FINAL

OPERATIONAL ASSESSMENT REPORT

Little Tub Harbour
Tobermory, Ontario

December 2016

PLANMAC ENGINEERING INC.

80 North Queen Street, Suite 302
Toronto, ON M8Z 2C9
Phone: (416)626-5300
Fax: (416)622-6710

TABLE OF CONTENTS

EXECUTIVE SUMMARY II
1.0. INTRODUCTION 1
2.0. BACKGROUND INFORMATION 1
3.0. EXISTING CONDITIONS 2
4.0. FLOATING DOCK SYSTEM OPERATIONAL ASSESSMENT 3
4.1. Existing Dock Configuration 3
4.2. Alternative Reconfigurations 5
4.3. Recommended Alternative 10
5.0. STRUCTURAL LOADING 11
5.1. Loading Capacity 11
5.2. Crowding and Queuing 12
5.3. Summary and Recommendations 13
6.0. STABILITY OF FLOATING DOCKS 13
6.1. Anchoring Methods 14
6.2. Dock Loading Capacity 16
6.3. Applied Loads 16
6.4. Recommendations 17
7.0. SUMMARY AND RECOMMENDATIONS 18

LIST OF APPENDICES

APPENDIX A SITE INSPECTION PHOTOS
APPENDIX B CONCEPTUAL PLANS
APPENDIX C EXERPTS FROM RIGGS ENGINEERING LTD. CONDITION SURVEY

EXECUTIVE SUMMARY

Planmac Engineering Inc., hereafter referred to as Planmac, has been retained by the Boghosian + Allen LLP Litigation Counsel to address operational issues associated with the configuration of the existing Little Tub Harbour in Tobermory, Ontario, for commercial and non-commercial uses. This includes:

- Undertaking an operational assessment of the existing floating dock system along Bay Street to determine if various boat sizes could be accommodated by better accommodating larger vessels while ensuring appropriate boating maneuverability;
- Completing a structural loading review of the floating docks systems to determine an appropriate maximum pedestrian loading restriction in order to address high volumes of pedestrians who may be standing and waiting to board tour boats; and
- Providing input and recommendations on the stabilization of the floating dock system adjacent to large vessels, with the intent to determine and provide input on a maximum vessel size that may be docked beside the Municipality's standard dock size.

Of the four alternative layouts shown in this report, Planmac recommends that Alternative 4, widening the Alley by shifting the steel-frame Alley Dock to the north, be considered for implementation. This option results in an **additional 438 ft of useable dock space**. See *Figure E.1* for a conceptual layout of this option.

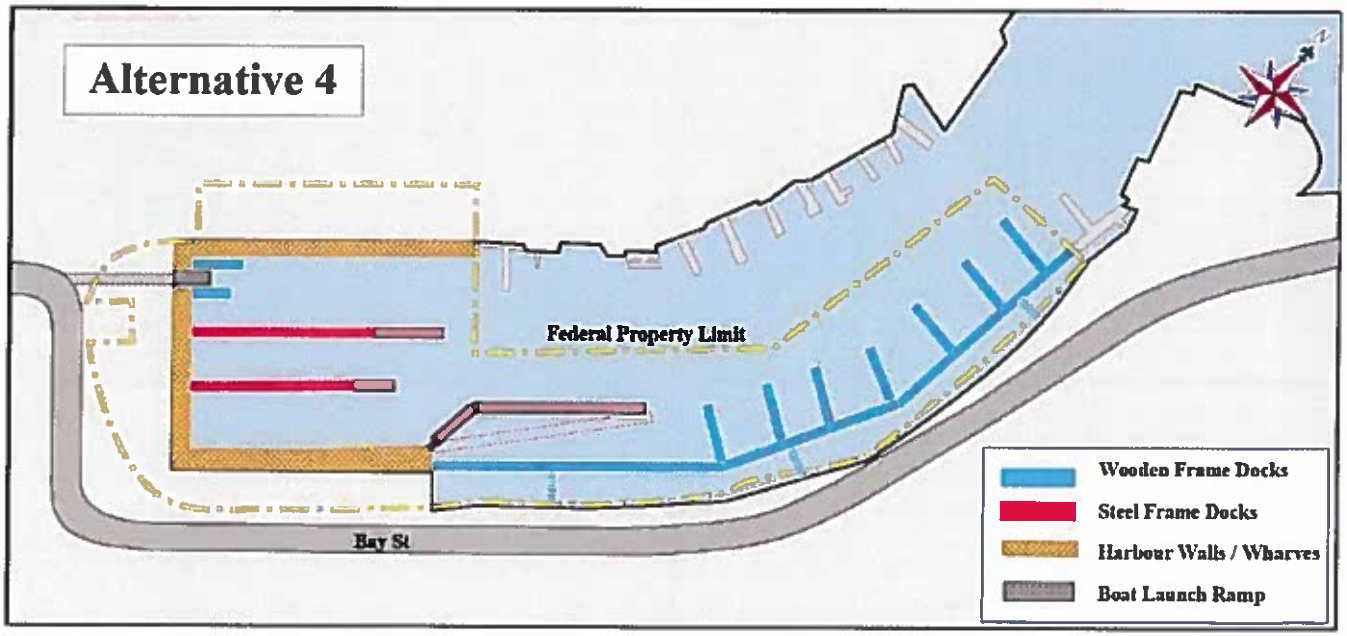


Figure E.1: Alternative 4 - Recommended Layout of Floating Dock System in Little Tub Harbour

Upon completion of a structural loading review of the floating docks system, Planmac has determined that an appropriate maximum pedestrian loading restriction of **nine (9) people** per 20 ft by 8 ft steel-frame dock section be implemented, and that **pedestrians should be discouraged from queuing on the dock**.

The existing concrete block anchoring method employed in Little Tub Harbour can safely support vessels with the properties outlined in *Table 6.1*, below.

Table 6.1: Maximum Vessel Properties

Vessel Type	Powerboat	Sailboat	Sport Fishing Boat
Maximum Length of Vessel	50 ft (15.3 m)	50 ft (15.3 m)	40 ft (12.2 m)
Maximum Weight of Vessel (including cargo and passengers)	68.8 kips (31.2 tonnes)		
Maximum Draft of Vessel	6 ft (1.83 m)		

1.0. INTRODUCTION

Planmac Engineering Inc., hereafter referred to as Planmac, has been retained by the Boghosian + Allen LLP Litigation Counsel to address operational issues associated with the configuration of the existing Little Tub Harbour in Tobermory, Ontario, for commercial and non-commercial uses. This includes:

- Undertaking an operational assessment of the existing floating dock system along Bay Street to determine if various boat sizes could be accommodated by better accommodating larger vessels while ensuring appropriate boating maneuverability;
- Completing a structural loading review of the floating docks systems to determine an appropriate maximum pedestrian loading restriction in order to address high volumes of pedestrians who may be standing and waiting to board tour boats; and
- Providing input and recommendations on the stabilization of the floating dock system adjacent to large vessels, with the intent to determine and provide input on a maximum vessel size that may be docked beside the Municipality's standard dock size.

Planmac's President, Mike Neumann, P. Eng. and Bob Maksymec, P.Eng., Senior Structural & Marine Engineer visited the site on July 22, 2016 to conduct a brief site review of the Little Tub Harbour. In addition, Planmac engineers met with Bill Jones of the Municipality of Northern Bruce Peninsula and discussed the relevant issues and scope of work.

The purpose of this report is to provide Boglaw with an operational assessment of the floating dock system of Little Tub Harbour with background information, and recommendations on the loading and stability of the floating docks.

2.0. BACKGROUND INFORMATION

The following documents were made available to Planmac prior to the completion of this document, and are included as appendices to this document:

- Excerpts from the Condition Survey, completed by Riggs Engineering Ltd. For Public Works and Government Services Canada in November of 2007. (*included as Appendix C*)
- Survey of Tobermory Harbour Floating Dock System, completed by Scott Coburn in November of 2016.

3.0. EXISTING CONDITIONS

Little Tub Harbour is located in Tobermory, Ontario, in the Municipality of Northern Bruce Peninsula. Tobermory sits at the northern tip of the Bruce Peninsula, which separates Georgian Bay from the remainder of Lake Huron. See *Figure 3.1*. Little Tub Harbour is one of two natural harbours in Tobermory, the other being Big Tub Harbour. Neither harbour is equipped with a breakwater, and rely on the natural topography and layout of the adjacent land and surrounding islands for protection from severe weather conditions. A large wharf sits between the mouths of Tobermory's twin harbours, and is dedicated to the MS Chi-Cheemaun passenger-car ferry which travels across the mouth of Georgian Bay between Tobermory, in the Bruce Peninsula, and South Baymouth, on Manitoulin Island. While Big Tub Harbour is the larger of the two, Little Tub Harbour serves as the town's commercial hub. See *Figure 3.2*. This harbour accommodates both private and commercial boats, and is equipped with a boat launch ramp, which is accessible from Bay Street near its intersection with Highway 6. Because of the appealing landscape and numerous shipwrecks in the area, Tobermory is a popular tourism destination, and is described as the "fresh water diving capital of the world". Due to the seasonal aspect of these features, most businesses in Tobermory are only open between May and Thanksgiving. During the remainder of the year, these businesses close, and the majority of the boats in Little Tub Harbour are taken out of the water to avoid damage caused by Tobermory's winter weather conditions. See *Figure 3.3*.

Figure 3.1: Municipality of Northern Bruce Peninsula, with Tobermory located at the northern tip

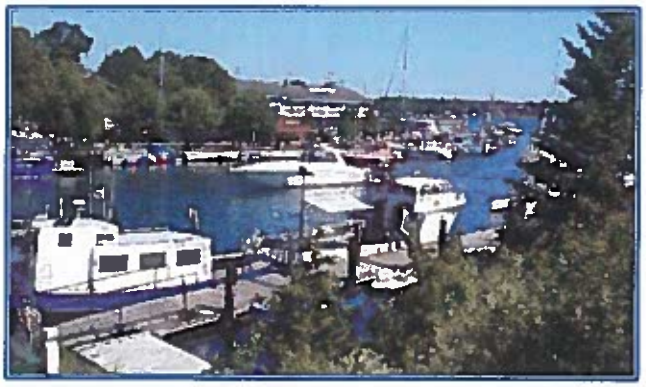


Figure 3.2: Little Tub Harbour, Tobermory, looking north

Figure 3.3: Little Tub Harbour during winter, looking west

4.0. FLOATING DOCK SYSTEM OPERATIONAL ASSESSMENT

As part of this project, Planmac has undertaken an operational assessment of the existing floating dock system along Bay Street in Little Tub Harbour in order to determine if more commercial boats can be accommodated while preserving adequate boating maneuverability. Please see below for Planmac's alternative solutions

4.1. Existing Dock Configuration

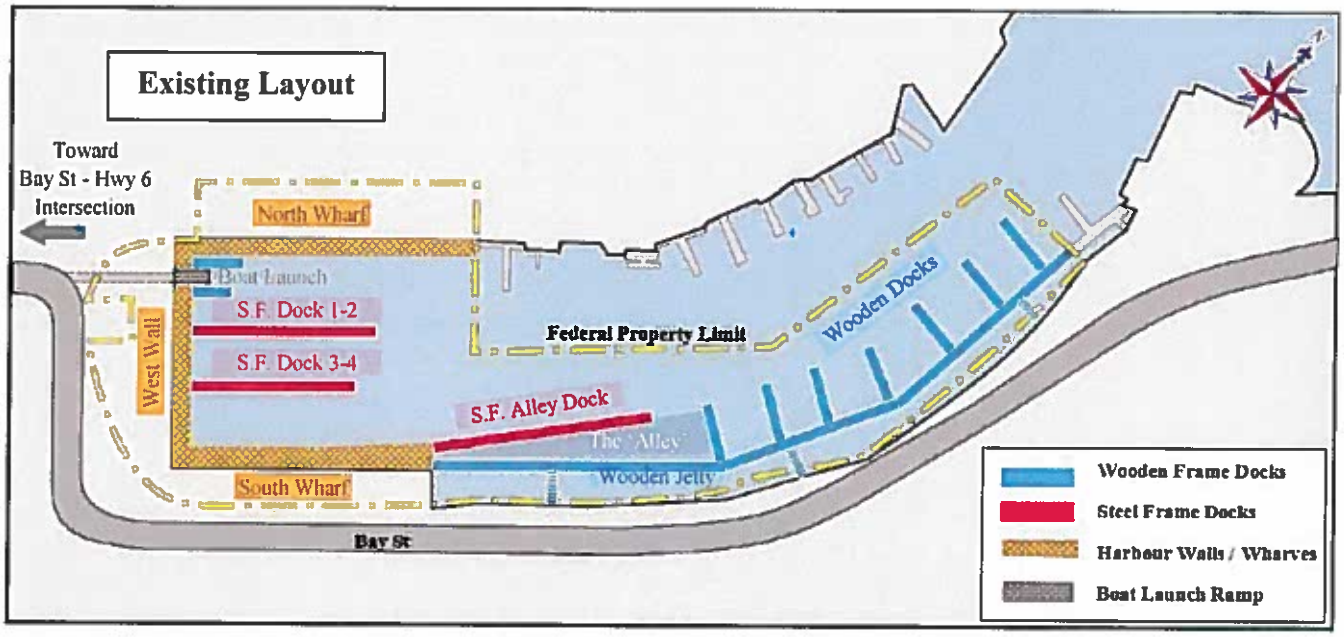


Figure 4.1: Existing Configuration of Little Tub Harbour

The existing configuration of Little Tub Harbour's dock system along Bay Street consists of many elements and features. Please note that the features listed below do not include any docks or jetties which lie outside of the federal property limit, marked out in yellow in *Figure 4.1*, above.

4.1.1 Harbour Walls and Wharves

Little Tub Harbour contains a wharf along its north edge, extending from the west end of the harbour to the Federal Property Limit, built with stone-filled timber cribs which support a timber deck. There is also a wharf along the south edge of the harbour, extending from the west end of the harbour, built with steel sheet piles, driven in front of stone-filled timber cribs and anchored to rock. Both of these wharves are equipped with pipe bollard horn cleats and can accommodate large commercial boats.

Figure 4.2: Boat launch ramp in the west wall, looking west from the north wharf

The wall running along the west edge of the harbour was built with steel sheet piles secured to concrete deadmen with tie rods. Due to the current configuration of the floating dock system, boats are not able to dock along this wall. There is boat launch at the north end of the west harbour wall. The boat launch consists of a 150 mm thick concrete ramp and a concrete retaining wall supporting the west harbour wall. It can be accessed by pedestrians, dollies, and vehicles towing trailers from Bay Street near its intersection with Highway 6. The boat launch is equipped with two short dedicated wooden frame (w.f.) docks.

4.1.2. Steel Frame (S.F.) Floating Docks

There are three steel frame (s.f.) floating docks in Little Tub Harbour. All three of the s.f. docks are equipped with electrical services for the use of the moored boats. The s.f. dock sections consist of a steel frame welded to steel pontoons with an outside diameter of 2 ft and a thickness of ¼ in, which run along both sides and both ends of the section. The steel frame supports timber stringers and decking. Boats can be tied to pipe bollards which are welded to the steel frame along the sides of the dock sections. The dock sections can be joined together at their ends such that they can hinge vertically with each other, but not horizontally.

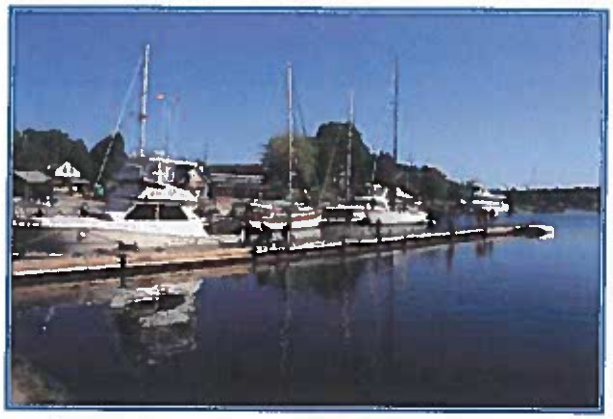


Figure 4.3: S.F. Dock 3-4 extending from the west wall, looking northeast

Two of these s.f. docks, Dock 1-2 and Dock 3-4, extend from the west wall, and can be accessed by pedestrians via short wooden ramps, which hinge vertically to adjust to changes in water level. These docks are secured in place with 1-tonne concrete anchors, and are both composed of 20 ft long by 8 ft wide s.f. dock sections. S.F. Dock 1-2, nearest the north wharf, consists of nine (9) sections and has a total length of 180 ft. S.F. Dock 3-4, nearest the south wharf, consists of eight (8) sections has a total length of 160 ft.

