June 2019

High Water Impacts Research on Lake Ontario and St. Lawrence River — Marinas and Yacht Clubs FINAL RESULTS

Prepared for the International Joint Commission
by LURA Consulting

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1. EXECUTIVE SUMMARY

2017 presented challenges for industry and businesses located along the shorelines of Lake Ontario and the St. Lawrence River. A very wet spring led to record high water levels on both Lake Ontario and the St. Lawrence River which resulted in flood and erosion damage to a variety of shoreline properties.

The IJC's Great Lakes St. Lawrence River Adaptive Management (GLAM) Committee has prepared a review of impacts across all sectors that were affected by high water levels in 2017 as well as an assessment of how the regulation of outflows from Lake Ontario impacted levels throughout the system, available here. Based on the availability of impact information for the GLAM Committee's report on 2017 conditions, the need for additional data collection was identified for a number of sectors. The GLAM Committee retained LURA Consulting to gather relevant information about 2017 high water impacts through surveys for two target groups: 1) recreational boating interests (marinas and yacht clubs), and 2) municipal water and wastewater operators and industrial facilities on the shorelines of Lake Ontario and the St. Lawrence River (downstream to Trois-Riviere).

The objectives of the research regarding high water level impacts on marinas and yacht clubs were:

1. To comprehensively assess the negative and positive impacts on Lake Ontario and St. Lawrence River marina and yacht clubs due to high water levels in 2017, the extent of those impacts, and critical water level thresholds for these respondents;

2. To understand the adaptive responses taken by marinas and yacht clubs during and after 2017 high water levels; and,

3. To accumulate data that will be used to help validate and/or improve existing models and support long-term activities to review regulation plans guiding water levels and flows in the Lake Ontario–St. Lawrence River System.

An exhaustive search was undertaken to identify potential respondents (marinas and yacht clubs) within the Lake Ontario-St. Lawrence River System. A total of 389 potential respondents were identified, with 189 potential respondents in New York State, 147 in Ontario, and 53 in Quebec.

Data collection occurred through an online survey, which was promoted through various means such as an official invitation (and later on, reminder) letter/email from the GLAM Committee, distribution through various umbrella organizations, direct phone calls to potential respondents, a web page on the GLAM Committee website. For this target audience, the passive approach of letters and emails proved to be far more effective in soliciting responses than the active approach of phone calls. Given that research efforts were occurring during the boating offseason, it could be that many facility owners, managers, commodores, etc. were not in the office or near the phone, but still monitoring emails. Though this is an assumption, and cannot be confirmed, it is recommended that any similar future research efforts be undertaken before the boating season draws to a close, to ensure respondents' facilities are open when outreach efforts are made.

This report details the findings of the 106 marinas and yacht clubs that responded to the survey respondents. Key findings from the survey include:

- The majority of respondents (81.7%) reported a “negative impact” to their facility’s operations. An additional 13.5% of respondents reported “both negative and positive impacts”. Five respondents indicated “no impact” or “positive impact”.
- Of those reporting impacts – 100 unique respondents reported impacts – “erosion of shorelines”, “submerged boat launch ramps” and, “flooding of fixed docks” were the most commonly cited impacts.
- When reviewing the total number of impacts reported by month, the highest number of impacts were reported in May (590 impacts reported), followed by June (562 impacts reported) and July (456 impacts reported). The overall number of impacts reported decreased throughout the late summer and fall.
- The largest number of respondents reported using the same number of boat slips as in a typical year, followed by ¾ of the slips used in a typical year. The number of respondents reporting typical usage increased over the course of the summer and into fall.
- The largest number of respondents in May and June had fewer boats moored compared to a typical year. The number of respondents reporting usage the same as in a typical year increased throughout the season.
- In terms of total revenue, the largest number of respondents reported ¾ of typical revenue earned during May/June. The number of respondents reporting the same amount of revenue as a typical year grew in July/August and again in September/October, representing the highest number of responses in both time periods.
- With respect to revenue from fuel sales, the largest number of respondents reported ¼ of typical revenues during May/June. The largest number of respondents reported ½ of typical revenue during July/August, shifting to typical revenues in September/October.
- In all months studied, the number of visiting vessels was reported as less than in a typical year. The situation improved only slightly throughout the season.
- The number of social events were reported to be less than in a typical year for May/June and July/August, with the situation improving slightly in September/October.
- May and April were the most commonly cited “earliest dates” for boats in the water in all three years (2016 to 2018). In 2017, “earliest dates” peaked in April/May but extended into the summer months for some facilities.
- Respondents were asked to identify other factors they felt influenced the impacts described above during the 2017 high water levels. The most commonly identified factors were: high precipitation; wind; and, closed boat launches along the waterway.
- The average cost of actions taken in 2017 was $27,912.89, with cited costs ranging from $50 to $200,000. Seventy-four (74) respondents reported costs associated with actions taken in 2017, while 32 reported no cost.
- In terms of actions taken since 2017, the average cost was $128,358.33. In this case, costs ranged from $200 to $3,000,000. Sixty-six (66) respondents reported costs associated with actions taken in 2017, while 40 reported no cost.
- The largest percentage of respondents from all three shoreline zones felt that their operations and business was better in 2018 than in 2017 (74.4%).
- On a scale of 1 (low) to 10 (high), one-third of respondents (33.3%) rated the overall impact as a “10”. The average rating was 7.3. Over sixty percent of respondents (62.2%) rated the overall impact as an 8, 9 or 10.

2. BACKGROUND

2.1. Background

2017 was a challenging year for industry and businesses located along the shorelines of Lake Ontario and the St. Lawrence River. A very wet spring led to record high water levels on both Lake Ontario and the St. Lawrence River which resulted in flood and erosion damage to a variety of shoreline properties.

The Great Lakes St. Lawrence River Adaptive Management (GLAM) Committee has prepared a review of impacts across all sectors that were affected by high water levels in 2017 as well as an assessment of how the regulation of outflows from Lake Ontario impacted levels throughout the system, available here. The GLAM Committee was established by the IJC in 2015 to examine the effectiveness of the existing rules for regulating the outflows from Lake Superior and Lake Ontario. It is also charged with looking at the impacts of past, present and potential future weather and climate conditions on water levels and outflow regulation, and how these factors affect different user groups throughout the Great Lakes-St. Lawrence River system. The GLAM Committee directive is provided on its website. The International Lake Ontario – St. Lawrence River Board urges everyone to be prepared to live within the full range of levels that have occurred in the past and of those that may occur in the future, recognizing that future climate conditions are uncertain, and more extreme water levels may be reached.

Based on the availability of impact information for the GLAM Committee's report on 2017 conditions, the need for additional data collection was identified for a number of sectors. The GLAM Committee retained LURA Consulting to gather relevant information about 2017 high water impacts from two target groups: 1) recreational boating interests (marinas and yacht clubs), and 2) municipal water and wastewater operators and industrial respondents on the shoreline.

There is indication from past surveys and research undertaken by the GLAM Committee as part of its report on 2017 conditions that the 2017 high water levels caused disruption in service or temporary closing of marinas and yacht clubs due to inundation of fixed docks, damaged electrical hook-ups, flooding of buildings, shoreline erosion, and other impacts. The current research will conduct a systematic examination of these impacts including: a) physical damage to respondents; and b) lost boating opportunity due to flooding of docks and boat slips, launches, gas stations and other respondents, and associated loss of business.

To enhance this understanding, extensive efforts were undertaken by LURA Consulting between January and March 2019 to survey marinas and yacht clubs on the shorelines of Lake Ontario and the St. Lawrence River. The survey was open from January 23, 2019 to April 5, 2019 (extended from the initial deadline of March 8, 2019). This report details the findings of this survey. Ultimately, the information collected will be used by the GLAM Committee to help improve the models used to assess the regulation of Lake Ontario outflows under a range of actual and potential future climate conditions.

2.2. Research Objectives and Questions

The objectives of the research regarding high water level impacts on marinas and yacht clubs were:

1. To comprehensively assess the negative and positive impacts on Lake Ontario and St. Lawrence River marina and yacht clubs due to high water levels in 2017, the extent of those impacts, and critical water level thresholds for these respondents;

2. To understand the adaptive responses taken by marinas and yacht clubs during and after 2017 high water levels; and

3. To accumulate data that will be used to help validate and/or improve existing models and support long-term activities to review regulation plans guiding water levels and flows in the Lake Ontario–St. Lawrence River System.

Key overarching questions that guided the research included:

1. What physical damage to respondents did yacht clubs and marinas experience due to high water levels in 2017 (month-by-month)?
2. How did the high water levels affect operations and revenue (negatively and positively) due to high water levels in 2017 (month-by-month)?
3. What adaptive responses did the facility take during the 2017 high water conditions to maintain operations?
4. What adaptive responses has the facility taken after the 2017 high water conditions to protect against future impacts?
5. Did the impacts of the high water levels in 2017 result in the facility re-assessing critical water thresholds?

The full approach to the survey and full set of questions within it is available as Appendix A.

2.3. Target Survey Audience

The key groups that were targeted for this survey included:

Marinas	Private or publicly-owned respondents allowing recreational watercraft access to water and offering mooring and other related services. These respondents are typically for-profit companies or municipal owned and operated respondents.
Yacht Clubs	Member-owned respondents allowing access to docks or mooring to recreational boaters, and often offering complementary services. Yacht club respondents are typically operated by a volunteer Board of Directors and are run as non-profit enterprises.

