APPENDIX: MARINA STRATEGIC PLAN

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1 Coastal Engineering Assessment of Marina Alternatives

1.0 INTRODUCTION

The City of Barrie, located on the shores of Kempenfelt Bay on Lake Simcoe, includes over 10 km of waterfront, extending around the Bay. The City has established many parks and amenities along the waterfront, for recreational, active and passive activities. In March 1997, City council directed staff to undertake a review of the City's Waterfront planning policies with direction to initiate a Waterfront Master Plan. This resulted in the development of Waterfront Master Plan 2000.

In November 2011, The Planning Partnership, with Baird & Associates as sub-consultant was retained by the City of Barrie to update the 2000 Waterfront Master Plan, including the development of a Marina Strategic Plan and a Waterfront Strategic Plan. Baird & Associates is providing coastal engineering expertise to the project.

The Marina Strategic Plan includes: development and clarification of the City's Marina mandate to become an economic and tourism destination; review of the marina business model; development of a long term strategic plan; development of conceptual designs for the possible marina expansion including the Spirit Catcher open space; consideration of operational and safety issues; recommendations regarding the Sea Cadets facility; and assessment of the impacts of the City's marina for future development, considering marina proposals within the study limits.

This report was prepared as input to the Marina Strategic Plan. It provides a concept level assessment of marina expansion alternatives. The alternatives were developed prior to completion of an assessment of user demand. The economic evaluation and development of land based amenities such as club house facilities, parking and winter storage are not included in the scope of this report, and were undertaken by others on the project team.

This report was prepared in support of the development of concept level alternatives. Simplifying assumptions have been made in developing the coastal environmental conditions (waves and water levels) and no field work was undertaken for the study. This information is not suitable for design purposes and additional analysis would be required for the development of preliminary and final designs.

2.0 SITE DESCRIPTION

The Barrie Marina is a small craft marina located at the head of Kempenfelt Bay as shown in Figure 2.1. The public marina is owned and operated by the City of Barrie. It accommodates approximately 326 permanent users and 50 transient boats, which include a combination of motor boats and sail boats. The marina is currently full, with a waiting list of approximately 200, based on discussions with City personnel.

The marina is sheltered from wave action by two breakwaters, constructed of fill, and protected with armourstone. The inner breakwater was recently repaired after storm damage. A steel sheet pile dock wall with timber decking provides access to floating finger piers that extend from the dock. Additional slips are provided along the inshore side of the outer breakwater. There is a launch ramp at the south end of the marina, along with a mast stepper. The marina facilities also include fuel, a pump-out and rest rooms.

Based on discussions with personnel from the marina, limited maintenance dredging is required at an approximate 10 year interval. Dredging is undertaken at the outlets to three tributaries that flow into the marina. City personnel reported that no dredging has been required at the marina entrance.



Figure 1: Location Map showing Barrie Marina

3.0 ENVIRONMENTAL AND SITE CONDITIONS

The following provides a brief overview of the site and environmental conditions that are most relevant to the breakwater design. This is intended to be an overview for a concept level assessment and a more detailed analysis would be required for preliminary and final design.

3.1 Depths

CHS Chart No. 2028, shown in Figure 3.1, indicates depths along the toe of the inner marina breakwater are in the range of 6 m (depths on chart are in feet). Depths along the alignment of the outer breakwater are

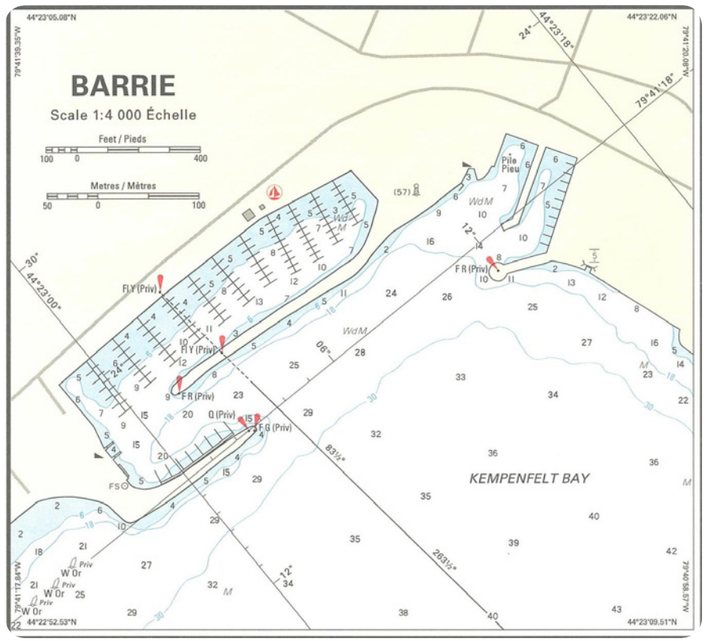


Figure 2: CHS Chart No. 2028 Showing Bathymetry at Barrie Marina (depths in feet)

approximately 8 m to 10 m. The nearshore lakebed is relatively steep and this is a consideration in terms of cost implications for a traditional rubble mound breakwater.

3.2 Water Levels

Water level data is available for three locations on Lake Simcoe: Atherley Narrows, Jackson Point and Gamebridge. Water level data dating back to the 1960s are shown in Figure 3.2. All depths are relative to Chart Datum, which is 218.7 m above the Geodetic Survey of Canada (GSC) Datum.

Data for Atherley Narrows and Jackson Point are available from 1998 to 2006 and data from the Gamebridge gauge are available for 1960 to 1995; therefore a data gap exists between 1995 and 1998. The highest peaks in the water level record are in 1967 and 1991 (nearly 0.65 m above chart datum) with lows in 1961 and 1965 (0.20 m below chart datum).

Water levels also vary seasonally, with higher water levels occurring in May to June and low water levels occurring in December and January. Historically, the range in seasonal fluctuations of water level on Lake Simcoe was nearly 0.70 m (during the 1960s), however it has more recently been in the range of 0.4 m, likely due to regulation.

3.3 Waves

3.3.1 Nearshore Wave Climate

A preliminary assessment of the wave climate at the project site was undertaken for this project. It was recommended that a more detailed assessment be completed, to determine if offshore breakwaters can provide sufficient protection to boats in the marina. The results of the that study are summarized in a separate report (Baird, 2012).

The Danish Hydraulic Institute (DHI) MIKE21 SW model was used to assess the wave climate at the study site. MIKE21 SW is a spectral wind-wave model that simulates the growth, decay and transformation of wind-generated waves. It is important to note, that model calibration and verification were not completed for this concept level assessment.

The model was run for a total of 396 scenarios, including wind speeds ranging from 0 m/s to 26 m/s at 2 m/s increments and for a 36 point compass with 10□ increments. A constant lake level, equivalent to the mean lake level of 218.9 m above GSC was used for all simulations.

The wave climate was derived by combining the probability of occurrence of the corresponding wind speed and direction based on wind data measured at Lagoon City, with the waves hindcast for each wind speed and direction with the MIKE21 SW model. The resulting scatter plot showing significant wave height, which is the average of the highest one-third of the wave heights (Hs) and peak period (Tp) for all directions is provided in Figure 3.3. Wave heights were less than 0.2 m, 94% of the time. The maximum predicted Hs was 0.5 m and the maximum Tp was just over 3 s.

An extreme value analysis was undertaken to define extreme waves for varying return periods. There was insufficient data to predict extreme events beyond the 10-year return period significant wave height, which was in the range of Hs = 0.45 m. Based on the methodologies used, this value is approximate and is not suitable for any design work.

3.3.2 Wave Criteria for Marinas

There are no universal criteria defining acceptable performance of a marina with respect to wave agitation (Fisheries and Oceans, 1992). Threshold wave height and frequency of occurrence criteria are a balance between performance and cost. Typically, improved performance (such as very infrequent wave action in the basin) means higher costs for protection structures. Factors to consider when evaluating performance requirements include:

- Type and size of boats;
- Type of docks;
- Requirements and expectations of marina users; and
- Degree of risk of unacceptable performance that the owner accepts.

Isaacson, Kennedy and Baldwin (1996) report that a design wave height of 0.3 m is often cited as the maximum allowable Hs inside a marina, under normal operation conditions. This implies a consideration of frequency of exceedance. Further, they note that since small craft are particularly sensitive to beam waves, additional wave agitation criteria also include the influence of wave direction and wave period. Typical recommended criteria from ASCE (2000, 1994) include a yearly maximum Hs of less than 0.3 m and a 50 year return period wave event Hs of less than 0.6 m.

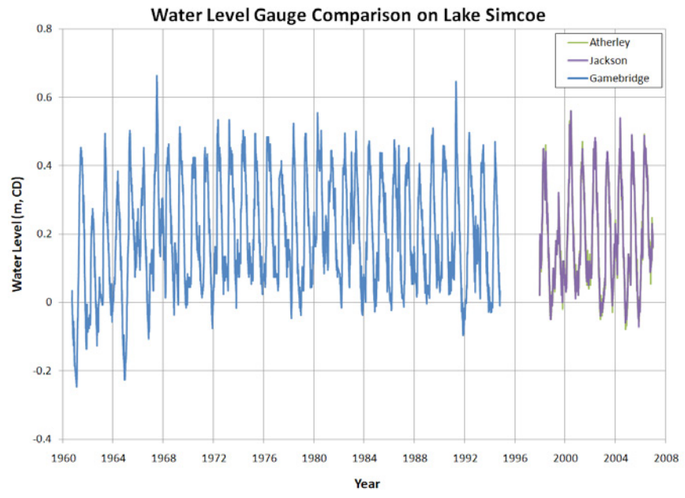


Figure 3: Water Level Data from Gauges at Atherley, Jackson, and Gamebridge

Wave Height (m)	Wave Period (s) 0.00-0.50	0.50-1.00	1.00-1.50	1.50-2.00	2.00-2.50	2.50-3.00	3.00-3.50	3.50-4.00	4.00-4.50	4.50-5.00	5.00+	Total	C(%)	Maximum Period (s)
0.00-0.10		32.80	30.48	0.57								63.85	96.50	1.50
0.10-0.20			13.61	15.02	1.38							30.01	32.64	2.10
0.20-0.30				0.74	1.66							2.40	2.64	2.47
0.30-0.40				0.00	0.10	0.11						0.22	0.24	2.86
0.40-0.50						0.02	0.00					0.02	0.02	3.12
0.50+													0.00	
Totals		32.80	44.08	16.34	3.14	0.13	0.00					96.50		
C(%)	96.50	96.50	63.69	19.61	3.27	0.13	0.00	0.00	0.00	0.00	0.00			

Table 1: Wave Scatter Plot for Offshore of Barrie Marina based on Wind Data from 1994 to 2011

3.4 Ice

Ice is an important consideration in the design of marinas. The breakwaters and docks, and their mooring systems will be exposed to ice forces. These include static forces associated with ice (thermal expansion/contraction), and dynamic forces due to ice floes driven by wind and currents and ice forces from a mass of broken pack ice driven against the structure.

Generally ice in marina basins may be characterized into three categories: fast intact ice where the whole basin is frozen solid; partially covered basins where the dockage is frozen in place; and partially covered basins where the dockage is not frozen into place. In addition, breakwaters at this location may be exposed to moving ice, for example during spring break-up.

In calm or very sheltered basins when the entire harbour basin is covered with ice, and the ice is "fast" against all structures, there is a significantly reduced risk of damage to the dockage structures. In these situations where all the boundaries of the ice sheet are restrained, the ice sheet and dockage will remain frozen or "locked" in place, and will not move sufficiently to cause damage. The ice loads are "static" and result from the thermal expansion and contraction of the ice with changing temperatures. Thermally induced ice loads can be very high, however, general experience has shown that individual foam-filled plastic dock floats can adequately resist thermal pressure "squeeze" (Wortley, 1984) in very sheltered basins with fast intact ice because the load applied to one side is resisted by the equivalent load from the other side.

When a basin is partially covered with ice, and the dockage is partly frozen within the sound ice sheet and partially in weak ice or open water, the greatest opportunity for damage to the docks occurs. In this non-uniform condition, in addition to the squeeze, thermal expansion can exert lateral push on the dockage and the thermal stresses will force the docks toward this weaker, weathered ice or open water zone. Portions of the dockage system can move relative to other fixed portions, creating very high flexural, shear and torsion loads on the docks and their connecting joints.

When a basin is only partially covered with ice, but the dockage is locked fast within that ice, there is a risk of damage occurring to the floating dockage systems, but the risk is not as significant as the case where the dockage is not locked within the primary ice sheet. In this case, the ice sheet is driven either by wind, currents, or thermal expansion forcing the ice sheet towards the open water. This movement forces the docks to tighten against their restraining chains or cables and then causes buckling, heaving, dragged anchors, broken chains or cables.

A floating structure may be designed to resist static loads associated with ice (e.g. thermal expansion/contraction), however, in general, should not be exposed to moving ice. At this location, depending on the wind direction during spring break-up, there is a possibility of moving ice. As a result, floating breakwaters would have to be removed and stored, or moved to a sheltered location for the winter. Floating docks located inshore of a floating breakwater would also have to be removed. Floating breakwaters were evaluated in terms of the level of protection they can provide from waves in a separate study. The results are summarized in Section 5.1 and discussed in detail in Baird (2012).

4.0 REGULATORY FRAMEWORK

This section provides an overview of some of the permitting requirements for coastal structures. The environmental assessment process may be undergoing change as a result of recent direction from the Federal Government at the time this report was in preparation.

The **Canadian Environmental Assessment Act** requires an environmental assessment be undertaken for a project, if a federal authority exercises one of the following: proposes the project, provides funding or financial assistance, disposes of an interest in land to enable the project to proceed, or exercises a regulatory duty in relation to a project, such as authorization under the Fisheries Act.

The **Federal Fisheries Act** prohibits activities that result in the harmful alteration, disruption or destruction of fish habitat. Fisheries and Oceans Canada (DFO) is responsible for implementation of the Act. DFO has a No Net Loss policy, and under this principle, projects must be designed to maintain productive capacity of fish habitat. Where a HADD does occur, a proponent may develop fish habitat compensation to achieve a no net loss of fish habitat. LSRCA has a Level III agreement with DFO and they are the first point of contact for in-water work in Lake Simcoe, with regards to the Fisheries Act.

The **Navigable Waters Protection Act** (NWPA) is a federal stature designed to protect the public right of navigation in navigable waters by prohibiting the building or placement of any work without the approval of the Transport Canada. Construction of a breakwater or any changes to docks and works in the marina would require a permit under the NWPA.

The **Public Lands Act**, which is administered by the Ministry of Natural Resources (MNR) provides for the management, sale and disposition of public lands, which includes the beds of most lakes and rivers. Construction on Crown land requires the approval of MNR.

The **Lakes and Rivers Improvement Act** gives the Ministry of Natural Resources the mandate to manage water related activities, particularly in areas outside the jurisdiction of Conservation Authorities. The Act applies to both private and public lands covered by water. Work permits are required for many activities including dredging, construction of breakwaters and shore structures with solid foundations.

Ontario Regulation 179/06 gives the Lake Simcoe Region Conservation Authority authorization to regulate development in areas adjacent or close to the shoreline of Lake Simcoe that are affected by flooding, erosion or dynamic beach natural hazards, and wetlands. Coastal works included in the proposed marina alternatives including buildings, docks, shoreline structures and placement/removal of fill require a permit.

5.0 ALTERNATIVE MARINA EXPANSION CONCEPTS

This section provides an overview of floating and rubblemound breakwaters, and describes five concepts for marina expansion, each of which includes a floating or rubblemound breakwater to provide shelter from wave action. As discussed in Section 2, the current marina has capacity for 326 boats plus an additional 50 transient users. The marina is currently full and there are 200 boat owners on the waiting list.

The concepts presented in this section, consider the coastal infrastructure required to increase the number of boat slips by approximately 30% to 100% (varying with alternative), as described below. Landbased facilities, such as showers, club house, parking and winter storage are not addressed in this report, and will be addressed by others. The development of concepts was undertaken prior to completion of the user demand survey and economic analysis (completed by others).

5.1 Overview of Floating and Rubblemound Breakwaters

Breakwaters are required to reduce the height of incoming waves and the level of wave agitation at the docks. Three breakwaters provide protection for the existing marina and government dock as shown in Figure 2.1. Additional breakwaters are included in the marina expansion alternatives described in this section.

Two types of breakwater were considered: rubblemound breakwaters and floating breakwaters. Rubblemound breakwaters typically consist of a quarried stone core and filter with an outer primary layer of larger armourstone. These structures can be designed to resist wave and ice action. They have a proven record of performance in locations similar to

the project site, and typically maintenance may be required approximately at 10 year intervals. At this site there are also some disadvantages to this type of breakwater. The water is relatively deep and a large volume of stone material would therefore be required, and this is costly. In addition, the fixed stone structure would occupy a relatively large footprint in the water, creating significant potential for harmful alteration, disruption or destruction (HADD) of fish habitat. This could result in a lengthy process to obtain permits and approvals, along with a requirement for habitat compensation. There is also potential for impacts on water circulation and interruption of sediment movement, which would be assessed as part of the permitting process. Finally, a fixed structure such as a rubblemound breakwater may require additional time and procedures for construction on water lots extending onto Crown land if/as required.

Floating breakwaters are suitable for providing protection from waves under specific conditions. These structures are only effective at locations where there is a relatively mild wave climate, with wave periods less than approximately 4 s. At locations exposed to more severe wave climates and longer period waves, the wave transmission through the breakwater will result in unacceptable wave heights inside the marina and damage to boats (see Section 3.3.2 for wave criteria for marinas). Based on the preliminary wave analysis presented in Section 3.3, the predicted waves were close to the limit of acceptable wave heights and periods for which a floating breakwater can provide sufficient protection from waves. It was therefore recommended that additional analyses be undertaken to better define the wave climate. A more detailed analysis of the wave climate was completed after the assessment of alternative concepts presented in this report (see Baird, 2012). It was concluded that standard floating breakwater products do not provide sufficient protection from extreme wave events. However, as that the wave study was completed after the concept development, the floating breakwater alternatives are included in this report.