The third s.f. dock, known as the 'Alley' dock, runs along the southern edge of the harbour, extending from the east end of the southern wharf. It is secured in place by steel H-piles, which are driven into the bed of the harbour. This dock is composed of ten (ten) 20 ft long by 8 ft wide dock sections, and has a total length of 200 ft. The docking area immediately south of this dock is commonly referred to as 'the Alley'.

4.1.3. Wooden Frame (W.F.) Floating Docks

The remainder of Little Tub Harbour's floating dock system consists of wooden-framed (w.f.) docks. Similarly to the s.f. docks, the w.f. docks consist of dock sections which are joined together with hinges. However, the structural frame of these docks are made of wood, and boats are tied to metal horn cleats which are attached to the timber decking, rather than pipe bollards welded to the frame. The w.f. docks are also equipped with electrical services.

The largest component of the w.f. floating dock system is a jetty, which stretches along the southern edge of the harbour from the south wharf to the eastern federal property limit. This jetty is comprised of many 16 ft long by 8 ft wide sections. Although this jetty is equipped with horn cleats, the majority of it is not useable for mooring boats due to the configuration of the harbour's dock system. Only a small portion of the jetty, situated at the wider eastern end of the Alley, can be used for mooring, as shown in *Figure 4.4*. Instead, this dock acts as an arterial walkway to enable pedestrians to access the eastern portion of the floating dock system. This jetty can be accessed via the south wharf, another w.f. jetty beyond the east federal property limit, and three sets of stairs that lead to Bay St.

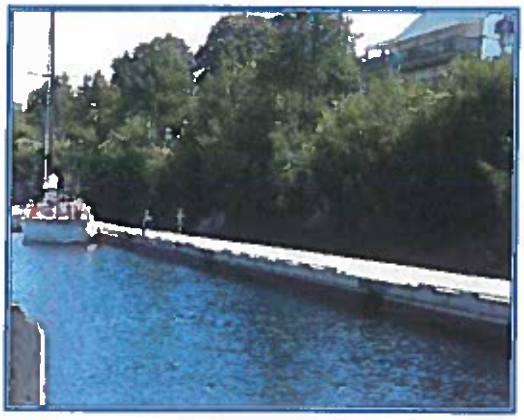


Figure 4.4: Wooden jetty, looking east from the southern steel dock

Just to the east of the Alley Dock, there are seven (7) 60 ft long by 8 ft wide w.f. finger docks extending from the w.f. jetty. These w.f. finger docks are spaced at approximately 64 feet, both sides of these docks can be used as mooring space. The four (4) westernmost docks are each comprised of three (3) 20 ft long sections, and the remaining three (3) easternmost w.f. docks are comprised of two (2) 30 ft long sections. All seven w.f. docks extend from, and are accessible from, the w.f. jetty.

4.2. Alternative Reconfigurations

After completing an assessment of the operational qualities of the harbour's features, such as useable docking space, maneuverability, material type and strength, Planmac has come up with four alternative reconfigurations of the floating dock system in Little Tub Harbour in order to accommodate more commercial boats in this space.

Through this assessment, Planmac has found that the seven w.f. docks extending from the jetty to the east, as well as S.f. Dock 1-2 and S.f. Dock 3-4, already use the available space quite efficiently. While we do not recommend reconfiguring these docks, extending Dock 1-2 and Dock 3-4 may be possible if they are appropriately anchored.

Planmac's four alternative solutions focus primarily on the central region of the harbour surrounding the Alley, containing the s.f. Alley Dock and a portion of the w.f. jetty to the south. The space between the Alley Dock and the w.f. jetty, known as the Alley, is very narrow, and this significantly limits the useable mooring space in this area. As a result, this region is currently the least efficient configuration of Little Tub Harbour's floating dock system. All four alternative reconfigurations of the dock system involve removing the piles supporting the Alley Dock, as well as either the relocation or removal of the Alley Dock in order to increase the efficiency of the use of harbour space in this area.

4.2.1. Alternative 1

Move the Steel-Frame Alley Dock to the North Side of the Harbour

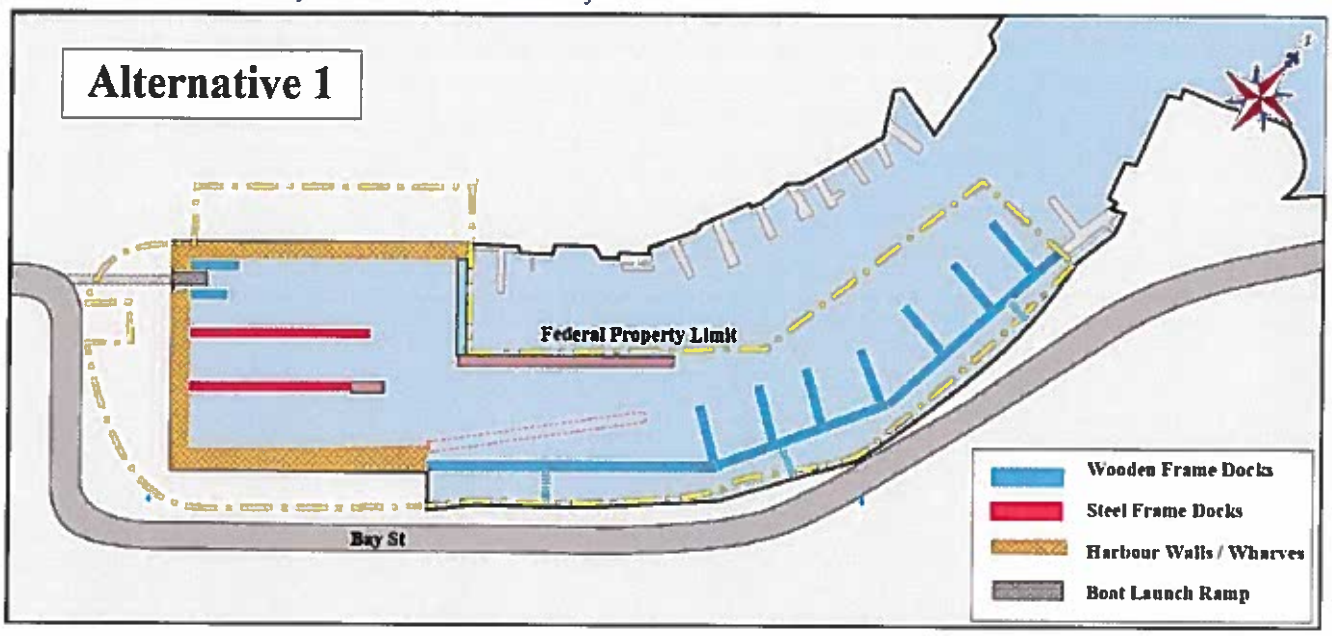


Figure 4.5: Conceptual Plan of Alternative 1

The first alternative involves relocating the s.f. Alley Dock northward, such that it lies against the federal property limit. This dock would be accessed via a new floating w.f. walkway, extending approximately 120 ft from the east end of the north wharf. Please refer to *Figure 4.5* or drawing number 3 in *Appendix B* for a conceptual plan of this alternative.

This reconfiguration allows for the full length of the 288 ft section of the w.f. jetty, extending from the south wharf, to be available as docking space for commercial boats. Currently, only about 50 ft of this dock is usable, result in a net gain of about 238 ft of usable docking space along the jetty. Two (2) additional 20-ft dock segments could be added to S.f. Dock 3-4, resulting in a gain of 80 ft of docking space. However, extending the northern S.f. Dock 1-2 is not possible as this would make maneuverability a major challenge for vessels docking on its north side or using the boat launch ramp. The maximum possible additional docking space for this alternative is 160 ft. See *Table 4.1*, below for more details.

This alternative has a number of drawbacks. The side of the Alley Dock abutting the Federal Property Line can no longer be used as docking space. This equates to a loss of 200 ft of useable docking space, which is not much less than the 238 ft gained along the w.f. jetty. Also, since the jetty is built with a wooden frame, it may not be able to accommodated the large commercial boats that are common to Tobermory, which are currently supported by the steel-framed Alley Dock. Another issue is the cost. A net gain of 38 ft of useable docking space (not including the extension of S.f. Dock 3-4) would allow for only one or two additional boats. The cost of cutting or removing the piles that currently hold the Alley Dock in place, as well as the cost of purchasing the new w.f. floating dock sections and anchors would likely not be justified by such a small net gain.

Another key issues of this alternative is maneuverability. As shown in the conceptual plan in *Appendix B*, the western half of Little Tub Harbour's floating dock system must navigate through a 50 ft wide gap. Not only is this gap very narrow for two-way boat traffic, many more turns and manoeuvres would be required for boats moored to Dock 1 or the North Wharf, or boats using the launch ramp. This positioning would also likely result in maneuverability challenges for boats using the area of Little Tub Harbour to the north of the Alley, lying outside the federal property line.

This alternative results in a maximum net gain of 118 ft of useable docking space. However, Planmac finds that the cost and unfavourable effect on maneuverability of this first alternative outweigh the benefit of the added docking space. Therefore, implementation of this reconfiguration it is considered feasible but is not recommended.

4.2.2. Alternative 2

Remove the Alley Dock, Add New Wooden-Frame Docks, and Extend Dock 1-2 and Dock 3-4

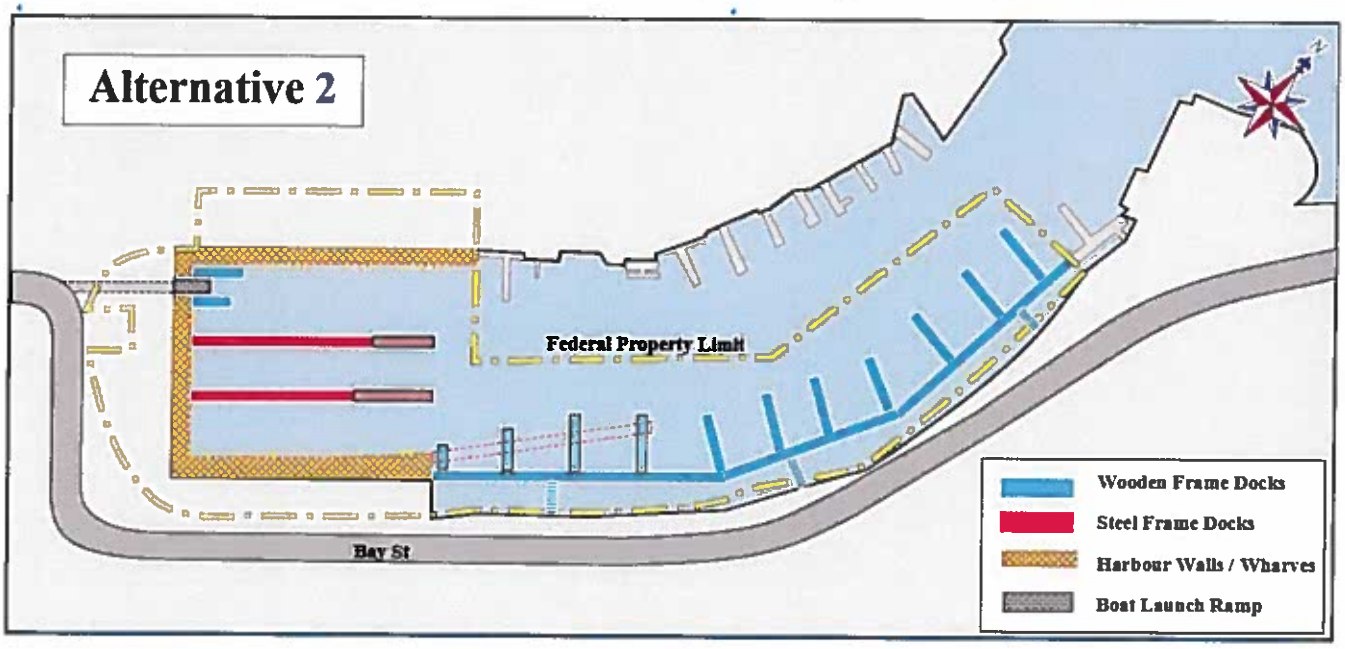


Figure 4.6: Conceptual Plan of Alternative 2

The second proposed alternative for the reconfiguration of Little Tub Harbour involves the removal of the Alley Dock, which would provide space for four new w.f. docks, to be extended from the jetty in what is currently the Alley. The four new w.f. docks would vary in length, as shown in *Figure 4.6*, above, so that they do not cause maneuverability issues for boats using Dock 4 or the South Wharf. The easternmost new w.f. docks would be 60 ft long to match the configuration of the existing w.f. dock system. The new docks would be spaced such there is at least 64 ft between two docks. This reconfiguration allows for S.f. Dock 1-2 and S.f. Dock 3-4 to be extended without significantly affecting maneuverability throughout the Harbour. Please see drawing number 4 in *Appendix B* for a conceptual layout of this alternative.

There are a number of benefits to this alternative. This reconfiguration matches the layout pattern of the existing floating dock system. As a result, it will be much easier for those who use the Harbour to adjust to the new layout, causing fewer impacts and maneuverability issues. This reconfiguration also results in a minimal impact to operation of the boats and docks outside of the federal property limits. It is therefore less likely to cause conflicts arising in Little Tub Harbour's close-knit community of private and commercial boat owners. This design can be implemented gradually over a number of seasons, and does not require all new dock sections and extensions to be installed simultaneously. The maximum possible additional docking space for this alternative is 360 ft. See *Table 4.1*, below for more details.

While it is possible to use the s.f. sections from the Alley Dock to extend Docks 1-2 and 3-4, some new s.f. and w.f. dock sections will be necessary to maximize the useable docking space of this configuration. Also, achieving the same stability of the existing Alley Dock in the proposed extended s.f. docks would require checking and potentially reinforcing, the anchoring system of these docks. For more details on how this could be accomplished, see *Section 6.0.*, below.

Planmac finds that the benefits of this alternative outweigh its drawbacks. This reconfiguration provides a net gain of 170 ft without causing any new maneuverability issues. Therefore, implementation of this alternative would be feasible and beneficial to the operation of Little Tub Harbour.

4.2.3. Alternative 3

Remove the Alley Dock, Add New Wooden-Frame Finger Dock System, and Extend Dock 1-2 and Dock 3-4

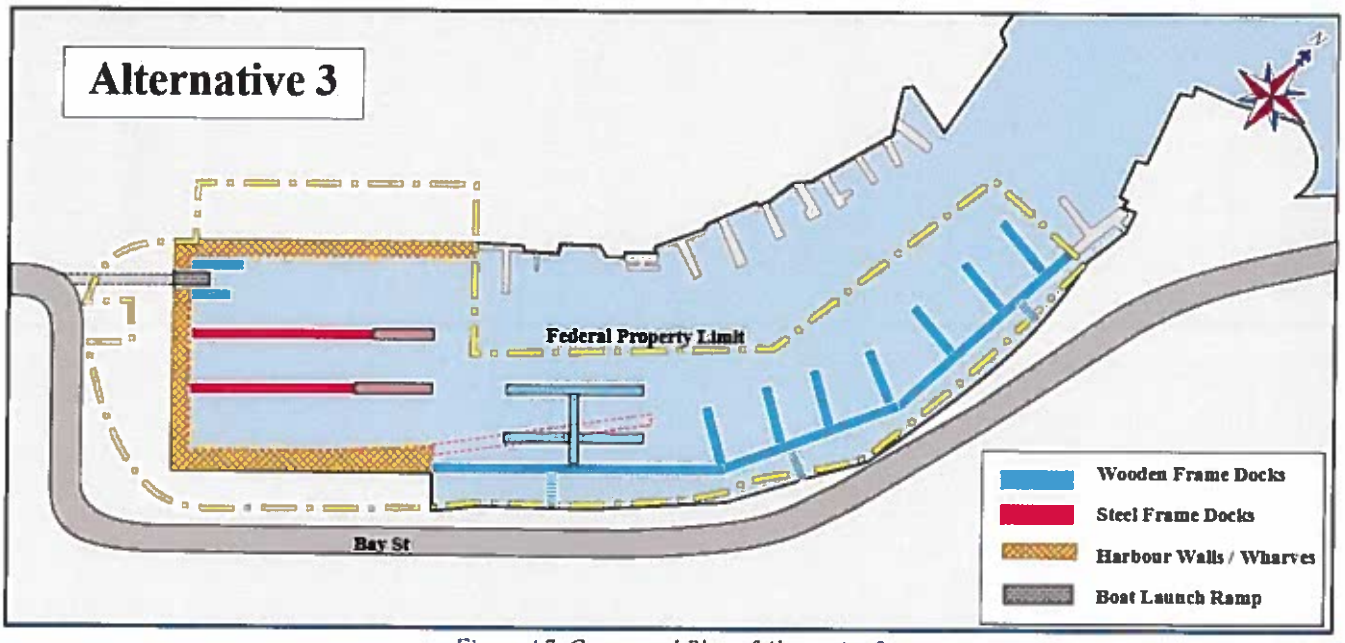


Figure 4.7: Conceptual Plan of Alternative 3

This third alternative reconfiguration of the Little Tub Harbour's floating dock system is similar to the second alternative (see *Section 4.2.2.*, above). By removing the Alley Dock, it is possible to extend Docks 1-2 and 3-4, and use the Alley area more efficiently. The main difference is that rather than adding four

new w.f. docks along the jetty, an array of finger docks would be added. This set of finger docks would involve four new 60 ft long docks extending from a new w.f. floating dock walkway, which is accessed via the existing jetty. Please refer to *Figure 4.7* or drawing number 5 in *Appendix B* for a conceptual plan of this alternative.