The geographic scope of these target audiences includes respondents located on the Canadian and United States shorelines of:

Lake Ontario	One of the five Great Lakes, bordered on the north and west by the Province of Ontario, and the south and east by the State of New York.
Upper St. Lawrence River	The portion of the St. Lawrence River upstream of the Moses-Saunders Dam at Cornwall, ON and Massena, NY is called the upper St. Lawrence River. It includes the entire river from Kingston/Cape Vincent to the power dam and locks at Cornwall-Massena, including Lake St. Lawrence.
Lower St. Lawrence River	The portion of the St. Lawrence River downstream of the Moses-Saunders Dam is called the lower St. Lawrence. It includes Lake St. Francis, Lake Saint-Louis, Montreal Harbour, Lac St. Pierre and the portions of the River connecting these lakes as far downstream as Trois-Rivieres, Quebec.

2.3.1. Sample Selection

A pre-existing list of marinas and yacht clubs on Lake Ontario and the St. Lawrence (developed in 2005 and updated in 2018) was the starting point for identifying respondents to reach out to regarding the survey. This was complemented with a number of other documents and sources, including:

- A New York State marina inventory report from a researcher at Cornell University;
- A review of Ontario Sailing's website;
- A review of the Lake Ontario Club Cruising Association website;
- A review of the U.S. Sailing website;
- A review of the Ontario Marinas and Marine Services of Lake Ontario website;
- A review of the Boating Ontario website;
- A review of the Quebec Sailing Federation website;
- A review of the Visit 1000 Island website;
- 'Ground truthing' via publicly available mapping software; and
- Internet searches to confirm whether a facility was still operational, and the completeness of previously documented information.

The number of identified respondents is summarized in Table 1, stratified by the three main geographic areas included in the study – the shorelines of Lake Ontario, the upper St. Lawrence River, and the lower St. Lawrence River. A total of 189 respondents were identified in New York State, 147 in Ontario, and 53 in Quebec.

Table 1: Number of yacht clubs and marinas in the study area

		Shoreline Location			
		Lake Ontario	**Upper St. Lawrence**	**Lower St. Lawrence**	**Total Number**
Type of Facility	**Yacht Clubs**	75	12	15	102
	Marinas	136	104	47	287
	Total	211	116	62	**389**

Table 2 displays the originally proposed target sample size for the survey. The number of respondents in each category was assigned proportionally across all three shoreline zones. respondents It is important to note that the information presented below does not represent a statistically representative sample, and the project scope never intended to generate a statistically significant sample. However, the sample identified below allowed for in-depth exploration of impacts on the diversity of respondents in the target group across the three geographical zones.

Table 2: Target number of responses from marina and yacht club operators

		Shoreline Location			
		Lake Ontario	**Upper St. Lawrence**	**Lower St. Lawrence**	**Total Number**
Type of Facility	**Yacht Clubs**	22	4	4	30
	Marinas	40	31	14	85
	Total	62	35	18	**115**

2.4. Methodology

2.4.1. Data Collection Approach

Data collection occurred through an online survey. The survey was available in English and French, and the French version was distributed as appropriate. The latitude and longitude for each responding facility was also documented in the database to connect responses to their geographical location. French responses were documented in a separate online platform, translated, and entered into the database in English for ease of analysis.

2.4.2. Promotion and Outreach Efforts

Official Letter/Email from GLAM Committee Introducing the Project

A formal letter/email was the first contact with marinas and yacht clubs and was sent to the full list of identified respondents via LURA Consulting. The letter/email included the GLAM Committee logo and outlined the importance of collecting the data about high water impacts in 2017 to support long-term activities to review existing regulation plans. It provided marinas and yacht clubs with the link to access the survey, and noted all respondents would be entered in a draw for one of two gift cards offered by LURA Consulting as an incentive. Letters/emails were sent in both English and French, as appropriate, on January 23, 2019. A copy is provided in Appendix A.

Umbrella Organizations

A host of umbrella organizations related to boating on Lake Ontario and the St. Lawrence River were contacted regarding promoting the survey to their member organizations. Of those that were contacted, Boating Ontario and Ontario Sailing distributed the survey to their contact lists.

Phone Contact

Attempts were made to reach respondents by phone between January 23, 2019 and March, 25 2019 – ahead of the closing date of April 5, 2019. Calls were made strategically to respondents where the sample was falling short of the identified target. Once the appropriate individual at a facility had been identified, the purpose of the survey and its importance were outlined for them, and they were invited to do the survey online at a time of their convenience. Calls were made in both English and French, as appropriate. GLAM Committee members also assisted in contacting potential respondents by email and phone.

GLAM Committee Website

Details of the survey were posted on the GLAM Committee website, inviting interested potential respondents to contact the GLAM Committee for information on doing the survey.

Official Reminder Letter/Email from GLAM Committee

A formal reminder letter/email was sent to the full list of identified respondents who had yet to complete the survey, reminding them to please do so, and that the closing date had been extended. Letters/emails were sent in both English and French, as appropriate, on March 4, 2019. A copy is provided in Appendix A.

2.4.3. Data Analysis Methods

Responses were collected via SurveyMonkey, in both English and French, as outlined above. Upon closure of the survey, all responses were exported into both MS Excel and PDF format. Responses included both quantitative and qualitative data.

First, data was reviewed in Excel to ensure completeness and consistency (i.e. removed duplicate or entirely incomplete responses, adding additional summary columns to aid in analysis). The latitude and longitude for each responding facility was also documented in the database to connect responses to their geographical location. Coordinates were located using Google Maps, based on the addresses provided by respondents.

Quantitative analysis was conducted in Excel, maintaining a "Master" tab with the complete dataset, and adding additional tabs for each question posed in the survey. Analysis was completed using a series of pivot tables to calculate count and percentage data, as applicable. Pivot charts were then used to present the data graphically. In some cases, multiple graphs were generated in order to best present the resulting information. Where applicable and appropriate, further analysis was conducted into correlations, exploring the data by month, facility type, location, and shoreline zone.

Qualitative analysis was conducted in NVivo – a purpose-built software for qualitative and mixed-methods[1] research. NVivo assists in managing and analyzing large datasets, and streamlines the identification of key themes emerging from qualitative data. First, the complete PDF of response data from SurveyMonkey was uploaded into NVivo software, and qualitative (open-ended) responses were categorized by question number. Again, working question-by-question, responses were "coded", manually identifying and highlighting key themes using thematic analysis techniques. Thematic analysis[2] is a method of data reduction, which involves summarizing and categorizing qualitative data such that the important concepts within the data set are captured. Once the thematic analysis was completed for each question, the collection of themes was used to formulate descriptive text to accompany the appropriate graphs (described above). The results of the coding are available in Appendix B.

The final step in the process was to present the quantitative and qualitative results together. Within this report, graphs have been presented with accompanying qualitative description, which builds upon the interpretation of the results. Additionally, respondents were invited to provide photographs from the 2017 high water event – these are available in Appendix C and are highlighted throughout the report.

[1] Where researchers analyze both qualitative and quantitative data in the same study
[2] Given, L. M. (Ed.). (2008). *The Sage encyclopedia of qualitative research methods*. Sage Publications.

2.4.4. Interpreting the Data

The overall approach taken to collect data for this project is referred to as purposive sampling[3]. This involves identifying a population of interest (marina and yacht club operators in this case) and developing a systematic way to obtain responses that is not based on any predetermined knowledge of what the responses or outcomes would be. The purpose of the research and data collection is to increase credibility, not to foster statistical representativeness.

It is important to note that the information presented below does not represent a statistically representative sample. This was not the intent of the research. However, the sampling approach described in Section 2.3.1 allowed for in-depth exploration of impacts on diverse respondents in the target audience across the three geographical zones. Further, it enabled a mix of quantitative and qualitative analysis on the extent and types of impacts experienced by marina and yacht club operators along Lake Ontario and the St. Lawrence River.

[3] Lavrakas, P. J. (2008). *Encyclopedia of survey research methods*. Sage Publications.

3. OVERVIEW OF RESPONSES

3.1. Response Rate

As shown in Table 3 (below), the overall response rate for the marinas and yacht clubs survey was one-hundred-and-six (n=106). This response represents 92% of the original target sample of 115. The lowest response rates came from marinas in the Lower St. Lawrence and Upper St. Lawrence areas.

Table 3: Response rate for marinas and yacht clubs

		Lake Ontario (Target)	Lake Ontario (Actual)	% of Target	Upper St. Lawrence (Target)	Upper St. Lawrence (Actual)	% of Target	Lower St. Lawrence (Target)	Lower St. Lawrence (Actual)	% of Target	Total Number (Target)	Total Number (Actual)	% of Target
Type of Facility	Yacht Clubs	22	37	168%	4	3	75%	4	6	150%	30	46	153%
	Marinas	40	38	95%	31	16	52%	14	6	43%	85	60	71%
	Total	62	75	**121%**	35	19	**54%**	18	12	**67%**	115	106	**92%**

Figure 1 (below) displays the response rate compared to the target sample. Geographically, the largest number of respondents were located on Lake Ontario (n=75). In terms of facility type, marinas were the most frequent respondents (n=60).