Some of the advantages of floating breakwaters include: regulatory permits would be easier to obtain, particularly with respect to fisheries requirements, as there would be minimal HADD; the capital costs of a floating breakwater are significantly less than the cost of a rubblemound structure, however maintenance costs would be higher for a floating breakwater and the lifespan is lower, requiring replacement sooner. There are significant concerns with the durability of a floating breakwater with respect to ice action. In addition to the static forces, the floating breakwater would be exposed to dynamic forces from ice floes driven by wind and currents. This is an important consideration and it was recommended that a floating breakwater should be removed during the winter months or moved to a sheltered location as discussed in Section 3.4. The docks behind the breakwater would also have to be moved to a sheltered location or removed.

5.2 1996 Alternative

A marina expansion alternative was developed for the City of Barrie in 1996. Some of the proposed features have been incorporated in the marina since 1996. Key coastal infrastructure included in this alternative is shown in Figure 5.1. The marina is divided into two areas with seasonal users located in the existing basin and a new breakwater constructed to protect a larger area created for transient users at the north end of the marina. The area for seasonal users remains largely unchanged. Ten additional slips are provided at the south end of the marina basin. The proposal called for sixteen additional slips along the outer breakwater and these have been added since 1996 (see Figure 5.1). The north end of the inner breakwater has been removed, permitting access to the seasonal slips from both the north and south. A small floating dock is provided on the inshore side of the inner breakwater, allowing access to the breakwater.

A new composite breakwater, with a rubblemound trunk and floating breakwater extension provides shelter to the transient basin. Since this alternative was originally proposed in 1996, a shorter breakwater was constructed along a slightly different alignment from the 1996 proposal. In order to develop a cost estimate for the 1996 alternative, it has been assumed that the existing breakwater would be removed and the material would be re-used in the construction of the new rubblemound structure. A preferred approach may be to utilize the existing breakwater (as was done for Alternatives A, C and D). Forty new transient slips are provided inshore of the new composite breakwater. The cadet boat ramp is removed and the shoreline extending to the inner breakwater is hardened with a stepped armourstone wall or similar treatment. The government dock has been removed, allowing for additional slips in the government dock basin. The tour boat dock is maintained in its present location.

In summary, this alternative provides 100 new boat slips. Key features include construction of a new composite breakwater (rubblemound trunk with floating breakwater extension), and removal of part of the existing inner breakwater to improve access to the seasonal marina. The floating breakwater could be moved inshore of the rubblemound breakwater during the winter, to protect it from ice. Some of the floating docks could also be moved to a more sheltered location during the winter. A concept level summary of probable costs for this alternative is provided in Section 6.

5.3 Alternative A

Alternative A (shown in Figure 5.2) provides an additional 164 slips and 14 offshore mooring buoys for transient boaters. A new 240 m long floating breakwater extends from the north shore breakwater. The floating breakwater provides protection for six new docks with finger piers. Transient boaters can also dock along the breakwater. Additional slips have also been added along the government dock, which will require some structural repairs. The tour boat dock is maintained in its present location. There is also potential for offshore mooring for transient boats as shown in Figure 5.2.

In summary, this alternative provides accommodation for an additional 164 new boat slips and 14 offshore mooring buoys for transient boaters. Key features include construction of a new floating breakwater and additional docks with finger piers. It is recommended that the floating breakwater be moved inshore of the inner breakwater during the winter, to protect it from ice. The floating docks located inshore of the floating breakwater would also have to be removed for winter storage or moved to a sheltered location in the marina. A concept level summary of probable costs for this alternative is provided in Section 6.

5.4 Alternative B

Alternative B (shown in Figure 5.3) provides an additional 252 slips and 14 offshore mooring buoys for transient boaters. A new 350 m long floating breakwater extends from the north shore. The floating breakwater provides protection for six new docks with finger piers. Additional slips have also been added along the government dock, which will require some structural repairs, and the tour boat dock has been maintained in its present location. There is also potential for offshore mooring for transient boats as shown in Figure 5.3.

In summary, this alternative provides accommodation for an additional 252 new boat slips and 14 offshore mooring buoys for transient boaters. Key features include construction of a new floating breakwater and additional docks with finger piers. It is recommended that the floating breakwater be moved inshore of the inner breakwater during the winter, to protect it from ice. There is limited location for storage of the floating docks during the winter and it is likely that they would have to be removed and stored onshore. A concept level summary of probable costs for this alternative is provided in Section 6.

5.5 Alternative C

Alternative C (shown in Figure 5.4) provides an additional 300 slips and 14 offshore mooring buoys for transient boaters. A new 440 m long rubblemound breakwater extends from the south shore. The rubblemound breakwater provides protection for fourteen new docks with finger piers. Additional slips have also been added along the government dock, which will require some structural repairs and the tour boat has been maintained at its present location. There is also potential for offshore mooring for transient boats as shown in Figure 5.4.

In summary, this alternative provides accommodation for an additional 300 new boat slips and 14 offshore mooring buoys for transient boaters. Key features include construction of a new rubblemound breakwater and additional docks with finger piers. Due to the breakwater footprint, the environmental and permitting process would likely be more onerous than for the 1996 Alternative and Alternatives A, B and C. A concept level summary of probable costs for this alternative is provided in Section 6.

5.6 Alternative D

Alternative D (shown in Figure 5.5) provides an additional 394 slips and 14 offshore mooring buoys for transient boaters. A new 385 m long rubblemound breakwater extends from the south shore. Both the existing inshore and offshore breakwaters have been removed, opening up additional dock space. Eight new docks with finger piers extend from the rubblemound breakwater, and the existing marina docks have been extended. Additional slips have also been added along the government dock, which will require some structural repairs, and the tour boat dock has been maintained in its present location. There is also potential for offshore mooring for transient boats as shown in Figure 5.5.

In summary, this alternative provides accommodation for an additional 394 new boat slips and 14 offshore mooring buoys for transient boaters. Key features include construction of a new rubblemound breakwater, excavation and dredging to remove the existing inshore and offshore breakwaters, and construction of new docks and finger piers. As with Alternative C, the breakwater is relatively costly due to the depths along the breakwater alignment. Due to the breakwater footprint and the dredging requirements, the environmental and permitting process would likely be more onerous than for some of the other alternatives. A concept level summary of probable costs for this alternative is provided in Section 6.

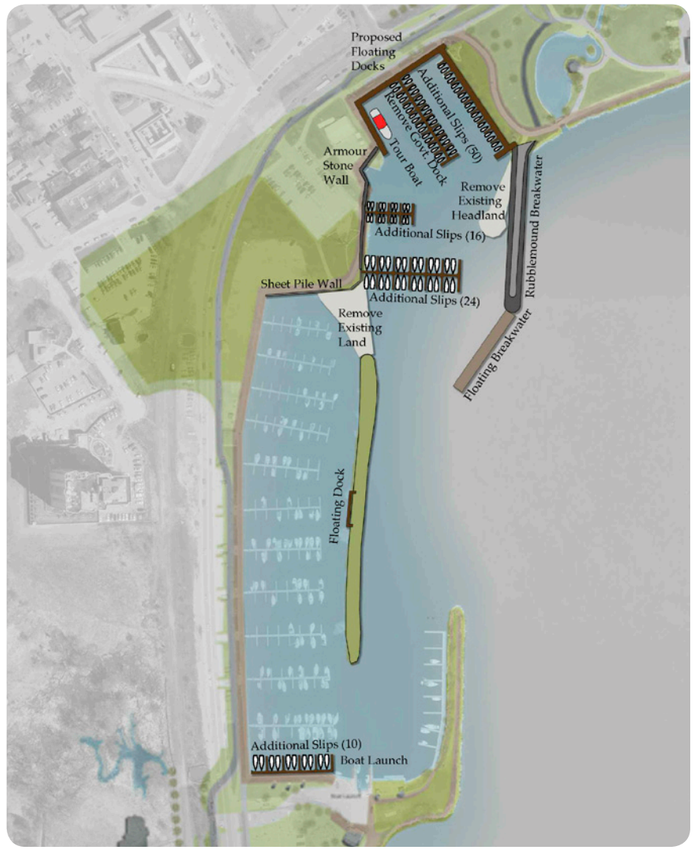


Figure 4: Marina Expansion 1996 Alternative

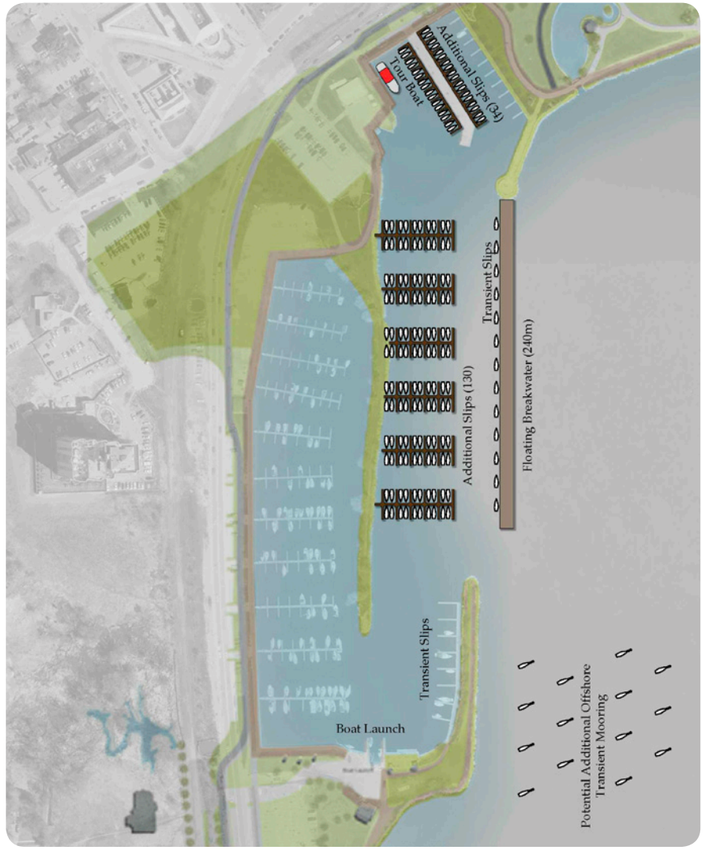


Figure 5: Marina Expansion Alternative A

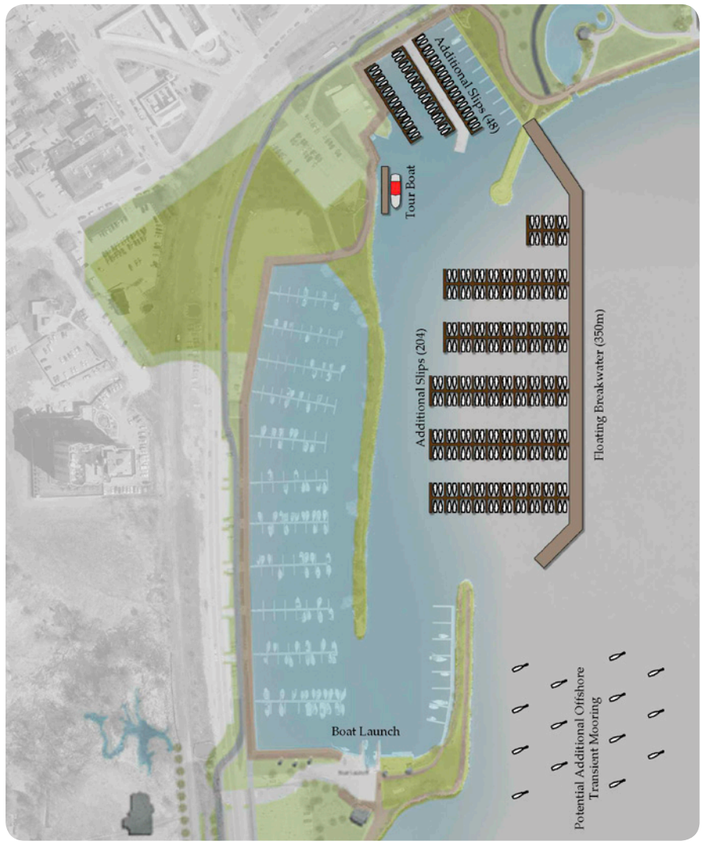


Figure 6: Marina Expansion Alternative B

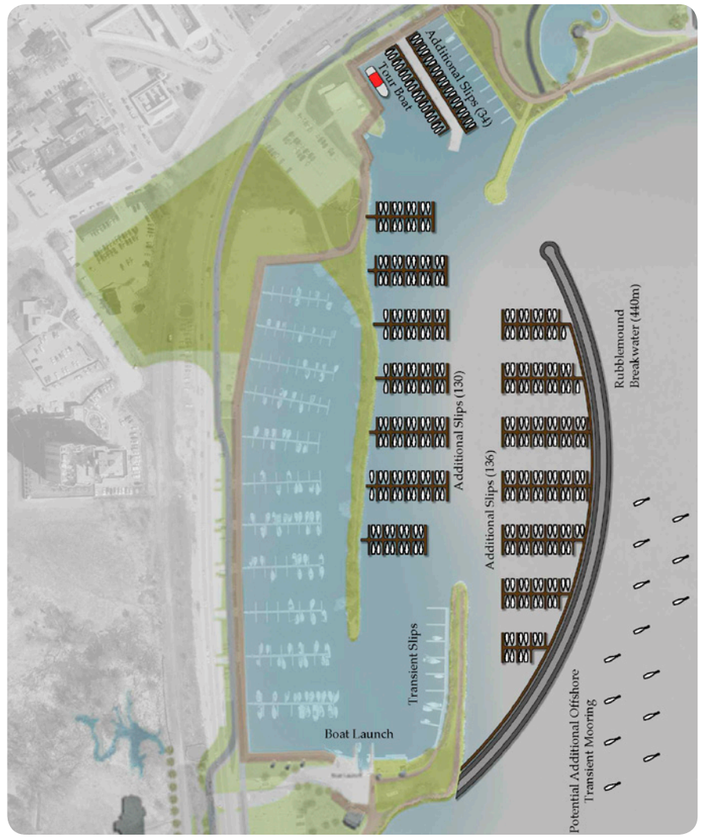


Figure 7: Marina Expansion Alternative C

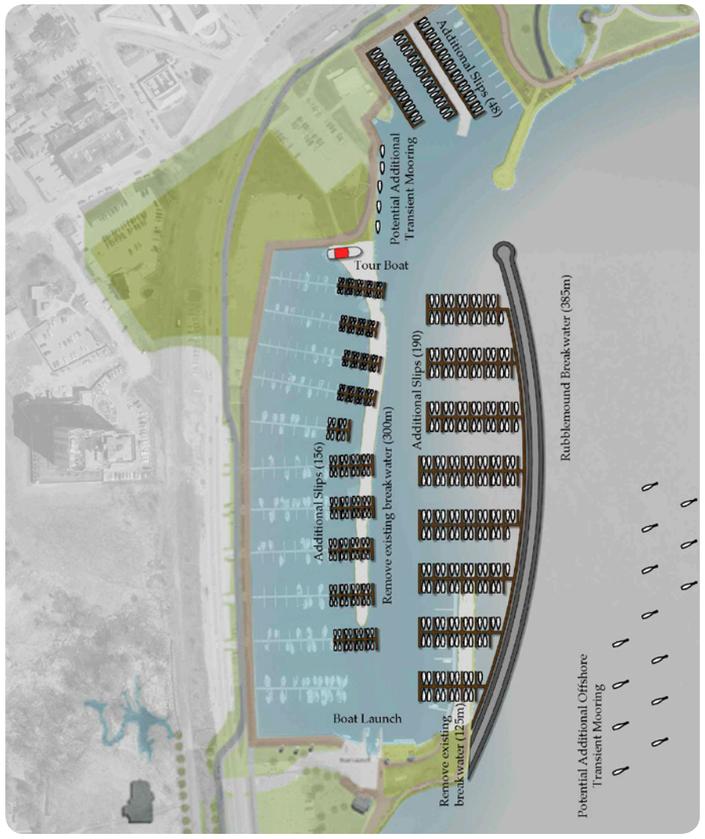


Figure 8: Marina Expansion Alternative D

6.0 ESTIMATE OF PROBABLE COST

This section provides a concept level estimate of probable cost for each of the alternatives described in Section 5. The estimate is based on concept level analysis and a more detailed assessment of costs will be required during design development. The costs include coastal works (breakwaters, dredging and docks). They do not include landbased facilities such as showers, club house, parking, winter storage of boats, etc.

It has been assumed that any dredging or excavation involves clean fill. This assumption would have to be verified with testing. A 30% contingency has been added, as this is a concept level estimate and many assumptions have been made in developing the alternatives. The estimated costs for each of the alternatives are summarized in Table 6.1.

There is a large range in the estimates of probable costs. The alternatives that include a rubblemound breakwater are significantly more costly than the floating breakwater alternatives. As noted in Section 5.1, although capital costs for floating breakwaters are lower than for rubblemound breakwaters, higher maintenance costs and lower lifespan can be expected. It has been assumed that the dredged and excavated material consists of clean fill. This would have to be verified through testing. Costs will be higher if contamination is found.

Table 6.1 Concept Level Estimate of Probable Cost for Marina Expansion Alternatives

Item	1996 Alternative	Alternative A	Alternative B	Alternative C	Alternative D
Floating Breakwater	$240,000	$800,000	$1,100,000	-	-
Rubblemound Breakwater	$2,600,000	-	-	$14,700,000	$10,500,000
Docks and Finger Piers	$680,000	$1,100,000	$1,700,000	$2,300,000	$2,300,000
Repairs to Gov't. Dock	-	$200,000	$200,000	$200,000	$200,000
Dredging and Disposal	$505,000	-	-	-	$1,700,000
Shoreline Treatment	660,000	-	-	-	-
Offshore Moorings	-	$14,000	$14,000	$14,000	$14,000
Contingency (30%)	$1,405,000	$630,000	$904,000	5,100,000	$4,400,000
TOTAL	**$6.1M**	**$2.7M**	**$3.9M**	**$22.3M**	**$19.1M**

7.0 COMPARISON OF ALTERNATIVES

This section provides a comparison of the alternative concepts discussed in Section 5, based on the effectiveness of the alternative, the number of additional slips provided, permitting requirements, cost and maintenance requirements. The factors used as the basis of the comparison are listed in Table 7.1 and the comparison of alternative concepts is provided in Table 7.2.