This alternative results in a larger total useable dock length than alternative 2, as the new w.f. finger docks would not have to be shortened to allow for boats to access the space between Dock 3-4 and the South Wharf. Also, the outermost edge of the finger docks would be a continuous docking edge approximately 128 ft long, providing docking space for very large or hard-to-manoeuvre boats.

Although the segments from the Alley Dock can be relocated and reused, this alternative would still require many new dock pieces. The new finger docks would require a new anchoring system in order to avoid putting excessive strain on the existing jetty. This configuration would also require more manoeuvring for boats docking in the south wharf area or on the new finger dock system.

While this third alternative would require more manoeuvring that the second alternative, it results in net gain of 368 ft of useable docking space for commercial boats in the harbour. While this alternative causes a few minor maneuverability issues, it provides almost twice additional space as the second alternative. Therefore, Planmac finds that the implementation of alternative 3 would be feasible and beneficial to the operation of Little Tub Harbour.

4.2.4. Alternative 4

Move the Alley Dock Slightly to the North, Extend Dock 1-2 and Dock 3-4

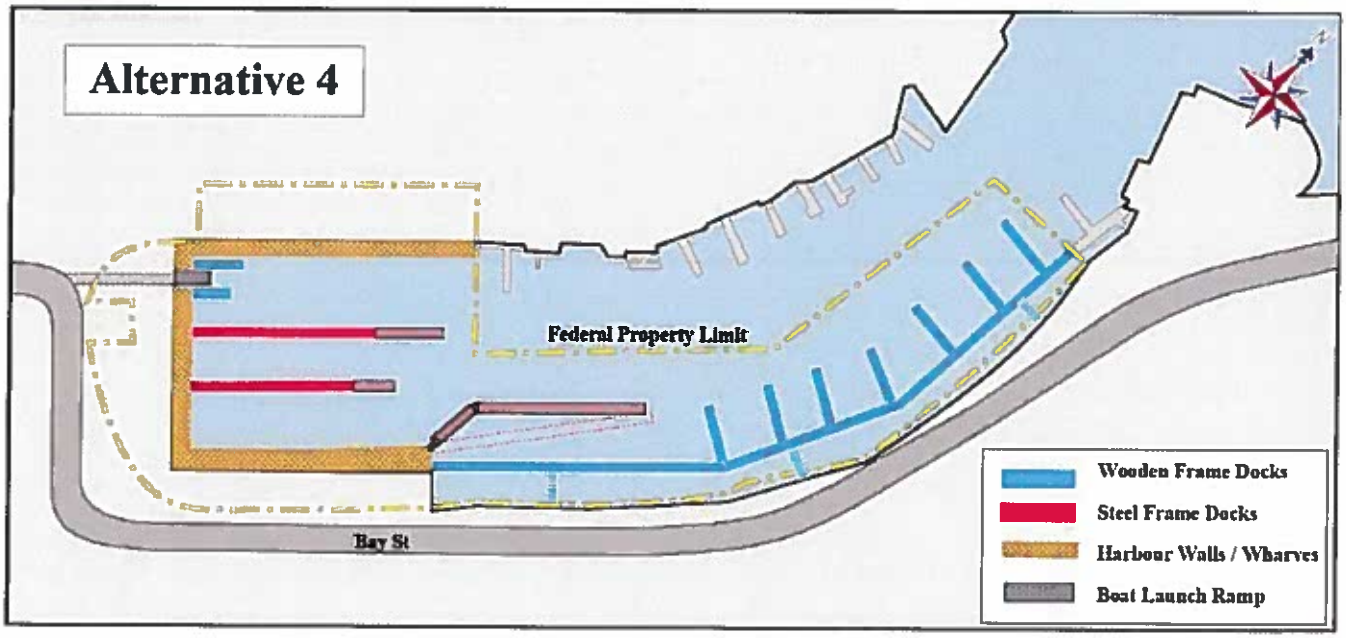


Figure 4.8: Conceptual Plan of Alternative 4

The fourth alternative reconfiguration of Little Tub Harbour involves shifting the Alley Dock slightly north of its current position, widening the Alley. The repositioned Alley Dock would still be accessed

from the southern wharf, as it is currently, but it would be accessed indirectly via an angled 60 ft long floating dock. This angled section of the proposed dock could be made of either wooden-frame dock sections or steel-frame dock sections. This alternative would allow some space to extend S.f. Docks 1-2 and 3-4. For a conceptual plan of this alternative reconfiguration, please refer to *Figure 4.8* or drawing number 6 in *Appendix B*.

This proposed layout enables commercial boats to access the currently unused segment of the w.f. jetty which runs along the south edge of the Alley. Out of the four alternatives, this alternative not only requires the fewest new dock sections, but results in the largest net gain of useable docking space. This is primarily due to the fact that this alternative involves the relocation, rather than the removal, of the 200-ft long Alley Dock. This layout also consists of long, unobstructed docking areas, rather than more short dock sections. This is beneficial to very large commercial boats which have difficulty turning and manoeuvring.

A major challenge caused by this alternative is the additional manoeuvring required to access the south wharf. Also, the manoeuvring difficulties for boats using the Alley will continue to be an issue. The north and south wharves provide the strongest and most stable support for large vessels in this harbour, which are generally the hardest boats to manoeuvre. By moving the Alley Dock north from its current position, the channel used to access the South Wharf will be constricted.

Planmac finds that the implementation of this alternative would be feasible and beneficial to the operation of Little Tub Harbour. It provides the most docking space for commercial boats when compared to the other alternatives, and it requires the fewest new dock sections. Therefore, this is the preferred option.

4.3. Recommended Alternative

4.3.1. Comparison of Useable Dock Space for Alternatives

Please refer to *Table 4.1*, below, for a summary of the above listed features of Little Tub Harbour, and the approximate amount of docking space they provide for commercial boats.

Table 4.1: Useable Dock Space for Existing Conditions and Proposed Alternatives

Configuration	Useable Floating Dock Space					Total / Net Gain
	Dock 1-2	Dock 3-4	Alley Dock	W.F. Jetty	W.F. Docks	
Existing Layout	360 ft	320 ft	400 ft	50 ft	840 ft	**1,970 ft**
Alternative 1	+ 0 ft	+ 80 ft	- 200 ft	+ 238 ft	+ 0 ft	**+ 118 ft**
Alternative 2	+ 120 ft	+ 160 ft	- 400 ft	- 50 ft	+ 340 ft	**+ 170 ft**
Alternative 3	+ 120 ft	+ 160 ft	- 400 ft	+ 0 ft	+ 488 ft	**+ 368 ft**
Alternative 4	+ 40 ft	+ 160 ft	+ 0 ft	+ 238 ft	+ 0 ft	**+ 438 ft**

Note that these values do not include the combined 530 ft of useable space along the North and South Wharves (shown in *Figure 4.1*, above). While all four alternatives would result in an increase in docking space for commercial boats in Little Tub Harbour, Planmac recommends that only alternatives two, three and four be considered for implementation. Of these, **Alternative 4 is the preferred option**.

5.0. STRUCTURAL LOADING

As part of this project, Planmac completed a structural loading review of Little Tub Harbour's floating dock system in order to determine an appropriate maximum pedestrian loading restriction. This structural loading review was completed based on the cross-sectional geometry of the 8 ft wide and 20 ft long steel frame dock sections which constitute Dock 1-2, Dock 3-4 and the alley dock, as shown in *Appendix C*. Cross-sectional information for Tobermory's w.f. floating dock sections were not made available to Planmac prior to the completion of this report. As a result, Planmac cannot provide meaningful input on their respective structural loading capacities.

5.1. Loading Capacity

5.1.1. Dock Buoyancy

Based on the cross-section of the 8 ft wide, 20 ft long steel frame dock section, as shown in *Figure 5.1*, the docks consist of wooden decking attached to a steel frame, which is in turn welded to four steel pontoons - one along each side and each end of the dock segment. Assuming the dock has reached its maximum capacity when the pontoons are fully submerged, the dock is capable of supporting a load equivalent to the weight of the displaced water. Therefore, the dock's pontoons are capable of supporting the weight of approximately 2,670 litres of water. Therefore, each s.f. dock section has a maximum buoyancy of **2,670 kg (5,890 lbs)**.

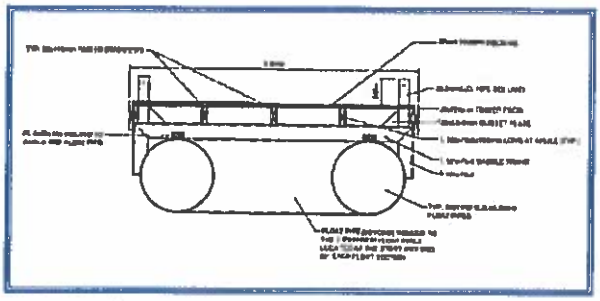


Figure 5.1: Cross Section of 8 ft Wide Steel Floating Docks

5.1.2. Factors of Safety

The maximum buoyancy of the dock sections as shown above describes the dock's capacity under ideal conditions. However, there are many factors which could affect the overall buoyancy and stability of the dock, including, but not limited to, the following:

- Heavy objects and equipment that are temporarily stored on or carried across the dock;
- Objects and equipment permanently resting on the floating docks, such as electrical services for the moored boats;
- Water leaking into the steel pontoons;
- Forces resulting from any boats secured to the dock;
- Environmental impacts such as high winds, large waves and strong currents;
- Uneven forces acting on the dock from an unbalanced anchorage system;

- Uneven loading, such as a queue of passengers waiting along only one edge of the dock; or
- Discrepancies between the true dock dimensions and those provided to Planmac and used for our calculations.

After consideration of these and other factors, Planmac recommends that a factor of safety of no less than **two (2)** be applied to the live loading applied to the dock sections.

5.1.3. Dead Loads

Based on the layout as shown in *Figure 5.1*, each dock segment is composed of the following elements:

Wooden Elements:

- 2" thick timber decking
- 2" x 6" timber stringers
- 2" x 10" timber covers along the facia
- Total weight of wooden elements = 450 kg (990 lbs)

Steel Elements:

- 2' outside diameter, ¼" thick float pipes
- Pipe bollards with gusset plates
- Steel saddle frame
- Steel joints, angles and welds
- Total weight of steel elements = 750 kg (1650 lbs)

The total dead load of each 20 ft by 8 ft dock section comes to **1,200 kg (2,640 lbs)**.

5.1.4. Live Load Capacity

Each 20 ft by 8 ft dock section has an ultimate loading capacity of 2,670 kg (5,890 lbs), and a self-weight of 1,200 kg (2,650 lbs). This leaves an ultimate live loading capacity of 1,470 kg (3,240 lbs). Therefore, under ideal conditions, i.e. with no factor of safety, each dock section can support a total of 18 people. However, if using a factor of safety of two (2), the *safe* live loading capacity becomes 735 kg (1,620 lbs). Therefore, **each dock section is capable of safely supporting 9 people**.

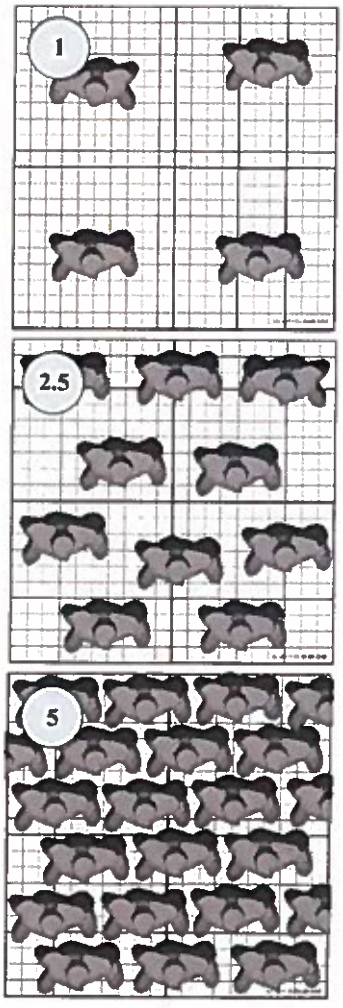


Figure 5.2: Visualization of Various Crowd Densities (People per Square Meter)

5.2. Crowding and Queuing

Little Tub Harbour is home to many commercial tour boats and ferries which can accommodate upward of 50 passengers at the same time. Therefore, loading restriction calculations for the docks must account for large numbers of passengers standing together along the dock while waiting to embark on these boats. If the loading of these queues

exceeds the safe loading limit, then these businesses should encourage their customers to wait for these boats on land rather than on the dock.

Standing crowd density typically ranges from 1 to 2.5 people per square meter, with maximum limit of 5 people per square meter. See *Figure 5.2* for a visualization of these crowd densities. A crowd density of 2.5 people per square meter can be used as a conservative estimate.

If queue of people is standing at a density of 2.5 people per square meter, **15 people** can fit along a 20 ft dock.

5.3. Summary and Recommendations

Each 20 ft by 8 ft steel-frame dock section has an ultimate loading capacity 2,670 kg (5,890 lbs), and a self-weight of 1,200 kg (2,650 lbs). Using a factor of safety of two (2), this leaves a **safe live loading capacity of 9 people per dock section**. This value can be multiplied by the number of 20 ft by 8 ft sections comprising the dock in question. Therefore, based on their current configuration, the safe pedestrian loading capacities of Dock 1-2, Dock 3-4 and the Alley Dock are 81 people, 72 people and 90 people, respectively. These values will change if dock sections are added or removed.

The live load value due to pedestrian crowding, calculated in *Section 5.2.*, above, was 15 people per dock section. This value lies between the safe and ultimate live loading capacities of 9 and 18 people, respectively. This implies that while under queuing on the docks may not result in the docks submerging under ideal conditions, it is not considered safe to do so. Crowded docks may also result in more injuries or incidents for pedestrians on the docks, as people are more likely to be pushed off and access to other boats on the dock may be blocked. Therefore, **Planmac recommends that passengers waiting to board vessels moored in Little Tub Harbour's floating dock system be discouraged from queuing on the floating docks**.

Please note that these calculations refer only to the 20 ft by 8 ft steel-frame dock sections used in Little Tub Harbour, as shown in *Appendix C*. These results may not be directly applicable to the wooden-frame dock segments used in the harbour.

6.0. STABILITY OF FLOATING DOCKS

Floating docks must be able to withstand many types of forces. The magnitude of these forces, such as wind loads and impact loads, are influenced by the size of the boats moored to the dock and approaching the dock, respectively. Due to the touristic nature of Tobermory's business sector, many of the commercial boats in Little Tub are quite large. As a result, the harbour's floating dock system must withstand correspondingly larger forces. This section provides a breakdown of various anchoring methods, as well as recommendations on the maximum sizing of boats using Little Tub Harbour's floating dock system.

6.1. Anchoring Methods

Based on the layout of the docks, Planmac proposes that one or more of the following anchoring methods be used for Little Tub Harbour's floating dock system.

6.1.1. Deadman Anchors

Deadman anchors are a very common anchoring method. They employ heavy 'deadman' weights, which are secured to the docks with a chain (see *Figure 6.1*). This method is generally used in sheltered water with a depth of 4 feet or more. To obtain optimal lateral stability, the length of the chain is approximately 2 to 3 times the depth of the water. When designing the weight of these anchors, it is important to take into account the buoyancy of various materials. Concrete, for example, weighs only 57% as much when underwater than it does on dry land.