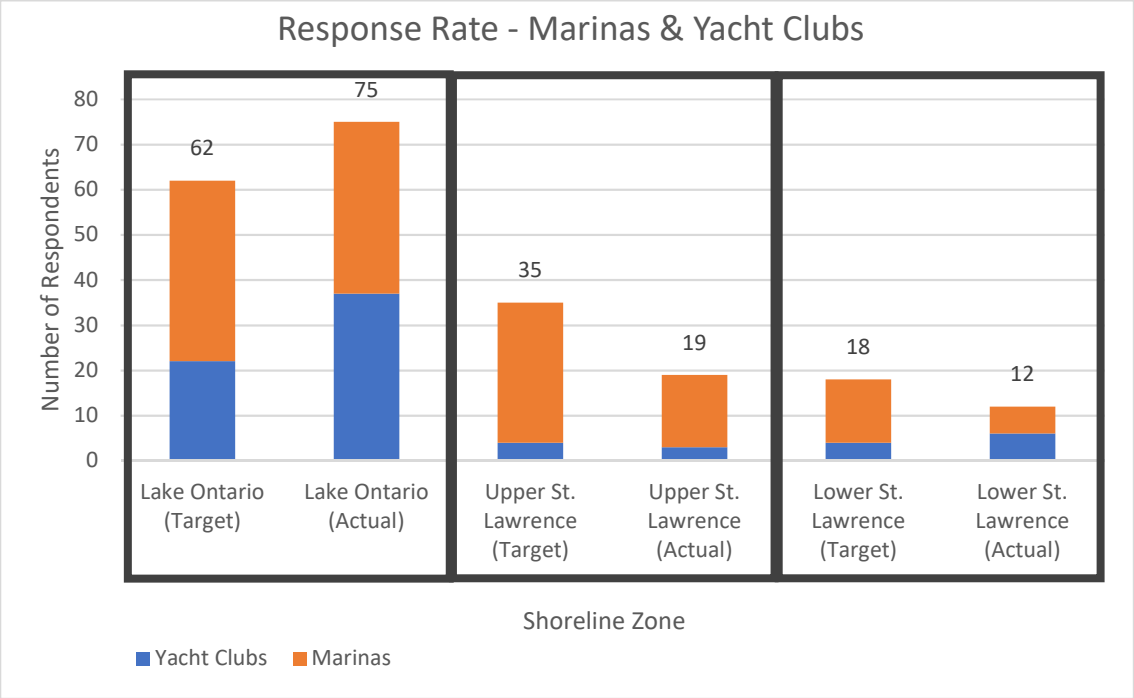

Figure 1: Response rate by facility shoreline zone and facility type (n=106)

4. CHARACTERISTICS OF RESPONDENTS

4.1. Respondents by Location

Figure 2 (below) shows each of the participating respondents based on their geographic location. Facility types are distinguished by colour.

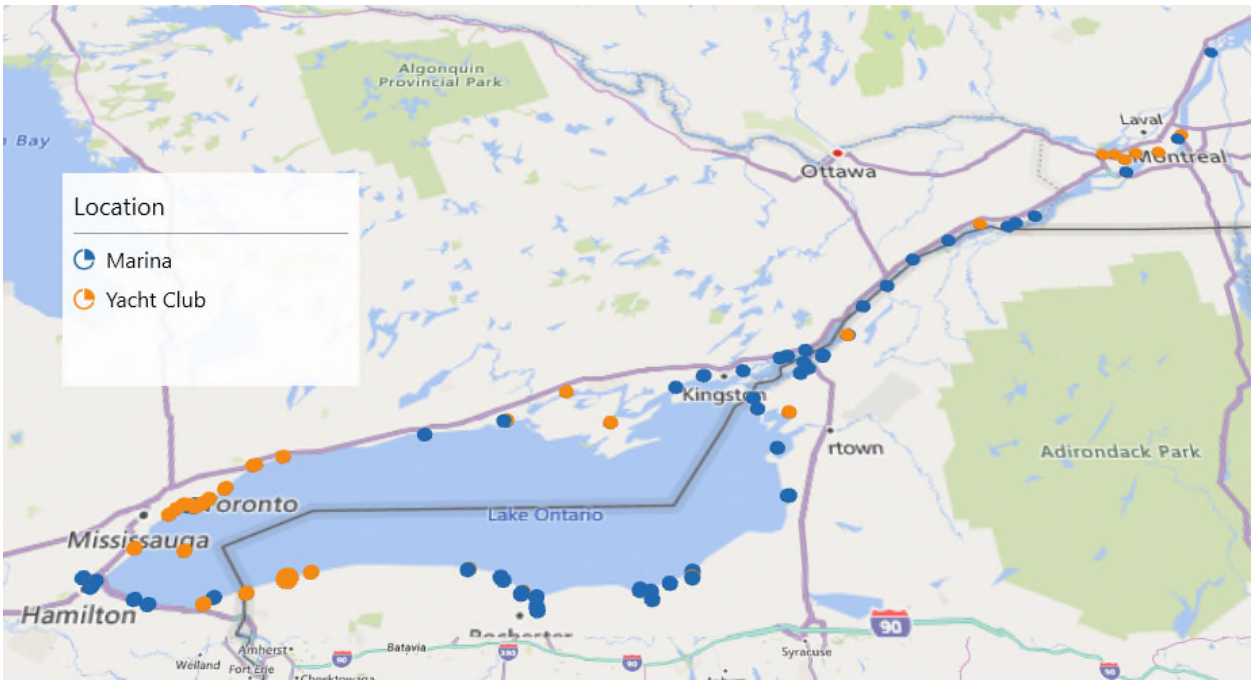

Figure 2: Map showing respondents by location and type

As shown in Figure 3 (below), the largest proportion of respondents were from yacht clubs in Ontario, and marinas in New York, both located on Lake Ontario. In comparison, the smallest number of responses came from marinas in Quebec, located on the Lower St. Lawrence River. Overall, fewer responses came from Quebec and the Lower St. Lawrence River.

It should be noted that only 16% of the total number of identified yacht clubs and marinas within the study area are located on the Lower St. Lawrence – representing a smaller pool of potential respondents. In comparison, 54% of the total number of yacht clubs and marinas within the study area are located on Lake Ontario, with the remaining 30% located on the Upper St. Lawrence River.

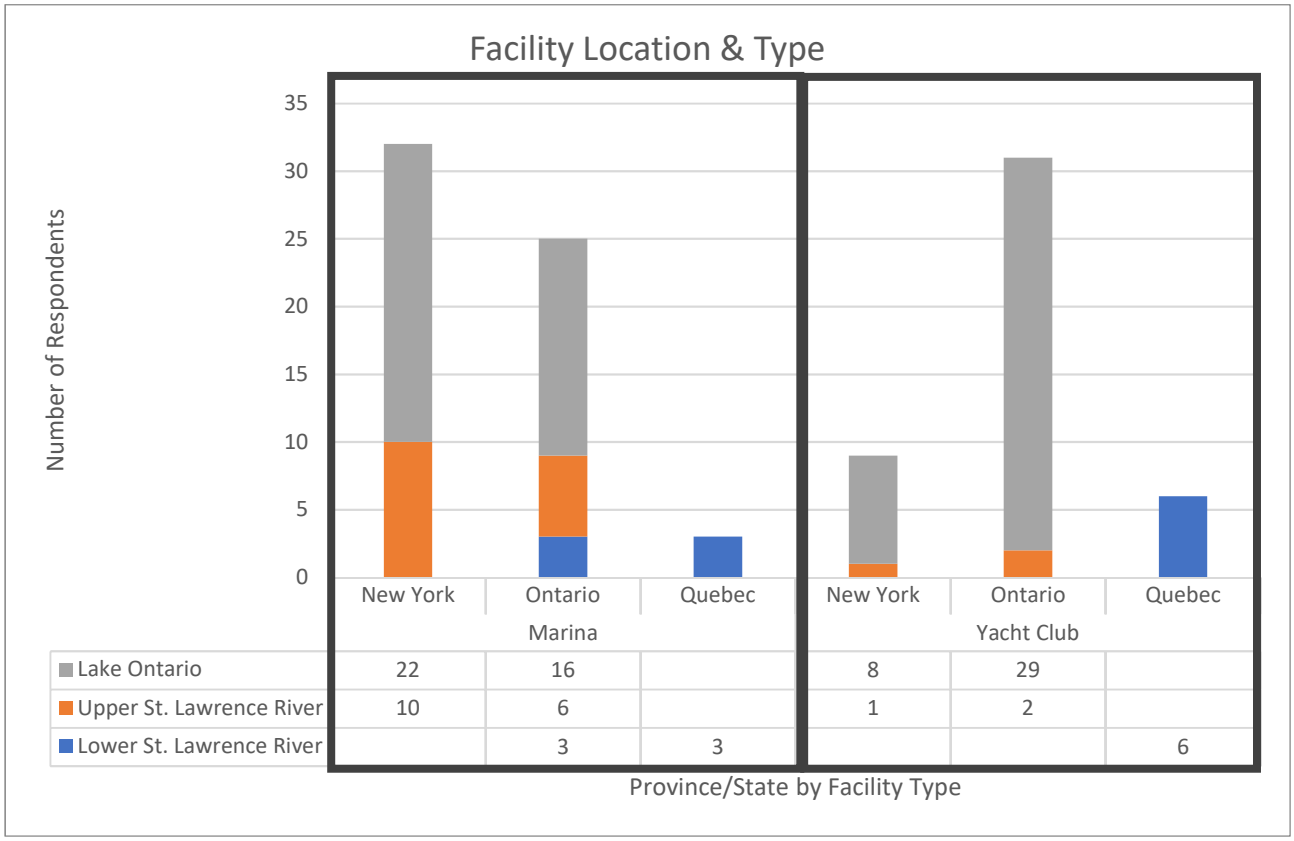

Figure 3: Responses by facility location and facility type (n=106)

4.2. Description of Respondents and Operations

Figure 4 (below) shows the *average* number: of boat slips; boats mooring in an average year; floating docks; and, fixed docks. Definitions are provided below.