In general, the alternatives that include a rubblemound structure have higher capital costs. The permitting process for the alternatives with a rubblemound structure will be more onerous, due to the HADD that results from occupation of lakebed. Based on the results of the detailed wave analysis completed after the alternative concepts were developed, and presented in Baird (2012), floating breakwaters were found not to provide adequate protection during extreme events. Floating breakwaters have a lower capital cost than rubblemound breakwaters, however there are higher maintenance costs and a shorter lifespan for these structures. In addition, ice is a concern and the floating breakwaters and docks behind them, should be moved to a sheltered location during the winter months.

Table 7.1 Evaluation Criteria used to Compare Alternative Concepts

Criteria	Description
Effectiveness	• suitability of the concept in addressing marina requirements
Size of Expansion	• number of additional slips
Environmental	• water quality, loss or change to fisheries and terrestrial habitat
Permitting Requirements	• consideration of agency requirements
Capital Cost	• opinion of probable cost
Maintenance Requirements	• need for and extent of maintenance

Table 7.2 Evaluation Criteria used to Compare Alternative Concepts

Criteria	1996 Alternative	Alternative A	Alternative B	Alternative C	Alternative D
Effectiveness	• floating breakwater provides inadequate protection during extreme events	• floating breakwater provides inadequate protection during extreme events	• floating breakwater provides inadequate protection during extreme events	• provides shelter from wave agitation	• provides shelter from wave agitation
Size of Expansion	84 slips	164 slips 14 moorings	252 slips 14 moorings	300 slips 14 moorings	394 slips 14 moorings
Environmental	• dredging results in habitat creation • suspension of fines during construction will need to be addressed • rubblemound breakwater results in HADD	• limited HADD due to shading	• limited HADD due to shading	• suspension of fines during construction will need to be addressed • rubblemound breakwater results in HADD	dredging results in habitat creation • suspension of fines during construction will need to be addressed • rubblemound breakwater results in HADD
Permitting Requirements	• possible issues with permitting for rubblemound breakwater and dredging • fish habitat compensation requirements	• permitting process expected to be less onerous than for alternatives that include rubblemound structures, dredging	• permitting process expected to be less onerous than for alternatives that include rubblemound structures, dredging	• possible issues with permitting for rubblemound breakwater • fish habitat compensation requirements	• possible issues with permitting for rubblemound breakwater and dredging • fish habitat compensation requirements
Capital Cost	$5.3M	$2.7M	$3.9M	$22.3M	$19.1M
Maintenance Requirements	• floating breakwater and docks require winter storage and annual maintenance • minimal annual maintenance for rubblemound breakwater	• floating breakwater and docks require winter storage and annual maintenance	• floating breakwater and docks require winter storage and annual maintenance	• docks require winter storage and annual maintenance • minimal annual maintenance for rubblemound breakwater	• docks require winter storage and annual maintenance • minimal annual maintenance for rubblemound breakwater

8.0 PREFERRED CONCEPT

8.1 Description of Coastal Works

A preferred concept, shown in Figure 8.1, was developed based on the analysis above and considering planning issues, the market analysis, SWOT analysis, financial analysis and input from the Client. The coastal works are described in this section, along with a summary of probable costs. Land based facilities, such as showers, club house, parking and winter storage, and landscaping are not addressed in this report, and will be addressed by others.

The preferred concept includes allocation of space in the existing marina for seasonal docking and commercial activities such as charters. The area at the foot of Bayfield Street will be allocated to large charters and transient docking. In terms of coastal works, the preferred concept includes the following key components:

1. Demolition and removal of the existing Government Dock. It is assumed that all material is concrete and clean fill, and that there is no contamination. Disposal of contaminated materials would be at additional cost.
2. Installation of a floating dock and finger piers to accommodate 34 additional boats, in place of the government dock. These would be similar to the docks currently used for seasonal docking in the marina.
3. A 60 m extension to the existing dock used by large charters, to accommodate additional vessels. The extension will be constructed of steel sheet piling, backfilled with granular, with a timber deck.
4. Construction of a new steel sheet pile dock (70 m in length), along the shoreline north of the inner breakwater, and south of the basin for large charters and transient docking. This area is marked “Staging Area” in Figure 8.1. A timber boardwalk will be constructed along the shoreline adjacent to the dock.

It was assumed that no dredging is required. No costs were included for repairs to existing coastal works.

8.2 Evaluation of Preferred Concept

This section provides comment on the preferred concept, in terms of the evaluation criteria discussed in Section 7.

Effectiveness: No additional breakwaters are required for the preferred concept. The staging area is not sheltered from wave action, however it is assumed that this dock is for short term use only. Removal of the Government Dock makes additional space available for transient docking.

Size of Expansion: The preferred concept includes 34 additional transient slips, additional space for large charters and a dock for short term use.

Environmental: Permits will be required for this work. The removal of the Government Dock will result in fish habitat creation, however impacts on fisheries and fish habitat will have to be addressed during the demolition and removal of the dock. Permits will also be required for the construction of the steel sheet pile walls.

Capital Costs: The estimated cost of the work described above is $2.1 million. This includes a contingency of 30%. A breakdown of costs is provided in Section 8.3.

Maintenance Requirements: Steel sheet pile walls that are well designed and constructed, typically have a service life that extends beyond 30 years. It may be assumed that timber decking will have to be replaced after 10 years. Floating docks typically have a service life of approximately 10 years.

8.3 Opinion of Probable Cost

Table 8.1 provides a concept level opinion of probable cost for the preferred alternative. The costs are for the coastal works described in Section 8.1. Landbased facilities such as showers, club house, parking, winter storage of boats and landscaping have not been considered. The estimate is based on concept level analysis and a more detailed assessment of costs will be required during design development. A 30% contingency has been added.

Table 8.1 Cost for Preferred Alternative

Item	Cost
Demolition and Removal of Government Dock	$ 75,000
Floating Dock and Finger Piers (34 slips)	$ 169,000
SSP Extension to Charter Dock, Timber Deck	$ 901,000
SSP Dock and Boardwalk	$ 444,000
Contingency (30%)	$ 477,000
TOTAL	$ 2.1M



Figure 9: Preferred Concept

9.0 REFERENCES

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2 Marina Economic Analysis

EXECUTIVE SUMMARY

The objective of this study is to assess local market demand and the feasibility for expansion at the City of Barrie Marina as it evolves within the context of the City of Barrie's updated Waterfront Master Plan. A key issue in determining the best approach to the Marina's growth is how, or if, a physical marina expansion could be accommodated from both a market and financial perspective. This report explores:

- The role of public marinas and local recreational boating market characteristics;
- The strengths, weaknesses, opportunities and threats of the current Marina operation, and;
- The economic viability of growth options.
- The following points summarize our analysis:
- Public marinas primarily function as a benefit servicing community recreation or local economic development initiatives. Few public marinas generate significant operating surpluses.
- Canadian boat sales statistics show the market as having declined in 2011 by about 20%. Notwithstanding this, local demand is strong; most of the marinas along the western edge of Lake Simcoe have operated at 100% capacity throughout recent boating seasons. The closure of marina facilities at Big Bay Point has likely helped put downward pressure on vacancy throughout the market area.
- A survey conducted in the spring of 2012 revealed a high level of boater satisfaction with the marina facility and staff. Key concerns related to parking, quality of washrooms/showers, the need for concessions and internet access.
- The current wait list for seasonal slips at the City of Barrie Marina is evidence of strong boater demand, supporting the case to explore opportunities for further progression of the Marina going forward. Expansion of the downtown condominium market also supports continued demand for boating facilities on the waterfront.
- Several models for marina expansion, which ranged up to 771 slips, were developed and tested in this analysis. Expansion options that required any extension to the breakwall structures were found to be either technically unfeasible or could not be supported financially with the projected revenues.
- While the current marina operation is considered to be well run and produces an annual revenue surplus, several key opportunities for the facility have been identified. These ideas have been incorporated into a preferred development concept. This development concept includes the following key capital improvements and operational adjustments.
- Expanding the Marina's capacity for transient boats by 36 slips;
- Constructing a new marina building that would offer improved services for both local and visiting boaters including improved parking, new washrooms and showers, concessions, and internet access;
- The preferred plan envisions the improvement of the area in front of the Sea Scout's facility and rubble mound shoreline with a new dockwall and boardwalk promenade that will have the dual role of improving accessibility to the water's edge but also allow for new commercial opportunities such as additional charter boats.
- Consider increasing berthing fees concurrently with service improvements;
- Impose user fees for boat launches and pump-out services.
- A financial analysis suggest that the increase operating revenue from these improvements would likely be sufficient to finance the capital costs provided that they are undertaken in phased manner.
- We have been asked to comment specifically about the advisability of selling or leasing the Marina to the private sector. In our view, there would be no significant advantages to the City. Given the marinas central placement in the waterfront and the opportunities that surround it for future public benefits, the disadvantages associated with losing control outweigh any benefits.
- A key issue to monitor is the imminent redevelopment of Big Bay point which would add additional boat slips into the marketplace and has the potential to threaten/weaken the City of Barrie's market share.

1. INTRODUCTION

- The Planning Partnership (TPP) has retained N. Barry Lyon Consultants Limited (NBLC) to undertake an analysis of the City of Barrie Marina (the Marina) as a component of TPP's work on conducting an update of the City of Barrie's 2000 Waterfront Master Plan.
- The City of Barrie is evaluating its options for the future of the Marina. A key issue in determining the best approach to the redevelopment is how, or if, the Marina should grow and operate in the future. This report explores:
- The role of public marinas and local recreational boating market characteristics;
- The strengths, weaknesses, opportunities and threats of the current Marina operation, and;
- Opportunities to grow and enhance the role of the Marina on the waterfront.
- This analysis is intended to inform the City's operational decisions for the Marina within the context of its broader waterfront planning context.



Figure 1: The City of Barrie Marina

2. THE ROLE OF PUBLIC MARINAS

- In general, governments build marinas primarily as a benefit servicing community recreation and/or supporting local economic development initiatives. The very significant capital costs and the relatively short Ontario boating seasons make the financial benefits a secondary interest. However, in our experience most public marinas generate operating surpluses that are almost always rolled back into improvements or repairs. Few municipally operated marinas would claim that economic performance was the core rational for operating a marina facility.
- This section of the report provides a summary of the role and broader scale benefits that result from public marinas.

2.1 Improving the Waterfront Experience:

- A public marina is a point of interest which adds to the enjoyment of the waterfront for the general public. As residents enjoy weekend picnics or a workday stroll along the waterfront, they can enjoy the visual amenity of boats entering and exiting the harbour.
- Marina facilities support other water-based activities, such as fishing, wind-surfing, community regattas, canoeing and kayaking. As a public facility, accessibility by the public to alternative uses benefits the greater community and has the potential to increase the animation and interest in the waterfront as a whole.
- In the absence of activity, waterfronts can present security issues especially during the spring and fall when traditional activities slow down. A marina creates activity and populates the waterfront during these periods which promote a feeling of safety and comfort for the community at-large.
- Public marinas offer venues to promote water safety and boater education, issue boating licenses or Pleasure Craft Operator Cards, and promote environmental best practices (e.g., the Ontario Marine Operators Association Clean Marine Program).

2.2 Tourism and Economic Impacts:

- Not every municipality has a waterfront or one that suitable for boating, For those that do, facilities that offer access to boating and other water based activities provide a competitive edge that supports growth and investment.
- The waters of Lake Simcoe, Couchiching and Georgian Bay are already considered one of the best areas to cruise in Southern Ontario. Boaters will be naturally attracted to the Marina so long as the Marina's infrastructure and facilities are maintained and transient slips are available at a competitive rate.
- It is important to note that the magnitude of benefit from the Marina to the community's tourism industry is largely dependent on the number transient slips. The more visitors occupying slips in a public marina, the greater the benefit to the community's tourism sector.
- Visitors will spend money at businesses within walking distance of the Marina. This will impact local employment and labour income in the local tourism sector; particularly those businesses providing marine services, and downtown restaurants, shops and entertainment venues.
- The Marina contributes towards a critical mass of activity on the waterfront. Its patrons, both seasonal and transient form a market segment that could, along with other customers, be the basis to support commercial ventures such as concessions or restaurants.
- A public marina acts as entry point to the City and is an important opportunity to introduce the features of the community and direct visitors to its attractions and services.



Figure 2: The transient boater market is composed primarily of larger power vessels.

3. MARINA MARKET CHARACTERISTICS

3.1 The Regional Market

The market demand for marina space is a direct function of the demand for recreational boating with vessels, largely over 18' LOA. According to the National Marine Manufacturers Association (NMMA) Statistics sales of recreational boats in 2011 were down 21% over 2011. There were 44,400 new boats sold during 2011 with an estimated retail value of $1.6 billion. These figures represent a 22 percent decline in unit sales and 18 percent decline in dollars from 2010. Interviews conducted by NBLC with local retailers confirmed that sales were down through 2011 and into the 2012 boat show season.

While sales of new vessels were down, a survey conducted by NBLC of GTA marinas and marinas within Lake Simcoe showed very little vacancy. As part of this study we interviewed several marinas and boat sales outlets who all confirmed that while sales were down the trend was towards larger, power vessels.

Owners of power boats tend to spend more than those with sail vessels. The larger the boat, the greater the spending. In 2007, the US Corp of Army engineers conducted a survey of boaters in both Canada and the U.S. that explore spending pattern of recreational boaters in the Great Lakes Basin. The survey indicated that an average boat owner spends about $3,600 (U.S.) per year on their boat including $1,400 on expenses (e.g., equipment, repairs, insurance, slip fees) and $2,200 on trips involving an average of 23 boat days. Owners of larger boats spend considerably more than these averages, up to as high as $20,000 per year for boats 41 feet and more. Average spending per boat day on trips varies from $76 for boats less than 16 feet in length to $275 per day for boats larger than 40 feet. The greatest trip expenses are for boat fuel (22%), restaurants and bars (17%) and groceries (14%) .

The NMMA estimated that 38 percent of Canadian adults went boating at least once during 2011, which translates to 10.5 million boaters. According to the NMMA, Current boating participants tend to be married, have children living at home, a household income of less than $80,000, be university educated, and work full time.

Looking forward, the limited supply of marina space and costly and time consuming process of expanding marinas suggest that even with weakening demand from new boat sales, the existing fleet is sufficient

in size to maintain demand for the marina space that exists. Factors influencing demand in the future will include:

- The cost of fuel which may inhibit boating for some;
- Demographics that pushing larger numbers of people into their higher earning years;
- retirement where boating may be more attractive;
- Lifestyle changes are shifting towards a greater emphasis on family and leisure;
- Increasing work place mobility will make working on boats continually easier;
- Increasing costs and regulatory restrictions inhibiting the expansion or development of marinas; and,
- Intensification of downtown areas that will attract new residents to boating

3.2 Local Marina Market

- The Lake Simcoe boating market is home to approximately 45 yacht clubs and marinas, with several thousand mooring spaces and club members spanning from Orillia to Keswick, and from Barrie to Gamebridge. A market scan was conducted of the facilities that are closest and most competitive to Barrie
- Lake Simcoe as a boating area is bolstered by the presence of Trent Severn Waterway. The Trent-Severn Waterway enters Lake Simcoe at it's easternmost point, near the community of Gamebridge. The western access is at the most northerly point of Lake Couchiching which makes a stop a Barrie a side trip requiring an extra day of travel. This likely discourages some visitors but, in general, is a benefit to the Marina. Boaters traversing the Trent Severn Waterway are the primary source of the strong demand from transient boaters at Barrie.

Apart from the Trent Severn Waterway, Lake Simcoe's very large surface area, relatively few obstructions and interesting surrounding communities make it highly desirable for both power and sail boats enthusiasts.

Although no new marinas have been added within the local market area in recent years, a number of marinas have adjusted their internal slip supply to account for the growing demand for dock space to accommodate larger vessels, particularly those in excess of 38 feet in length overall (LOA). The growing supply of larger slips has, if anything, decreased the overall supply of marina slips as none of the Lake's marinas have expanded their overall basin footprints.

While a number of yacht clubs offer exclusivity and specialized programming, such as high caliber racing and extensive social programs, public marinas such as the City of Barrie Marina serve the middle of the market, offering better affordability, a broader mix of boats and a wider range of socio-economic groups. This greater acceptance of a broader range of boats and boaters, and a more easy-going attitude, is part of the attraction of public marinas.

Conversely, yacht clubs typically have the ability to offer a deeper social offering with well established program offerings, dining facilities, children activities and other offerings. Accordingly, as some boaters within public marinas become more established in boating, particularly sailing, they choose to move to club environments. However, as the Kempenfelt Bay Yacht Club moors at the City of Barrie Marina, a number of these users are likely to continue to sail out of the Barrie Marina for longer than they otherwise might.

Following are some other key findings generated through a review of the local marina marketplace:

- Boater demand for slips throughout Ontario is strong, most market areas are experiencing modest growth year-over-year. The bulk of new boater demand is being driven by regional population growth;
- The gradual evolution and intensification of downtown Barrie is helping to animate the waterfront, exposing a greater proportion of the population to recreational opportunities along the water, which in turn fuels demand at marinas like Barrie's;
- Boat sales are trending towards larger boats. An increasingly large proportion of boaters no longer trailer their boats due to size constraints, fueling demand for seasonal slip space;
- Low interest rates, an aging population and high levels of inheritance and personal wealth have helped sustain a generation of boomers which bodes well for continued boater demand;
- A high degree of waterfront activity in Barrie and around Lake Simcoe has established a diverse range of marinas, from public operations, private marinas and club facilities;
- Currently, the demand for slips throughout most marinas on Lake Simcoe is strong. Most of the marinas along the western edge of the lake surveyed throughout the course of this study have operated at 100% capacity throughout recent boating seasons. The closure of marina facilities at Big Bay Point has likely helped put downward pressure on vacancy throughout the market area; and,
- The current wait list for seasonal slips at the City of Barrie Marina is evidence of strong boater demand, supporting the case to explore opportunities for further progression of the Marina going forward. However, as recreational boating is strictly a luxury activity, optimism should be somewhat tempered as demand could be affected by a range of economic fluctuations.
- The concept of selling or including boat slips as part of a larger residential development has been explored by several local developers in recent years, however Big Bay Point is the only nearby development with firm plans to add boat slips as part of its residential resort development. Through our discussions with representatives at Big Bay Point, it was noted that while the final organizational strategy have not yet been finalized, slips will likely be sold to the development's home owners, not the general public. The cost of these slips is also undetermined. Recent information indicates that the resort development is now being branded as "Friday Harbour", the project will include up to 2,000 residential units and a 1,000 slip marina. The marina basin is now undergoing dredging, and the resort is planned to open in the fall of 2014. The entire development is scheduled to occur over a 10-year build out.



