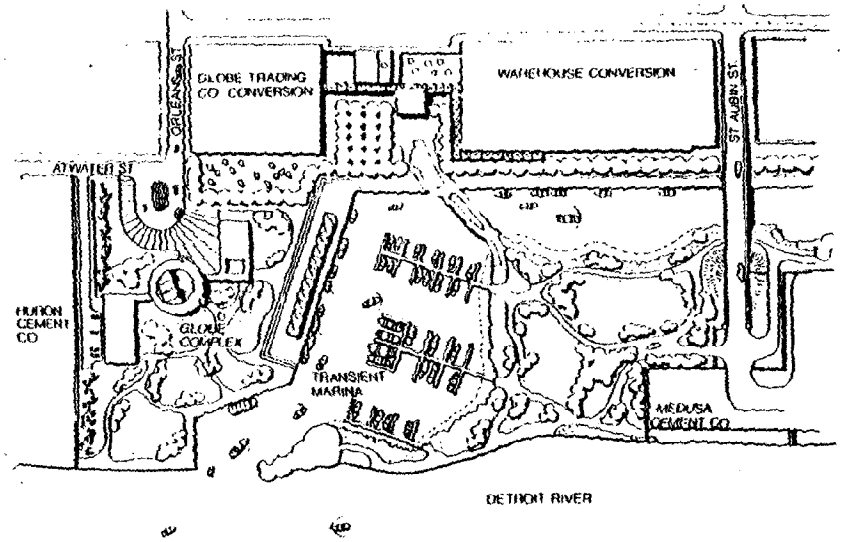


FIGURE 4.2: POTENTIAL GLOBE THEATER SITE

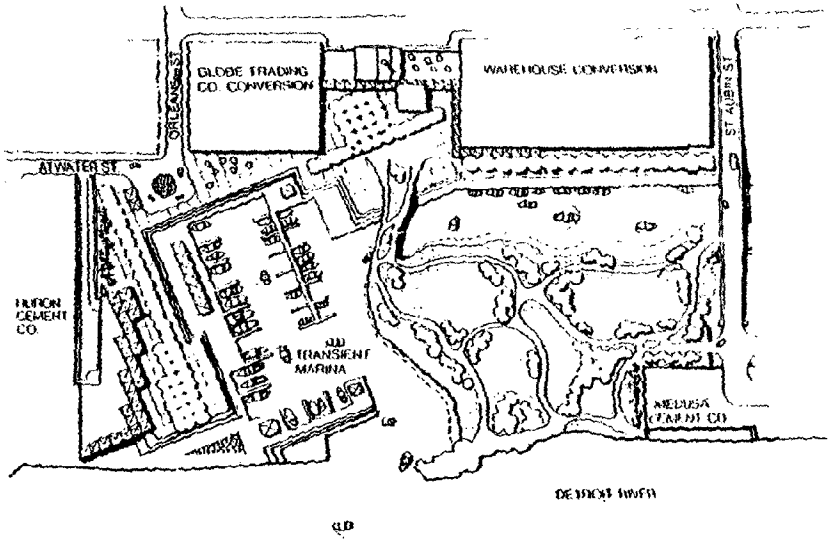


FIGURE 4.3: REDUED MARINA

The construction cost for marina slips in the Chene/St. Aubin basins are estimated to be $3,500/slip exclusive of dredging and seawall construction (these costs are included elsewhere in this report and are summarized in Chapter 5). The 82 slips in the Chene and St. Aubin basin would totally cost approximately $287,000, which includes 30 amp electric and water service to each slip, floatation docking, ice control devices and lighting. The additional cost of boat parking along the remainder of the canal is negligible since this boat parking is parallel to mthe edge and the wood deck is priced as part of the seawall edge price.

For several reasons, maximizing the number of boat slips in the St. Aubin basin may not be desirable. The Waterboard site is programmed for private development and is potentially the site of the proposed Wayne State University Globe Theatre (Further discussion of this concept is found in Chapter 5). This theatre may require an expanded Waterboard site thereby reducing the potential size of the marina, Figure 4.2. The theater, on the other hand, would create even additional need for transient boat slips. Likewise, the Recreation Department may desire, because of programming demands, that the useable land area of the St. Aubin Park be increased for other viable park functions that are more compelling than transient boat parking. This will be easier to determine when surrounding land use plans for new development are finalized. Assuming a desire to reduce marina size, an alternative plan was generated which reduces the number of St. Aubin basin slips from 70 to 53, Figure 4.3; even more reductions are, of course, possible.

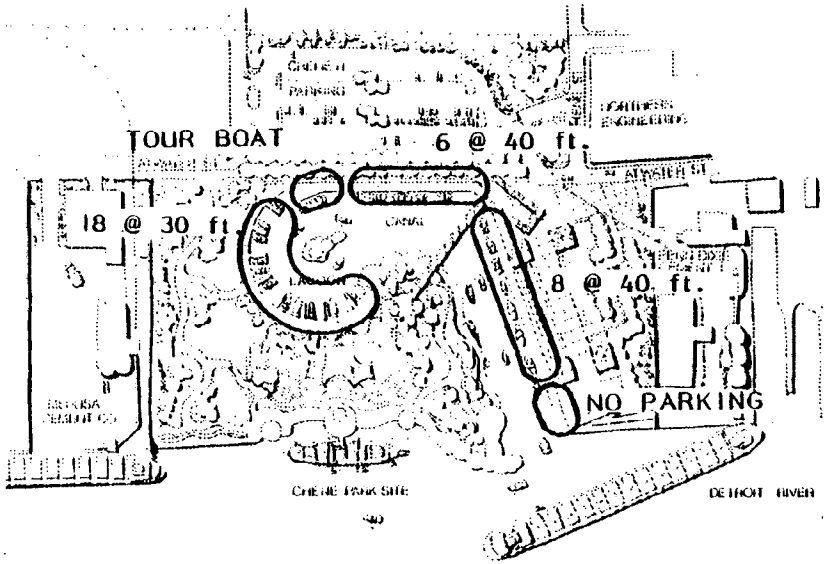


FIGURE 4.4: BOAT SPACES: MARINA/LAGOON

MARINA/LAGOON ALTERNATIVE
BOAT SPACES AVAILABLE

	30'	40'	TOTAL
Chene Basin (slip parking not open to sailboats)	18		18
Canal Edge (open to sailboats)		8	8
Canal Edge (not open to sailboats)		6	6
Total	18	14	32

Marina/Lagoon Alternative

Without the development of the St. Aubin site, the number of boats accommodated by this alternative is drastically reduced from the first alternative. A total of 32 spaces are provided, 18 in slips and 14 parallel to the canal edge. The 18 slips would cost approximately $105,000 exclusive of seawall and dredging. No 60 foot boats are accommodated except insofar as they can occupy two 40 foot spaces along the canal edge.

4.3 DESIGN CRITERIA

The design and layout of the marina/canal configuration alternatives take into consideration current trends in boating and marina operations and recognized marina criteria for site size and program.

The following criteria were derived through consultations with Mr. Keith Wilson of the Department of Natural Resources and the Bureau of Environmental Health accepted design criteria and general practice:

1) for overnight stays at transient marinas water and electric utilities are provided;

2) gas is not necessary, but may be provided for convenience;

3) sewage pump-out facilities are a requirement of the Department of Public Health when parking 15 vessels or more;

4) the Department of Public Health also regulates water supply systems, hose lines, litter containers, toilet facilities, and sewage receiving units;

5) in the State of Michigan, boat slips are designed to accommodate 60',45', and 30' long boats;

6) the rule for sizing marina fairway widths is:

under 30'...twice the length of boat
over 30'...one and one half times the length of the boat;

7) service piers to slips are usually 8' to 10' wide;

8) catwalks to individual boats are usually 3' wide;

9) boaters have problems navigating any docking surface that is not flat;

10) openings to the Detroit River at the entrance and exit to the canal should be 80' to 100' wide;

11) water depth for the marina and canal are contingent upon the type of vessel to be accommodated: 4' depth...pleasure power boats;
6' depth...non-fixed keel sailboats;
10' depth...fixed keel sailboats;

12) the Department of Natural Resources marinas do not exceed 6' to 7' in depth;

13) height of bridges can be used to control size of boats desired beyond the bridge. Specific lengths of boats and clearances needed are as follows: 20' length... 6' clearance;
25' length... 9' clearance;
30' length...11' clearance;
45' length...16' clearance;
60' length...18' clearance;