Boat Slip	A space where a boat can be secured at a dock.
Mooring	Securing a boat to any secure structure.
Floating Dock	A dock which rises and falls with the water level; anchored but does not rest on the ground.
Fixed Dock	A dock which rests on the ground in the water.

On average, the respondents participating in this survey reported more floating docks than fixed docks. Excluding zeros, the ranges in these values are as follows: boat slips (2 – 400); boats mooring (6 – 1200); floating docks (1 - 350); and, fixed docks (1 - 222).

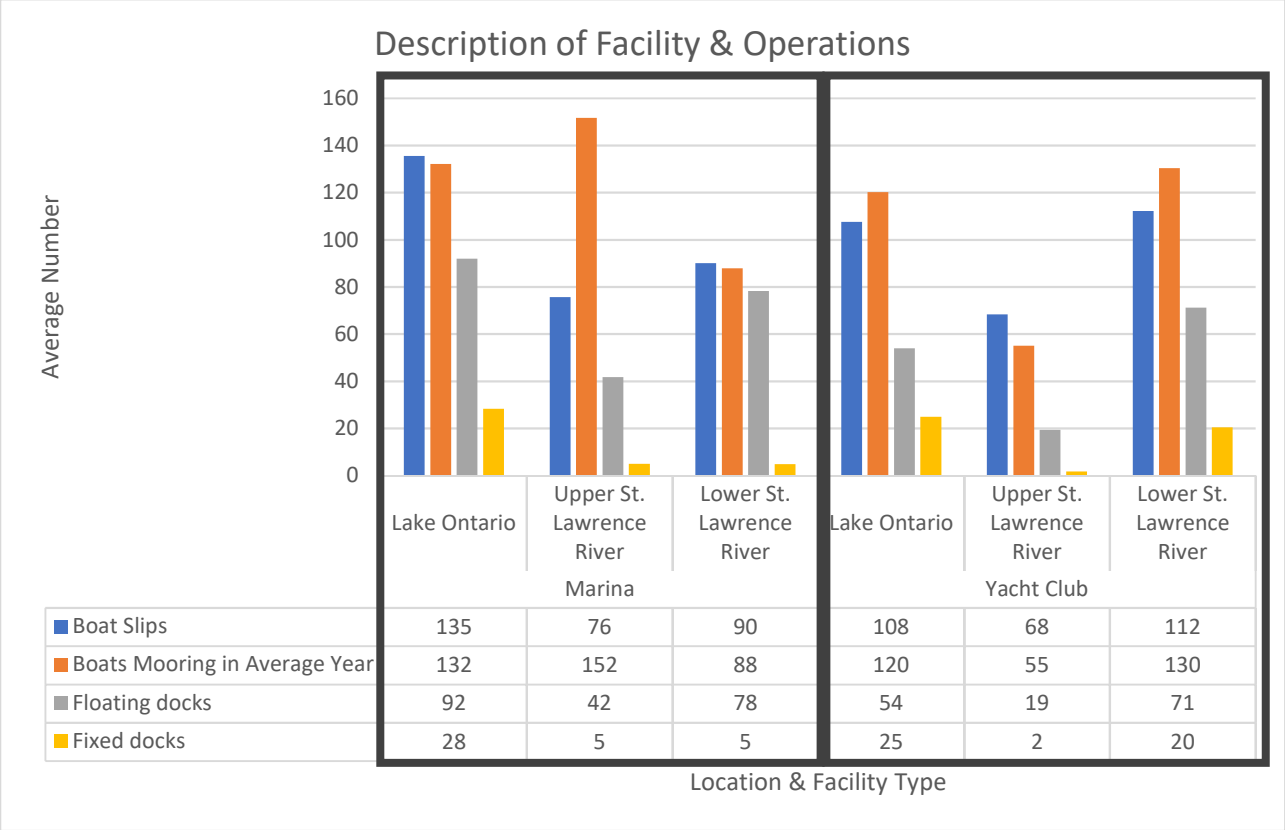

Figure 4: Description of respondents and operations, average values (n=106)

Respondents were categorized[4] based on the number of boat slips at their marina or yacht club. As shown in Figure 5 (below), the largest number of marinas and yacht clubs on Lake Ontario and the Upper St. Lawrence River have a small number of boat slips. The Lower St. Lawrence River sample contains a mix of respondents with both small and medium numbers of boat slips.

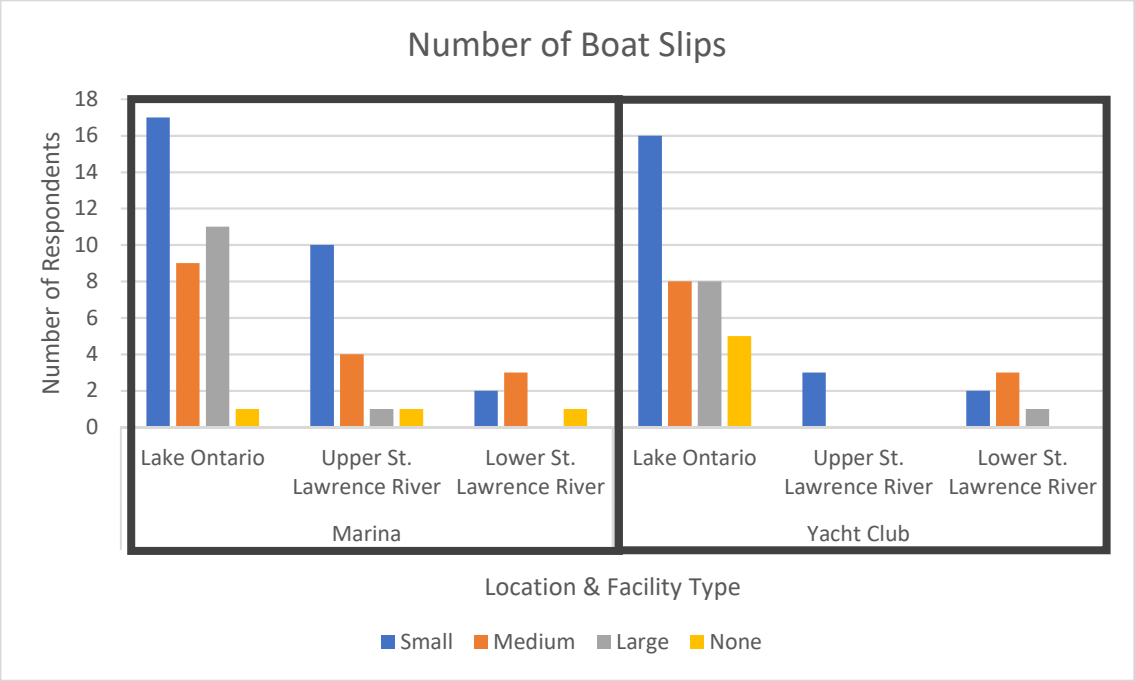

Figure 5: Description of respondents by number of boat slips (n=106)

[4] Number of boat slips was categorized as "Small" (1 – 99 slips); "Medium" (100 – 199 slips); and, "Large" (200 or more slips).

Next, respondents were categorized[5] based on the number of boats mooring at their marina or yacht club. As shown in Figure 6 (below), the largest number of marinas and yacht clubs on Lake Ontario and the Upper St. Lawrence River have a small number of boats mooring. The Lower St. Lawrence River sample contains a mix of respondents with both small and medium numbers of boats mooring (marinas), and respondents with a medium number of boats mooring (yacht clubs).

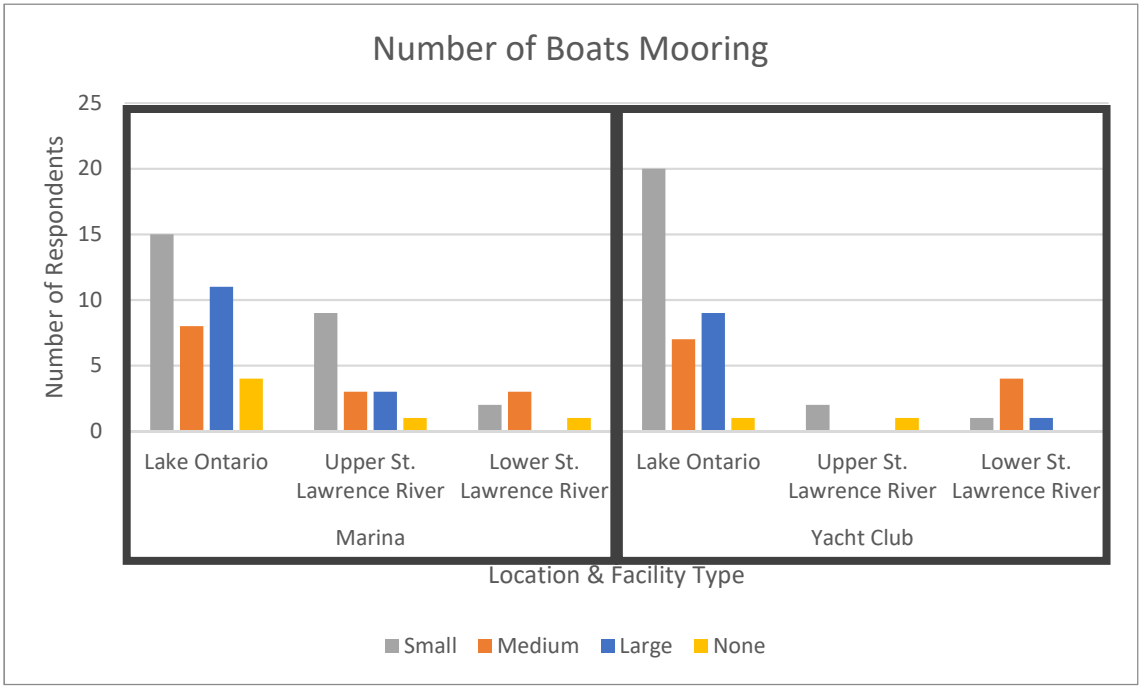

Figure 6: Description of respondents by number of boats mooring (n=106)

[5] Number of boat mooring was categorized as "Small" (1 – 99 mooring); "Medium" (100 – 199 mooring); and, "Large" (200 or more mooring).