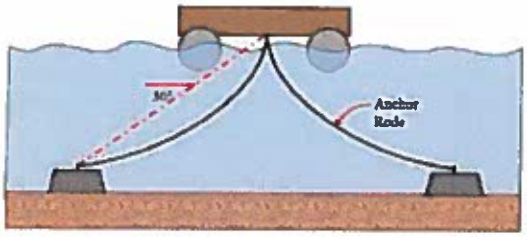


Figure 6.1: Deadman Anchoring Method

This is the current anchoring method used for Little Tub Harbour's floating dock system, with the exception of the Alley Dock. Each of the remaining s.f. and w.f. floating dock sections in the Little Tub Harbour are secured by two (2) 1-tonne concrete weights. The concrete weights are connected to the dock sections via chains which are angled at about 30° from horizontal.

There are a number of benefits to using this anchoring system. First of all, this method is much less expensive than alternative methods, as it requires very few specialized materials and can usually be installed without heavy equipment. This method is also very adjustable compared to other techniques. The deadman weights can be easily relocated or adjusted to adapt to changing water levels.

However, compared to the other methods listed in this report, deadman anchors are the least stable. As the weights are not driven or dug into the waterbed, they can be moved or shifted by much smaller forces than those required to move soil anchors or piles. The stability of deadman anchors depends on the size of the weights used, where heavier weights result in increase stability, as well as the type and quality of the soil at the surface of the waterbed, where siltier, clay soils provide less support than sandier soils.

6.1.2. Soil Anchors

Figure 6.2: Soil Anchor

Soil anchors work similarly to deadman anchors in that they are attached to the floating docks via angled chains. However, rather than providing stability through weight, soil anchors are buried into the harbour bed.

This method provides more holding strength than the deadman anchoring method. Whereas deadman weights are prone to lifting and sliding along the waterbed, soil anchors use the weight and cohesion of the soil to resist these forces. The strength of soil anchors is affected by the depth at which it is buried, the size of the anchor, and the properties of the soil.

The disadvantages of using soil anchors include higher costs than deadman anchors, as well as increased difficulty of implementation. Also, once put into place, soil anchors are hard to shift or relocate without being dug out of the ground, which is also very costly. However, once implemented, small adjustments can be made to the length of the chains which attach them to the docks in order to account for changes in water level or small adjustments to the positioning of the floating docks.

6.1.3. Pile Anchors

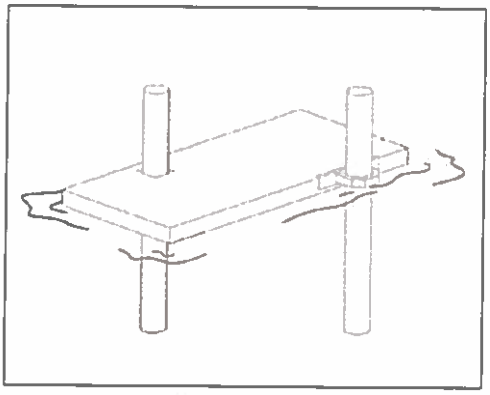


Figure 6.3. Pile Anchoring Method

The pile anchoring method involves securing the floating dock sections to structural piles that are driven deep into the waterbed, or drilled into bedrock. In this method, the floating docks are typically attached directly to the pile anchors, as shown in *Figure 6.3*. This method is currently used to secure the Alley Dock in place.

Of the three anchoring methods listed in this section, this method provides the most stability. If properly designed and braced, pile anchors could support very large vessels in Little Tub Harbour. Also, since the floating docks are attached directly to the piles, they experience limited lateral displacement when compared to the methods above which use chains. This connection only allows for vertical movement, to account for changes in water level.

However, this method is also the most expensive out of the three listed. Even after implementation, removing, cutting or relocating the piles is also very expensive. While Planmac has not been provided with site-specific geotechnical information, we know that the geology of the Bruce Peninsula area consists primarily of limestone, so securing new piles into the bed of Little Tub Harbour would likely be difficult and expensive.

6.2. Dock Loading Capacity

There are a number of failure modes to consider when calculating the loading capacity of Little Tub Harbour's floating dock anchorage system. The following failure modes apply to the harbour's steel-frame floating docks. These docks are comprised of 20 ft long, 8 ft wide sections, each of which is chained to two (2) 1-tonne deadman anchors – one on each side.

6.2.1. Failure of Bolts Connecting Dock Sections

The dock sections are connected to each other with two (2) 1" (25.4 mm) diameter bolts. Therefore, each dock section connection can resist a longitudinal axial force (i.e. along the length of the dock) of up to 362 kips (1,608 kN) in either tension or compression, or resist a lateral moment of up to 13,452 kip-ft (1,860 kNm). These numbers represent extremely strong forces, and so it is highly likely that the anchors stabilizing these dock sections will shift before the connections between them break.

6.2.2. Maximum Holding Force of Concrete Anchor

Each 20 ft dock section is held in place by a 1-tonne concrete deadman anchor on each side. These anchors are connected to the floating docks via steel chains. If subjected to a large enough force, these anchors can lift and slide along the bed of the harbour. Each concrete anchor is capable of resisting a load of **1,012 lbs (4.5 kN)** acting laterally on the dock before shifting. This result is based on typical soil types and concrete anchor properties.

6.3. Applied Loads

6.3.1. Wind Loads

The mean hourly average wind speed in Tobermory is about 5 knots. However, these hourly average speeds can reach over 20 knots. While boats are moored onto floating docks, these strong winds push against their hulls, resulting in lateral forces acting on the docks. Boat hulls with a larger surface area above water level are affected more by this wind, and result in greater forces pushing laterally against the dock.

Figure 6.4: Sport Fishing Boat

The force caused by the wind pushing the unsubmerged portion of a moored boat's hull increases in proportion to the boats length and height. Using the maximum holding force of the concrete anchors of 1,012 lbs (4.5 kN), the docks can safely support **powerboats and sailboats** with lengths of up to **50 ft (15.3 m)**. Sport fishing boats, such as the one shown in *Figure 6.4*, generally have a higher profile than powerboats and sailboats of the same length. As a result, the docks can only safely support **sport fishing boats** with lengths of up to **40 ft (12.2 m)**. Vessels with lengths greater than those described above may cause the concrete anchors stabilizing the docks to shift along the harbour bed.

6.3.2. Docking Impact Forces

The forces resulting from the impact between a vessel and a floating dock while docking are proportional to the boat's weight and the speed at which it is moving. Although boats approaching Little Tub Harbour's floating docks will have low speeds, the boats can be quite large.

Assuming a boat is approaching the dock at an angle, travelling at 1 mph (1.61 kph), which is 20% of the 5 mph (2.25 m/s) 'no wake zone' speed limit in the harbour, the docking force can be calculated as a function of the weight of the boat, its cargo and its passengers. Since the anchor holding force is 1,012 lbs (4.5 kN), the maximum weight of a boat that can safely dock on Little Tub Harbour's floating dock system is **68.8 kips (31.2 tonnes)**. This weight would be typical of a commercial boat approximately 55 ft (16.8 m) long, or a recreational boat approximately 75 ft (22.9 m) long. Vessels with a weight greater than 68.8 kips (31.2 tonnes) may cause the concrete anchors stabilizing the docks to shift along the harbour bed.

6.3.3. Maximum Draft of Boat

In order to avoid catching the anchor rode on the bottom of a vessels keel whilst against the dock, the draft (or draught) and beam of the vessel must be proportioned such that the boat is does not pass the 30° line from one end of the anchor rode to the other, as shown in *Figure 6.1*. A maximum draft of **6 ft (1.83 m)** is recommended.

6.4. Recommendations

Using the current concrete block anchorage system, the floating dock system in Little Tub Harbour can safely accommodate a vessel with the following properties:

Table 6.1: Maximum Vessel Properties

Vessel Type	Powerboat	Sailboat	Sport Fishing Boat
Maximum Length of Vessel	50 ft (15.3 m)	50 ft (15.3 m)	40 ft (12.2 m)
Maximum Weight of Vessel (including cargo and passengers)	68.8 kips (31.2 tonnes)		
Maximum Draft of Vessel	6 ft (1.83 m)		

Should a boat exceed the properties listed above in Table 6.1, we recommend that it be docked along the north or south wharf. In order to accommodate larger vessels, the floating dock system must be secured

with larger concrete anchors, or must employ a stronger alternative anchoring system, such as those listed above in Section 6.1.

7.0. SUMMARY AND RECOMMENDATIONS

In order to address operational issues associated with the configuration of the existing Little Tub Harbour in Tobermory, Ontario, for commercial and non-commercial uses, Planmac was retained to:

1. *Undertake an operational assessment of the existing floating dock system along Bay Street to determine if various boat sizes could be accommodated by better accommodating larger vessels while ensuring appropriate boating maneuverability.*

   Of the four alternative layouts shown in this report, Planmac recommends that Alternative 4, widening the Alley by shifting the steel-frame Alley Dock to the north, be considered for implementation. This option results in an additional 438 ft of useable dock space. See *Figure 7.1* for a conceptual layout of this option.

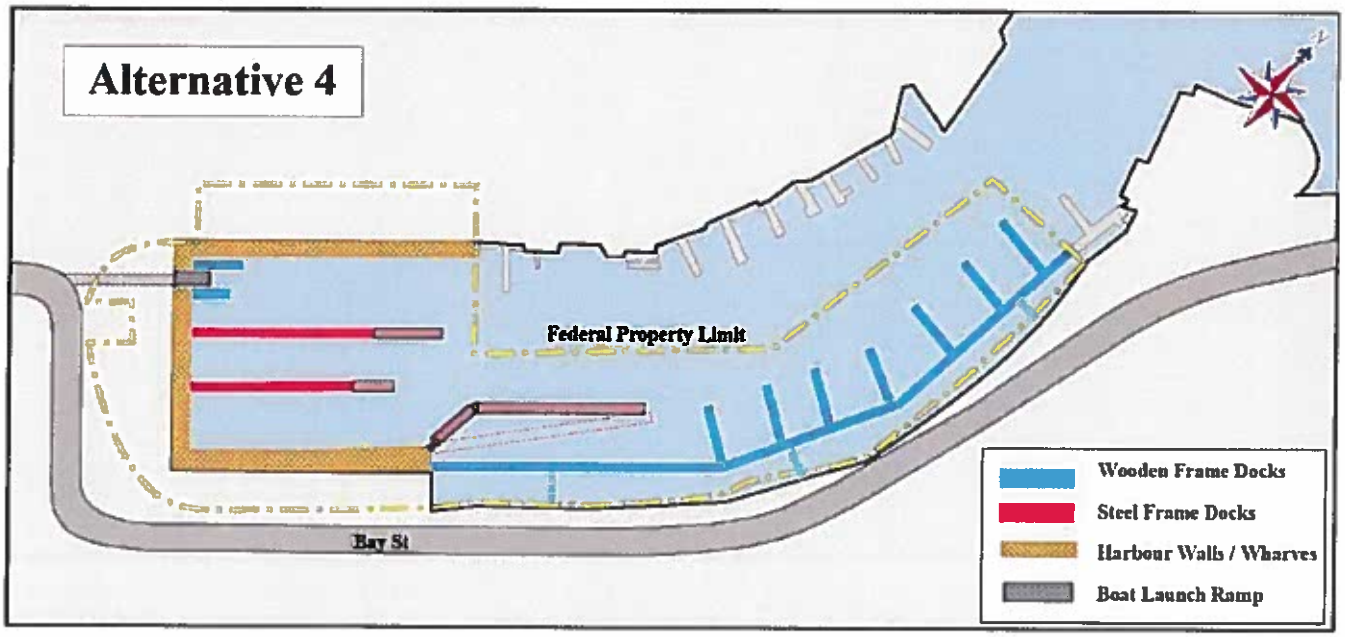


Figure 7.1: Alternative 4 - Recommended Layout of Floating Dock System in Little Tub Harbour

2. *Complete a structural loading review of the floating docks systems to determine an appropriate maximum pedestrian loading restriction in order to address high volumes of pedestrians who may be standing and waiting to board tour boats.*

   Upon completion of a structural loading review of the floating docks system, Planmac has determined that an appropriate maximum pedestrian loading restriction of nine (9) people per 20

ft by 8 ft steel-frame dock section be implemented, and that pedestrians should be discouraged from queuing on the dock.

3. *Provide input and recommendations on the stabilization of the floating dock system adjacent to large vessels, with the intent to determine and provide input on a maximum vessel size that may be docked beside the Municipality's standard dock size.*

   The existing concrete block anchoring method employed in Little Tub Harbour can safely support powerboats and sailboats with a maximum length of 50 ft (15.3 m) and sport fishing boats with a length of up to 40 ft (12.2 m). Vessels using the floating dock system can not exceed a weight of 68.8 kips (31.2 tonnes), including the weight of its hull, fuel, cargo, passengers, etc. and can not exceed a draft of 6 ft (1.83 m).

We trust that the information presented within this report is sufficient for the purpose of this Operational Assessment Report. If you have any questions concerning this report, please feel free to contact the undersigned.

Yours Truly,

PLANMAC ENGINEERING

Report Prepared By:

Percy Fulford, B.A.Sc., EIT

Report Reviewed By:

Robert Maksymec, P.Eng.

Report Reviewed By:

Terry Gregg, M.A.Sc., P.Eng.