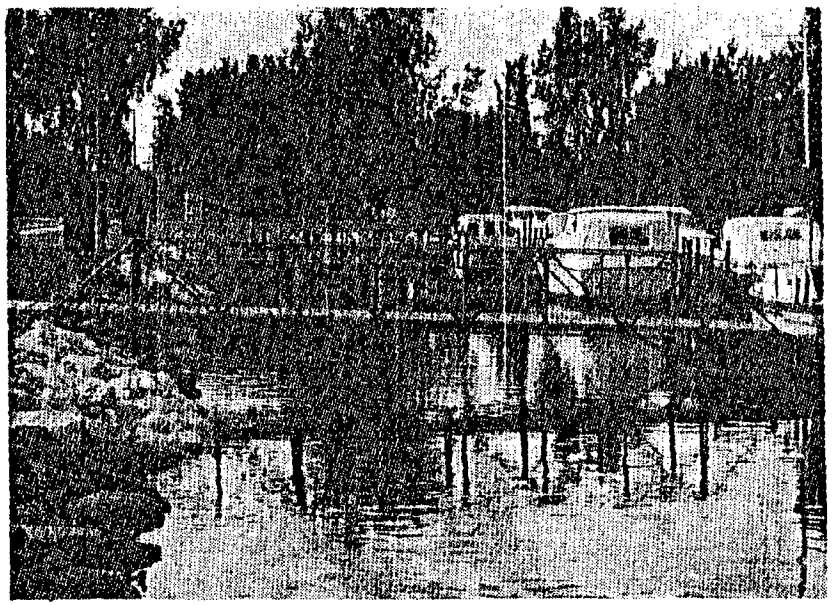
14) boat parking is directly influenced by the fluctuation of the water surface elevation. To account for this fluctuation, two solutions are used: 1) floating docks or catwalks with guideposts, attached to sliding ladders; 2) manually adjustable catwalks which are changed as the water fluctuates;

15) water fluctuation is not always accommodated in the design. Often the deck elevation is fixed and ladders or steps are provided to board the boats; and

16) if boat parking occurs along a sheet piling edge, 6" x 6" wood 'fenders' on 8' centers are used to protect the boat from the piling.

4.4 OPERATIONS AND MAINTENANCE

The information contained in this section was gathered from the Bureau of Public Health document on marina facilities; Keith Wilson, Chief of the Michigan State Waterways Commission of the Department of Natural Resources; William Sherman, Supervisor of Metro Beach Metro Park; and Hira Harrington, Harbor Master of the Port Austin Transient Marina.



To operate transient marinas certain facilities must be provided. These include restrooms, sewage, pump-out station, harbor master office and slip utilities. The Marina/Canal Alternative containing 120 slips will require the following toilet facilities:

	Male	Female
Water Closets	2	4
Urinals	2	-
Lavatories	4	4
Showers	2	2

To house these facilities will require a structure of approximately 690 S.F. and would cost an estimated $58,000.

Any other facilities provided on site such as restaurants, concessions, parkland or amphitheater will require additional toilet fixtures.

The Marina/Lagoon Alternative, with 32 slips, will require the following toilet facilities:

	Male	Female
Water Closets	2	2
Urinals	0	-
Lavatories	2	2
Showers	1	1

To house these facilities would require a structure of approximately 220 S.F. and cost an estimated $18,700.

The operation of marina restroom facilities can be on a pay basis or on a key deposit basis. Automatic pay showers are used at Metro Beach Metro Park, but are subject to vandalism. The state op-

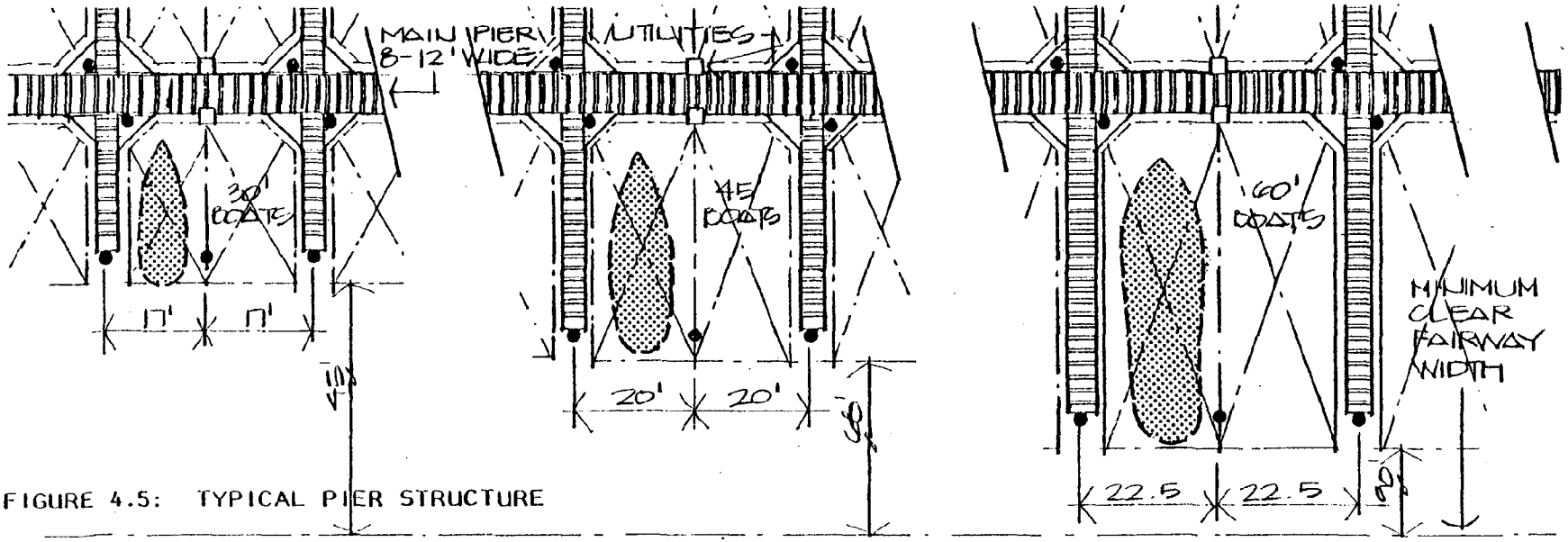
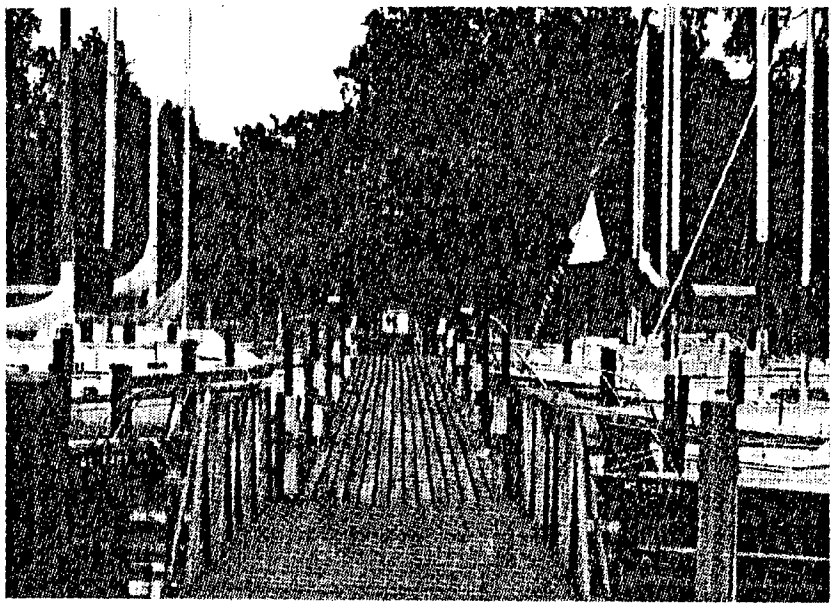


FIGURE 4.5: TYPICAL PIER STRUCTURE



erated transient marinas use keys lent to boaters with a deposit of one dollar. This method keeps the users of the restrooms limited to boaters, but requires an operator to collect fees and distribute keys.

Since the restrooms will probably be built in conjunction with other park toilet and concession facilities, keyed showers are recommended to limit their use.

Marinas are required to install pump-out facilities. This facility must be capable of lifting sewage not less than 12 feet under vacuum and deliver it to the receiving unit free from spillage. Pump out facilities at state operated facilities charge $3.25 per use and are operated by employed personnel of the marina. At Metro Beach pump out facilities were boat-owner operated by means of a coin box, but due to mechanical complications and boat owner inexperience and abuse it was converted to operation by personnel of the marina (in this case, the Harbor Master Station operates the facility). The cost of the pump out facility is included in the overall marina costs.