Figure 3: Lake Simcoe and the Trent Severn Waterway (purple)


Figure 4: Lake Simcoe Marina - Many marinas in the market area offer cover slips

4. ANALYSIS OF CITY OF BARRIE MARINA FACILITIES

The City of Barrie Marina offers 327 seasonal and 51 transient slips. The Marina is fully occupied and has a waiting list each year. The majority of slips are occupied by power vessels and the average vessel size by LOA is about 25'. The Marina manager notes that demand for berthing from larger boats is increasing. Following is a SWOT analysis (strengths, weaknesses, opportunities and threats) which aims to outline the various dynamics which shape the Marina currently, as well as the details which should be considered as the City's marina operation and waterfront evolves in the future.

4.1 Strengths

- Low cost – The Marina's tailored service offering allows rates to be kept low; the Marina is highly appealing to mid-market boaters.
- Essential boater services – The Marina's gas dock, pump-out, potable water, power, launch and restroom facilities are basic services essential to the boater community. Boaters do not have to travel elsewhere for these basic needs.
- Annual surplus – The Marina operates consistently with no seasonal vacancy and generates positive annual earnings. Marina revenues also contribute to area landscaping, lighting and other park features enjoyed by a broader public.
- Proximity to downtown services – The Marina is located within walking distance to downtown, allowing relatively convenient access to a variety of services and shopping opportunities for boaters. The Marina's convenient location is cited by its seasonal users as a key benefit.
- Destination marina – Given its position on the western-most shore of Lake Simcoe and its distance from the Trent-Severn Waterway, transient visitors have likely selected Barrie a primary destination on their trip. Barrie is a prime destination on Lake Simcoe.
- Planned events – The City's use of waterfront park space as an event venue allow the Marina to facilitate an additional tourism draw throughout its ability to accommodate transient boaters.
- Good dock infrastructure – Recent and ongoing marina facility improvements have improved the Marina's appeal to boaters and presents a positive image along the waterfront. Marina management has a planned program for reinvestment in marina infrastructure that responds well to client requirements.
- Park and beach – The Marina's barrier-free integration with Heritage Park and Centennial Park project a public and accessible feel towards the City. Boaters, especially transient users, benefit from access to parks and beaches nearby.
- Good management – Through our discussions with other operators and boater surveys, management is described as being highly responsive to boater needs. Marina manager is highly experienced and knowledgeable.

4.2 Weakness

- Limited Trent-Severn traffic – The Marina's distance some 42 kilometers away from the entrance to the Trent-Severn Waterway limits the Marina's exposure to transient traffic.
- Poor restroom facilities – The Marina's showers and washrooms are in need of updating and should be accessible to boaters (especially transients) 24-hours per day.
- Limited boater amenities – Unlike many competitive marinas on Lake Simcoe, the Marina does not offer lockers, laundry, wi-fi, cable, or club house facilities to its clients.
- Lack of food services – Very few food service options are available at the Marina. While Downtown Barrie has many options, some boaters may not be aware of them, and others might perceive this as being inconvenient.
- Limited Marina backland:
  - Lack of parking – Heavy use of the waterfront on weekends limits boater accessibility to parking in peak periods. Road realignment will further reduce parking going forward.
  - Lack of winter boat storage – The Marina has a very limited amount of land to use for winter boat storage, restricting revenue generating opportunities in the off season.
- Limited capacity to accommodate large boats – The maximum boat length for seasonal boaters at the Marina is 35'. Boat lengths are trending upwards throughout the market.
- Marina administration building – The current Marina administration building is tight space housing an office, restrooms and utilities. The building presents an unfavourable image towards transient visitors in particular and is not reflective of Barrie's high quality downtown image.

4.3 Opportunities

- City of Barrie Marina seasonal slip rates are typically 20% to 40% less expensive than the rates at other nearby Lake Simcoe marinas which offers the potential to consider rate increases.
- Lakeshore Drive will be relocated west of its current alignment to increase both the park space as well as parking facilities for both marina patrons and day users. This major new improvement should help mitigate parking issues but also offer expanded opportunities to offer winter boat storage within close proximity to the launch ramp/haul out facility.
- Launch and pump-out fees – Currently only non-Barrie residents are charged to use the City's boat launch and for other services like pump-outs and mast stepping. Charging all users would add a potentially significant new revenue stream for the Marina.
- Service expansion – some expansion to marina service offerings would further increase the appeal of the Marina, relatively inexpensive offerings could include offering laundry facilities and wi-fi.
- Economic impact – Transient boaters can generate a significant economic benefit to surrounding businesses and services. Particularly with regard to food and entertainment services. Based on our research and the City's survey, during the average stay, each boater typically spends $40 to $60 on these services. Based on this, and assuming a 16 week season, at 60% occupancy, a transient slip could be generating between $2,744 to $4,032 in spending. While there is little published research in this area a study conducted by the University of Maryland suggests the economic impacts, at least in the Chesapeake Bay, are even more significant.
- Growth potential – the Marina has an opportunity to capitalize on the strength of existing boater demand by increasing its number of boat slips for both seasonal and transient marina users.
  - Seasonal boaters – The Marina currently waitlist of over 200 boaters, an increase in slip capacity would satisfy this demand. A reconfiguration or expansion could also increase the Marina's capacity to accommodate larger vessels.



FIgure 5: Demand from the residents of new waterfront condominiums is expected to grow in the City

- Transient boaters – Transient slips are heavily utilized at peak periods throughout the boating season when the City's waterfront is utilized to host numerous events. An expansion in the number of transient slips could support additional marina revenue and provide opportunities for visitors to explore Barrie's downtown and produce economic spinoff.
- Improve marina & waterfront visibility – despite its prominent location along the waterfront, the Marina and waterfront's visibility from beyond the Lakeshore Drive could be improved via signage along the 400 and the City's major thoroughfares.
- Commercial opportunities – A broad range of commercial opportunities could be supported out of an expanded marina facility and/or along the waterfront given its extensive use and public land ownership. Opportunities include:
  - Boat rentals/ dry sailing;
  - Jet ski rentals;
  - Expanded charter fishing facilities, including bait sales;
  - Food services/ restaurant/ convenience;
  - Sailing lessons;
  - Boat servicing/ mechanical; and,
  - Ice fishing and snowmobile centre (bait, gas and concessions)
- Spinoff economic effects – The Marina has the opportunity to facilitate some economic spinoff for local business located in Barrie's downtown. Options for encouraging this growth could be explored through a partnership with a Downtown BIA.
- Gateway to Barrie – the Marina acts as an additional gateway to the Downtown from a transient boater perspective. The Marina presents an opportunity to provide visitor information, with staff also acting as economic development ambassadors.
- Critical mass – There is an opportunity to create a consolidated waterfront activity centre acting as an anchor for both active and passive waterfront activity. This waterfront centre could house Marina administration offices, shower, locker and laundry facilities for boaters, and could present multiple opportunities to facilitate other waterfront activities throughout all four seasons. In addition to providing some space for the commercial opportunities previously noted, the facility could house a power squadron and waterfront education centre.
- Banquet/ conference/ wedding facilities – There is a good opportunity for a banquet facility and/or restaurant to occupy the second floor of a consolidated waterfront activity centre. A review of the City's waterfront and downtown banquet facilities revealed very strong market conditions with limited availability throughout the rest of 2012.

4.4 Threats

- Access to capital – Expanding the Marina's physical infrastructure and service offerings would require access to capital in order to finance improvements. Expansions would have to be financed through Marina reserves and its annual surplus.
- Resistance from current seasonal slip users – There is a general resistance from the Marina's current seasonal lessees to pay for increased levels of service.
- Market growth – The imminent redevelopment of Big Bay point could add additional boat slips into the marketplace and has the potential to satisfy some of the excess demand not currently being served by the City of Barrie Marina. At this point Big Bay point has not determined exactly how its marina will be managed.
- Stress on waterfront land – Any increase to marina facilities will further increase the demand for waterfront land to accommodate vehicle parking and the other boater-related activities including boat and trailer storage.
- Safety and liability – expansion to marina facilities or spinoff service offerings within the publicly owned and accessible waterfront area might present increased exposure to liability and safety concerns for waterfront users.
- From a financial perspective, the marina will be continually faced with increasing costs, not only due to inflation but also due the need for continual maintenance. The current management has wisely instituted a program of continually reinvesting in marina infrastructure. However, these costs are expected to increase overtime and without offsetting revenue sources, the operating surplus that has been used to fund these works will diminish.

4.5 Tenant's Survey

A survey of marina patrons was conducted during the winter of 2012 and revealed the following key findings:

- Overall, of the 92 respondents, 97% of the marina patrons ranked the facility, in terms of operations, staff and equipment, either satisfied or extremely satisfied;
- Access to parking, especially on weekends, appears to the be the issue of greatest concern;
- In terms of identified facility improvements, the following items were ranked the highest:
  - Improved washrooms: 41%;
  - Internet access: 37%;
  - Vending machines, concessions: 32%, and,
  - Cable TV: 22%.
- About 70% of respondents supported a rate increase.

4.6 Summary

The City of Barrie Marina is a well run facility that enjoys strong demand, a high approval rating from its patrons, and an annual operating revenue surplus. The current operating model provides positive net cash flow to the City. Taking into consideration the next 10 years of projected operating revenues and costs, the net present value (NPV) of the annual net operating income is estimated to be in the order of $1.38M. (See Appendix D) Furthermore, it is estimated that current transient traffic contributes about $137,700 to $204,000 in direct spending to the local economy.

Looking forward, marina initiatives should build on its success by responding to the needs of its customers and enhancing its broader role to the waterfront and the downtown.

The Marina could have an even stronger presence and act as a centre of activity and animation for the waterfront. Centred around a new administration facility opportunities to connect visitors to the waterfront to attractions and services downtown and other parts of the City. The facility could also address issues such as improved washrooms and showers as well as providing commercial services for food and supplies.

While the Marina enjoys a positive bottom line, costs, including those for improvements suggested in this report are likely to increase while pressure to keep fees low will be strong. Opportunities to generate new revenues, through rate increases, new services and or slip expansions will be important to consider to maintain the standard of service set to date.

5. OPTIONS FOR THE CITY OF BARRIE MARINA

Section Four of this report outlines the key issues impacting on the Marina facility that will shape its future. This section considers those issues and summarizes the extensive research that explored a wide range of options that include modest changes to very large expansion alternatives

Each option considered was subjected to a technical reviewed carried out by W.F. Baird & Associates Coastal Engineers Ltd. (Baird) and an order-of-magnitude financial analysis by NBLC. This analysis was conducted at necessarily high level and is subject to further refinement and study through the development of detailed site plan and designs and other analysis.

For each of the options, NBLC developed a conceptual proforma analysis that assessed the costs and revenues over a ten year period. A net present value of the resulting annual net operating revenue stream is then calculated as method to compare the relative value of each model. A summary of this research is provided in Appendix B. The assumptions contained in these proformas are outlined in Appendix C.

5.1 Expansion Options

Baird and NBLC developed five conceptual marina expansion alternatives for potential infrastructure growth at the City of Barrie Marina (under separate cover) that explored modest to very large expansion plans. Each concept required expansion of the breakwater infrastructure. Understanding the very high cost of this infrastructure, Baird also explored alternatives such as floating breakwater technology. The options evaluated by Baird included a previous marina expansion plan from 1996 and four other expansion alternatives. The expansion options assessed included:

- 1996 Plan 441 slips;
- Option A 554 slips;
- Option B 626 slips;
- Option C 677 slips; and,
- Option D 771 slips.

The work of NBLC was conducted iteratively with that of Baird which ultimately revealed that all the major expansion options where either technically and/or financial unviable. From the analysis of each option, the following key conclusions should be noted:

- Each potential option would require that the Marina have access to funds for financing and/or the ability to finance expansion costs through the tax base.
- Expansion alternatives that incorporate rubblemound breakwall construction (the 1996 alternative as well as alternatives C and D) inflate construction costs to a point beyond what is reasonable from a financial position. Each of these scenarios would result in a significant negative net operating position.
- Options C and D also involved major slip growth and high expansion costs that would be excessively risky from both a market demand and capital investment perspective, with very significant land requirements for parking.
- From a market perspective, there is likely enough demand to support the potential growth (in terms of the number of slips) illustrated in the 1996 alternative as well as alternatives A and B. However, like alternatives C and D, significantly higher construction costs in the 1996 alternative would put the Marina in a negative net operating position.
- Alternatives A and B likely represent the best options for expansion at the Marina and showed good financial results based on preliminary cost estimates. However, the floating breakwater technology available today was judged by Baird to be inadequate to properly protect the inner basin from local hydraulic conditions.

Illustrations and the summary proforma analysis for each of these options attached as Appendix B.

5.2 The Preferred Marina Plan – Minor Expansion and Improvement to Facilities

Understanding the technical difficulties with the expansion options discussed above an approach was explored that worked within the confines of the existing breakwater infrastructure.

5.2.1 Expansion of Transient Slips

An important consideration in the evaluation of physical growth options for the City of Barrie Marina is the ability to increase the facility's capacity for transient boaters. Based on our assumptions for transient boater traffic generated through consultation with marina staff and a review of comparable transient boater impact studies, we estimate that transient boater spending equates to approximately $2,700 -$4,000 of direct spending in Barrie per transient slip, per season, and a significant amount of this spending is likely to occur close to the Marina, likely within Downtown. As transient boaters are typically not residents of Barrie their spending represents a net-new economic benefit to the City. Any improvement to the Marina's capacity to accommodate increased transients will likely have an impact on local businesses.

The limitations imposed by the hydraulic characteristics of Kempenfelt Bay restrict improvements to the marina within the confines of the existing basin and shoreline infrastructure. The basin itself is fully developed leaving limited opportunities for improvements to the infrastructure with the exception of adjustment to the mix/sizing of slips. There is opportunity to expand the number of transient slips by removing the government pier and replacing it with floating docks. The proximity of these slips near the downtown area is ideal for the expansion of berthing facilities for visitors to the City.

5.2.2 Expansion of Commercial/Charter Boat Area

The preferred plan envisions the improvement of the area in front of the Sea Scout's facility and rubble mound shoreline with a new dockwall and boardwalk promenade that will have the dual role of improving accessibility to the water's edge but also allow for new commercial opportunities such as additional charter boats. To be conservative, we have not project any revenue from these potential services but costing has been developed.

5.2.3 New Marina Building and Service Improvements

The planned realignment of Lakeshore Drive westward will create new parking and boat storage areas that will immediately improve access to the Marina and resolve a key patron issue. The new Marina building with its new washrooms and showers will be a major improvement to the services offered to both Marina patrons and the general public. This building could also be designed to accommodate a commercial concession that could offer supplies, snacks and other convenience items. Internet access as part of the berthing fee should also be explored.

5.2.4 Rate Increases and User Fees

As noted previously, the City of Barrie Marina charges rates for seasonal slip usage that are less than all of the other competitive marina rates on the western edge of Lake Simcoe. We believe that with the proposed service improvements, there is an opportunity to adjust rates upwards without impacting boater demand. To this end, we modelled a seasonal slip increase in the order of 15%, to $74 L.O.A., or based on a 23' average boat length, a rate of $1,700 per season, per slip (up from $1,550 currently).

We also modelled the user fees for boat launches and pump-outs. We estimate a $10 rate per launch applied to all boat launches in each growth scenario as well as a $10 charge for pump-outs. The boat launch fees could be instituted through a payment for parking the car and trailer.

5.3 Costs

To provide an assessment of the likely financial viability of the preferred concept a high level pro forma analysis was undertaken. This analysis makes several broad assumptions with respect to capital and operating costs in the future. These assessments are made without the benefit of detailed studies such as engineering design work. They do, however, reflect the experience of the consultant team from other similar assignments. The assumptions are also considered conservative.

Table 5.3 Capital Budget Estimates

Capital Budget Estimates		
Item	Budget Estimate	Source
Removal of Government Dock	$98,000	Baird
Construction and New Transient Slips	$220,000	Baird
Pay Station for Boat Launch	$15,000	NBLC
Line Painting/Signage (budget)	$5,000	NBLC
Marina Building Hard and Soft Costs	$1,000,000	TPP
Furniture and Fixtures	$150,000	NBLC
Initial Phase	$1,488,000	
Construction of new dock for commercial	$1,200,000	Baird
Construction of dockwall	$580,000	Baird
Second Phase	$178,000	
Notes		
Subject to detailed design		
It is assumed that all material to be disposed of is clean fill		
No dredging assumed		
No repairs to existing docks		
30% contigency		

5.3.1 Capital Costs

The following cost estimates and assumptions for this option are provided by NBLC, Baird and the Planning Partnership. Table 1 summarizes these costs estimates.

5.3.2 Operating Expenses and Revenues

The operating cost projection is based on assumptions that have been developed within the course of this study or have been provided by other consulting team members. We have assumed that berthing rates would be increased immediately by about 15%, however, it may be more appropriate that this rate by phased in which would delay revenues and potential delay the proposed initial capital improvements. We have also assumed 25 new winter storage spots. With the new parking lots, this may be a conservative estimate. The following are other key assumptions:

- We have assumed that operating expenses would increase proportionately with expansion of 36 slips with the exception
- Additional 36 transient slips (occupied 60% of the season) in 2014;
- Additional 25 winter boat storage spaces in 2013;
- Paid public boat launch and pump outs for all marina patrons in 2014;
- Both fuel expenses and sales are assumed to increase proportionately with slip occupancy;
- We assume any new revenue that may accrue from a concession in the new marina building will be modest and not have a significant bearing on this analysis;
- We assume two new summer staff; and,
- We assume revenues and expense increase, on average by 1.5% annually over the 10 year forecast period. The exception is for payroll costs which we assume increase by 3.0%. In the proforma, this shows berthing rates increasing annually. Given the practical and political realities, future rate increases would more likely be imposed every several years.