Respondents were then categorized[6] by the number of floating docks at their marina or yacht club. For both marinas and yacht clubs across all three shoreline zones, the highest number of respondents reported a small number of floating docks.

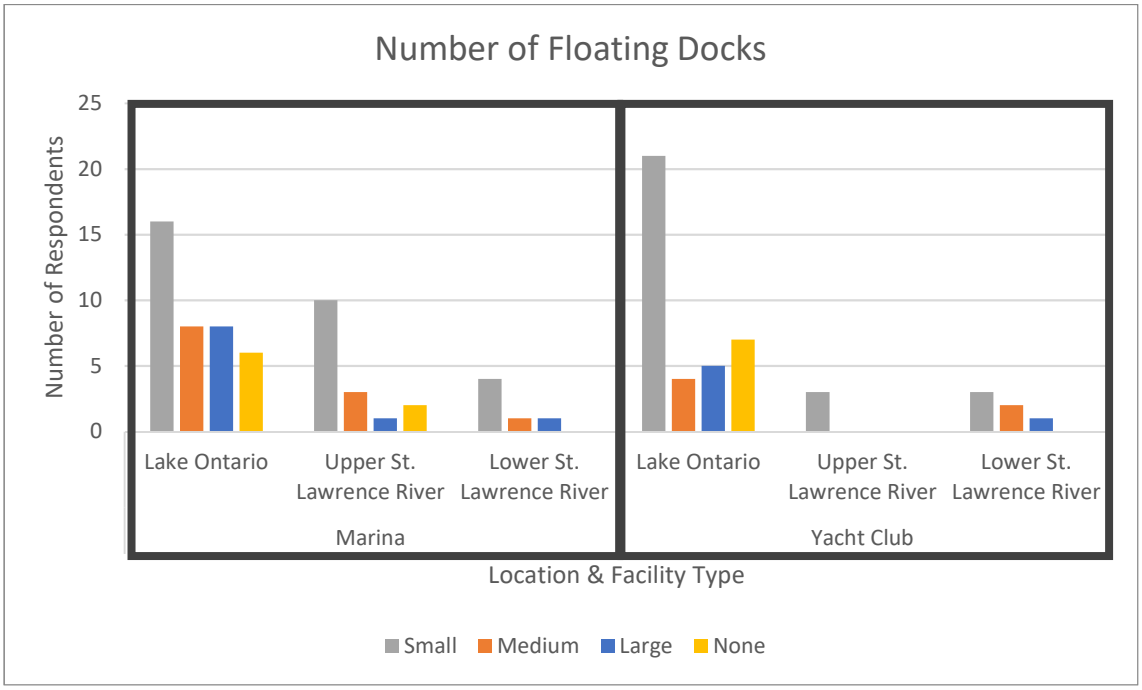

Figure 7: Description of respondents by number of floating docks (n=106)

[6] Number of floating docks was categorized as "Small" (1 – 74 docks); "Medium" (75 – 149 docks); and, "Large" (150 or more docks).

Finally, respondents categorized[7] by the number of fixed docks at their marina or yacht club. For both marinas and yacht clubs across all three shoreline zones, the highest number of respondents reported a small number of fixed docks.

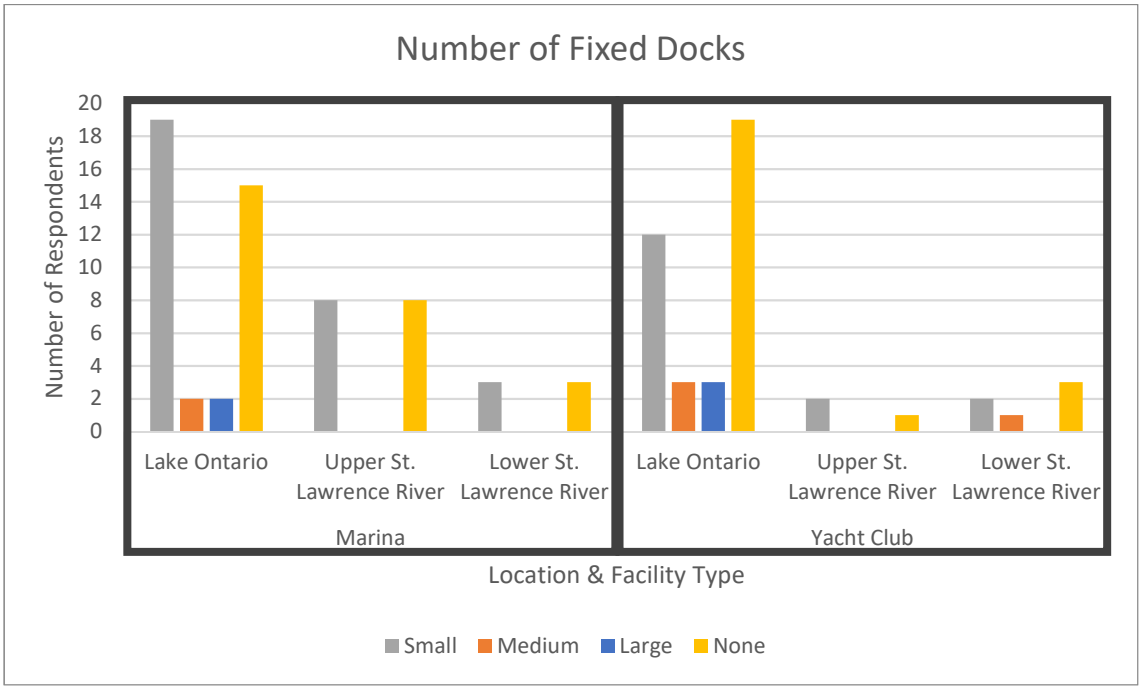

Figure 8: Description of respondents by number of fixed docks (n=106)

[7] Number of fixed docks was categorized as "Small" (1 – 74 docks); "Medium" (75 – 149 docks); and, "Large" (150 or more docks).

4.3. Services Offered

Among both marinas and yacht clubs, the most common services provided were: electricity hook-ups; boat storage; and, water hook-ups. The least common service was basement or below-grade storage. Forty-seven respondents reported other services offered by their respondents. These services include: sailing lessons and other recreational activities; launch ramps; boat rentals; mechanical services and repairs; general storage; washroom respondents; and, accommodations.

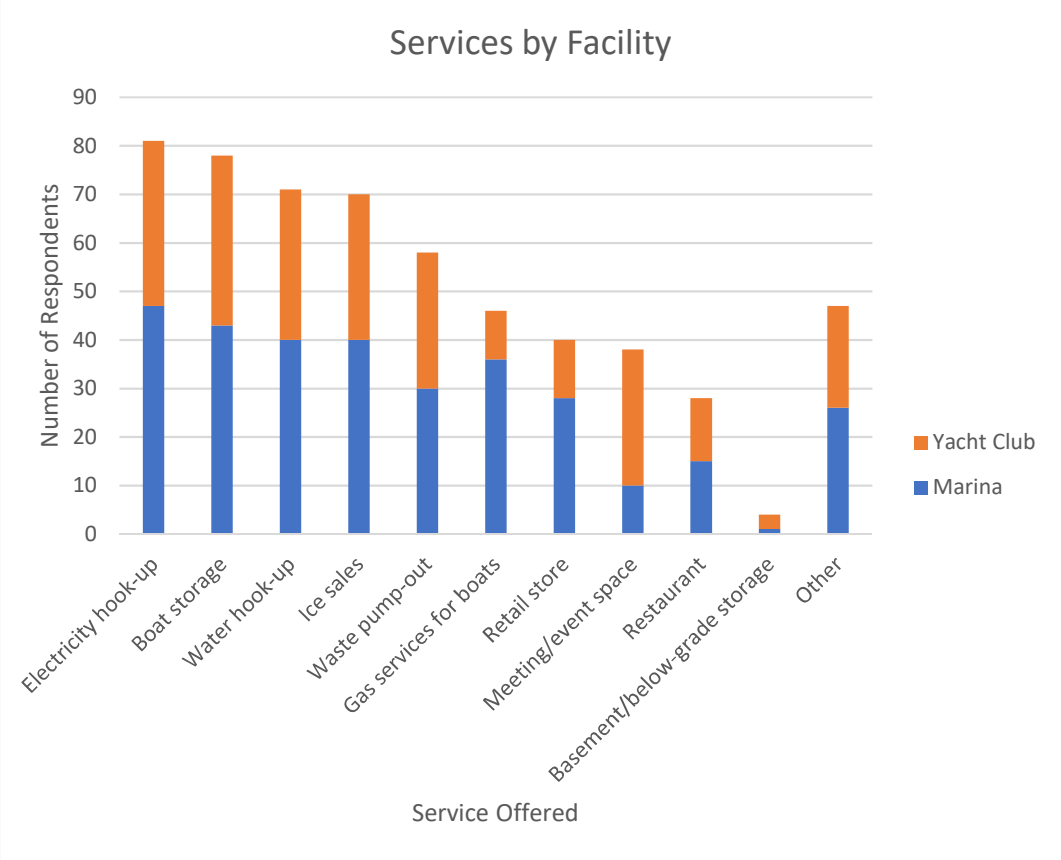

Figure 9: Services by facility type (n=106)

5. IMPACTS OF HIGH WATER LEVELS

5.1. Degree of Impact

Respondents were asked to identify the degree of impact that the 2017 high water levels had on their facility's operations. As shown in Figure 6 (below), the majority of respondents (81.7%) reported a "negative impact" to their facility's operations. An additional 13.5% of respondents reported "both negative and positive impacts". Five respondents indicated "no impact" or "positive impact".