A Harbor Master office, from which the harbor master can easily supervise the marina facility, is required. From this station fees would be collected, records kept, the pump-facility operated and the marina patrolled. A ship to shore radio may be provided to work in conjunction with the Coast Guard as is done at state operated transient marinas. This station may be built in conjunction with the toilet facilities or may be a free standing office. To reduce utility and construction costs and increase security of the restrooms it is recommended that the office be built in conjunction with the toilet facilities and is estimated to add 150 S.F. to the structure and cost $15,000. This facility would be similar for both marina/canal configurations.

Utilities to the marina will include lighting, utilities to the toilet/office facility, and utilities to the individual wells. The lighting will be provided in conjunction with the general park lighting and will be automatically controlled in the mechanical space of the Harbor Master Office/ toilet facilities building. This building will require electric, water, gas, telephone and sewer connections. The marina transient docking facilities will include 30 amp electric and water connections.

Several methods exist for collection of transient marina fees including hourly parking meters, coin operated electric service, and half day or daily rate:

1) Hourly Parking Meters: parking meters may be installed at each mooring location and charge

.50¢ an hour for parking. This method has several drawbacks in that it requires constant supervision by the Harbor Master to guarantee the meter has been paid and that some boaters do not pay until immediately before inspection. Until this season, Metro Beach employed this method of payment; but converted to half day and daily rates. Some distant wells still remain on the meter system for the convenience of boaters who did not wish to stay an entire half day.

Charging varies between marinas. The state operated marinas charge per 12 hours (or nightly) based on the size of the boat. The charge at the Port Austin marina is shown below:

2) Half Day and Daily Rates: Metro Beach and state operated transient marinas operate on this method. The boater arrives at the marina, docks, and then registers at the Harbor Master's office and pays the required fee. The boater receives a tag to display in a conspicuous window of his craft. This method reduces the need for constant supervision and provides more accurate means of record keeping for future needs.

Per Night Charge at Port Austin Marina

20 Foot Boat	$ 3.25/Night
30 Foot Boat	$ 6.25/Night
40 Foot Boat	$ 9.25/Night
50 Foot Boat	$12.25/Night
60 Foot Boat	$15.50/Night
60+Foot Boat	$20.75/Night

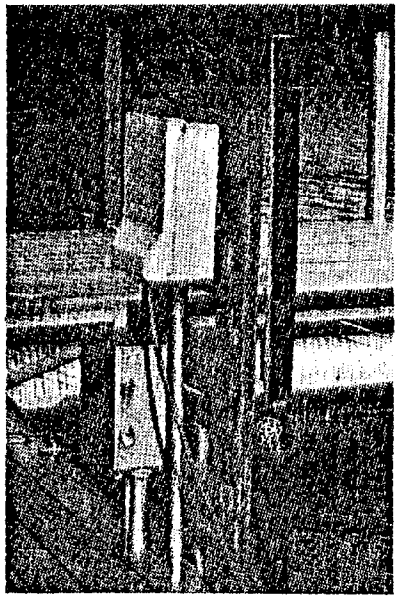
Docking fees at Metro Beach' Metro Park are shown below:

Dock Fees at Metro Beach

10AM to 4PM	$ 3.25
4PM to 10PM	$ 3.25
Overnight	$ 5.00

3) Coin Operated Electric Service: William Sherman of Metro Beach recommended coin operated electric service. This method operates the electric service on an hourly basis when .50¢ is inserted for each hour.

It is recommended that since the users of the marina/canal will not only visit the parks, but also surrounding commercial/entertainment facilities including the Central Business District, hourly fee structures are not necessary. A half day/daily rate similar to that used at Metro Beach seems preferrable. This type of operation will only require one full time person to collect fees, run the sewage pump-out, supervise the parking, operate the radio and keep records. At peak periods such as weekends or holidays, two people may be required; one to operate the Harbor Master's station, the other to supervise the marina.



Maintenance of a seasonal marina has three aspects: seasonal maintenance, periodic maintenance and special maintenance:

1. Seasonal maintenance involves closing down the marina in the fall and opening the marina in the spring. In the fall the following must be done:

a) turn off electric and seal boxes to reduce vandalism;

b) empty the pump out facility and seal;

c) turn off water and drain lines;

d) clean, turn off water, drain and close toilet facilities;

e) store waste baskets, fire extinguishers and other equipment; and

f) install air bubblers around docks to minimize damage;

In the spring, all that was closed down in the fall must be opened. Also, damage and vandalism that may have occurred throughout the winter must be repaired and cleaned up.

2. Periodic maintenance includes work done on a continuing basis throughout the season to maintain a safe and clean marina. Items include:

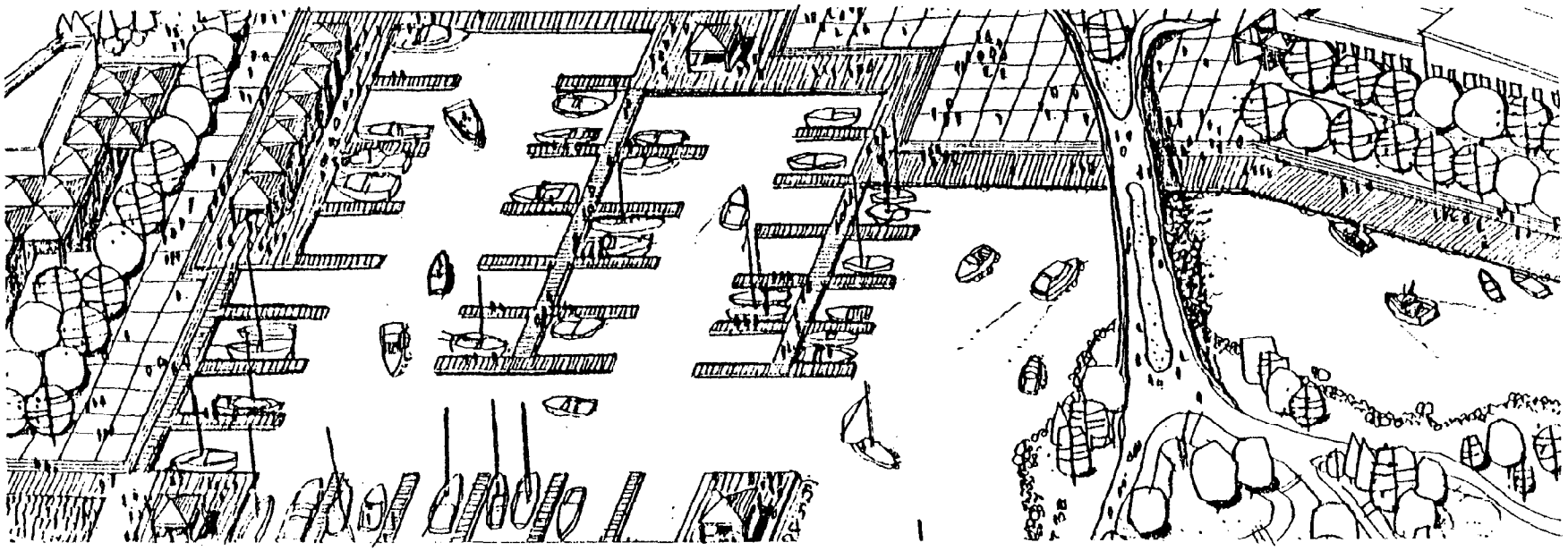
a) refuse removal;

b) litter pick up;

c) minor dock repair;

d) electric and light inspection; and

e) empty pump-out facility.



3. Special Maintenance includes large scale and special repairs and improvements to keep the marina operable. Items include:

a) dredging;

b) mooring post replacement; and

c) repair of major damage.