APPENDIX A

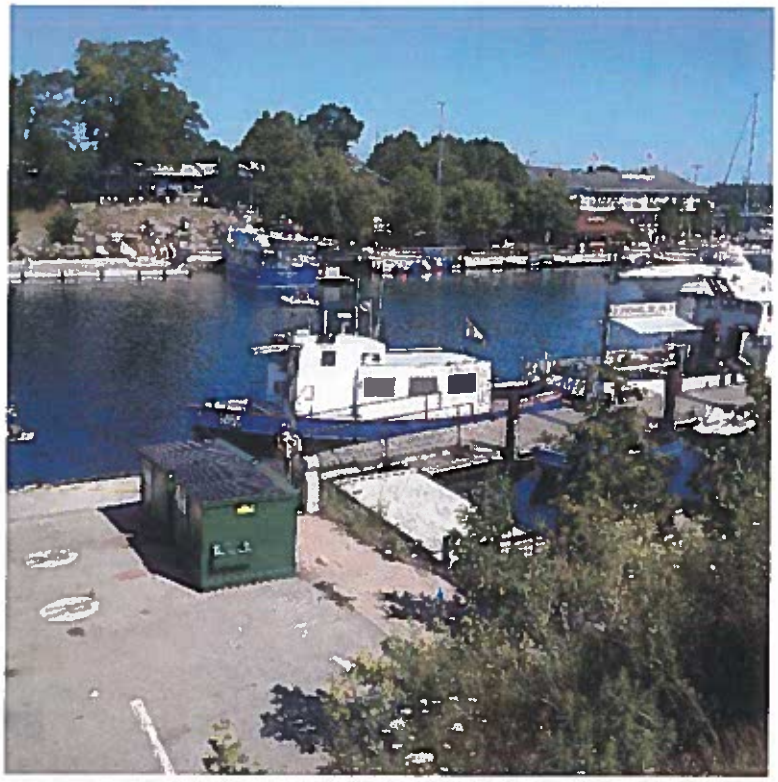


Figure 1: South Wharf and Alley Dock, Looking North

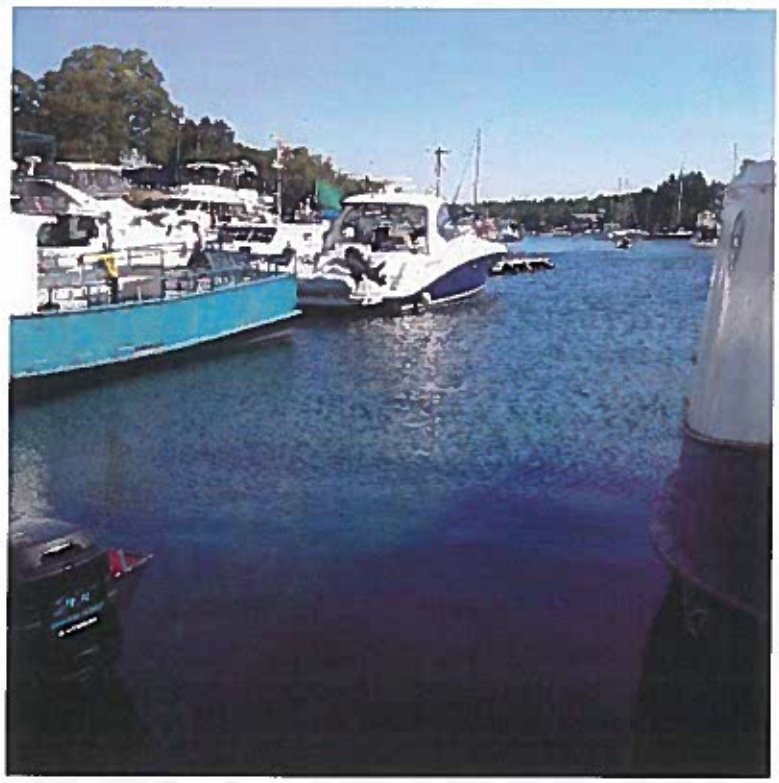


Figure 2: Little Tub Harbour, Looking East from West Wall

Figure 3: Fish Tug Moored to South Wharf

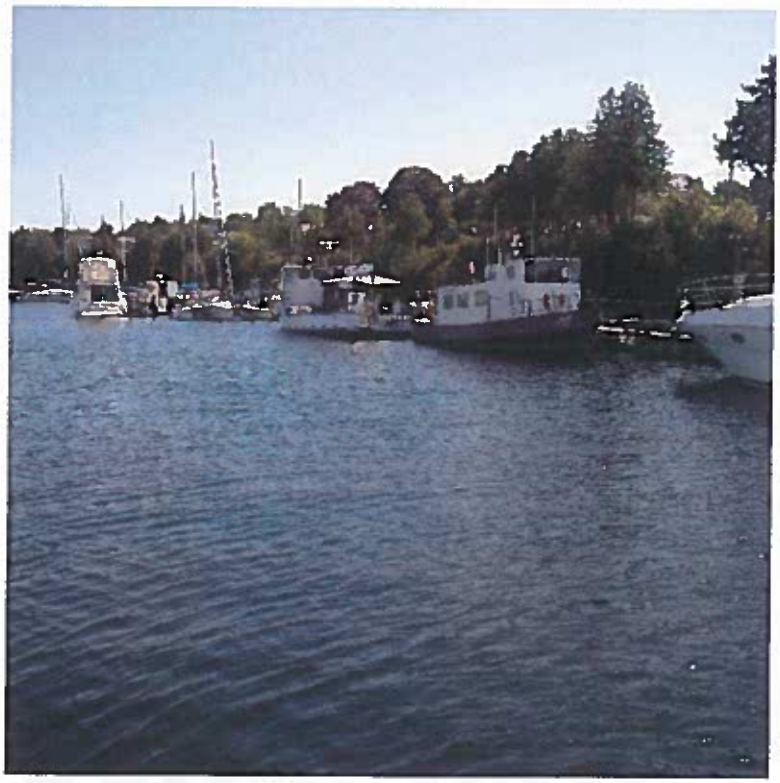


Figure 4: Boats Moored to South Wharf and Alley Dock, Looking Southeast from West Wall

Figure 5: Steel Dock 3-4 and South Wharf, Looking West

Figure 6: Pedestrian Access Ramp from West Wall to Steel Dock 3-4

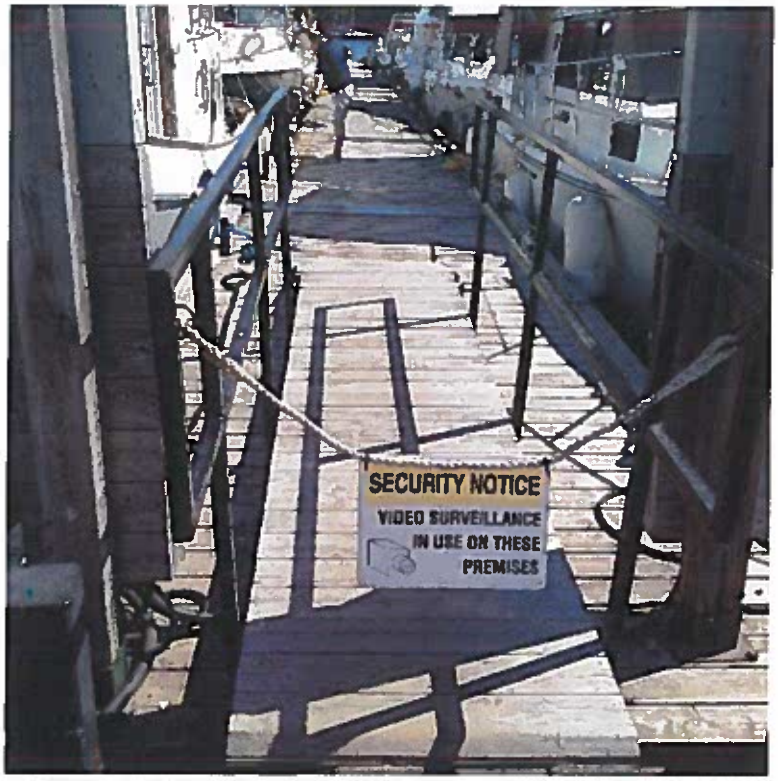


Figure 7: Pedestrian Access Ramp from West Wall to Steel Dock 1-2

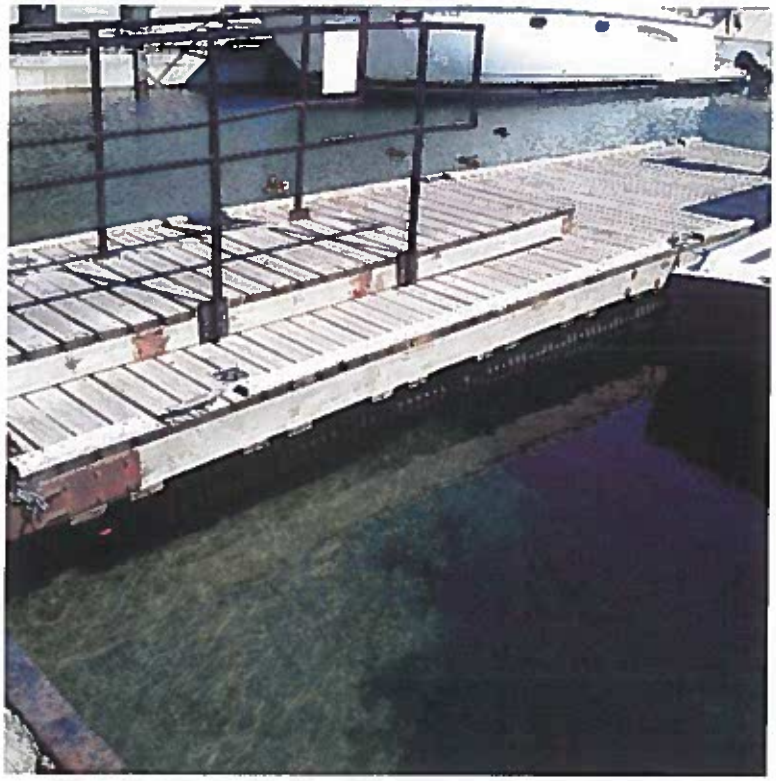


Figure 8: Small Dock to the South of Boat Launch, Looking Northeast from West Wall

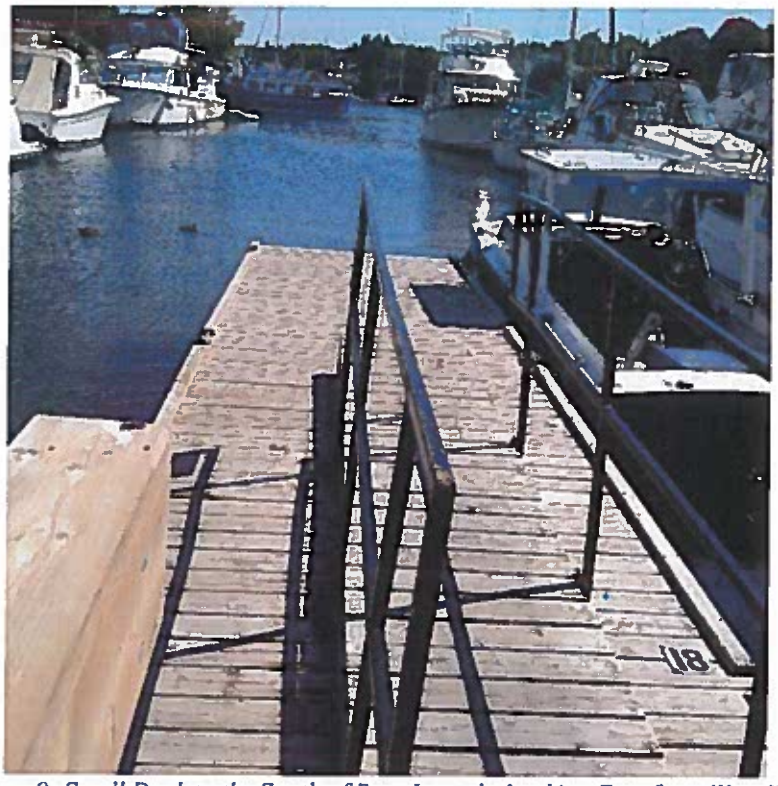


Figure 9: Small Dock to the South of Boat Launch, Looking East from West Wall

Figure 10: Small Dock to the North of Boat Launch, Looking Northeast from West Wall

Figure 11: Small Dock to the North of Boat Launch, and Boat Launch Ramp, looking Southwest from North Wharf

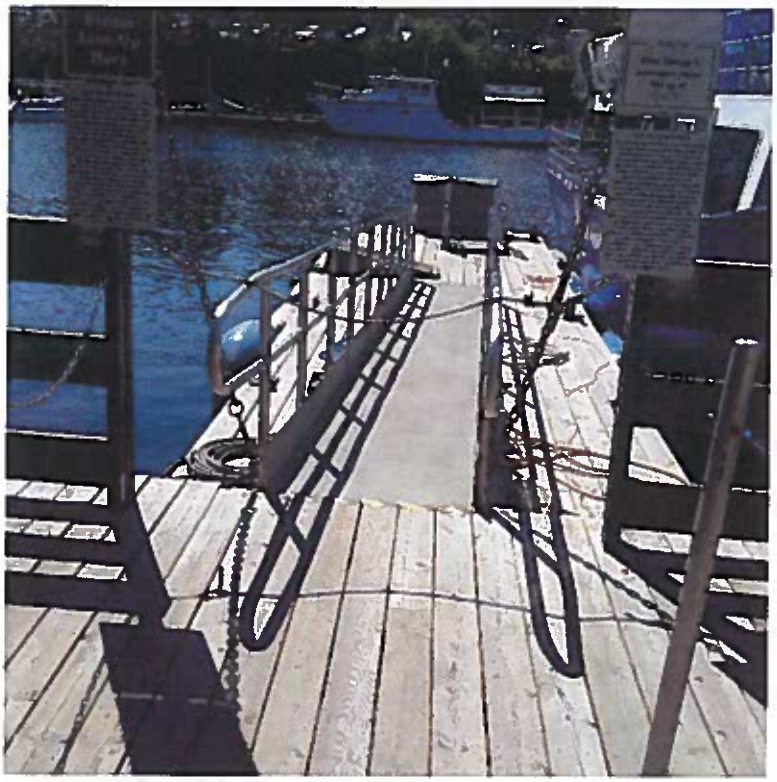


Figure 12: Queuing Location and Dock for Blue Heron Cruise Vessel, Beyond Federal Property Line, Looking South

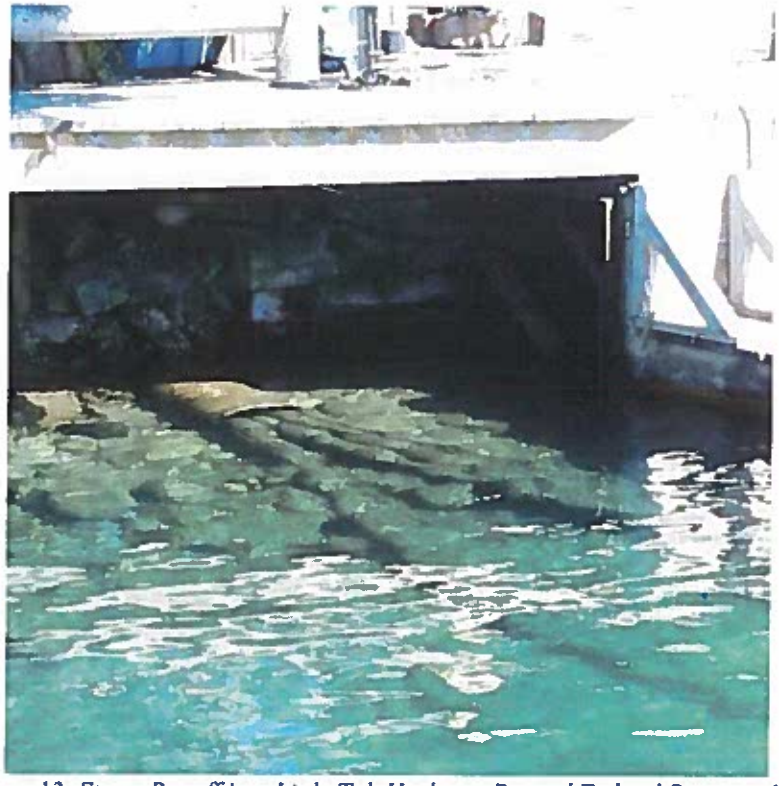


Figure 13: Storm Runoff into Little Tub Harbour, Beyond Federal Property Line

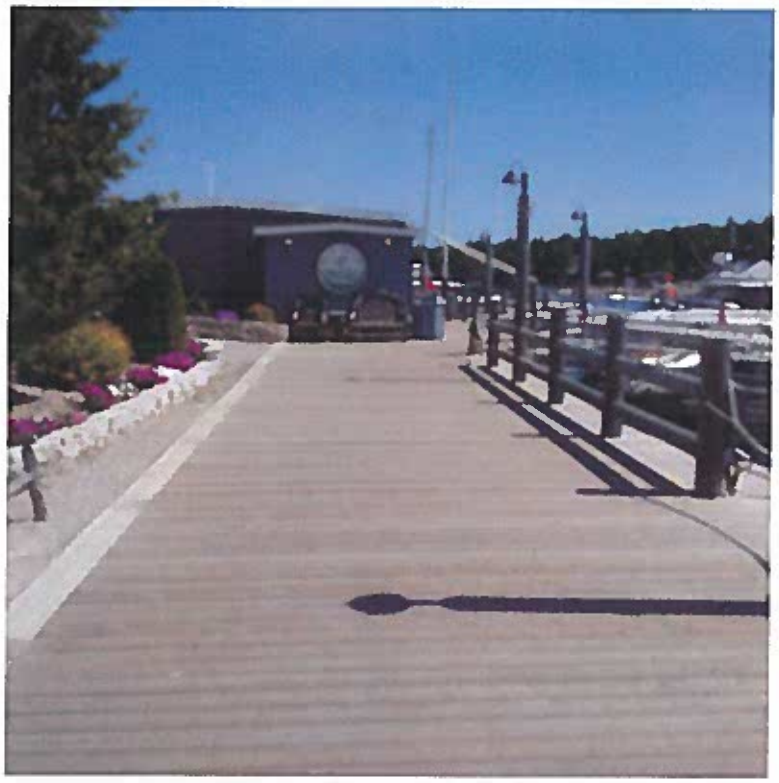


Figure 14: North Wharf, Looking East

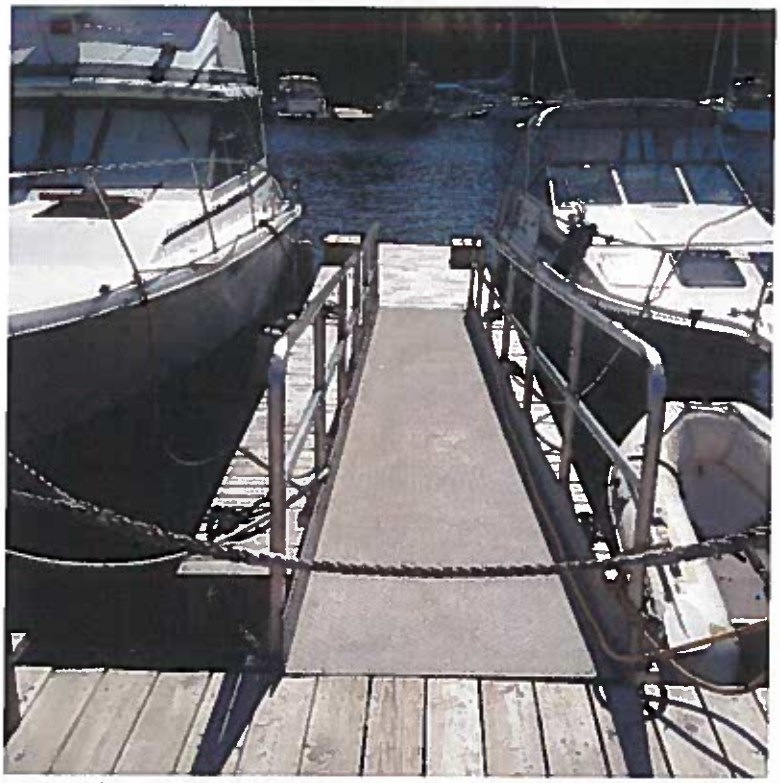


Figure 15: Private Docks (front of image) and Wooden Finger Docks (back of image), Looking South