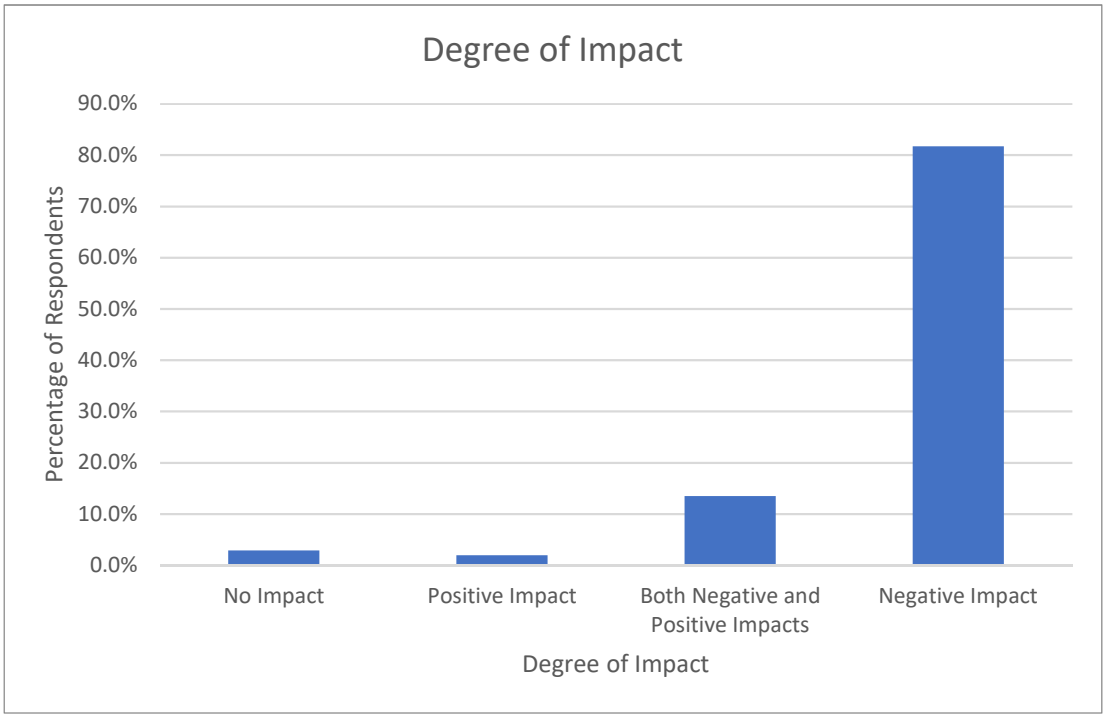

Figure 10: Degree of impact on respondents (n=104)

5.2. Experience of Physical Impacts

Next, respondents were asked to identify any physical impacts experienced during the 2017 high water levels. Figure 11 (below) displays the number of respondents reporting specific impacts at any point during the 2017 boating season (April to October for purposes of the survey). Of those reporting impacts – 100 unique respondents reported impacts out of the 106 that responded to the survey – "erosion of shorelines", "submerged boat launch ramps" and, "flooding of fixed docks" were the most commonly cited impacts.

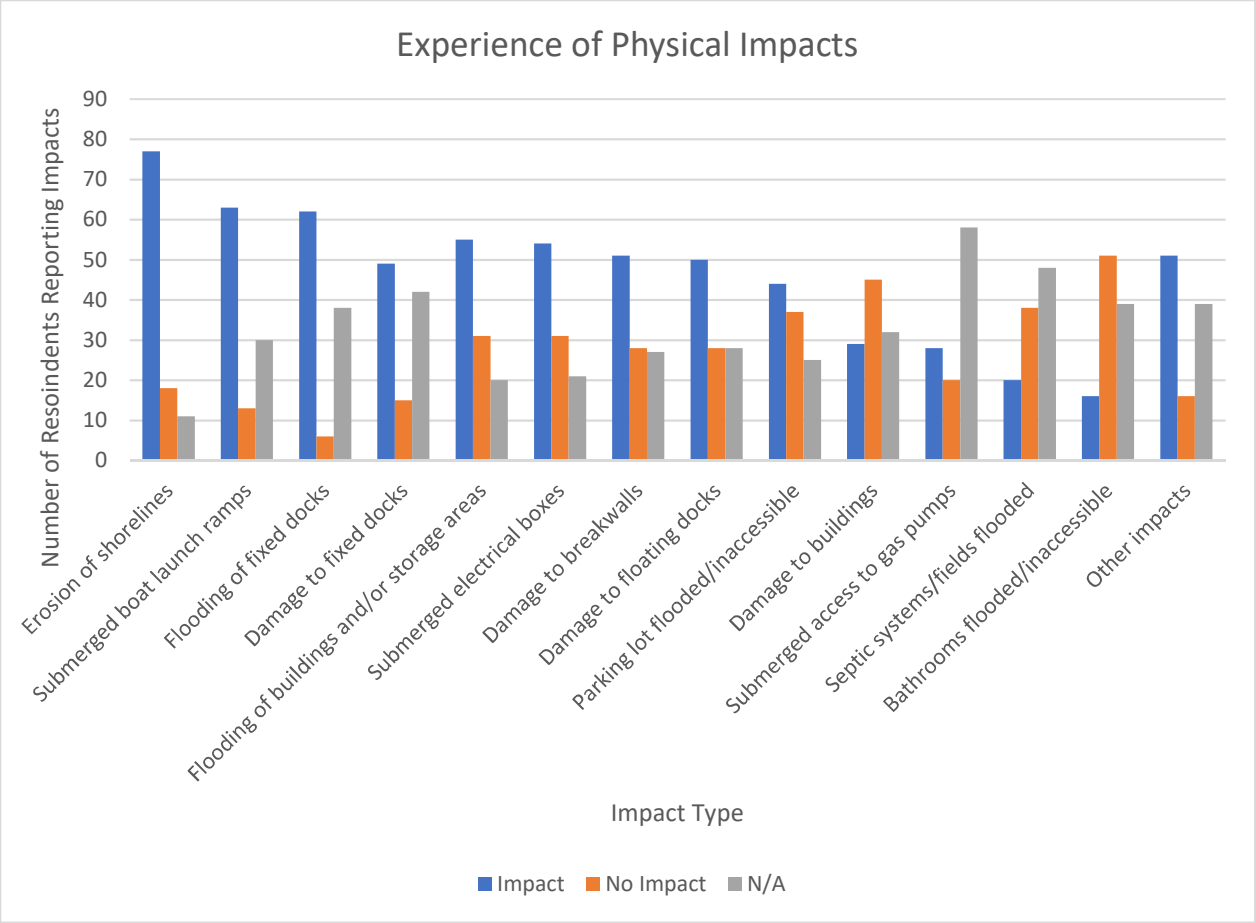

Figure 11: Experience of physical impacts on respondents (n=106)

Figure 11a (below) displays the experience of physical impacts by location. For reference, forty-one respondents were from New York, fifty-six were from Ontario, and nine were from Quebec. Among respondents from all three locations, “erosion of shorelines” was the most frequently cited impact.