4.5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter dealt with the need for and programming of the proposed transient marina. Design criteria, operations and maintenance of marinas were investigated. Major conclusions and recommendations are as follows:

1) a transient marina is recommended as more viable than a seasonal marina;

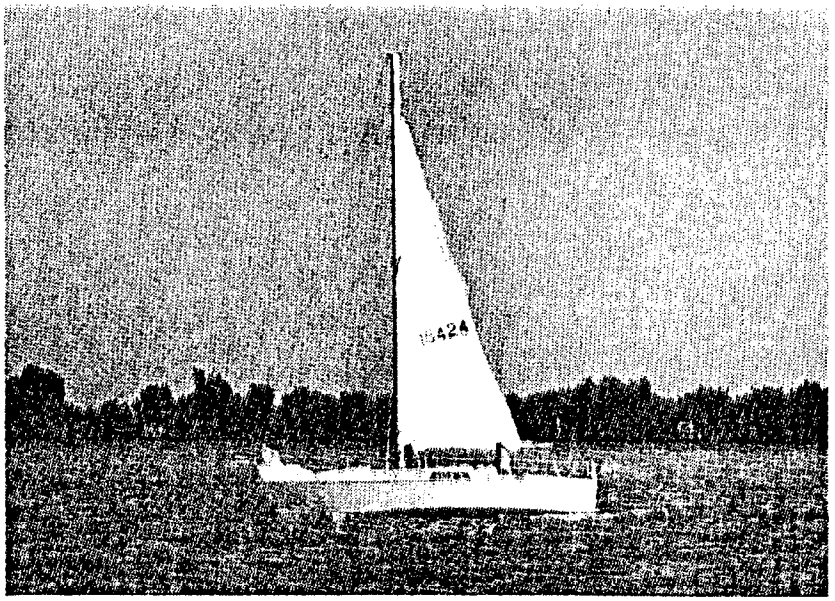
2) the need for transient space cannot be fulfilled by maximum use of the Chene/St. Aubin sites, however, maximum site utilization may not be desirable relative to other programmed recreational uses or new private development;

3) sailboat parking should be accommodated, but it is not feasible, due to bridge restrictions, to allow sailboats to traverse the entire canal;

4) the marina should accommodate primarily 30 foot and 45 foot boats to maximize potential usage;

5) a Harbor Master office, restroom facilities and sewage pump-out station should be built in conjunction with the marina; and

6) half day and daily rate fee schedules should be utilized as opposed to hourly meters.



Economic Impacts 5.0

5.1 INTRODUCTION

It is difficult, if not impossible, to do an objective cost-benefit analysis of an urban open space. A park, occupying valuable urban land, does not typically create revenue; it is developed, rather, by the public for the public good. A park does, however, provide a direct amenity to surrounding land uses, thereby increasing their value and potentially spawning new development. This is the basic assumption of the Linked Riverfront Parks Project, albeit unusual to look at recreation as a catalyst for new development.

The Linked Riverfront Parks Project has, even before construction of the first park, generated interest in east riverfront development. The proposed Wayne State University Globe Theater is the first direct spin-off of the parks project; adaptive re-use studies are being performed on warehouses adjoining the park sites; and attempts to assemble land for new and converted housing has begun at least in part due to the proposed parks. Intuitively, it can be assumed that the city's commitment to provide urban amenities help spawn new development.

The program for the Chene/St. Aubin park has both intensive recreation functions (the marina/canal, water play feature, amphitheater and stage, facilities for docking, restaurant barges or concert barges, etc.) and more traditional passive recreational functions (picnicing, fishing, jogging, strolling, bicycling, viewing, etc.). This categorizes the park as both natural (rural) and intense (urban). Although a completely natural park is a necessary amenity, the close proximity of the 928 acre Belle Isle Park diminishes the potential impact and usefullness of a totally natural Chene/St. Aubin Park (Gabriel Richard Park, for example, is essentially a grassy field on the riverfront near Belle Isle which is generally underutilized). On the other hand, developing the Chene/St. Aubin Park as totally hard-paved and urban is not called for by surrounding existing or proposed density. It is not directly in the dense Central Business District and does not have to fulfill the need for an intense urban park of the nature of Hart Plaza.

The proposed Chene/St. Aubin Park lies between the intensely developed Belle Isle "rural" park and the intensely developed Hart Plaza "urban" park, both in distance and in concept. Consequently, the Chene/St. Aubin Park has the potential of relieving the tremendous pressure on these two parks and thereby gain significant use. This would especially be true if the proposed linkage system between Hart Plaza and Belle Isle was developed.

The key to the success of both Belle Isle and Hart Plaza is in their intensity. It is the marina/canal which is a prime ingredient in making the Chene/St. Aubin Park "intense" and something more than a "grassy field". This intensity increases not only park use, but also brings people to the commercial establishments that presently exist in the east riverfront (especially restaurants) and spurs development of new commercial, entertainment and residential uses. Hart Plaza was utilized by approximately 6.5 million people in 1979 and Belle Isle by approximately 8 million people. If the Chene/St. Aubin Park is somewhere in between these two parks it might have a use of 200,000 people/acre/year or 4.5 million people. This potential use has significant economic impacts on the surrounding area.

In addition, the park provides the potential of relieving the overcrowding of both Belle Isle and Hart Plaza during major special events such as The Freedom Festival, ethnic festivals, fireworks,

displays, concerts and the like. Although the marina/canal is estimated to contribute only 75,000 of the users during boating season, it is still a major amenity that will add to the excitement of the park and draw people well beyond the boat users. The Marina/Canal Alternative will add one mile of publically accessible river's edge to the city. This new edge will not only increase boater access, but will also provide promenade, bicycle path, ice skating, tour boat and other water related functions to the park in a way that is a scalar change from the wider Detroit River to the more intimate canal.

It is strongly felt that for the reasons given above, the construction cost of the marina/canal is far outweighed by not only the general public benefits, but the potential economic benefits as well.

5.2 CONSTRUCTION COSTS OF MARINA/CANAL IMPROVEMENTS

The following summary of construction costs are of those costs directly attributable to the marina/canal aspects of total park development exclusive of those costs related to Medusa relocation and reconfiguration. The costs are based on 1980 estimates; escalating factors must be applied for future construction.

Marina/Canal Alternative

A. Utilities	
Chene	$ -0-
Dubois/St. Aubin/ Orleans	1,900,000
Sub-Total	$1,900,000
B. Excavation	
220,000 CY @ $1/CY (Excavated material to be wasted on site)	$ 220,000
Sub-Total	$ 220,000
C. Canal Seawall	
Edge Type A: 420' @ $901/Ft.	$ 378,420
Edge Type B (Mod): 430' @ $896/Ft.	$ 385,280
Edge Type C: 920' @ $126/Ft.	$ 115,920
Edge Type D: 900' @ $852/Ft.	$ 766,800
Edge Type D (river): 160' @ $1275/Ft.	$ 204,000
Edge Type G: 2960' @ $641/Ft.	$1,897,360
Overlook: 725' @ $1230/Ft.	$ 891,750
Transition: 150' @ $1000/Ft.	$ 150,000
Sub-Total	$4,789,530
D. Marina	
Floatation Docking System, utilities, etc.	
82 slips @ $3,500/slip:	$ 287,000
Office/Restroom/Shower Building:	53,000
Sub-Total	$ 340,000
E. Pedestrian Bridges	
Chene Bridge	$ 112,250
St. Aubin Bridge	$74,000
Sub-Total	$ 186,250
Total Construction Costs: Marina/Canal Alternative	$7,435,780

Marina/Lagoon Alternative

A. Utilities		$ -0-
B. Excavation		
58,000 Cy @ $1/yard (Excavated material will be wasted on site)		$ 58,000
Sub-Total		$ 58,000
C. Canal Seawall		
Edge Type A:	180' @ $901/Ft.	$ 162,180
Edge Type C:	250' @ $126/Ft.	$ 31,500
Edge Type D:	200' @ $852/Ft.	$ 170,400
Edge Type D (river):	160' @ $1275/Ft.	$ 204,000
Edge Type G:	1030' @ $641/Ft.	$ 660,230
Overlook	350' @ $1230/Ft.	$ 430,500
Transition:	150' @ $1000/Ft.	$ 150,000
Sub-Total		$1,808,810
D. Marina		
Floatation Docking System, utilities, etc. 18 slip @ $3,500/Slip:		$ 63,000
Office/Restroom/Shower Building		33,700
Sub-Total		$ 96,700
E. Pedestrian Bridge		
Chene Bridge		$ 111,250
Sub-Total		$ 111,250
F. Total Construction Cost Marina/Lagoon Alternative		$2,074,760