5.4 Analysis

Incorporating these assumptions, the net operating income is forecasted to increase from about $200,000 to about $370,000 (before debit payments and contingencies) per annum. The net present value of the net operating income would increase from about $1.3M to about $2.5 M with the proposed improvements. It should be noted that the proposed fee increase, capital improvements to the transient slip expansion and the pay station improvements generate the majority of the new revenue. The capital improvements associated with the new charter boat staging area have no direct revenue in our analysis.

Table 2 is a proforma model that illustrates the effect of these additional costs and operating revenues. We have not included any projections for new commercial ventures, however the new infrastructure would provide opportunities for expanded uses and revenue.

We assume in our analysis that an initial phase of capital works is initiated in 2013 that includes the following:

- transient docking expansion;

- the public boat launch pay station; and,
- the new marina building

We also assume (arbitrarily) that the initial phase of development, estimated at $1,488,000, would be financed over 7 seven years at a rate of 5%. The analysis illustrates that there will be sufficient funds to allow for consideration of moving forward on the proposed infrastructure improvements with more detailed planning.

Once this phase of the project was completed, the second phase could commence.

The estimated impact of spending from the new transient boaters is estimated to be between $97,200 to $144,000 per annum or $234,900 to $348,000 per annum in total.



Figure 5: The Preferred Plan

Table 5.3.1 Preferred Model-Rate Increase

Preferred Model - Rate Increase/Fee for Use Boat Launch/Fee for Pump Out/Increase Transient Slips and Winter Boat Storage												
				1	2	3	4	5	6	7	8	9	
				2013	2014	2015	2016	2017	2018	2019	2020	2021	
REVENUE	***Current***	**Proposed**											
Summer Mooring	*$472,374*	$554,852	*	$554,852	$571,622	$580,197	$588,900	$597,733	$606,699	$615,800	$625,037	$634,412	$64
Pump-out, Stepper & Sundry	*$4,320*	$20,320	^	$20,320	$20,934	$21,248	$21,566	$21,890	$22,218	$22,552	$22,890	$23,233	$2
Fuel	*$185,776*	$200,638		$203,648	$209,803	$212,950	$216,144	$219,386	$222,677	$226,017	$229,408	$232,849	$23
Launch Ramp	*$6,483*	$20,000	^	$6,483	$20,605	$20,914	$21,227	$21,546	$21,869	$22,197	$22,530	$22,868	$2
Winter Boat Storage	*$10,000*	$20,000	**	$20,300	$20,914	$20,914	$21,227	$21,546	$21,869	$22,197	$22,530	$22,868	$2
Transient Boaters	*$91,392*	$155,904	***	$91,392	$160,616	$163,025	$165,471	$167,953	$170,472	$173,029	$175,625	$178,259	$18
TOTAL	***$770,344***			**$896,994**	**$1,004,493**	**$1,019,247**	**$1,034,536**	**$1,050,054**	**$1,065,805**	**$1,081,792**	**$1,098,019**	**$1,114,489**	**$1,13**
OPERATING EXPENSES													
Operations and maintenance	*$307,061*	$331,625	****	$307,061	$331,625	$346,774	$351,975	$357,255	$362,614	$368,053	$373,574	$379,177	$38
Contracted services	*$57,866*	$62,496		$58,734	$62,496	$65,350	$66,331	$67,326	$68,335	$69,360	$70,401	$71,457	$7
Utilities	*$9,283*	$10,026		$9,423	$10,026	$10,484	$10,641	$10,801	$10,963	$11,127	$11,294	$11,464	$1
Insurance	*$14,881*	$14,881		$15,104	$15,331	$15,561	$15,794	$16,031	$16,271	$16,516	$16,763	$17,015	$1
Advertising	*$4,269*	$4,610		$4,333	$4,750	$4,821	$4,893	$4,967	$5,041	$5,117	$5,193	$5,271	$
Sundry expenses	*$11,396*	$12,308		$11,567	$12,680	$12,870	$13,063	$13,259	$13,458	$13,660	$13,865	$14,073	$1
Full-time Salaries	*$85,865*	$92,734		$87,153	$98,382	$101,333	$104,373	$107,504	$110,729	$114,051	$117,473	$120,997	$12
Casual and Part-time Wages	*$59,567*	$66,567		$60,460	$66,567	$72,739	$74,921	$77,169	$79,484	$81,869	$84,325	$86,854	$8
Benefits	*$23,781*	$24,673		$24,137	$24,673	$26,961	$27,770	$28,603	$29,461	$30,345	$31,255	$32,193	$3
TOTAL				**$577,972**	**$626,529**	**$656,893**	**$669,762**	**$682,914**	**$696,357**	**$710,097**	**$724,143**	**$738,501**	**$75**
NET OPERATING INCOME				**$319,022**	**$377,965**	**$362,354**	**$364,774**	**$367,140**	**$369,448**	**$371,694**	**$373,876**	**$375,988**	**$37**
New Infrastructure for Intial Phase					$257,156	$257,156	$257,156	$257,156	$257,156	$257,156	$257,156		
Debt Financing (retired in 2014)				$54,112	$53,011								
CONTINGENCY FUND (10%)				$57,797	$62,653	$65,689	$66,976	$68,291	$69,636	$71,010	$72,414	$73,850	$7
ANNUAL CASH FLOW				**$207,113**	**$5,145**	**$39,509**	**$40,642**	**$41,693**	**$42,656**	**$43,529**	**$44,306**	**$302,138**	**$30**

Note: Cost/revenue estimates are generally based on the City of Barrie's annual financial statements.

*Projected based on an average 23' average boat length, with 326 occupied slips, at a rate of $74/LOA.

^Charge for all pump-outs & boat launches. Est 100 ea per week at $10 per.

**Estimate based on 25 boats, at a rate of $400/ea/ per season.

***Estimate based expansion of 36 slips on a $40/night fee 60% vacancy across the boating season.

6.OPERATIONAL APPROACHES

Understanding the opportunities for growth at the City of Barrie Marina, the following discussion is intended to evaluate how the Marina should it be managed, assessing whether there is there a better way to achieve this than the current approach.

6.1 Key Issues

- Key issues to consider in the operation of the Marina are as follows:
- Financial sustainability;
- Operation within a public park;
- Decision making and management; and,
- Cost sharing and responsibilities shared between City departments.

Following is a discussion of the various operational models available to the City.

6.1.1 Public Operation (Current Approach)

Currently, there are about seven different departments involved in decision making at the Marina. The City's 2000 Waterfront Master Plan recommended the City develop a clear schedule of maintenance responsibilities to endure the waterfront is maintained in a safe and aesthetically pleasing manner, to do this it recommended budget allocations and staffing be allocated to the waterfront from a variety of departments.

Under public operation, the same core principles apply to the operation of the City of Barrie Marina as outlined above. However, under public operation the Marina has the benefit of achieving some additional cost recovery (does not pay for admin, HR, garbage collection, etc.). This presents a strong argument to maintain and improve the current operating structure as operational surpluses are retained by the City.

An important note here is that while several departments are charged with maintaining various pieces of marina property, the investments in waterfront infrastructure made by the Marina benefit not just boaters, but all of the City's residents and visiting waterfront users. Recent examples of this investment are numerous, and include shoreline and pier improvements, waterfront lighting improvements and landscaping. Moreover, public operation of the Marina presents an opportunity for visitor spending to be directed towards downtown Barrie. A publicly operated Marina allows the ability for marina staff to act as City ambassadors as they are the first point of contact for many visitors.

In our estimation, the input from various City departments in Marina operation and maintenance are likely balanced out by the reinvestment of marina dollars in waterfront improvements which benefit all waterfront users alike. That said, the current operational model appears to be somewhat ad hoc; a more formalized structure would benefit the Marina if public ownership and operation is continued.

6.1.2 Public Private Partnership

In a public private partnership, the Marina operation would be leased to the private sector. Some key considerations are noted in this case:

- The private operator's core principle would be purely economic, with strong motivation to turn a profit. This would mean an increase in Marina service rates to market rents, or above (likely 15% to 20%). In addition a private sector operator would encounter additional expenses from the City which would erode the profitability of the Marina in this scenario which would include:
  - Marina security and insurance costs be higher and a key consideration to a private operator;
  - A private operator would be exposed to both property and business taxes not currently applied to the public model; and,
  - A private operator would have to pay rent to the City.
- A private marina operator would be incentivized to capture the economic spinoffs within the Marina itself – not in the downtown.

The benefit to the City would be a steady rent payment regardless of market fluctuations, and no ongoing maintenance requirements. However, in our experience with similar arrangements, private operators tend to defer major maintenance projects to the end of their lease period. As such, the City would likely have to be prepared to incur some maintenance costs (dock replacement, etc.) towards the end of the lease agreement.

6.1.3 Sell the Marina

Many of the same considerations as outlined in the Public Private Partnership model would also become pertinent if the City were to sell the Marina land and business to a private entity. However, the major difference in this case would be the City's loss of control over this land; while the private sector would benefit by eliminating the requirement to pay rent.

The sale of the City's marina and water lots to a private operator would likely create a significant shift in the look and feel of the current marina operation given the many philosophical differences noted herein. This may also stir up some political issues given the fact that the current operation is relatively well maintained and provides a positive net financial benefit to the City.

6.1.4 Arm's Length Agency – Waterfront Corporation/ Commission

Another potential operating model would be to establish an arm's length agency to run the Marina and/ or all waterfront facilities. In doing so, the following would be key considerations:

- The agency would require separate administration and other human resources which are currently provided by the City; and,
- The Marina is one of, if not the only, revenue generating facility on the waterfront aside from perhaps the South Shore Community Centre. Revenues from these facilities would have to cover the operation of the agency.

Without adding some significant new waterfront concessions or engaging in the sale of waterfront land for private redevelopment, there is likely insufficient revenue to support the creation of a separate waterfront body. In other locations, high real estate values and large scale redevelopment opportunities can support staff and operations. However in this case, that redundancy and relatively limited economic generating opportunity on the waterfront would likely not sustain such an endeavour.

7. RECOMMENDATIONS

Understanding the current marina operation and the market outlook for a marina in Barrie, the following are our core recommendations for the City of Barrie Marina going forward:

- Maintain public ownership and operation of the Marina. In its current form the Marina provides positive net benefits to the City as a whole and several opportunities exist to leverage this to a greater degree in the future. In our view, several potential conflicts with private operation or ownership are likely to arise given the fact that the interests between the City and a private operator are not aligned. Maintaining ownership also means that the City can develop a comprehensive strategy for the waterfront which includes the Marina as a public asset where investments in the Marina and its infrastructure benefit all local residents.

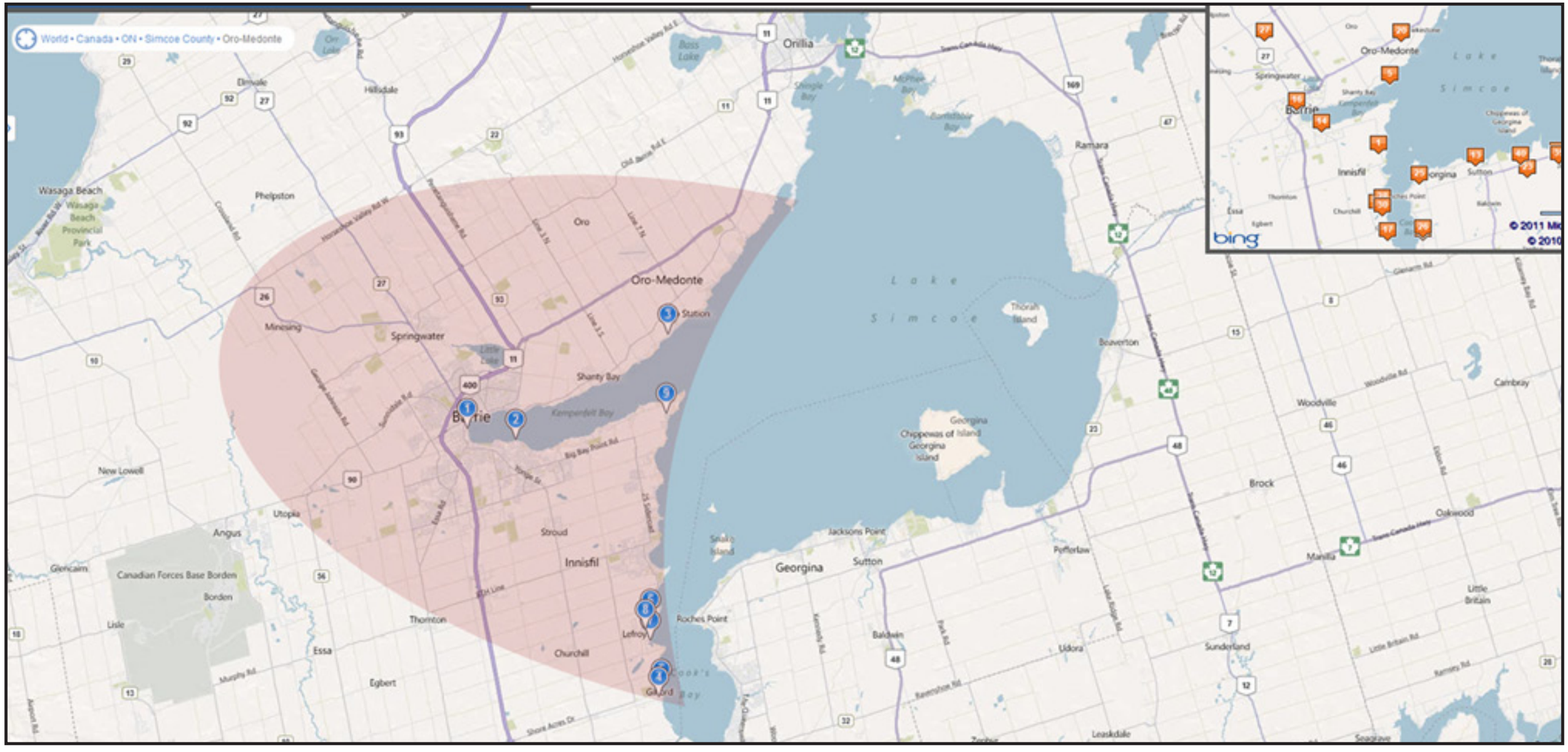
- The preferred approach would see a coordinated effort for the organization of broader waterfront maintenance and responsibilities organized through an Interdepartmental Waterfront Committee that is established through a memorandum of understanding. This model allows the City to maintain control of the waterfront's evolution and an ability to leverage the opportunities at the Marina throughout the entire waterfront and the nearby downtown.

- It is recommended that the Marina look at gradually increasing slip rates with the service improvements proposed and charging all users a nominal fee for boat launches and other boater services. Given that current rates are less expensive than many other competitive marinas, these increases will likely have a minimal effect on demand. Any near term expansion of marina facilities should be focused towards increasing the capacity for transient boaters. This should occur through physical improvements to Government Dock along with a focused operational strategy that manages the docks and cross promotes with the Downtown BIA.

- Improvements to the dockwall east of the new transient docks should be phased in once the transient docks are completed and occupied. Similarly the new marina administration building on the east side of the Basin should be phased in as funding permits.

Table 7. Western Lake Simcoe Marina Facility Review

Western Lake Simcoe Marina Facility Review																	
Name	No. Seasonal Docs	Max Length	Transient Docks	Shore Power	Draft	Fuel	Repair Services	Sales	Storage Facilities	Yard	Food/ Beverage Services	Shower/ Restroom Facilities	Pumpout Services	Boat Launch	Seasonal Slip Rates	Winter Storage Rates	2011
City of Barrie Marina	326 (132 for 22' and under 154 w/hydro for 20' +)	35' (Seasonal) 60' (Transient)	16 (addtnl 35 at adj. Gov. Wharf basin) $40/day $200/week	30 amp	7'	Yes	No	No	Limited	Crane	No	Yes	Yes Seasonal Slip users: free Non-seasonal users: $30	Two	Piers A, B, C, D (2012, rates include HST): - Up to 16': $1,015 - 17' to 20': $1,171 - 21' to 24': $1,415 Piers E, F, G, H, I, J, K (2012, rates include HST): - 17' to 20': $1, 293 - 21' to 24': $1, 538 - 25' to 28': $1,787 - 29' to 32': $2, 032 - 33' to 35': $2, 277 **- Avg $ 63x LOA**	$400 per boat. Limited availability, mostly KBYB sailors.	100% (200 on waitlist)
Brentwood Marina	132 (82 Covered & 50 Open)	42'	N/A	30 amp	6'	Yes	Boat, Engine & Trailer	No	Indoor &	Yes		Yes	Yes	Yes	Open Slips - 18' - 25': $2,500/year - 21' - 26': $2,700 - $3, 200/year - 26' + :$3,500+/year Covered Slips add an additional $1,000/year Rates include 12-month service and include water storage. - Avg $100x LOA		100%
Cooks Bay Marina Inc.	160	30'	Yes	30 amp	4'	No	No	Yes	Indoor &	Crane & Hydraulic Trailer	Variety	Yes	Yes	Yes	Up to & including 20': $1,700; Over 20' & including 23': $1,900;		N/A
Golden - Medonte Powerboat Club	55	30'	No	N/A	8'	Yes	Engine & Trailer	No	Indoor	Fork Lift	N/A	Yes	N/A	N/A	$2,000/ season for boats up to 20' & including 23': $1,900		95%
Kon Tiki Marina Ltd.	200	46'	Yes $1.50/ft LOA	30 amp	4'	No	Boat 7 Engine	N/A		Crane & Travel Lift	Snack Bar	Yes	Yes	Yes	Specific Rates based on slip location & boat length (22' to 46'). Rates range from $1,575 to $5,250/season, averaging $2,735/season or $86x LOA Rates increasing 4% in 2012	Uncovered: $18/ft LOA Covered: $36/ft LOA Indoor heated storage available	100%
Lake Simcoe Marina Ltd.	92	35'	N/A	30 amp	5'	No	Boat, Engine & Trailer	Parts &	Indoor &	Fork Lift	Snack Bar	Yes	N/A	Yes	Open Slips 12' - 18': $560 - $1,180/season. Open side tieups up to 26': $725 - $1,000. Add winter storage to above for $13/ft LOA (untarped), or $20/ft LOA shrink-wrapped. Cover Slips w/hydro (incl. launch, lowering, hoisting & winter storage): - 18' to 20': $1,650 - $2,018/season - 21' to 23': $2,075 - $2,180/season Overall avg $95x LOA Covered Winter storage: - Shed: $20/ft LOA - Yard (incl. shrink-wrap): $20/ft LOA - Yard (untarped): $13/ft LOA		N/A
Lefroy Harbour Resorts Inc.	300	60'	Yes $1.50/ft LOA	30 amp	6'	Yes	Boat, Engine & Trailer	Yes	Indoor &	Crane & Travel Lift		Yes	Yes Single: $20 Double: $30	Yes	Specific Rates based on slip location & boat length (22' to 60'). Rates range from $1,575 to $7,350/season, averaging $4,585/season or $129x LOA Rates increasing 4% in 2012	Uncovered: $18/ft LOA Covered: $36/ft LOA Indoor heated storage available	100%
N. Barry Lyon Consultants Ltd.																	