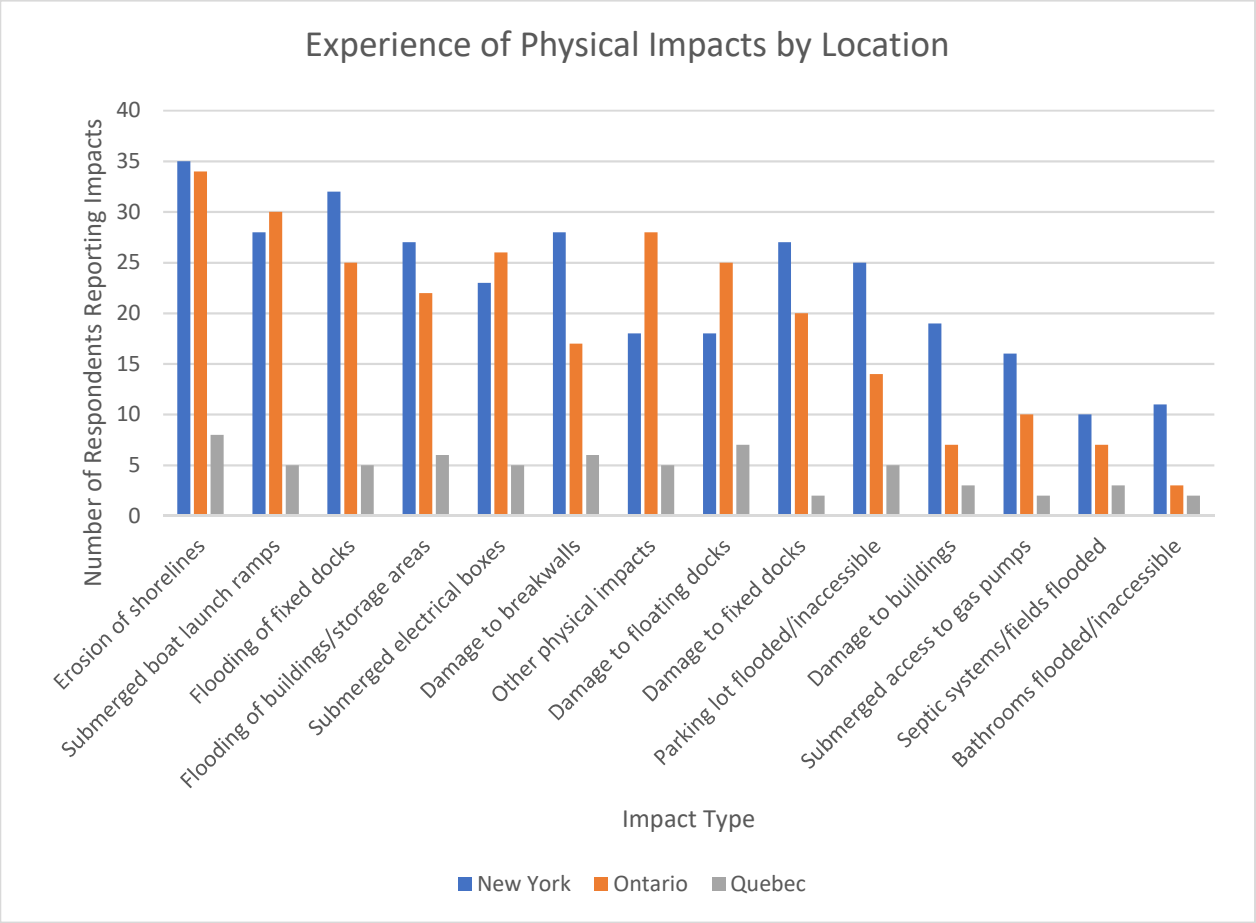

Figure 11a: Experience of physical impacts by location (n=106)

Where applicable, the following subsections include images that are representative of the associated impact. A compete collection of images submitted by respondents is provided in Appendix C.

Figure 12 (below) shows the number of different types of impacts (e.g., erosion of shorelines, submerged boat launch ramps, etc.) reported by respondents at any point in the season (i.e. the impact was reported in one or more months). As shown, 17 respondents reported five impacts out of a possible 14. The majority of respondents (52.8%) reported between four and eight impacts.

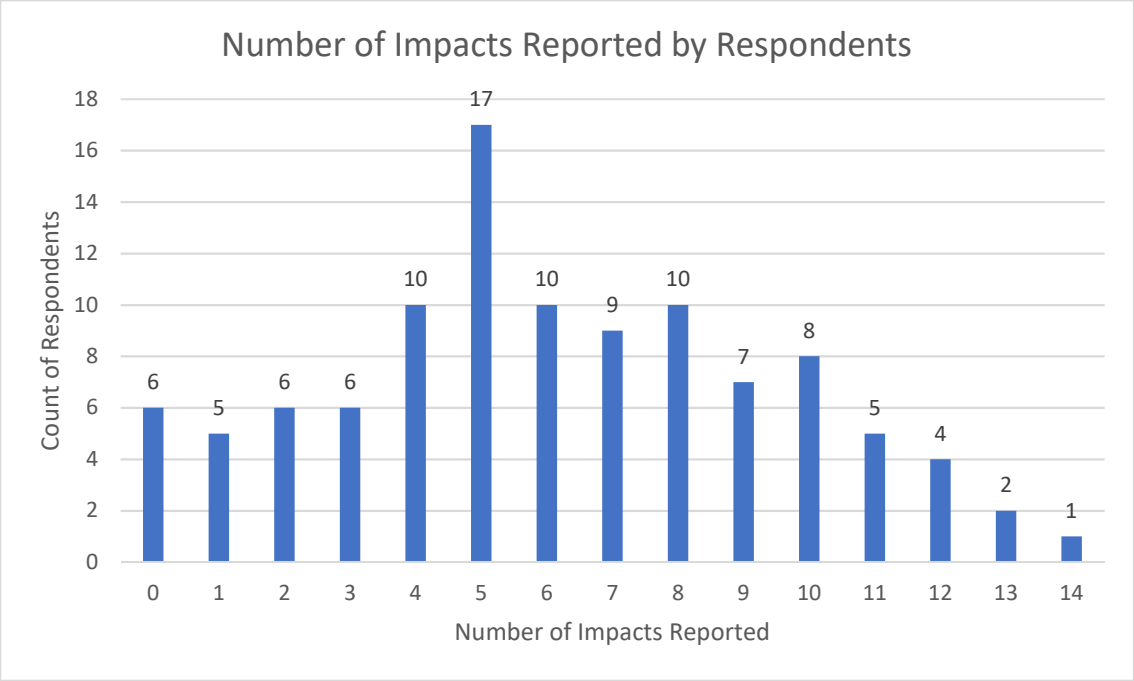

Figure 12: Number of impacts reported by respondents (n=106)

Figure 13 (below) shows the average number of different types of impacts reported at any point in the season by facility type and shoreline location. As shown, yacht clubs on the Lower St. Lawrence and marinas on Lake Ontario had the highest average number of reported impacts (over 7 impacts reported). Marinas on the Lower St. Lawrence River had the lowest average number of reported impacts (just over 3 impacts).

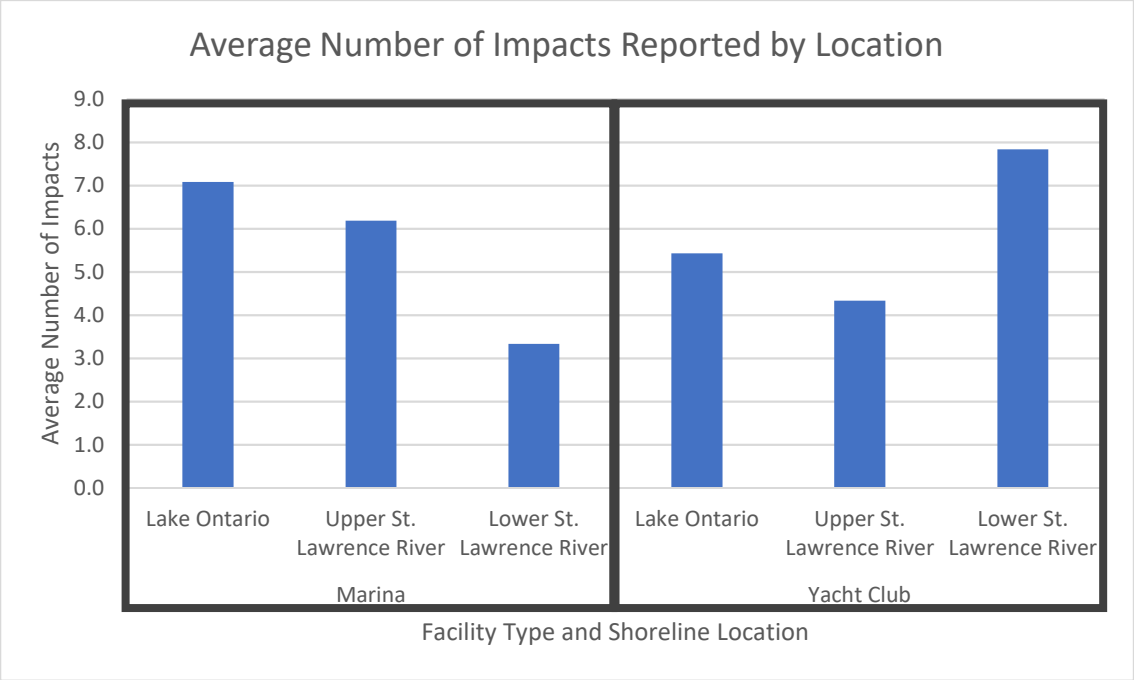

Figure 13: Average number of impacts reported by facility type location (n=106)

5.2.1. Erosion of Shorelines

Erosion of shorelines was most often identified during the months of May, June and July. Of the 95 respondents answering this question, 77 reported impacts in one or more months and, 18 reported no impacts associated with erosion of shorelines.