5.3 CONSTRUCTION COSTS OF MEDUSA IMPROVEMENTS

The Medusa Cement Company has been extremely cooperative in providing information contained in this report. Every attempt has been made to deal directly with any concerns or conflicts that Medusa might have relative to park development. The potential exists for a truly unique cooperation and compatibility between recreation and industrial use - a combination that is possibly more exciting than Gas Works Park in Seattle. One of the more interesting functions of the Chene/St. Aubin Park will be the ability of the public to watch an industrial process unfold, from ship docking and unloading to truck transport off the site. Interpretive signage, graphics and telescopes are being programmed into Phase I of Chene Park to heighten this function. Assuming that Medusa concerns are dealt with in a feasible manner, the marina/canal and park development are of benefit to Medusa in several ways: 1) they are economically viable and wish to stay in Detroit and this cooperation strengthens their commitment to the city; 2) being literally in the middle of a public park enhances their public image, making the public more aware of cement industry contributions; 3) improved truck routing and safety; 4) improved access to the entire length of the Medusa Challanger; 5) improved security; 6) improved total environment; and 7) potentially more efficient operations. Construction costs for all improvements to Medusa property, the proposed land trade and realignment of operations are summarized below:

Marina/Canal Alternative

A. Truck Bridge	$640,000
B. Conveyor System	200,000
C. Site Improvements	336,000
Total	$1,176,000

Marina/Lagoon alternative

A.	Truck Bridge	-0-
B.	Conveyor System	-0-
C.	Site Improvements	$ 75,000
Total		$ 75,000

5.4 TOTAL CONSTRUCTION COSTS OF MARINA/CANAL AND MEDUSA IMPROVEMENTS

Marina/Canal Alternative

A.	*Marina/Canal Improvements*	$7,435,780
B.	Medusa Improvements	1,176,000
Total Cost:		$8,611,780 (1980)

Marina/Lagoon Alternative

A.	Marina/Lagoon Improvements	$2,074,760
B.	Medusa Improvements	75,000
Total Cost:		$2,149,760 (1980)

5.5 MARINA REVENUE

It is assumed that all marina operations (boat slip charges, concessions, sewage pump-out, coin-operated electrical, keyed showers, etc.) are self-supporting, i.e. they minimally cover expenses. The primary feasibility concern would be that boat slip charges do not become excessive where boaters refuse to use them. Based on the $3.25/half day rate at Metro Beach it is assumed that a downtown transient marina could accept a half-day rate of at least $5.00. In order to determine if this is feasible an estimate of expenses (disbursements) and occupancy must be determined.

Marina/Canal Alternative

It is assumed that the typical boating season is 20 weeks and 22 weekends. Based on Metro Beach figures, it can be concluded that weekend occupancy (not including overnight) will be 100% for 3 days and weekly occupancy will be 50% for 4 days (not including overnight). In twenty weeks, at two turnovers a day and 50% occupancy, the 120 slips of the Marina/Canal Alternative will have a total weekly occupancy of 9600 half day users. *Using the same rationale, and 100% occupancy*, the total weekend occupancy will be 15,840 users. Total half-day users will be 25,440. Assuming three people/boat this will bring 75,000 people/year to the park.

Based on surveys of state marinas, and assuming higher expenses in the City of Detroit, the following estimated yearly operation costs were derived:

A.	Salaries:	$35,000
B.	Utilities:	$ 4,800
C.	Maintenance:	$24,000
Total Expenses		$63,800

Assuming 25,440 half day users, $2.50/half day would have to be changed to break even. This is well below $5.00/half day and, therefore, more money could be charged to defray the cost of the initial capital investment or to accumulate capital for major repair requirements and times of reduced occupancy.

Marina/Lagoon Alternative

Using the same rationale as the Marina/Canal Alternative, this alternative will generate a total

of 10,600 half day users or 31,800 people. Operation costs, however, will be somewhat higher per slip because the number of slips are reduced, but certain costs stay fixed:

A.	Salaries:	$30,000
B.	Utilities:	$ 2,080
C.	Maintenance:	$ 10,400
Total		$42,480

Assuming 10,600 half day users, $4.00/half day would have to be charged to break even. This is below $5.00/half day and, therefore, feasible; although less attractive than the larger marina of the first alternative.

5.6 FUNDING POTENTIALS

The Linked Riverfront Parks Project study laid out, in detail, potential funding sources for all major elements of the park system, including the majority of construction elements contained in this study. To date only Coastal Zone Management Program funds (for planning), Land and Water Conservation Funds, and city matching funds have been allocated for park construction. Other funding sources will have to be tapped to bring the marina/canal and total park development to fruition.

Land and Water Conservation Funds, assuming availability, can continue to be used for park development. In particular, at the present rate of park funding (1.2 million/year including city match), LWCF monies can build a majority of the canal seawall if it can be phased in at least two parts. For this reason, if the Marina/Canal Alternative is implemented, it is recommended that the Marina/Canal Alternative be constructed as Phase I of the final Marina/Canal Alternative. Unless present funding levels are raised, a possibility, LWCF monies are not enough to complete the whole project. A commitment more on the order of 2.5 million dollars a year is required. Additional monies from Waterways Division Funds (DNR) could be utilized for marina dockage systems and other marina amenities. Community Block Grant Funds, Public Works monies, or even general revenue bonds might possibly add to this total.

The costs of Medusa improvements are assumed to be primarily a burden of the public sector since the reconfiguration is required both for a public park and to better utilize land for future private development. Assuming the benefits to Medusa are great enough, however, Medusa might be willing to invest their own money into certain improvements, especially site improvements. The truck bridge could be financed through state and/or federal highway funds especially if the St. Aubin truck route is designated a spur of the state or federal highway system. Community Block Grant Funds or Urban Development Action Grants could be utilized to defray site improvements, building relocation, and other costs associated with the acquisition of Medusa property for the proposed land trade. Participation and a firm resource commitment would be required from Medusa to utilize UDAG funds.
It is strongly felt that with a firm commitment on the part of the city, funds can be found to build the entire park concept and that the return to the city would far outweigh these costs.

5.7 OTHER ECONOMIC DEVELOPMENT

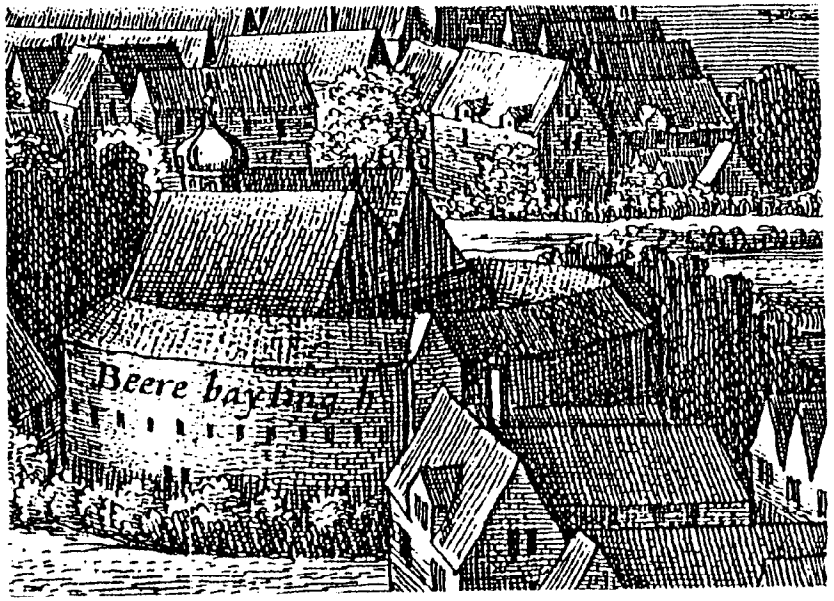
It has been assumed that the development of a marina/canal, in conjunction with the Chene/St. Aubin park, would spur other economic developments by the private sector. All sites aligning Atwater directly north of the canal, including the city-owned Chene #2 and Ainsworth sites, are

prime for redevelopment. Two feasibility studies are presently underway that address part of this potential development. One study is of the proposed Globe Theater; and the other is for the proposed adaptive re-use of the Globe Trading Company warehouse.

Globe Theater

Wayne State University, through their Theater Department, is exploring the economic and architectural feasibility of reconstructing a replica of the authentic Shakespearean Globe Theater. An international symposium, held at Wayne State University, was the final catalyst for attempting this reconstruction. At that symposium the City of Detroit offered help in finding a site for the theater in the Linked Riverfront Parks Project area. Preliminary efforts have focused on the feasibility of utilizing the Waterboard portion of the St. Aubin Park site as the location of the Globe Theater. This site is attractive to the proponents of the Globe for several reasons: 1) it is located on the Detroit River, which allows for a historical relationship similar to its original location near the Thames; 2) it will be adjacent to a major new park system; 3) the proposed marina/canal allows boat access to the theater (which historically was the means of access) and adds to the "festive" nature of the theater; 4) the Globe Trading Company warehouse across the street has the potential of housing ancillary functions; 5) the proposed Detroit subway system will have a stop within walking distance; and 6) numerous restaurants are within walking distance.