Map 1 - Location of Marinas

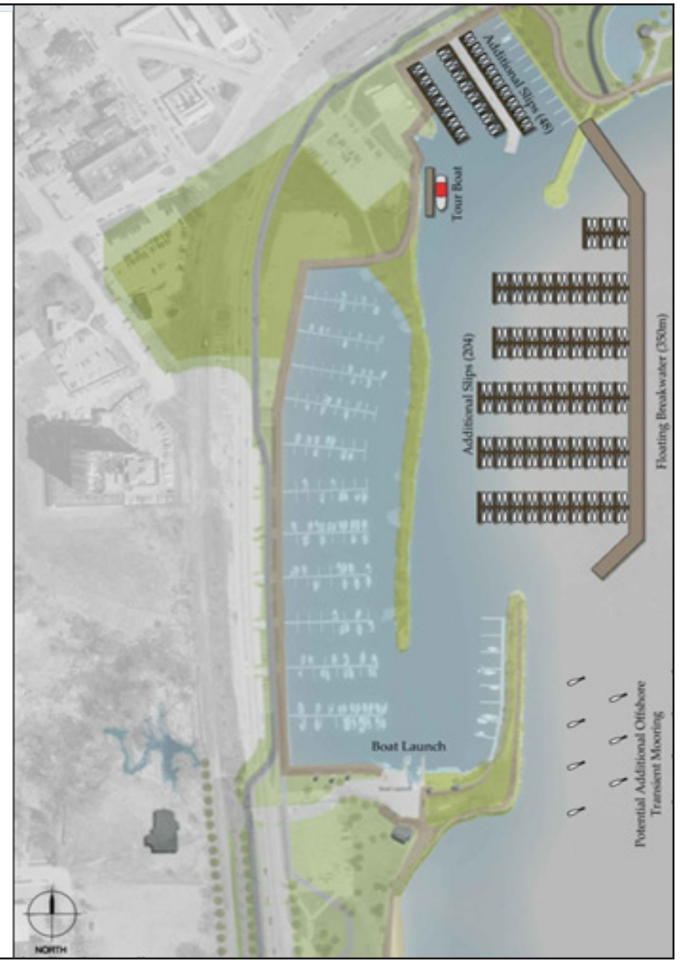
ATTACHMENT B – DEVELOPMENT OPTIONS

1996 ALTERNATIVE

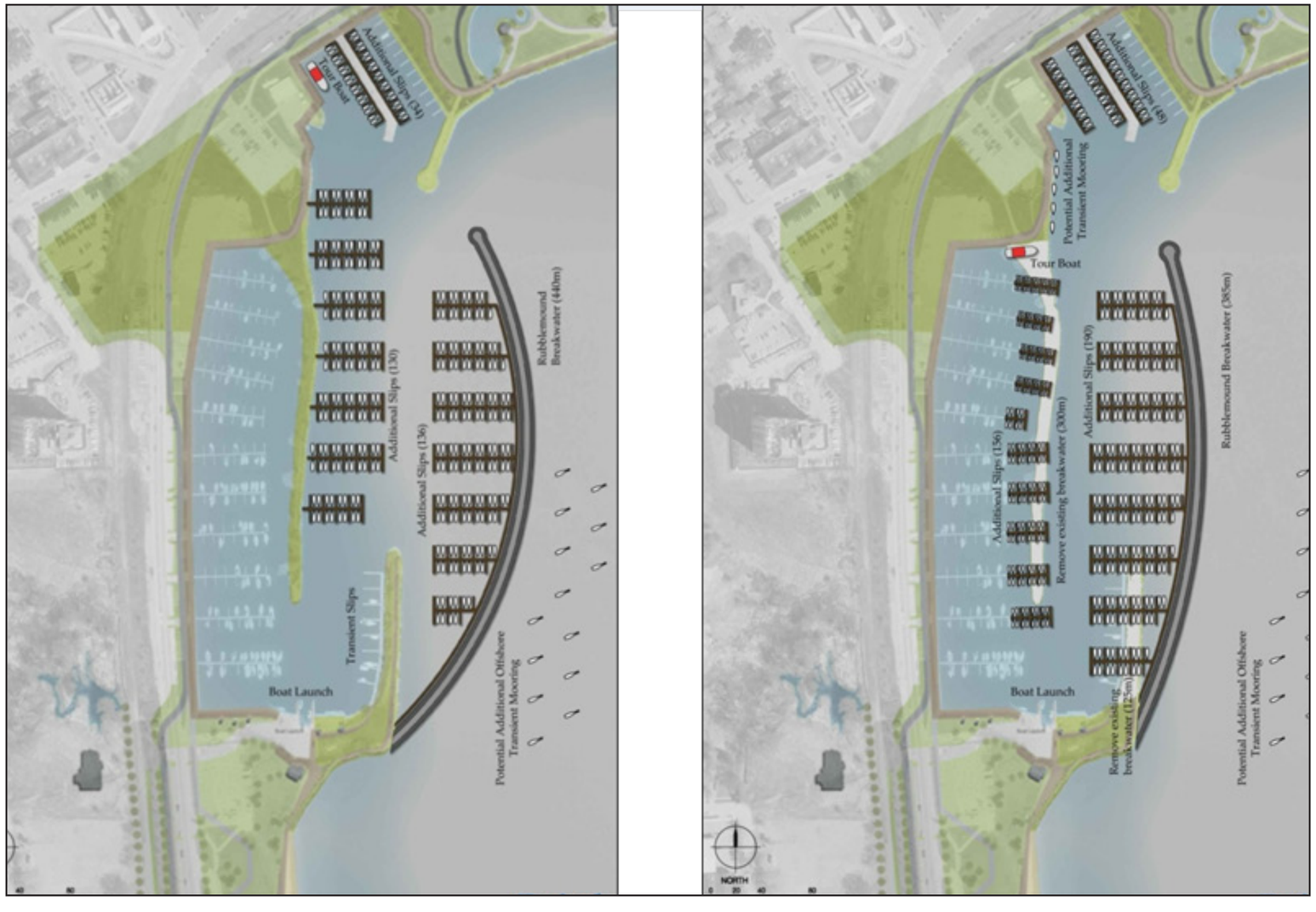


ALTERNATIVES A & B





ALTERNATIVES C & D



ATTACHMENT C - PROFORMA ASSUMPTIONS

- To measure the viability and impacts of various marina expansion options, we have developed a cash flow pro forma which imputes projections of operational costs and revenues over time. Following are key assumptions in the pro forma:
- Base operational cost and revenue projections are generally based on five years of financial information provided by the City of Barrie Marina (2007 to 2011);
- The recreational boating market remains strong throughout Barrie and on Lake Simcoe, and a reasonable increase in mania fees will not affect slip demand;
- All costs are inflated and 1.5% per annum, except for wages and benefits which are inflated at a rate of 3% per annum;
- All revenues are inflated at 1.5% per annum;
- Operating costs increase proportionately with the rate of physical slip growth projected in each physical marina expansion alternative;
- It is assumed that expansion alternatives would be funded by paying 20% of the estimated expansion costs up front and financing the balance over 15 years;
- It is assumed that annual floating breakwall maintenance would be covered by a $10,000 allocation of operating costs;
- All scenarios include a contingency fund (10% of annual operating costs), as well as a capital reserve fund contribution estimated at around $50,000 per annum;
- It is assumed that the Marina, as a City-run entity, is exempt from paying property taxes;
- Base summer mooring revenues are projected based on current City of Barrie Marina rates and assumes a 23 foot average boat length, a seasonal mooring rate of $63/ft LOA, and 326 occupied seasonal boat slips;
- Launch ramp revenues are projected based on an estimate of a total of 100 launches per week, over 16 boating weeks, at a rate of $10 per launch;
- Pump-out service revenues are projected based on an estimate of a total of 100 launches per week, over 16 boating weeks, at a rate of $10 per boater;
- Transient slip revenue and transient spending is projected based on a 60% transient slip vacancy rate across the boating season (112 days). It is assumed that transient visitors spend $40 per day, and that there are two persons per boat; and,

ATTACHMENT D – PROFORMA STATUS QUO

Status Quo												
			1	2	3	4	5	6	7	8	9	
	Base (2011$)		2013	2014	2015	2016	2017	2018	2019	2020	2021	2
REVENUE												
Summer Mooring	$472,374	*	$479,460	$486,652	$493,951	$501,361	$508,881	$516,514	$524,262	$532,126	$540,108	$548
Pump-out & Sundry	$4,320		$4,384	$4,450	$4,517	$4,585	$4,653	$4,723	$4,794	$4,866	$4,939	$5
Fuel	$185,776		$188,563	$191,391	$194,262	$197,176	$200,134	$203,136	$206,183	$209,275	$212,414	$215
Launch Ramp	$6,483		$6,580	$6,679	$6,779	$6,881	$6,984	$7,089	$7,195	$7,303	$7,412	$7
Winter Boat Storage	$10,000	**	$10,150	$10,302	$10,457	$10,614	$10,773	$10,934	$11,098	$11,265	$11,434	$11
Transient Boaters	$91,392	***	$92,763	$94,154	$95,567	$97,000	$98,455	$99,932	$101,431	$102,952	$104,497	$106
TOTAL			**$781,900**	**$793,628**	**$805,533**	**$817,615**	**$829,880**	**$842,328**	**$854,963**	**$867,787**	**$880,804**	**$894**
OPERATING COSTS												
Operations and maintenance	$307,061	****	$311,667	$316,342	$321,087	$325,903	$330,791	$335,753	$340,790	$345,902	$351,090	$356
Contracted services	$57,866		$58,734	$59,615	$60,510	$61,417	$62,338	$63,274	$64,223	$65,186	$66,164	$67
Utilities	$9,283		$9,423	$9,564	$9,707	$9,853	$10,001	$10,151	$10,303	$10,458	$10,614	$10
Insurance	$14,881		$15,104	$15,331	$15,561	$15,794	$16,031	$16,271	$16,516	$16,763	$17,015	$17
Advertising	$4,269		$4,333	$4,398	$4,464	$4,531	$4,599	$4,668	$4,738	$4,809	$4,881	$4
Sundry expenses	$11,396		$11,567	$11,741	$11,917	$12,096	$12,277	$12,461	$12,648	$12,838	$13,031	$13
Full-time Salaries	$85,865		$88,441	$91,094	$93,827	$96,642	$99,541	$102,527	$105,603	$108,771	$112,034	$115
Casual and Part-time Wages	$59,567		$61,354	$63,194	$65,090	$67,043	$69,054	$71,126	$73,260	$75,457	$77,721	$80
Benefits	$23,781		$24,494	$25,229	$25,986	$26,765	$27,568	$28,395	$29,247	$30,125	$31,028	$31
TOTAL	**$573,969**		**$585,116**	**$596,507**	**$608,148**	**$620,044**	**$632,201**	**$644,626**	**$657,327**	**$670,308**	**$683,578**	**$697**
NET OPERATING INCOME			**$196,783**	**$197,121**	**$197,385**	**$197,572**	**$197,679**	**$197,702**	**$197,636**	**$197,479**	**$197,226**	**$196**
Debt Financing (retired in 2014)			$54,112	$53,011								
CONTINGENCY FUND (10%)			$58,512	$59,651	$60,815	$62,004	$63,220	$64,463	$65,733	$67,031	$68,358	$69
Net			**$84,160**	**$84,459**	**$136,570**	**$135,568**	**$134,459**	**$133,239**	**$131,904**	**$130,448**	**$128,868**	**$127**

Note: Cost/revenue estimates are generally based on the City of Barrie's annual financial statements.

* Projected based on an average 23' boat length, with 326 occupied slips, at a rate of $63/LOA.

** Estimate based on 25 boats, at a rate of $400/ea/ per season.

***Estimate based on a $40/night fee 60% vacancy across the boating season.

3 Analysis of Wave Climate to Assess Floating Breakwater Feasibility

1.0 INTRODUCTION

The City of Barrie is located on the shores of Kempenfelt Bay on Lake Simcoe and includes over 10 km of waterfront. In November 2011, The Planning Partnership, with Baird & Associates (Baird) as sub-consultant, was retained by the City of Barrie to update the 2000 Waterfront Master Plan, including the development of a Marina Strategic Plan and a Waterfront Strategic Plan. Baird's role was to provide coastal engineering expertise to the project.

The Marina Strategic Plan includes: development and clarification of the City's Marina mandate to become an economic and tourism destination; review of the marina business model; development of a long term strategic plan; development of conceptual designs for the possible marina expansion including the Spirit Catcher open space; consideration of operational and safety issues; recommendations regarding the Sea Cadets facility; and assessment of the impacts of the City's marina for future development, considering marina proposals within the study limits.

In May 2012, Baird completed a coastal assessment, to support the development of concept level marina expansion alternatives. Simplifying assumptions were made in assessing the coastal environment and no field work was undertaken for the study, aside from a site reconnaissance. Various alternatives were evaluated including both rubblemound breakwaters and floating breakwaters. Recognizing the limitations of floating breakwaters, particularly when exposed to more severe wave climates, it was recommended that additional analyses should be undertaken to better understand the wave climate at the site and to assess the ability of a floating breakwater to provide adequate protection for the marina.

In July 2012, Baird was retained to undertake a more detailed coastal analysis to define the design wave climate at the project site. The analysis focused on the recreational boating season and considered wind, wave and water level analyses. This report describes the findings of that study.

2.0 SITE DESCRIPTION

The Barrie Marina is a small craft marina located at the head of Kempenfelt Bay on Lake Simcoe (see Figure 2.1). The public marina accommodates approximately 326 permanent users and 50 transient boats, which include a combination of motor boats and sail boats. The marina is currently full, with a waiting list of approximately 200.

Although the marina is located at the end of Kempenfelt Bay, it is exposed to waves generated on Lake Simcoe. In particular, during a northeast wind, the site is exposed to waves generated over a 40 km fetch (the distance the wind blows over to generate waves).

The marina is sheltered from wave action by two breakwaters, constructed of fill, and protected with armourstone. The inner breakwater was recently repaired after storm damage. A steel sheet pile dock wall with timber decking provides access to floating finger piers that extend from the dock. There are additional slips along the inshore side of the outer breakwater.

Depths immediately offshore of the existing breakwaters are in the range of 6 m. The lakebed drops off steeply and depths along the alignment of the outer breakwater, where a new breakwater would be considered for a marina expansion, are in the range of 8 m to 10 m.

3.0 ENVIRONMENTAL AND SITE CONDITIONS

The coastal environment has a significant impact on the performance of floating breakwaters and the two most important factors are waves and water levels. This section summarizes relevant metocean conditions used to support the development of design conditions at the project site. Water levels and wave conditions are defined as a function of return period. Figure 3.1 provides an overview of the data used in this study to estimate design conditions at the marina.

3.1 Bathymetry

Lake Simcoe bathymetry was extracted from the 1957 field sheet obtained from the Canadian Hydrographic Service (scale 1:3000). Landsat imagery was used to define shoreline features around the lake. This information was used to support the development of the numerical model mesh, which describes the bathymetric features in the computational domain. Figure 3.2 provides an overview of the bathymetry in Lake Simcoe and Figure 3.3 shows the bathymetry at the marina (note that the depths on the CHS chart are in feet). The horizontal projection of the data is UTM 17N NAD83. Kempenfelt Bay is relatively deep with water depths in the range of 30 m to 40 m.



Figure 1: Location Map showing Barrie Marina

3.2 Water Levels

Water level data is available for three locations on Lake Simcoe: Atherley Narrows, Jackson Point and Gamebridge. Water level data dating back to the 1960s are shown in Figure 3.4, a summary of annual conditions is provided in Figure 3.5. All depths are relative to Chart Datum, which is 218.7 m above the Geodetic Survey of Canada (GSC) Datum.

Data for Atherley Narrows and Jackson Point are available from 1998 to 2006 and data from the Gamebridge gauge are available for 1960 to 1995; therefore a data gap exists between 1995 and 1998. The highest peaks in the water level record are in 1967 and 1991 (nearly 0.65 m above chart datum) with lows in 1961 and 1965 (0.20 m below chart datum).

Water levels also vary seasonally, with higher water levels occurring in May to June and low water levels occurring in December and January. Historically, the range in seasonal fluctuations of water level on Lake Simcoe was nearly 0.70 m (during the 1960s), however it has more recently been in the range of 0.4 m, likely due to regulation.

An extreme value analysis based on annual maxima was carried out on the available water level data. Figure 3.6 summarizes water level as a function of return period based on the Three-Parameter Weibull distribution. The annual (taken to be a return period of 1.5 years) and 50 year water levels were determined to be 0.46 m and 0.64 m, respectively.

3.3 Wind Conditions

Wind conditions on Lake Simcoe were analysed using measured data collected from the three stations summarized in Table 3.1 (station locations are shown in Table 3.1)

Table 3.1 Lake Simcoe Wind Stations

Station	ID	Source	Period of Coverage
Wind Data			
Lagoon City	6114295	Environment Canada	1994 to 2012 (hourly)
Barrie	6117700	Environment Canada	2003 to 2012 (hourly)
Lake Simcoe Buoy	C45151	Environment Canada	1999 to 2012 (hourly)

Wind data at the Barrie station was limited to only nine years of data (2003 to 2012). The Lagoon City station contained the longest period of record (1994 to 2012) and was ultimately used to define the wind conditions at the site given the period of coverage and the relatively close comparison with measured winds from the buoy. The Lake Simcoe buoy (C45151), which measured winds back to 1999, is only deployed during the ice-free season (nominally April to November). This corresponds generally to the boating season, and is the period considered for this study. As such, recorded wind data at the buoy were used to assess and correct for the difference in wind speed strength between land stations and water stations. This is discussed in more detail below.