Figure 16: Little Tub Harbour, Looking South from North Mouth of Harbour

Figure 17: Coast Guard and Bruce Anchor Cruise Boat Moored to Concrete Dock Near North Mouth of Harbour

Figure 18: Pedestrian Access Ramp from South Wharf to Alley Dock, Looking West from Alley Dock

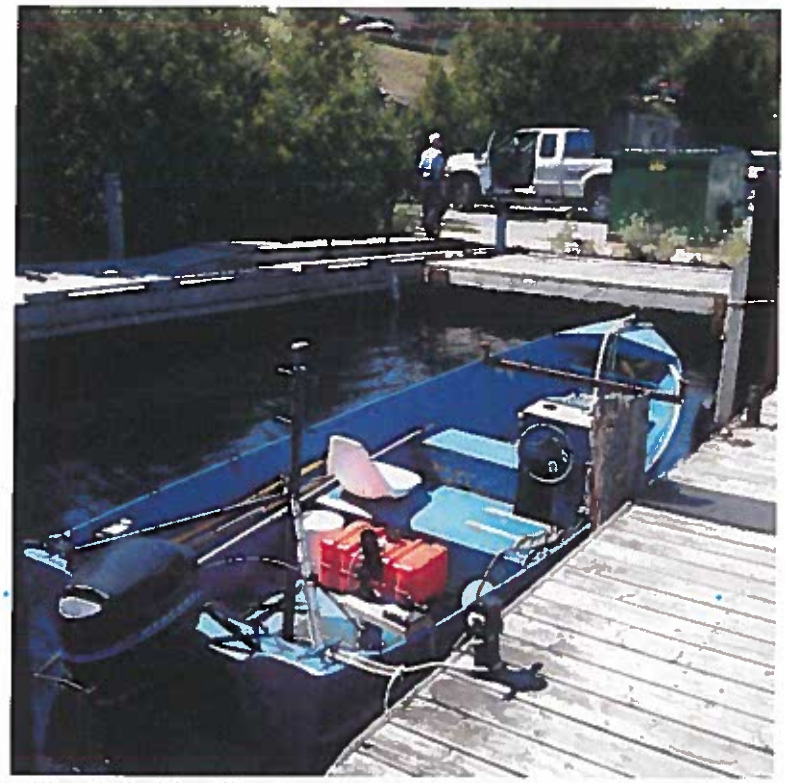


Figure 19: Narrow West End of the Alley, Showing Steel Alley Dock (front of image) and Pedestrian Access Connecting Wooden Jetty to South Wharf, Looking Southwest from Alley Dock

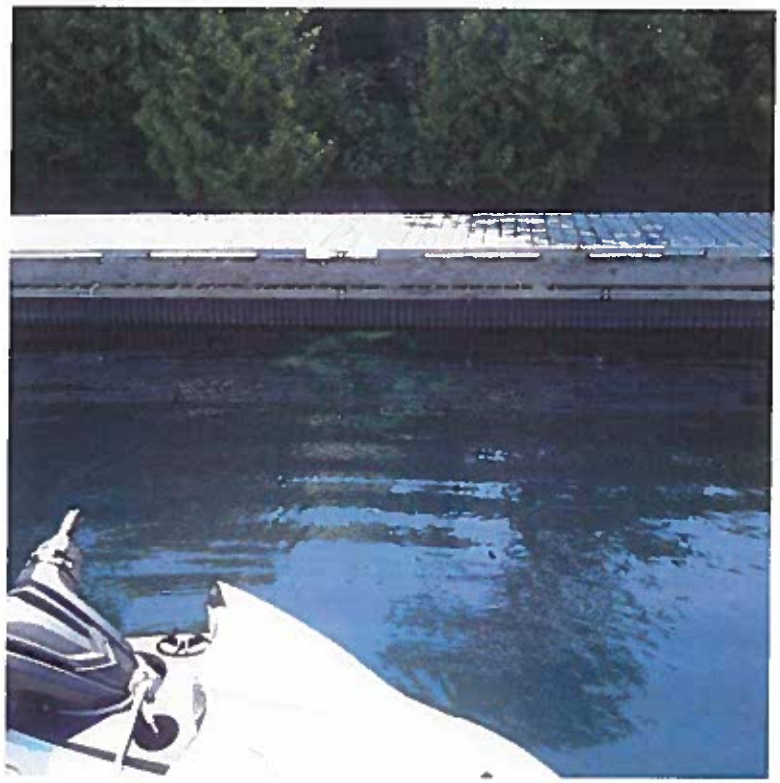


Figure 20: Wooden Jetty, Looking South Across the Alley from the Steel Alley Dock

Figure 21: Steel-Framed Alley Dock Supported by Wooden Piles to the North (left of image) and Steel H-Piles to the South (right of image), Looking East

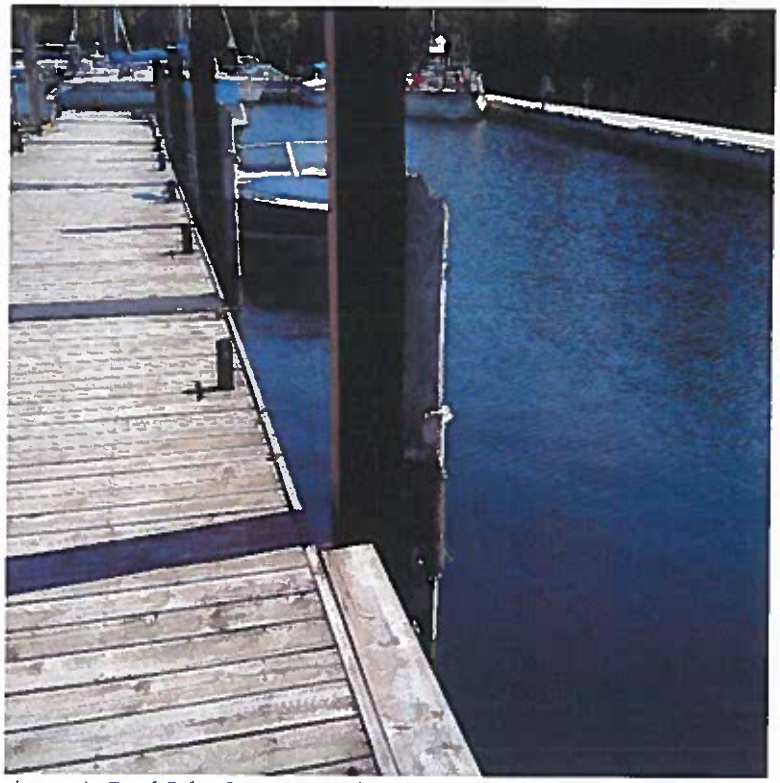


Figure 22: The Alley (centre), Steel Piles Supporting the Alley Dock (left), and Wooden Jetty (right), Looking East from Alley Dock

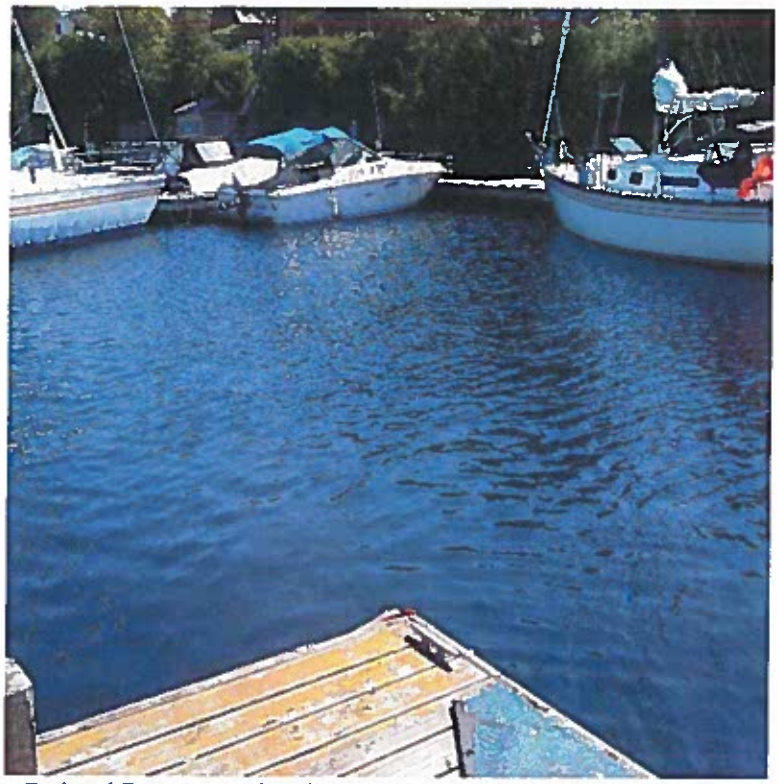
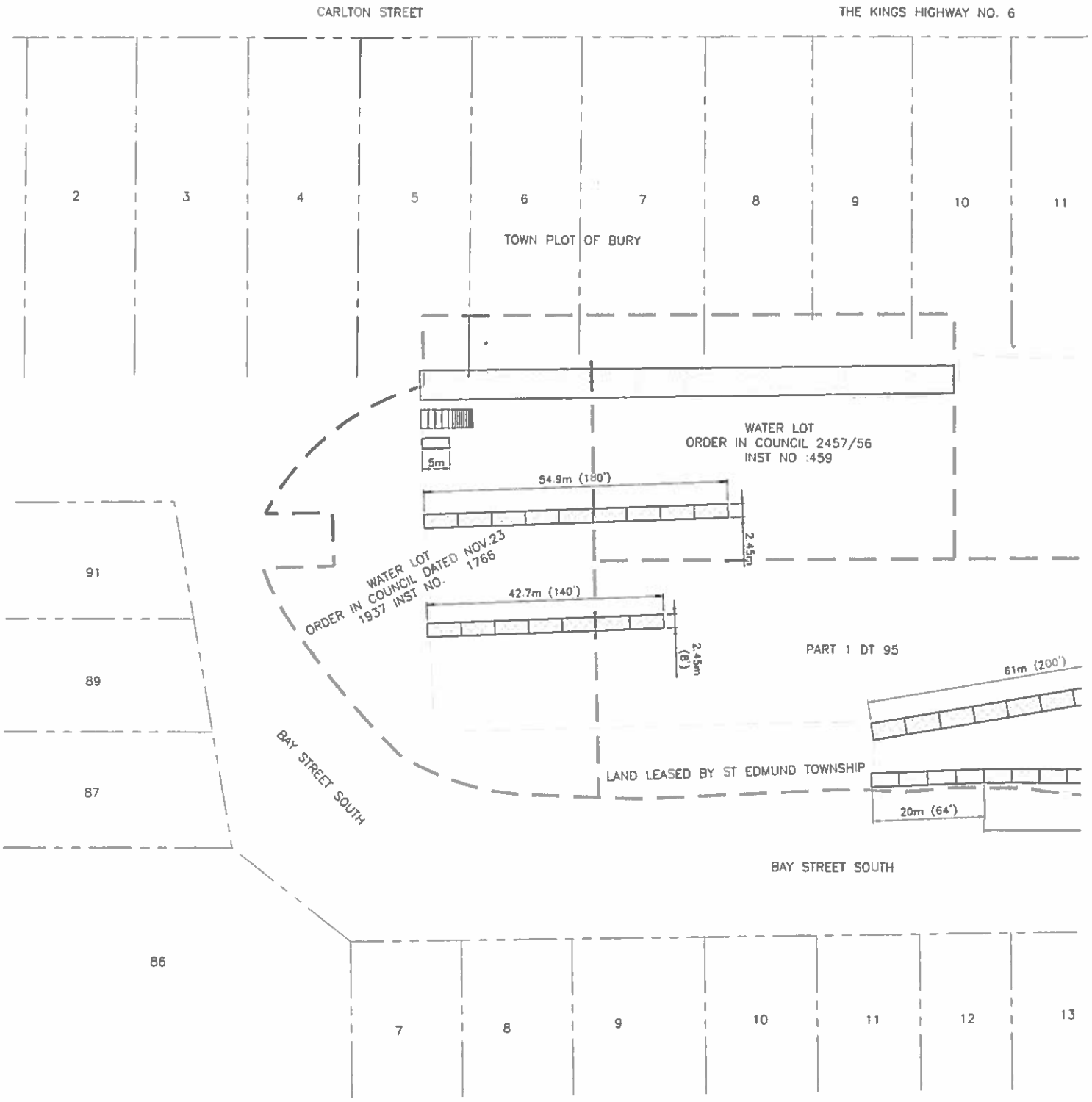


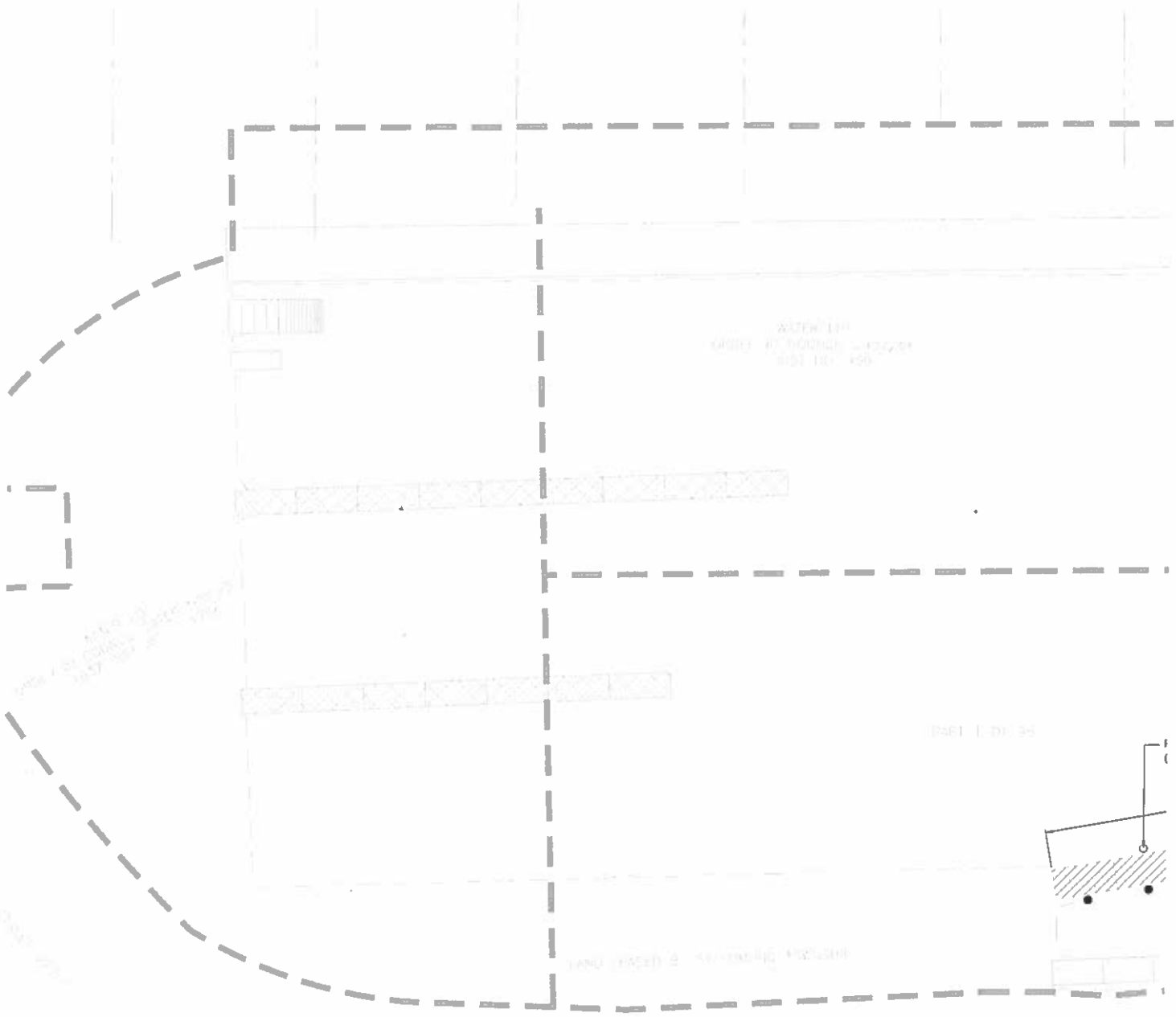
Figure 23: Wider East End and Entrance to the Alley, With Wooden Jetty and First Wooden Finger Dock, Looking Southeast from End of Alley Dock