The possible development of the marina/canal makes this site very attractive to Wayne State University. The placement of the Globe, however, may call for the reconfiguration of the Waterboard site. In this instance, the marina might



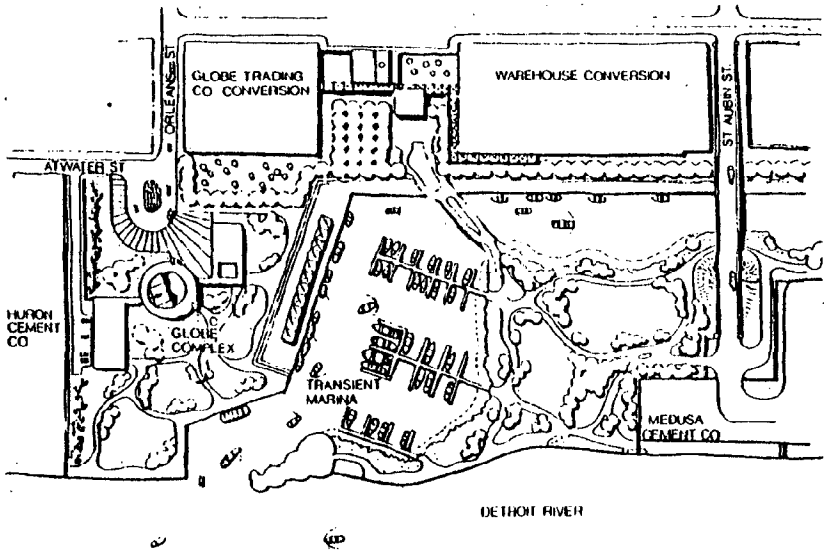
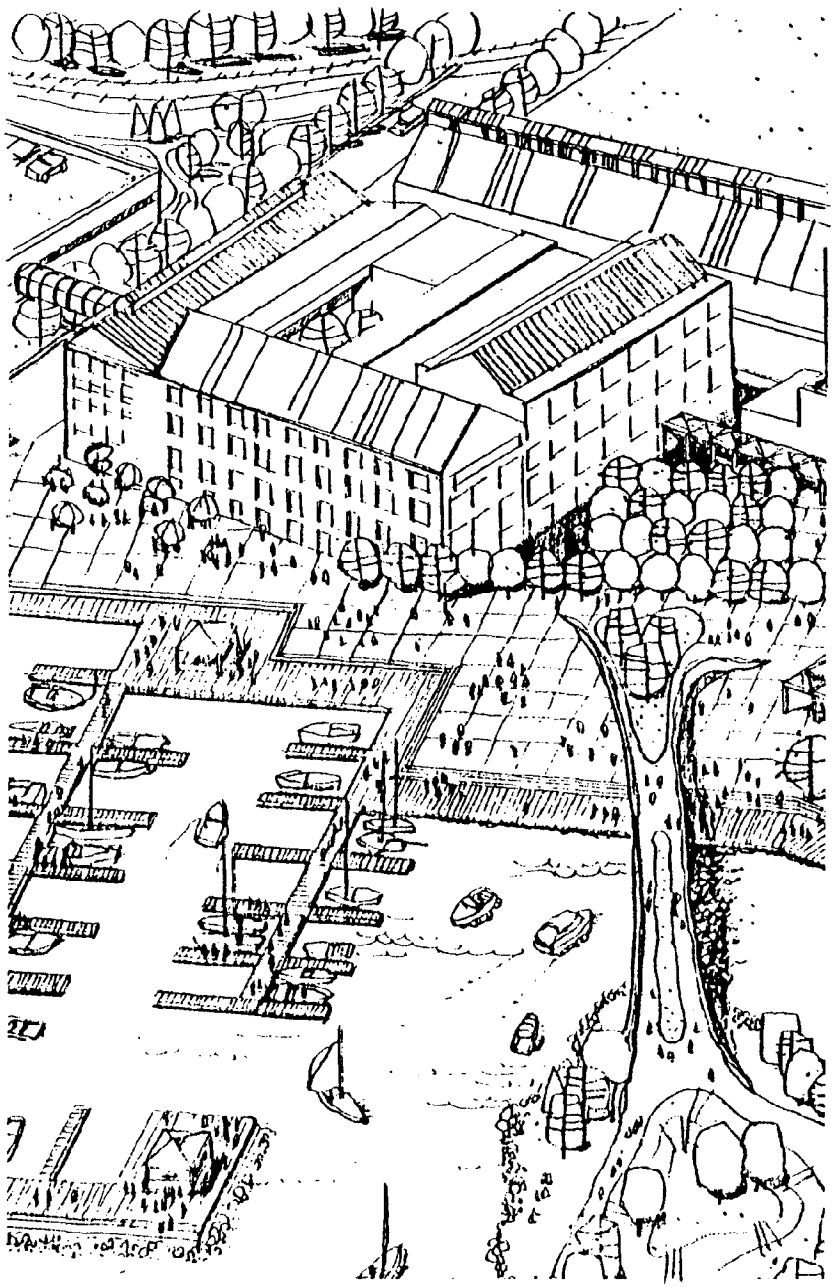


FIGURE 5.1: POTENTIAL GLOBE SITE

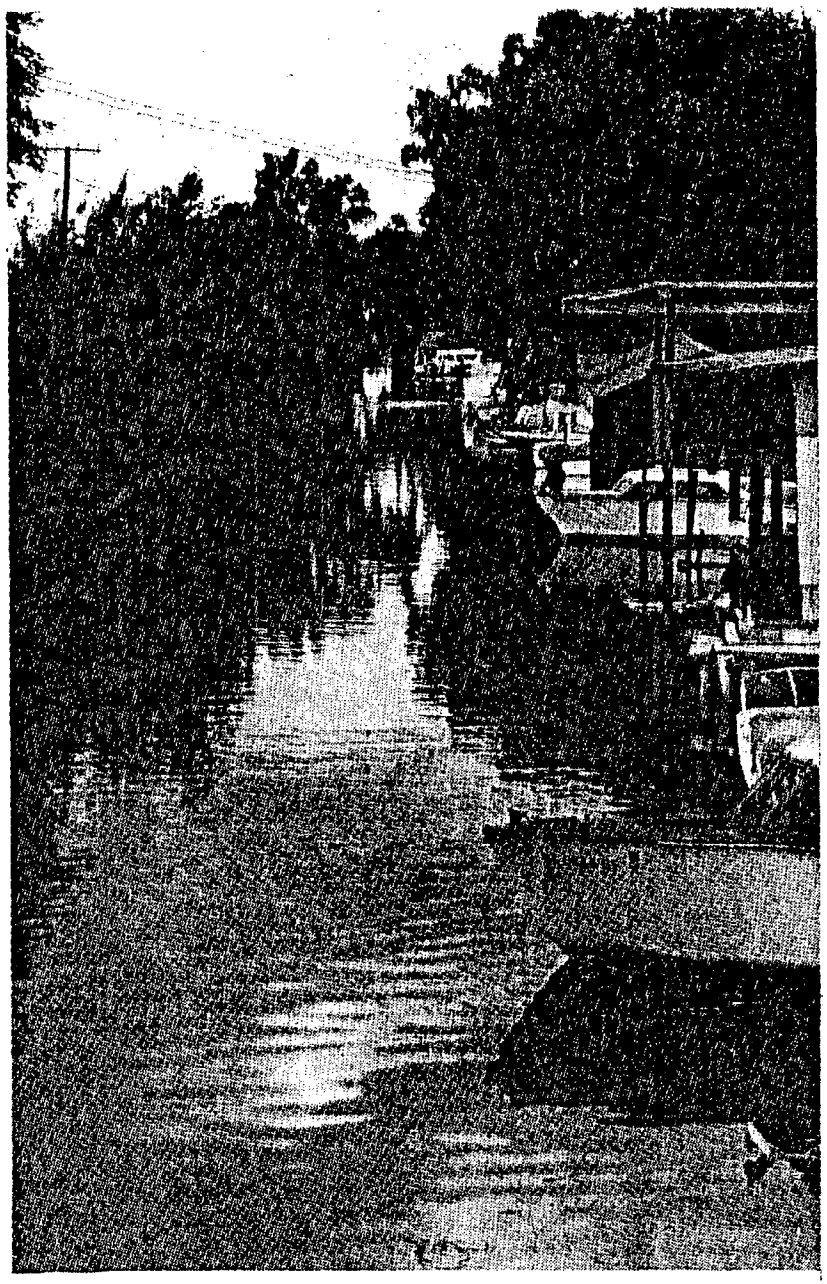


be pushed further east, thereby reducing the number of boat slips by approximately twenty. The possible impact of the Globe Theater on marina design is shown in plan illustration. This same plan also indicates an alternative alignment of the canal through the St. Aubin marina basin. In this instance the marina is on the "island" part of the park, which has the advantage of greater marina control, but the disadvantage of greater walking distance from the marina to surrounding developments. The boat entry configuration is essentially the same as in the marina/canal alternative and, therefore, wave action concerns are similarily resolved.