In general, wind conditions on Lake Simcoe during the ice free season are dominated by westerly winds (NW to SW) as shown in Figure 3.7, which summarizes wind conditions at buoy C45151 in the form of a wind rose. The largest waves at Barrie Marina are wind-waves generated by less frequent NE winds, and waves generated by the dominant westerly winds are smaller due to the limited fetch from this direction.

The strength of the wind speeds measured at land stations such as Barrie and Lagoon City are not necessarily representative of conditions over water, as topographical features, buildings, and the location of the gauge may cause an underestimation of the wind speed. In order to utilize the longer data series collected at Lagoon City, wind speeds were compared with data measured at buoy C45151. Although the period of coverage at the Barrie gauge is limited and the data were not used to define extreme winds, a similar analysis was carried out given its proximity to the marina. A statistical summary of the comparison is presented in Figures 3.8 and 3.9 in the form of Quantile-Quantile (Q-Q) plots. A Q-Q plot is a graphical technique for assessing whether two datasets are statistically equivalent. In this approach the quantiles (percentage of data points below a given wind speed) were plotted against the quantiles of the second dataset.

Wind speeds from the Lagoon City station compared well with the wave buoy, however the wind speeds measured at the Barrie station were lower; this may be due, in part, to the location of the gauge, which is further inland relative to the Lagoon City station. Based on the findings from this analysis and recognizing that Lagoon City has the longest period of record, this station was used to define extreme wind events.

Although a relatively good comparison was observed between Lagoon City and buoy C45151, a directional analysis was carried out and wind speeds were corrected to the buoy data in order to improve the statistical comparison. The results are presented in Figure 27.

An extreme value analysis was completed using the corrected winds from the Lagoon City station. Only the NE quadrant was considered given that the Barrie Marina is subjected to the largest waves from approximately NE. Figure 3.11 summarizes the wind speeds as a function of return

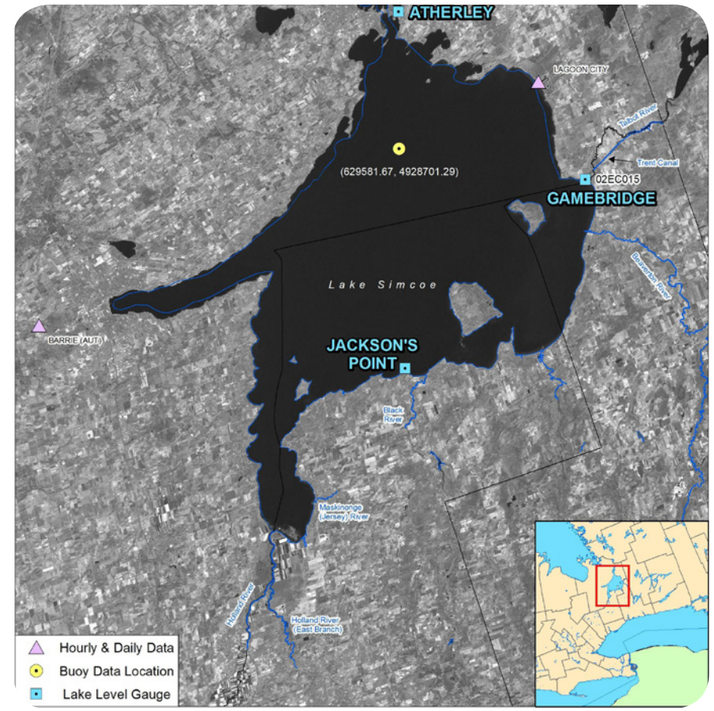


Figure 2: Map Showing Metocean Stations used in the Study

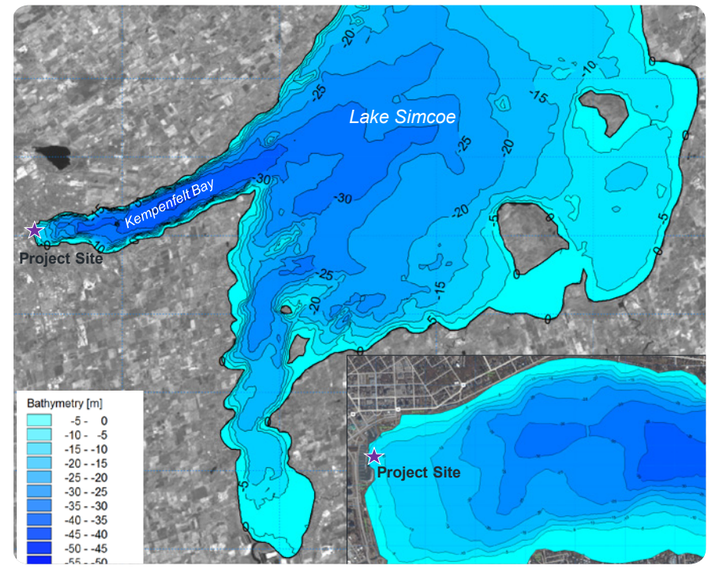


Figure 3: Lake Simcoe Bathymetry (depths in metres)

period. The annual wind speed from the NE was determined to be 11 m/s, while the 50 year return period event was estimated to be 16 m/s. The 50 year return period wind corresponds to the extreme wind that would be expected to occur once in 50 years. It is noted that the extreme value analysis was based on 18 years of data and prediction of longer return period events have a higher level of uncertainty.

4.0 DESIGN WAVES

4.1 Design Life and Return Period

The design life of a project is the service life, or period over which it is expected to function. The design life is not equivalent to the return period of the design conditions. Return period is selected based on the acceptable risk. Figure 4.1 provides a series of distributions between acceptable level of risk and return period for varying design life. The design life of a floating breakwater may be in the range of 20 years. If we assume a 20 year design life and 50 year return period water levels and waves, this results in an acceptable level of risk of 33%, i.e. there is a 33% risk of the breakwater being exposed to the design condition within its design life. The acceptable level of risk should be determined with input from the client. For the wave analysis, the 50 year return period event will be used, along with a more frequent event of approximately 1 year return period. In this case, transmission of waves through the breakwater during its design life, the acceptable level of wave agitation for boaters, and the potential for damage to boats are also important considerations.

4.2 Wave Modelling

In the previous phase of this study, Baird completed a preliminary investigation to define the operational wave climate at the site for the purpose of evaluating concept level expansions for the marina (Baird, 2012). Based on that analysis, the estimated significant wave height for a 10 year return period event was approximately 0.45 m with wave periods in the range of 3 seconds. Considering the preliminary nature of the analysis, it was noted that the results were not suitable to support design decisions. The results from the wave analysis generated conditions that were close to the performance threshold limits for floating breakwaters. As such, further analysis was recommended following that work, to improve the design wave estimates. This involved an examination of key elements, including: the sensitivity of numerical formulations for modelling waves down long narrow fetches, a review of mesh type and resolution, and a more detailed understanding of extreme wind conditions from the NE (as addressed in Section 3.0).

Design waves were derived at the project site using a combination of numerical and desktop methods. Parametric wave hindcasting was initially used to estimate wave height and period at the site based on fetch, storm duration and depth of water in the generating area. Note that fetch is the distance the wind blows over the water to generate waves. These simplified methods were used to guide the design process and provide initial data for reference against the more detailed two-dimensional spectral wave model, which is required given the complexity of modeling waves down long narrow fetches such as Kempenfelt Bay. Various numerical (spectral and time) formulations were considered in order to examine the impact on wave conditions at the project site.

Design waves at the project site were ultimately predicted using the Danish Hydraulic Institute's (DHI) spectral wave model (MIKE21 SW). MIKE21 SW is a full plane two-dimensional phase averaging model that simulates the growth, decay and transformation of wind-generated waves. Figure 4.1 provides an overview of the model mesh. The strength of the flexible mesh approach is that higher resolution can be applied in regions of interest. The resolution of the Lake Simcoe mesh ranges from 400 m out in the main lake down to 80 m near the project site.

The MIKE21 SW model was used to predict waves for both the annual (1.5 year return period) and 50 year return period wind and water level events; these are summarized in Table 4.1. This selection of wind and water level conditions provided the upper and lower boundaries of the design wave envelope as it describes both operational and extreme events.

Table 4.1 Design Wind and Water Level Conditions

Return Period	Wind Speed (m/s)*	Water Level (m) CD
Annual	11	0.46
50 year	16	0.64

* Wind speeds based on an analysis of winds from the NE quadrant

The Barrie Marina is subjected to waves generated from NE winds. The model simulations that were carried out considered both constant and variable wind conditions to ensure that the design waves were captured at the project site. Variable winds were based on a consistent NE event that occurred on October 19, 2004. The wind speeds on this date were scaled accordingly to match the annual and 50 year speeds presented in Table 4.1. It should be noted that both the constant and variable wind simulations showed similar wave heights suggesting that the peak waves were captured in the modeling process. Figure 4.2 compares the predicted wave heights under fully developed seas for the annual and 50 year event. The results showed that larger waves do propagate down the main channel of Kempenfelt Bay. Wave periods in the bay ranged from 3s to 4s for the 1 year event and 4s to 5s for the 50 year event; this is a critical design component for floating breakwaters which are generally effective for periods under 3s. This is discussed further in Section 5.

Wave heights were extracted offshore of the existing marina along the north and south side of the bay. The extraction location and model results are presented in Figure 32.\

The results showed that a significant wave height of 0.6 m to 0.7 m could occur at the project site on an annual basis with wave heights of 1.25 m to 1.36 m under the 50 year event. This is based on relatively consistent NE wind events. Wave periods ranged from 3 to 5 seconds and as previously discussed may exceed the threshold criteria for floating breakwaters. This is discussed further in Section 5.

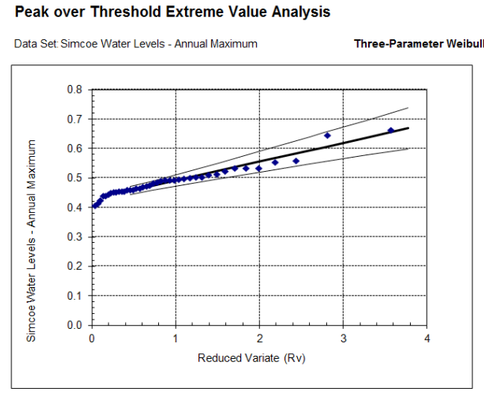


Figure 4: Water Levels as a Function of Return Period based on the Three-Parameter Weibull Distribution

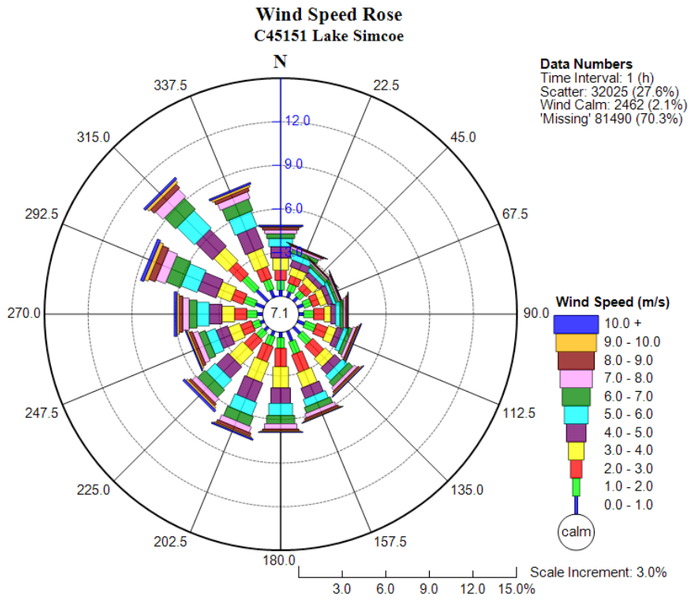


Figure 5: Summary of Wind Speed and Direction at Buoy C45151 in the Form of a Wind Rose

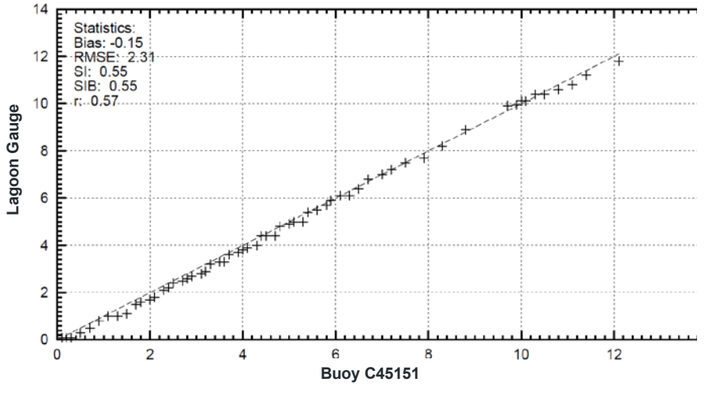


Figure 6: Corrected Lagoon City and Buoy C45151 Quantile-Quantile Comparison of Wind Speed

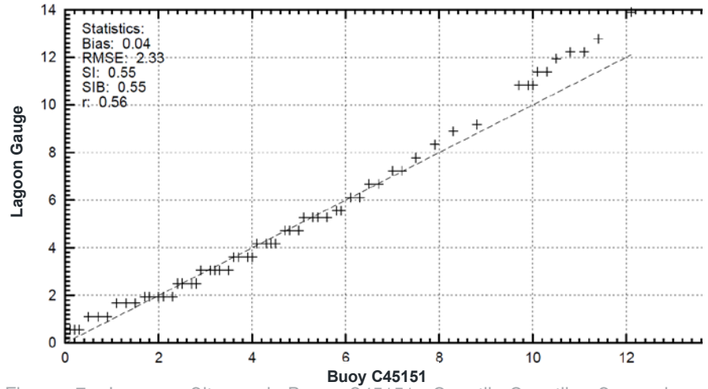


Figure 7: Lagoon City and Buoy C45151 Quantile-Quantile Comparison of Wind Speed

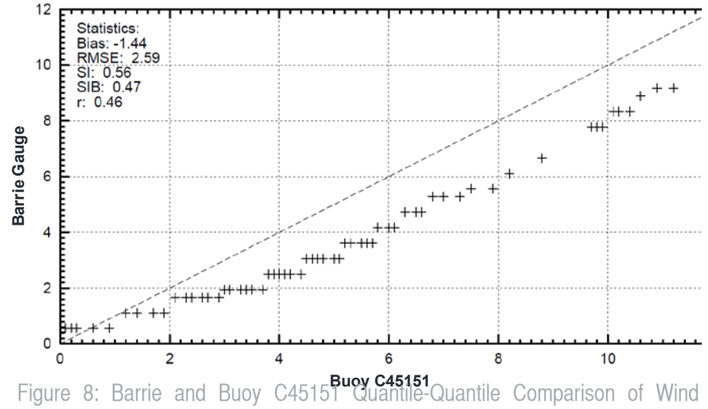


Figure 8: Barrie and Buoy C45151 Quantile-Quantile Comparison of Wind Speed

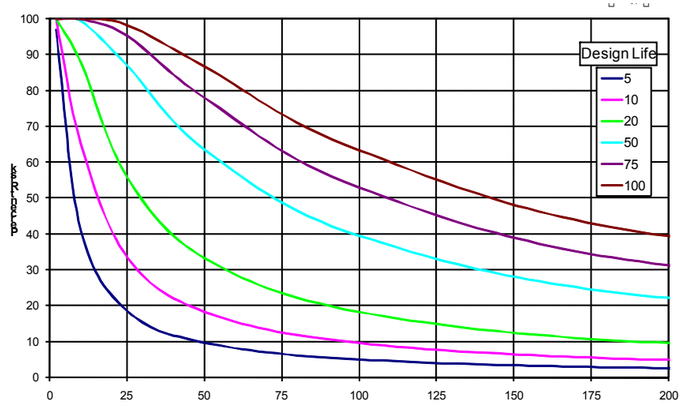


Figure 9: Risk of Event Occurring within the Design Life of a Structure

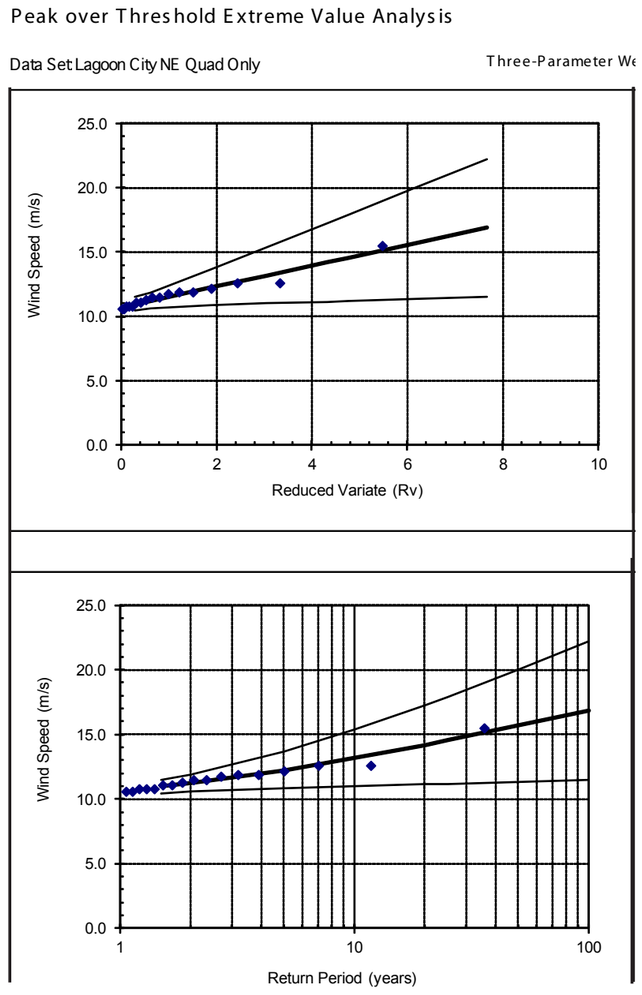


Figure 10: NE Wind Speed as a Function of Return Period based on the Three-Parameter Weibull Distribution

5.0 MARINA AND FLOATING BREAKWATER DESIGN CONSIDERATIONS

5.1 Wave Criteria for Marinas

There are no universal criteria defining acceptable performance of a marina with respect to wave agitation (Fisheries and Oceans, 1992). Ultimately, this is a decision for the marina operator and users. Threshold wave height and frequency of occurrence criteria are a balance between performance and cost. Typically, improved performance (such as very infrequent wave action in the basin) means higher costs for protection structures. Factors to consider when evaluating performance requirements include:

- Type and size of boats;
- Type of docks;
- Requirements and expectations of marina users; and
- Degree of risk of unacceptable performance that the owner accepts.