APPENDIX B



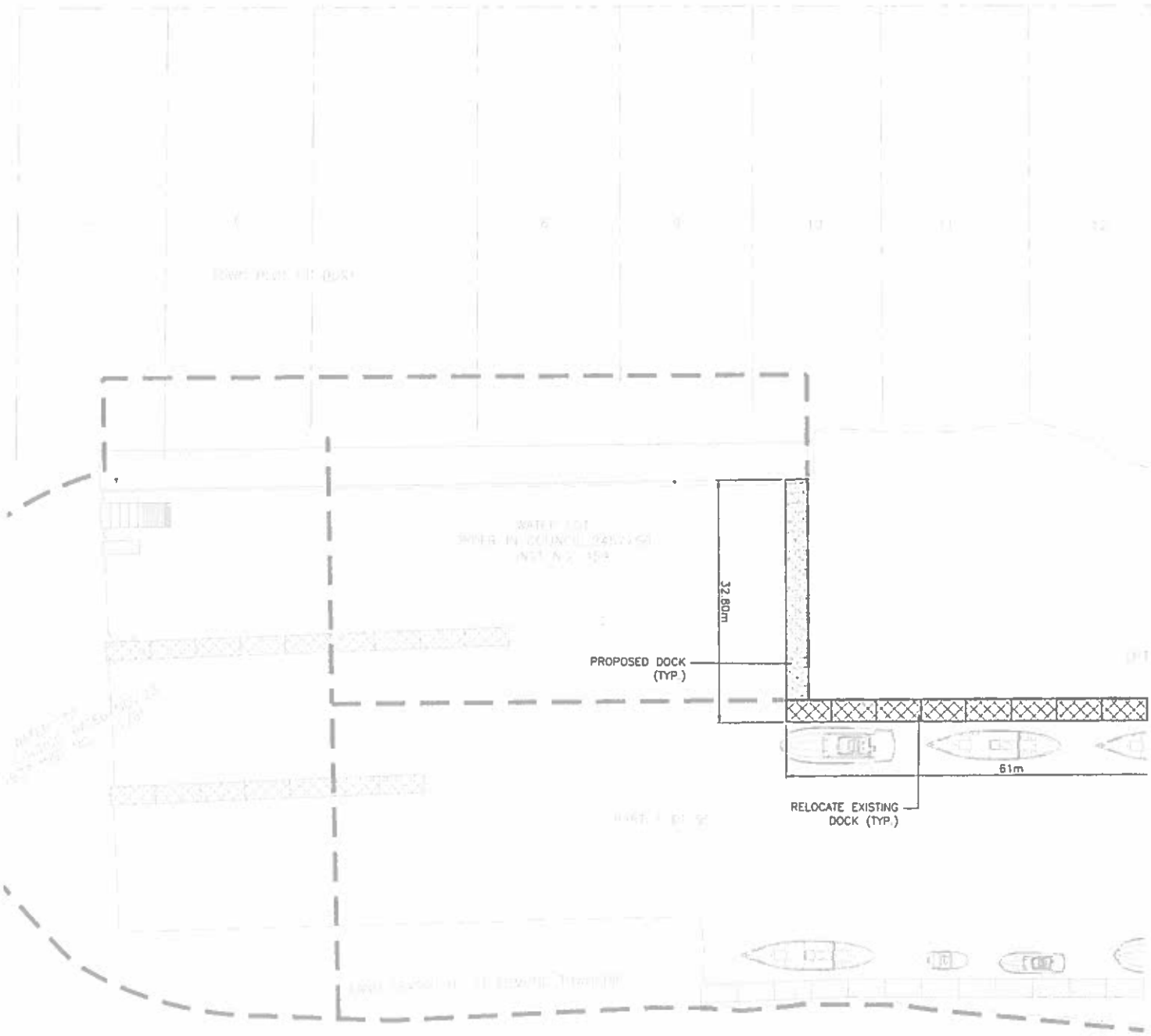
EXISTING S

SCALE 1



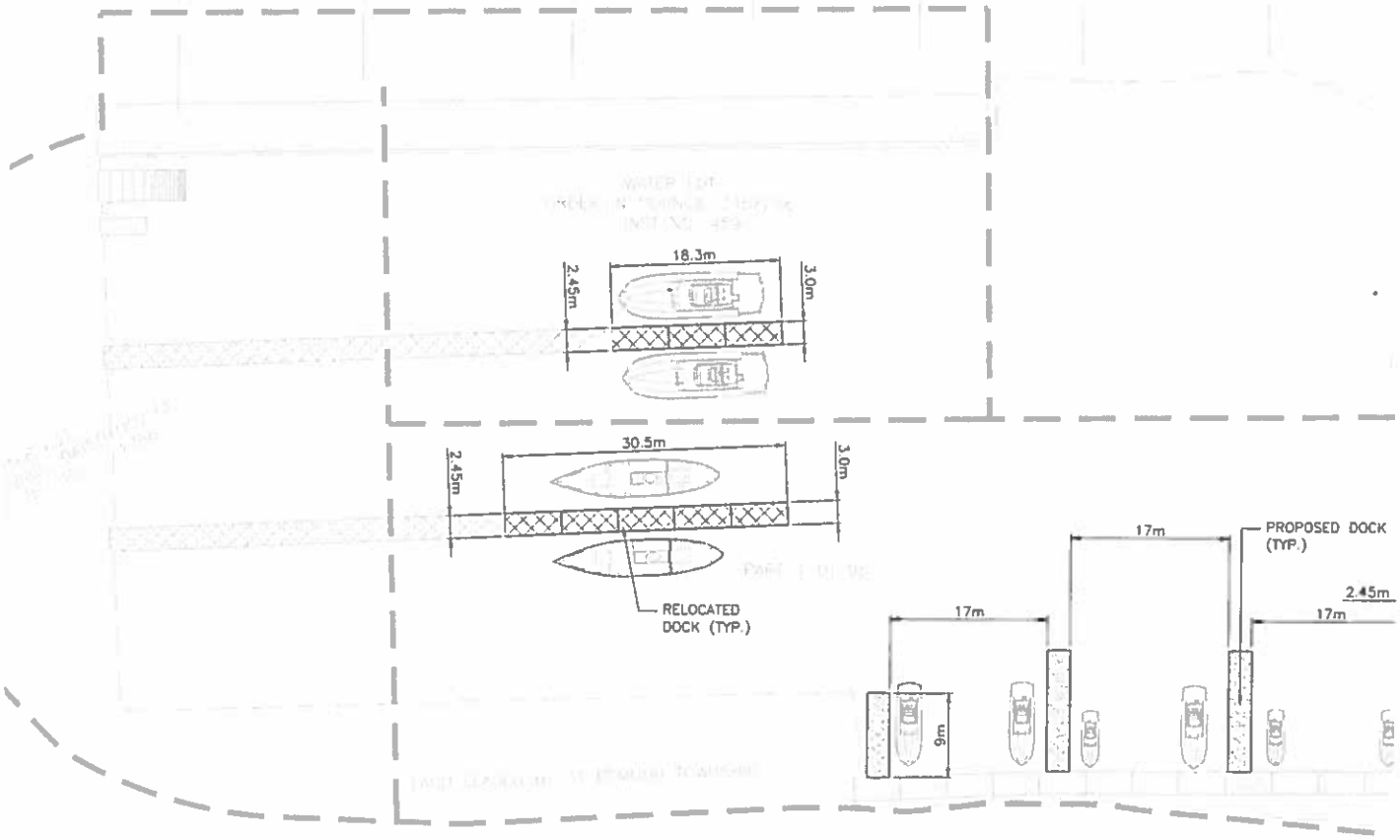
REMOVAL

SCALE



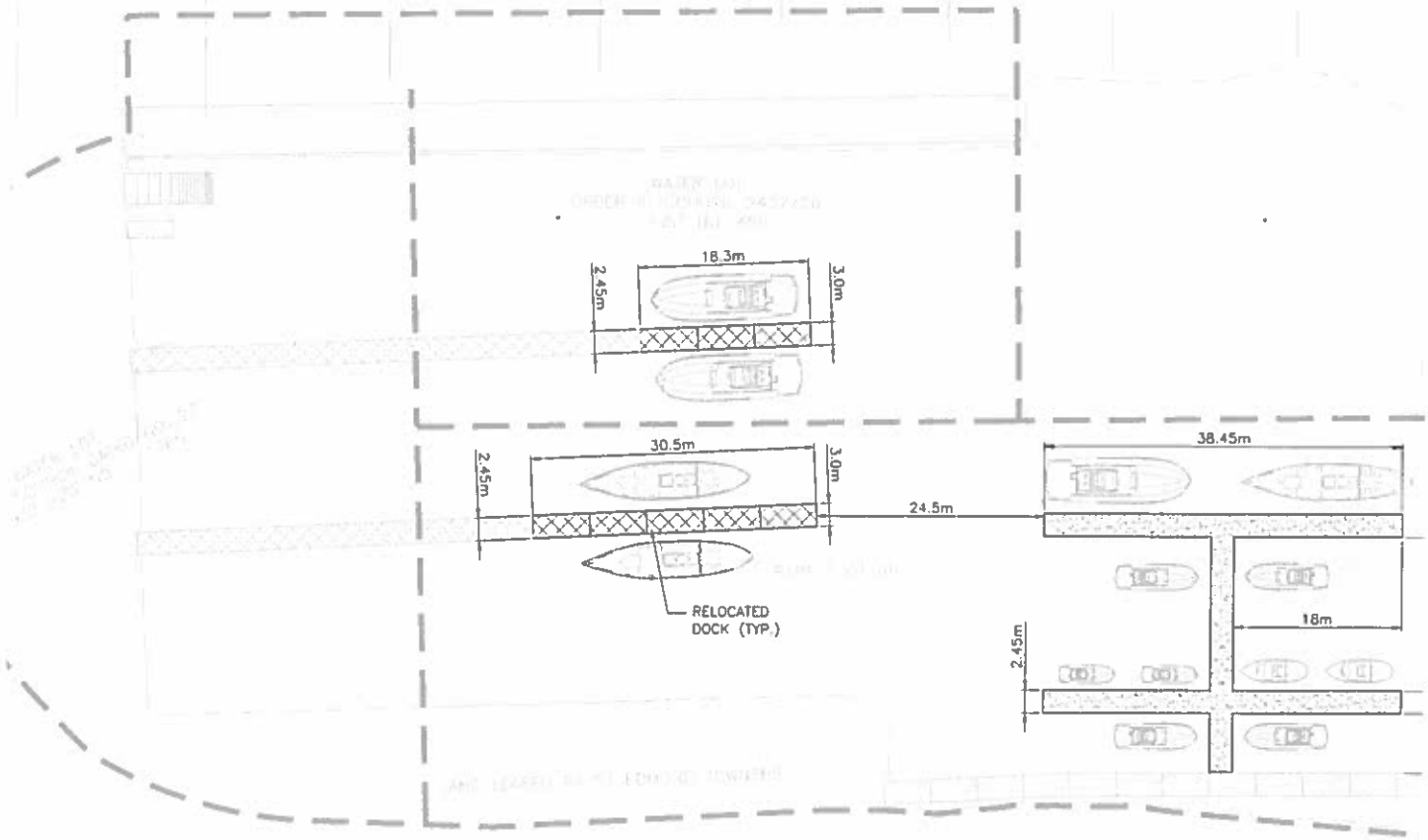
PROPOSED PLAN C

SCALE 1:500

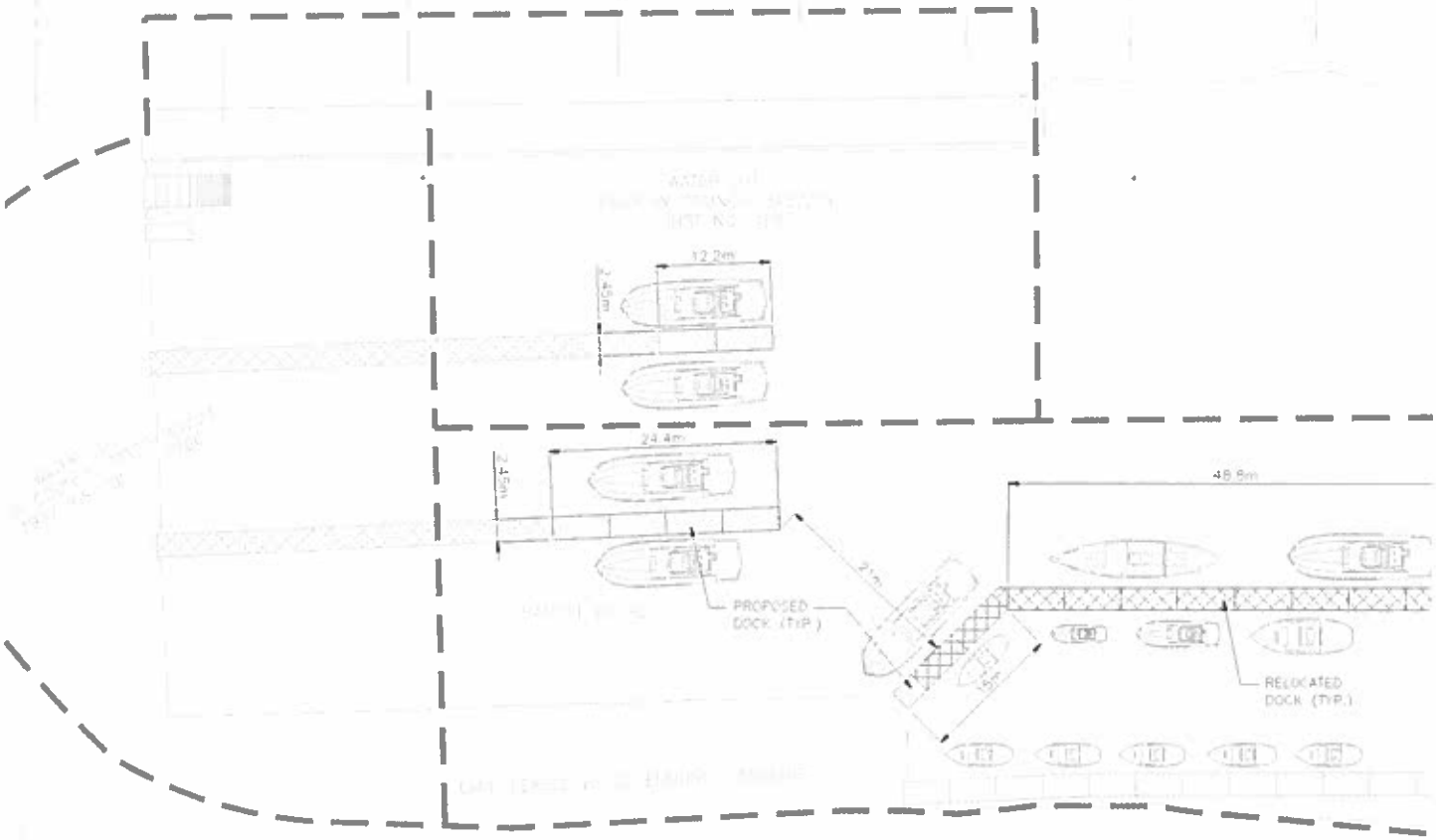


PROPOSED PLAN OPT

SCALE 1:500



PROPOSED PLAN
SCALE 1:50



PROPOSED F
SCA

APPENDIX C

1. INTRODUCTION

Riggs Engineering Ltd. was requested by Public Works and Government Services Canada to carry out a detailed inspection of the marine facilities at Little Tub Harbour, Tobermory in November 2007. The previous inspection was completed in 2003 and concentrated only on the North Wharf. In December 2007, Riggs Engineering Ltd. undertook a detailed above-water and below water inspection. The underwater components were inspected by remote camera and a sounding survey along the face of the harbour facilities was also undertaken. This report is a summary of the accumulative inspection results, along with evaluation, recommendations and cost estimates.