Globe Trading Company Warehouse

An adaptive re-use feasibility study of the Globe Trading Company is presently being performed by Landmark Design Services, Inc. under a Coastal Zone Management grant. Preliminary results of this study show the Globe Trading Company as primarily commercial/retail in use with restaurants predominating. This function would be greatly enhanced by the closing of Atwater, the development of the marina/canal and the construction of the Globe Theater. This building can also, potentially, be partially utilized by ancillary Globe Theater functions. Boaters would be able to park directly next to indoor and outdoor restaurants and see a theater performance before or after dinner.

Summary 6.0



6.1 FEASIBILITY OF MARINA/CANAL CONFIGURATIONS

It is the conclusion of this study that the alternative marina/canal configurations are technically feasible with only minor modifications. Both wave action and hydraulic concerns are adequately addressed on the proposed designs. Potential industrial, recreational, transportation and utility conflicts can be resolved within reasonable constraints and in a manner compatible to overall park development.

With a commitment on the part of the City of Detroit and the Medusa Cement Company, and a channeling of available public funding sources, the alternative marina/canal configurations are economically viable. In conjunction with private developer investment surrounding the park site, the parks have the potential of catalyzing new development throughout the east riverfront area.

6.2 IMPACT ON CHENE PHASE I DESIGN

At the present time, working drawings are being prepared for the first phase of construction on Chene Park to begin in the summer of 1981. Phase I work includes basic grading, fill, utility and seawall construction. This study has altered Phase I design in several ways. A proposed retention basin will now take on the configuration of the proposed marina/lagoon. This shape has diminished the area for development of the amphitheater and, therefore, the north side of the amphitheater hill is steeper requiring some retainage; this, combined with reducing the number of bridges from two to one on the Chene site, moved the proposed location of the water play feature north and west. In this location, the water play feature is still the focus of the pedestrian bridge, but can act as a retainage system for the amphitheater hill; likewise, if surface aeration is required in the lagoon, a portion of

the water play feature can be utilized for this. Because of retainage and aeration, the water play feature is now more sensibly built in Phase 2 construction as an integral and necessary part of park development rather than in Phase 3 construction as a separate element.

6.3 APPLICABILITY TO OTHER SITES

The analysis and information in Chapter 2 and 4 of this study is generally applicable to other waterfront sites in the City of Detroit. Even though the Chene/St. Aubin park is in a less restrictive channel than many other riverfront sites (and, therefore, surge is not considered as critical as bow waves and wind waves) the entry and exit design criteria can be applied to marinas anywhere along the Detroit River, including restrictive channels, to mitigate against wave action. The design criteria for marinas is likewise applicable elsewhere. The various cost studies for the feasibility of different seawall edge conditions are also applicable to other sites assuming similar soil conditions. Because of the nature of the data generated, this report may be used as a general guide to marina design on the entire Detroit riverfront.

6.4 PHASING

The marina/canal is easily phased into three segments. This is considered necessary to allow for land acquisition, funding, private development and planning and because of the costs associated with sewer relocation and Medusa improvements. These phases of marina/canal construction are blended with the four proposed phases of park construction. The marina/lagoon alternative can be constructed in Phase 2 of Chene Park; the major marina can be constructed in Phase 1 of St. Aubin Park; and the final link between these two segments can be constructed in Phase 2 of St. Aubin Park. This final link involves sewer relocation and Medusa improvements.

Each proposed phase can stand alone as a functioning park, lagoon or marina. Table 6.1 shows the various park construction phases and costs associated with the marina/canal. Figure 6.2 aligns these phases to the marina/canal alternative plan.

TABLE 6.1

TABLE 6.1
MARINA/CANAL PHASE COST

CHENE PARK	
Phase 1	
Phase 2	
Marina/Lagoon	$2,074,760
Medusa Improvements	75,000
Total	$2,149,760
ST. AUBIN PARK	
Phase 1	
Marina Construction	$2,652,860
Sub-Total	$2,652,860
Phase 2	
Canal Construction	$ 808,160
Sewer Relocation	1,900,000
Medusa Improvements	1,101,000
Sub-Total	$3,809,160
Total	$6,462,020
TOTAL MARINA/CANAL	$8,611,780

Figure 6.1 shows how these various park and marina/canal phases coordinate with development surrounding the park sites such as the Globe

Playhouse, the Globe Trading Company and the Atwater Mall. The marina/lagoon is shown under construction in the spring of 1982 with the total marina/canal completed by 1985.

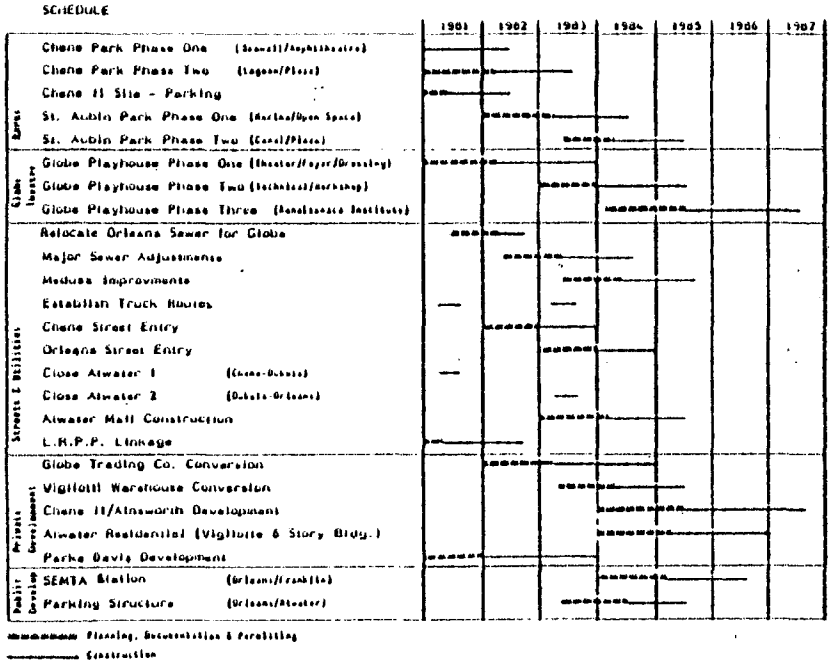
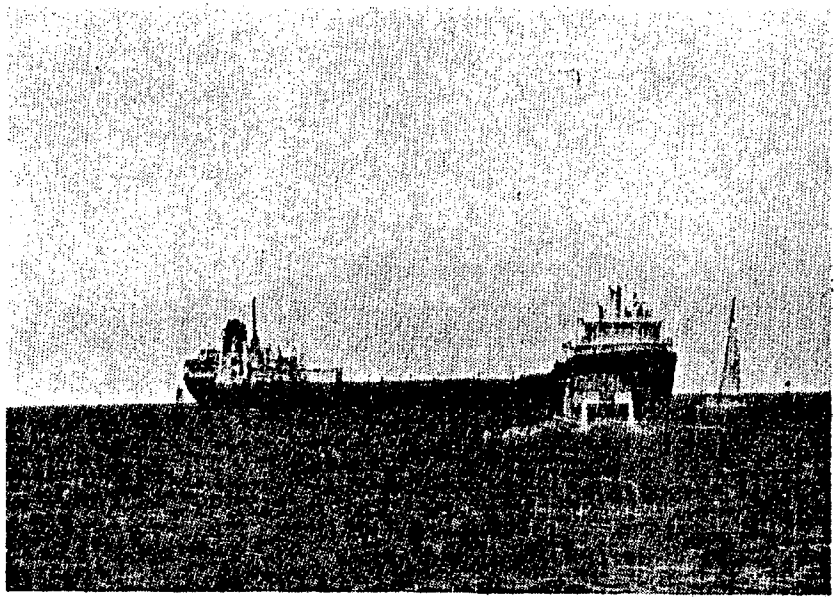


FIGURE 6.1: TIMING SCHEDULE

6.5 RECOMMENDATIONS

The major recommendations of this study are as follows: 1) assign an individual from the City of Detroit to coordinate and oversee land acquisition, consultants, governmental agencies, City departments, private developers, public and private sector funding sources and affected industries for realization of the total park concept; 2) immediately and actively begin proceedings to acquire the Consolidated Docking site; 3) immediately begin negotiations with the Medusa Cement Company concerning the recommended land trade, truck bridge and other related items that affect canal construction; 4) increase city commitment and intensify additional funding sources for public improvements beyond basic recreational aspects, i.e truck bridge, marina, Medusa relocation, Atwater Mall, water play feature, etc; 5) commit to construction of the total marina/canal alternative as phased in 6.4; 6) finalize programming of the St. Aubin Park and choose a marina alternative which maximizes transient boat parking in balance with other park functions; and 7) construct the canal entry and exit as proposed in this study to mitigate against wave action and to promulgate flow.