Isaacson, Kennedy and Baldwin (1996) report that a design wave height of 0.3 m is often cited as the maximum allowable Hs inside a marina under normal operation conditions. This implies a consideration of frequency of exceedance. Further, they note that since small craft are particularly sensitive to beam waves, additional wave agitation criteria also include the influence of wave direction and wave period. Typical recommended criteria from ASCE (2000, 1994) include a yearly maximum Hs of less than 0.3 m and a 50 year return period wave event Hs of less than 0.6 m for head seas. Lower values are recommended for beam seas.

Based on the wave analysis provided in Section 4, a significant wave height of 0.6 m to 0.7 m could occur at the project site on an annual basis with wave heights of 1.25 m to 1.36 m under the 50 year event. This means a floating breakwater must be capable of providing a transmission coefficient of 0.46 for the 1 year event and the 50 year event.

5.2 Floating Breakwater Performance

Floating breakwaters have been considered in several of the marina expansion alternatives for Barrie Marina. They are less costly than traditional rubblemound breakwaters at this site, where the lakebed drops off steeply.

Floating breakwaters reduce wave energy through wave reflection, wave transformation and dissipation of wave energy. The ability of a floating breakwater to reduce wave energy in its lee is a function of several factors including the incident wave height and period, water depth and the natural oscillation of the breakwater. The performance is governed by the breakwater geometry and mass distribution, and the mooring system.

Floating breakwaters are generally effective for wave periods in the range of 3 seconds or less. For higher wave periods, the orbital velocities of the wave increase, creating larger forces on the breakwater. Where wave periods exceed the period of the breakwater oscillation, the waves are transmitted through the breakwater. Therefore, careful design and often modeling (numerical and/or physical) are required to assess the performance of the floating breakwater.

The effectiveness of a floating breakwaters is defined in terms of Kt, the transmission coefficient. Kt is defined as the transmitted wave height divided by the incident wave height. A higher Kt value indicates that the breakwater is less effective.

The Barrie Marina is exposed to wave periods in the range of 3.5 s during the 1 year event, and 4.5 s during the 50 year event. The breakwater would be located in depths in the range of 8 to 10 m. This is at the limit of the conditions for which floating breakwaters are generally effective.

Various types of floating breakwater systems are available including pontoon, caisson and perforated wall. There are also a number of manufacturers. Two manufactures were consulted with regards to application of their system at the Barrie Marina:

- RIXO-bryggan (Bohusgjuteriet Ab, Sweden)
- KROPF (Parry Sound, On, Canada)

RIXO-bryggan floating breakwaters, manufactured in Sweden and shown in Figures 5.1 and 5.2, have been installed at numerous locations around the world, including the North Sea and the Mediterranean. The manufacturer was provided with site location information including site maps, bathymetry and the wave conditions described in Section 4. RIXO indicated that the predicted wave periods are beyond the capabilities of floating breakwaters in general, and their standard product. They also noted concerns with exposure to ice. This is consistent with Baird's findings.

KROPF floating breakwaters have been installed at various locations around North America including Kingston, Ontario and on Lake Champlain in Vermont. The manufacturer was provided with site location information including site maps, bathymetry and the wave conditions described in Section 4. KROPF recommended their largest floating breakwater, a diffuser attenuator shown in Figures 5.3 and 5.4, with the following specifications:

- 5/16" x 34" spiral-welded steel floatation pipes
- Welded HSS crossers cut through pipes with saddle plates
- Diffuser baffle system below pipes
- 12' wide main attenuator sections with maximum lengths possible for specific layout
- 30' stabilizing fingers on lee side of attenuator to increase effective width
- Rugged tire connection system
- Steel catwalks for service work only – no decking
- 27 six ton anchor blocks
- System anchored with a combination of 5/8" Gr 100 chain and 1" Amsteel rope
- Submersion option for winter storage (requires approximately 2 days labour for 4 man crew)
- Supplied, delivered, and installed by Kropf Industrial Inc.
- The approximate cost for this floating breakwater is $6,000 - $7,500 per linear metre.

The manufacturer claims that the diffuser attenuator will provide a Kt value of 0.2 to 0.3 for waves periods of 3 s or less. During extreme events such as the 1 year and 50 year events defined in Section 4, the manufacturer predicted a Kt in the range of 0.7. This would result in wave heights of 0.5 m in the marina during the 1 year event, and 0.9 m during the 50 year event.

The manufacturer further recommend that the docks behind the attenuator be well-constructed steel tube docks as other dock designs, such as aluminum or wood frames, may be damaged during storm events, based on the predicted wave heights. During the winter season, the manufacturer recommended that docks located behind the floating breakwater should be relocated behind the rubblemound breakwaters.

6.0 SUMMARY AND RECOMMENDATIONS

6.1 Summary

- A coastal analysis has been completed to define the wave climate offshore of the Barrie Marina, in order to determine whether floating breakwaters can provide adequate protection to the marina;
- Water levels from three gauges on Lake Simcoe were used to define extreme water levels on the lake. The predicted 1.5 and 50 year return period water levels are 0.46 m and 0.64 m above Chart Datum. These values were used in the wave modelling.
- Wind data from three stations were reviewed and used to define extreme winds for the boating season. The 18 year wind record from Lagoon City was corrected using the more representative buoy data, and used to predict extreme wind events. The annual wind speed from the NE, which represents the longest fetch exposure for Barrie Marina was determined to be 11 m/s, while the 50 year return period event was estimated to be 16 m/s.
- Design waves were developed at the project site using a combination of numerical and desktop methods. The MIKE21 SW spectral wave model predicted a significant wave height of 0.6 m to 0.7 m could occur at the project site on an annual basis with wave heights of 1.25 m to 1.36 m under the 50 year event. This is based on relatively consistent NE wind events. Wave periods ranged from 3 to 5 seconds. These compare to a predicted 10 year wave of 0.45 m with a period of just over 3s in the more simplistic analysis undertaken in the first phase of the study.
- Floating breakwaters are generally effective for wave periods in the range of 3 seconds or less. Waves with larger periods can be transmitted through the floating breakwater.
- Although there are no universal criteria defining acceptable performance of a marina with respect to wave agitation, recommended criteria from ASCE (2000, 1994) include a yearly maximum Hs of less than 0.3 m and a 50 year return period wave event Hs of less than 0.6 m for head seas. Lower values are recommended for beam seas. Ultimately, this is a decision for the marina operator and users.
- The effectiveness of a floating breakwaters is defined in terms of Kt, the transmission coefficient. Kt is defined as the transmitted wave height divided by the incident wave height. A higher Kt value indicates that the breakwater is less effective.
- Two floating breakwater manufacturers were contacted and provided with the predicted wave conditions at the site. The Swedish manufacturer (RIXO-bryggan) concluded that the predicted wave periods are beyond the capabilities of their standard products. They also expressed concerns about exposure to ice.
- KROPF, out of Parry Sound concluded that their product would provide a Kt value of 0.2 to 0.3 for waves periods of 3 s or less. During extreme events such as the 1 year and 50 year events defined in Section 4, the manufacturer predicted a Kt in the range of 0.7. This would result in wave heights of 0.5 m in the marina during the 1 year event, and 0.9 m during the 50 year event. These wave heights exceed recommended wave heights for marinas and could result in damage to docks and boats.

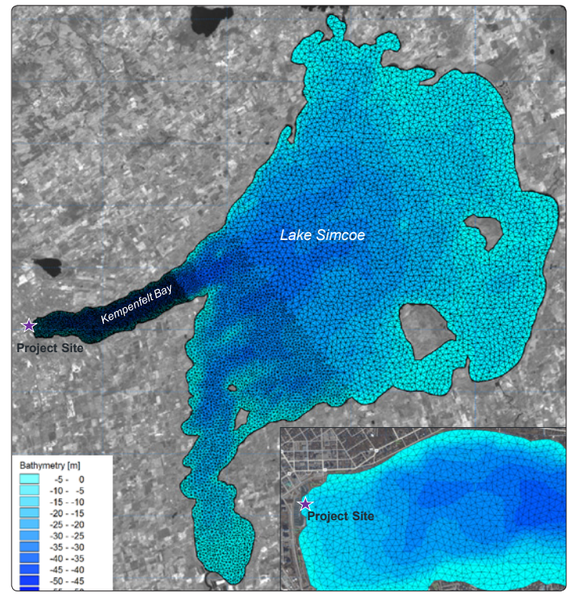


Figure 11: Numerical Model Mesh of Lake Simcoe (air photo courtesy of Bing)

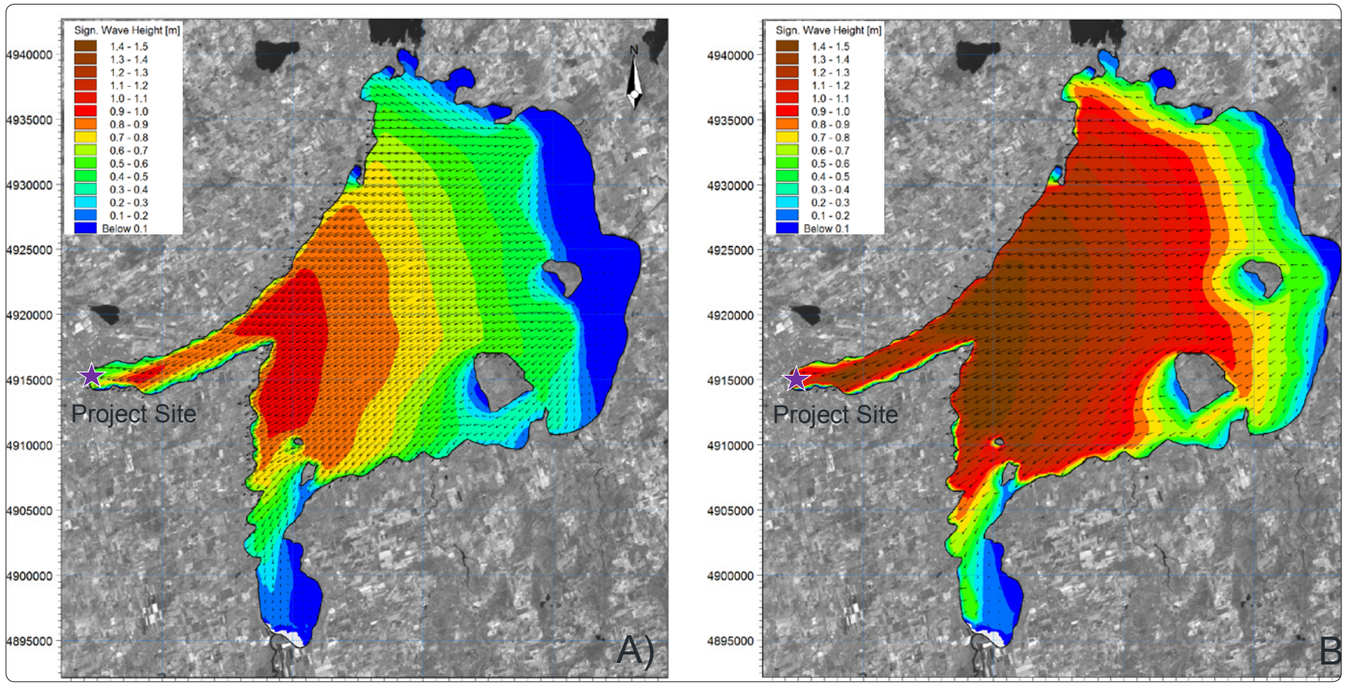


Figure 12: Map of Significant Wave Height under A) Annual Event and B) 50 Year Event?

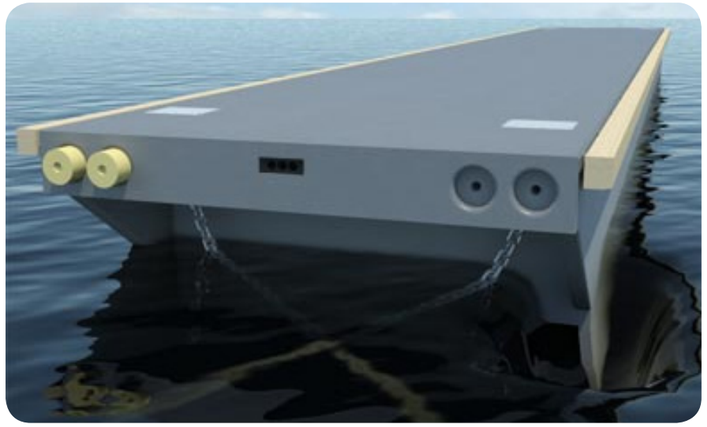


Figure 13: RIXO-bryggan Breakwater (photograph from www.rixo.com)



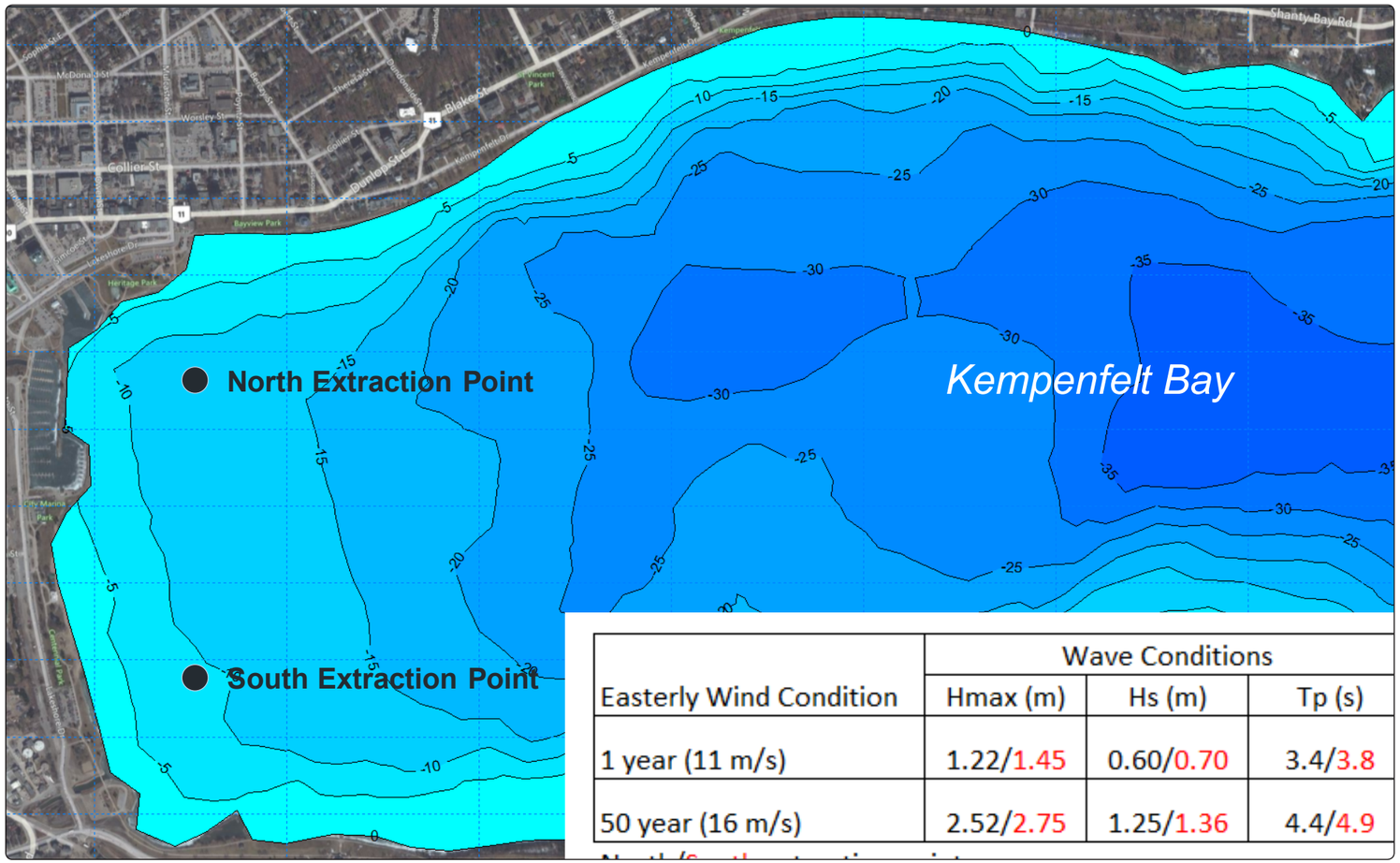
Figure 14: RIXO-bryggan Breakwater During Storm Event (photograph from www.rixo.com)



Figure 15: KROPF Diffuser Attenuator (photograph curtsy of KROPF



Figure 16: KROPF Diffuser Attenuator in Kingston, Ontario (photograph curtsy of KROPF)



Easterly Wind Condition	Wave Conditions		
	Hmax (m)	Hs (m)	Tp (s)
1 year (11 m/s)	1.22/1.45	0.60/0.70	3.4/3.8
50 year (16 m/s)	2.52/2.75	1.25/1.36	4.4/4.9

Figure 17: Predicted Wave Conditions at the Project Site for the Annual and 50 year Wind Events (air photo courtesy of Bing)

6.2 Recommendations

- Based on the predicted waves at Barrie Marina, standard floating breakwater products do not provide sufficient protection from extreme wave events.
- There are concerns with exposure to ice and it is recommended that the floating breakwaters would have to be stored in a sheltered location for the winter.
- The level of confidence in the predicted wave climate would be improved, if the model were calibrated with measured wave data. This would require deployment of a wave recorder in Kempenfelt Bay.
- Updated bathymetry data, particularly in the vicinity of, and immediately offshore of the marina would be beneficial for future analyses

7.0 REFERENCES

ASCE Task Committee on Marinas 2000, 1994. Planning and design guidelines for small craft harbours. American Society of Civil Engineering Manual and Reports on Engineering Practice, No. 50.

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