Tobermory is located at the northern tip of the Bruce Peninsula in the Municipality of Northern Bruce Peninsula at latitude 45°15'30"N, longitude 81°40'10"W.

Little Tub Harbour facilities were divided into the following sections:

- South Wharf;
- West Wall;
- North Wharf;
- Launching Ramp; and
- Floating Docks.

The stationing of the facilities commenced from the east end of the South Wharf and continued around to the end of the North Wharf.

A site plan of the harbour facilities identifying the various structures is shown in Fig. 1.

2. HARBOUR HISTORY AND BACKGROUND

Tobermory is located at the northern tip of the Bruce Peninsula in the Municipality of Northern Bruce Peninsula and is 300 kilometres northwest of Toronto at latitude 45°15'30"N, longitude 81°40'10"W. The Bruce Peninsula situates between the main basin of Lake Huron and Georgian Bay. Tobermory's Little Tub Harbour is owned by the federal government and is under the administration and control of the Department of Fisheries and Oceans, Small Craft Harbours Branch.

Little Tub Harbour facilities are divided into the following sections:

- South Wharf;
- West Wall;
- North Wharf;
- Launching Ramp; and
- Floating Docks.

2.1 SOUTH WHARF

The South Wharf was originally constructed in 1929. Steel sheet piles were driven in front of the original stone-filled timber cribs during the 1963 reconstruction. The steel sheet pile face was anchored to rock.

2.2 WEST WALL

The West Wall, originally constructed in 1936, was constructed from steel sheet piles secured with tie rods to concrete deadman.

2.3 NORTH WHARF

This section was originally constructed in1954 with stone-filled timber cribs supporting a timber deck. The timber deck and stringers were replaced in 1967 and were further repaired in 1986.

2.4 LAUNCHING RAMP

The launching ramp was first installed in 1974. In 1983 additional improvements were made as the existing concrete ramp was replaced with a new 150mm thick concrete ramp and sidewall.

2.5 FLOATING STEEL DOCKS

The floating steel docks were first installed in the early 1960s and since then there have been several repairs. Electrical services were added to the floating docks in 1985.

3. PROJECT TEAM AND METHODOLOGY

The project team included staff from Riggs Engineering Ltd. The above-water inspection team consisted of:

Phil Lampkin, P. Eng.	Senior Engineer	Riggs Engineering Ltd.
Julie Bui, EIT	Engineer In Training	Riggs Engineering Ltd.

The topography survey team consisted of:

Jill Coles, P. Eng.	Engineer	Riggs Engineering Ltd.
Jamie Thomas, EIT	Engineer In Training	Riggs Engineering Ltd

Riggs Engineering Ltd. completed the layout work with new stationing for the facilities. Station 0+000 starts from the inner corner of the South Wharf return wall and commences toward the end of the North Wharf. The above-water inspection was carried out on December 11 and December 12, 2007 and the underwater component was performed on December 12, 2007. The sounding survey was carried out on December 10 and December 11, 2007. The topographic survey was completed on January 11, 2008.

The above-water work involved visual examination of the observable components on top and along the face of the structures. Deficiencies were recorded on field inspection sheets and a photographic record was taken, which is also logged on the field inspection sheets. The condition below the timber deck was also recorded. The timber planks at five different locations were removed and replaced, making visual examination possible. Individual components were measured and elevations on structures were taken to compare with as-built plans. Visual examination was made of the structures and photographs were also taken along the face of the structures from a small craft on the waterside.

The underwater components were inspected by remote camera.

The sounding survey was performed along the face of the harbour facilities and utilized a weighted graduated tape to allow a more precise measurement and for ease of measuring.

The existing conditions and observations of the structures are summarized in this report along with a separate table for calculated useful residual life. The facility evaluation and recommendations are based upon the observations and useful residual life. Cost estimates are presented based upon the recommendations.

4. DESCRIPTION OF STRUCTURES

The following is a general description of the structures found in the harbour with typical cross-sections reflecting the present as-built condition. All figures related to the description of the structures are presented at the end of Section 4.

Description of the facilities are presented in the following subsections:

- South Wharf;
- West Wall;
- North Wharf;
- Launching Ramp; and
- Floating Docks.

4.1 SOUTH WHARF

The structure is approximately 89.6 metres long. Station 0+000 is located at the southeast corner of the return wall and the structure continues westerly to Sta. 0+089.6. Figures 2, 3 and 4 show typical cross sections of this structure.

A steel sheet pile wall was driven in front of 3 existing stone-filled timber cribs in the 1963 reconstruction. The top of the existing timber cribs was removed for the placement of the tie rods, which anchored the wall to sound rock. The tie rods are approximately 10 metres long. Frodingham No. 2, steel sheet pile sections were installed between Sta. 0+000 and approximately Sta. 0+043.8, while Frodingham No. 1A sections continue from Sta. 0+043.8 to Sta. 0+089.6 and the intersection with the West Wall. There is an asphalt pavement surface overlaying the original pit-run gravel top that was added after the original steel sheet pile construction. There is a boat slip approximately 14 metres from the return wall, which was part of the 1963 reconstruction, but it was subsequently filled in.

There is no wheel guard; however, vertical timber fenders, bollards and safety ladders are installed along this structure.

4.2 WEST WALL

The West Wall is approximately 59 metres long and commences at Sta. 0+0+89.6 and continues to Sta. 0+148.8. A typical cross section is shown in Fig. 5.

The West Wall is constructed of Algoma B5 steel sheet piles that are secured with tie rods to concrete deadman. The tie rods are approximately 10 metres long, 38mm in diameter and spaced at every 12th pile. A berm of one-man stone was placed at the back of the steel sheet pile wall for an approximate length of 60 metres. In addition, a similar one-man stone berm was placed in front of each concrete deadman. Dredged material was placed behind the wall as fill. The present deck surface consists of interlocking unit pavers, behind which is asphalt pavement.

There are no fenders, wheel guards or safety ladders along this structure. Instead of a bollard, there is a 'U' shaped mooring staple bolted to the steel cap at approximately 6 metre intervals. Several float strings are secured to the wall during the boating season.

4.3 North Wharf

The North Wharf is approximately 91.2 metres long and continues from Sta. 0+148 to Sta. 0+240. Figure 6 presents a typical cross section of this structure.

The North Wharf consists of a 4.2 metre wide timber deck that is supported by timber stringers. Spanning the cross timbers are 6 stone-filled timber cribs, set on the varying harbour bottom. The height of each timber crib increases toward the easterly direction.

There are no fenders or safety ladders along this structure. The bollards are bolted to the timber curb, which runs along the edge of the timber deck.

4.4 Launching Ramp

The launching ramp is approximately 4.5 metres wide, starts at Sta. 0+140.8 and continues to Sta. 0+145.3. A cross section is shown in Fig. 7.

The upper slope of the launching ramp is a reinforced concrete slab on grade. The lower section of the ramp, which is partially submerged, is constructed of 24 precast concrete slabs (610mm wide by 4877mm long) seated on timber sleepers from elevation +1.18m to the toe at elevation –1.99m±.

4.5 Floating Steel Docks

There are 3 steel floating docks, 2 of which are attached to the West Wall and 1 of which is attached to the South Wharf. Refer to Fig. 1: Little Tub Harbour for the layout of the floating docks. A typical cross section of the steel floats is shown in Fig. 8.

observed. It was noted that the stones filled almost half of the corrugated outfall pipe located under the ramp and may possibly cause drainage problems.

Several depressions/pot holes were observed within the asphalt pavement behind the concrete apron joint.

5.5 Floating Steel Docks

Refer to Appendix B, Photo Nos. 91 to 96

The floats are still buoyant, but the surface corrosion at the waterline may be causing some leakage in the steel pipe, which in turn could cause loss of buoyancy.

Some damage to the timber headers and fascia boards was observed. As well, there is also some evidence of decay in the timber. There was snow coverage on the floats' timber decking at the time of the inspection and as a result, full inspection was not possible.

The access ramp to the floats attached to the South Wharf appears to be in good condition. At the outer end of these floats, excessive tilting/slag or buoyancy issues were observed and this may be due to the excess weight of the extended deck width.

Table 9.7: Launching Ramp Repairs Cost Estimate

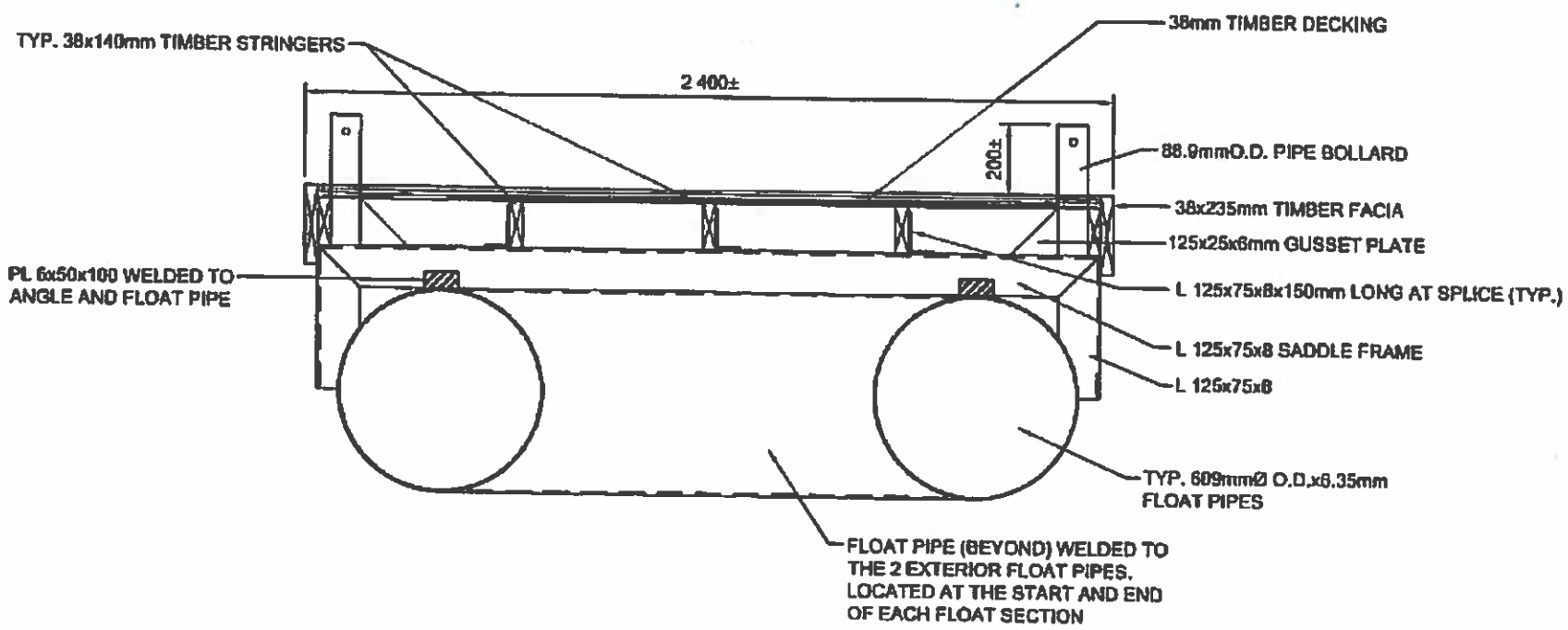
Item	Description(s)	Cost Estimate
1	Undermining Repairs	$ 5,000
2	Asphalt Repairs	$ 2,000
	Subtotal	$ 7,000
	Engineering Fees/contingency	$ 3,000
	Total	$ 10,000

9.5 FLOATING STEEL DOCKS

The floating steel docks are generally in good condition. Buoyancy is being lost in some of the floats. Removal for inspection should be anticipated in the next 5 to 10 years and replacement anticipated at the next inspection interval. At the present time there are areas of maintenance required on the various timber components such as fascia and deck planks. An allowance for repairs is shown in Table 9.8.

Table 9.8: Steel Floats Cost Estimate

Item	Description(s)	Cost Estimate
1	Maintenance Allowance	$ 30,000
2	Float Replacement	$ 100,000
	Subtotal	$ 130,000
	Engineering Fees/contingency	$ 26,000
	Total	$ 156,000



NOTE:
ALL DIMENSIONS ARE IN mm
UNLESS NOTED OTHERWISE.

FIGURE 8
TYP. STEEL FLOATS

RIGGS ENGINEERING

CLIENT
PWGSC

0 0.25 0.5 0.75m 1:20

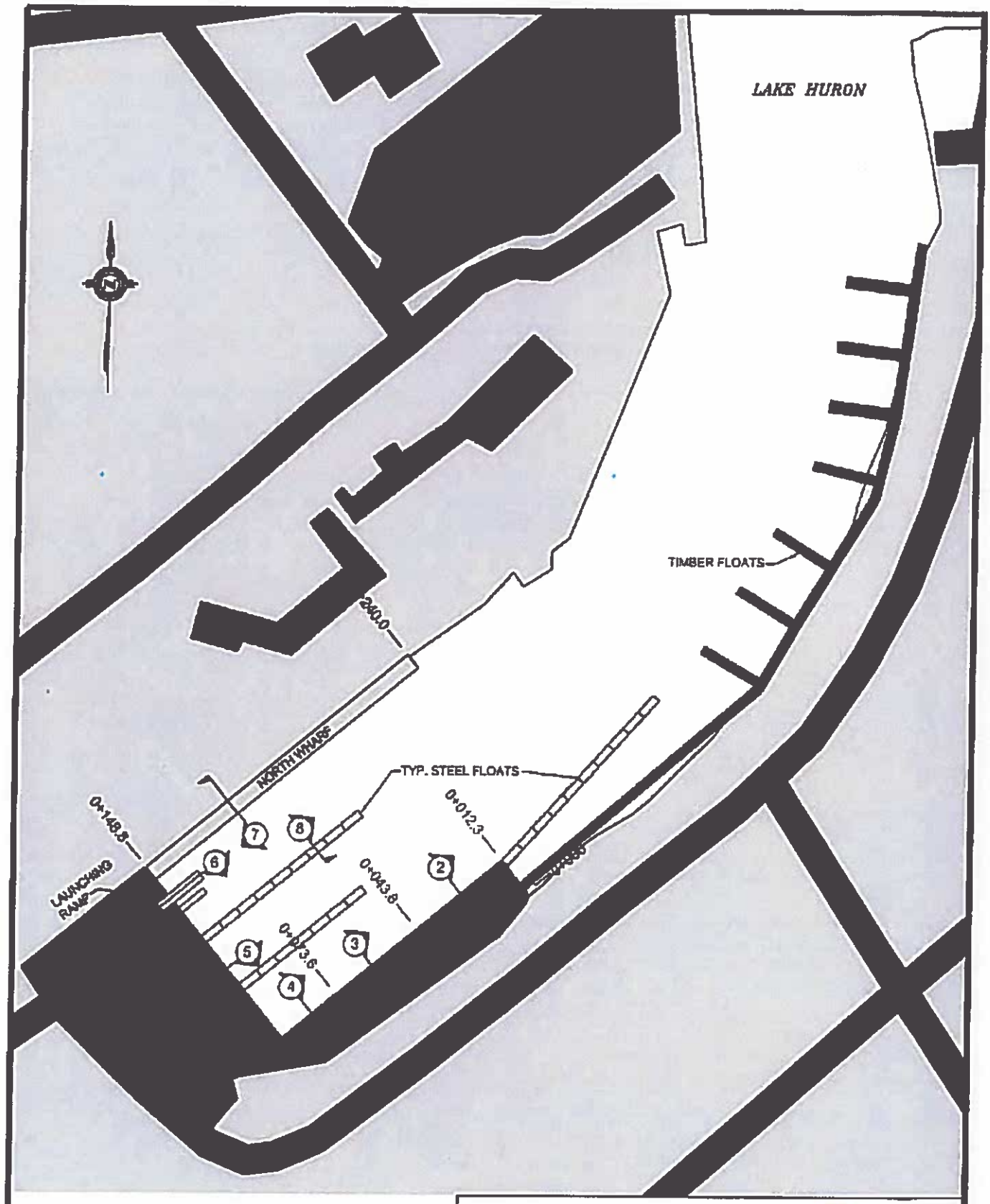


FIGURE 1
LITTLE TUB HARBOUR, TOBERMORY

RIGGS ENGINEERING

CLIENT PWGSC

0 7.5 22.5 45m 1:1500