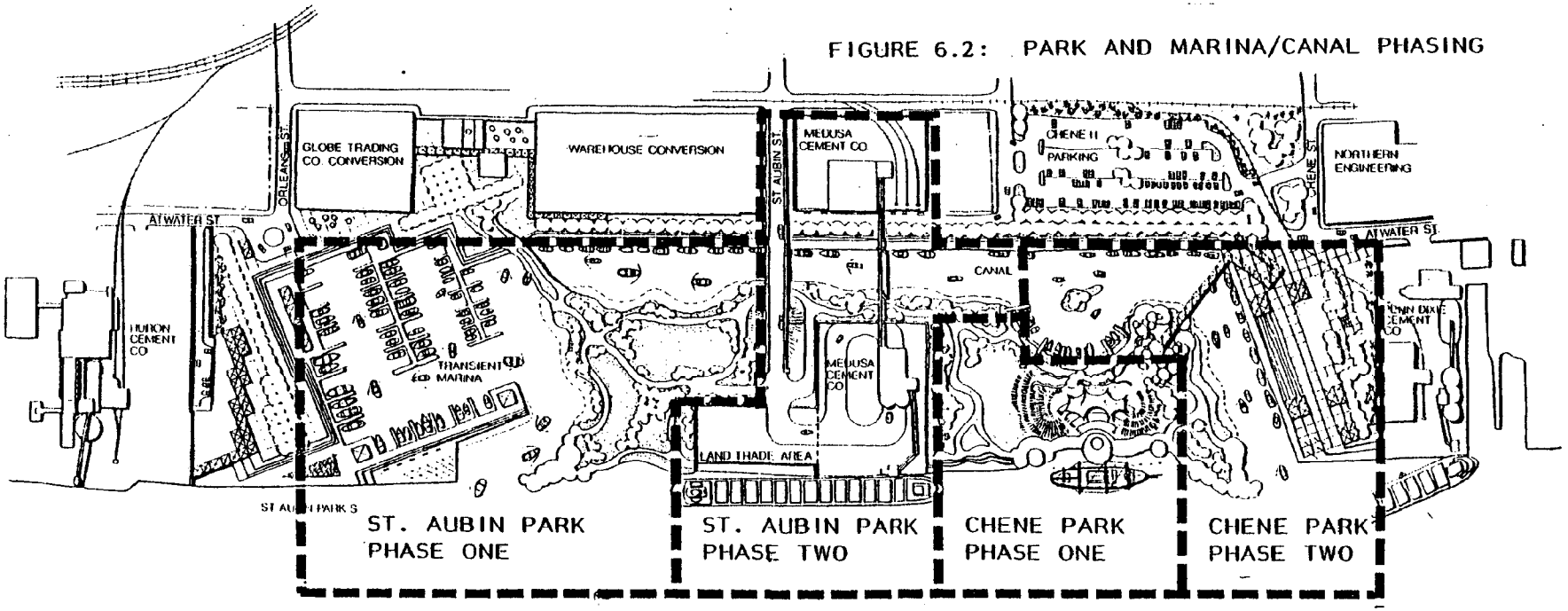


6.6 CONCLUSION

The construction of the Chene/St. Aubin marina/canal is important because of the positive impacts it will have on the parks, the total concept of the Linked Riverfront Parks Project and development in the east riverfront and Central Business District of the City of Detroit. It will provide public access to the riverfront not only for the people of Detroit, but also to tourists, conventioneers and other regional and out-of-state visitors. It's uniqueness in combining industry and recreation will make this park nationally notable and will reinforce the Detroit renaissance; a renaissance that does not copy the efforts of other cities.

Based on this challenging concept, the study has proposed ways of solving concerns and conflicts that might stand in the way of bringing the marina/canal to full fruition. Wave action concerns including surge, hydraulic concerns, and engineering aspects of the proposed design are shown to be solvable problems. Conflicts with utilities, transportation systems and industrial land uses are resolved. The need for and programming of a downtown transient marina is accomplished through a clear rationale. And finally, the economic impacts of such a venture are shown to be in the best interest of the city. This study, through these analyses, should clear the way for the commitment to construct the Chene/St. Aubin Park marina/canal.

FIGURE 6.2: PARK AND MARINA/CANAL PHASING



REFERENCES

1. LeMehaute, Bernard, "Wave Agitation Criteria for Harbors", Ports '77, Volume I, pp. 366-372. American Society of Civil Engineers, 1977

2. Personal Communication, Sargent B. Jiminesh, Detroit Harbormaster.

3. Brater, E.F. and H.W. King, "Handbook of Hydraulics" 6th ed., pp. 10-59, McGraw-Hill Book Co., New York, 1976

4. Michigan Department of Natural Resources. Wyandotte Wave Study, 1969

5. Personal Communication, Petty Officer Garner Marine Inspection Office, U.S. Coast Guard

6. Personal Communication Dr. E.F. Brater, Professor of Hydraulics, University of Michigan.

7. Personal Communication, Dr. R.B. Couch, Professor of Naval Architecture, University of Michigan.

8. U.S. Army Coastal Engineering Research Center, Shore Protection Manual, Volumes I and II. Fort Belvoir, Virginia, 1973

9. University of Michigan Coastal Zone Laboratory, Draft. Riverfront Capabilities Expansion Analysis. Ann Arbor, Michigan, July, 1979.

10. Snell Environmental Group, Inc. Hydraulic Study Chene/St. Aubin Riverfront Canal. Lansing, Michigan, 1979

PLANNING TEAM

Recreation Department

Harriet Saperstein, Principal Planner
Edward Viall, Chief Landscape Architect

Schervish, Vogel, Merz, P.C.

David W. Schervish, AIA, ASLA, Project Manager
Stephen Vogel, AIA
Kenneth Berendt
Rainy Hamilton
Robert Holmes
Randall Machelski

Snell Environmental Group, Inc.

Donald Emery, P.E.
Al Halbeisen, Project Engineer
Dr. Sam Nalluswani, P.E.
James Walker, Project Engineer

University of Michigan

Dr. Ernest Brater, P.E.

Michigan State University

Dr. David Wiggert, P.E.

ACKNOWLEDGEMENTS

Michigan Department of Natural Resources
Chris Shafer
David Warner
Michigan State Waterways Commission
Keith Wilson
Raymond Lawrence
Recreation Department
Daniel Krichbaum, Director
Ted Jordan
Harriet Saperstein
Edward Viall
Joseph Eckert
Ray Bennet
Loretta Brown
Carl Ackerman
Betsy Reich
Planning Department
Robert Hoffman
Community & Economic Development Department
Greg Sun
Candice Sweda
Robert Holland
Huron Clinton Metropolitan Authority
Richard Chadwick
William Sherman
Medusa Cement Company
Howard Simpson
Albert Jacoby
Jim Graham
Jim Urbanski
John Fildew
Penn-Dixie Cement Company
David Williams
Frank Trombetta
Black & Veatch
Tom Decker
Fred Lenone
Bob Pierce
United States Coast Guard
CWO John Powers
Huron Cement Company
Thomas Gruss
Rex Trucking Company
Tom House
Renaissance Excursions
Josephine Bennet
Bayview Yacht Club
Ed Zemmin, Rear Commodore
Detroit Yacht Club
Ross Fowler
Cusumano's and Tommy's Marina
Josephine Cusumano
Kean's Detroit Yacht Harbor
John Kean
Craig Becker
The Roostertail
Sal Marino
Gail Pelto
Landmark Planning
Arthur Ziegler
Ellis Schmidlapp
Vigliotti Realty
Ralph Vigliotti
Tom Vigliotti
Water and Sewer Department
Lyle Duke
Charles Gray
Dave Dunham