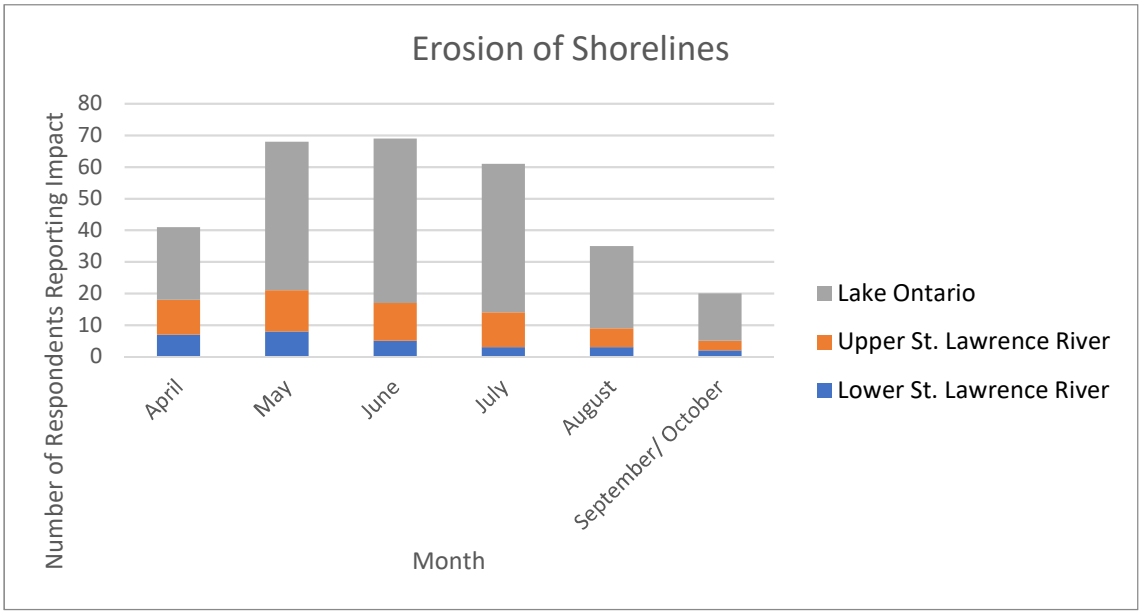

Figure 14: Erosion of shorelines per month (n=95)

Image 1: Sandbags holding back erosion (Photo Credit: RCR Yachts Inc.)

5.2.2. Submerged Boat Launch Ramps

Submerged boat launch ramps were most often identified during the months of May and June, followed by July. Of the 76 respondents answering this question, 63 reported impacts in one or more months and, 13 reported no impacts associated with submerged boat launch ramps.

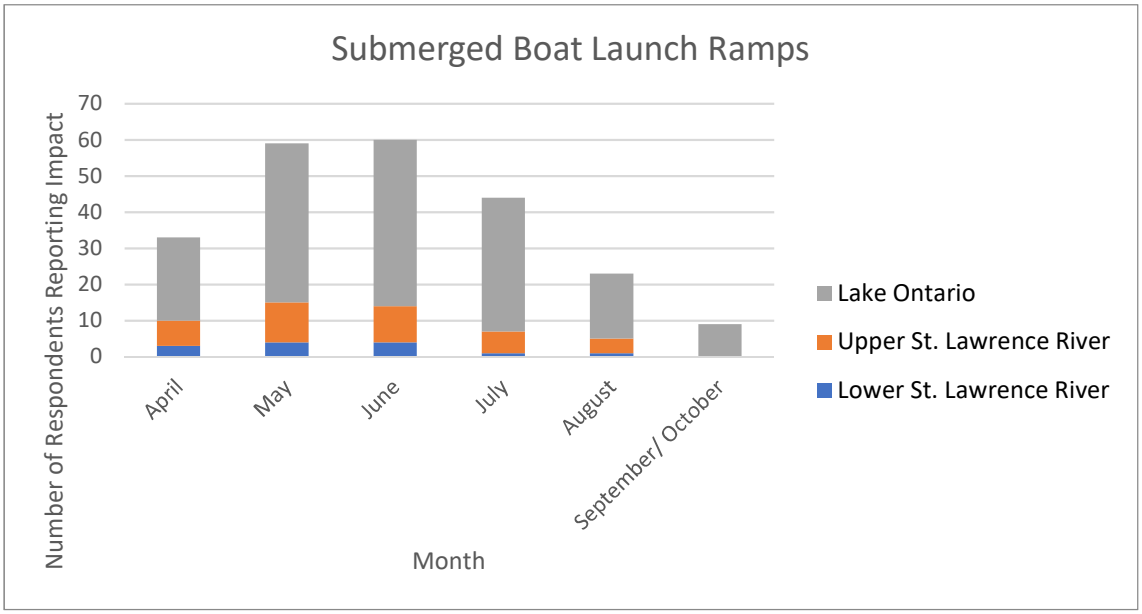

Figure 15: Submerged boat launch ramps per month (n=76)

Image 2: Submerged boat launch ramp. (Photo Credit: Douglas Bryant, Burlington Sailing and Boat Club)

5.2.3. Flooding of Fixed Docks

Of the 68 respondents answering this question, 62 reported impacts in one or more months and, six reported no impacts associated with flooding of fixed docks. Again, flooding of fixed docks was most often cited in the months of May and June, followed by July.

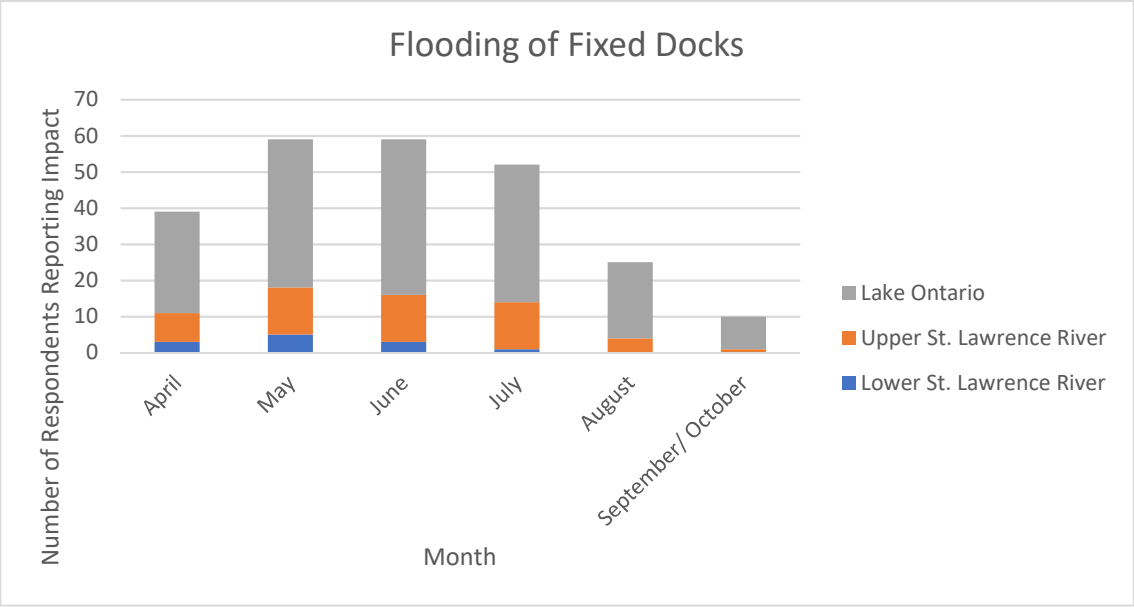

Figure 16: Flooding of fixed docks per month (n=68)

Image 3: Flooding of a fixed dock (Photo Credit: Anonymous, Toronto Sailing & Crane Club)

5.2.4. Damage to Fixed Docks

Damage to fixed docks was most often reported in June, followed by May and July. Of the 64 respondents answering this question, 49 reported impacts in one or more months and, 15 reported no impacts associated with damage to fixed docks.

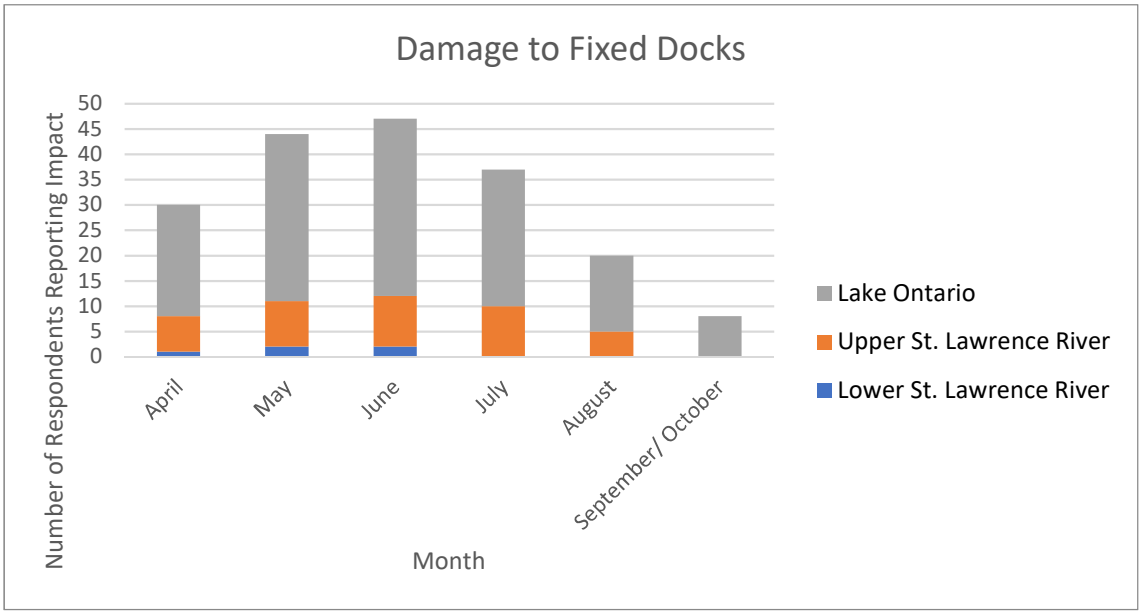

Figure 17: Damage to fixed docks per month (n=64)

Image 4: Flooded and damaged service dock (Photo Credit: David Speak, Beaconsfield Yacht Club)

5.2.5. Flooding of Buildings and/or Storage Areas

Flooding of buildings and/or storage areas was most often cited in the months of May and June, followed by July. Of the 86 respondents answering this question, 55 reported impacts in one or more months and, 31 reported no impacts associated with flooding of buildings and/or storage areas.

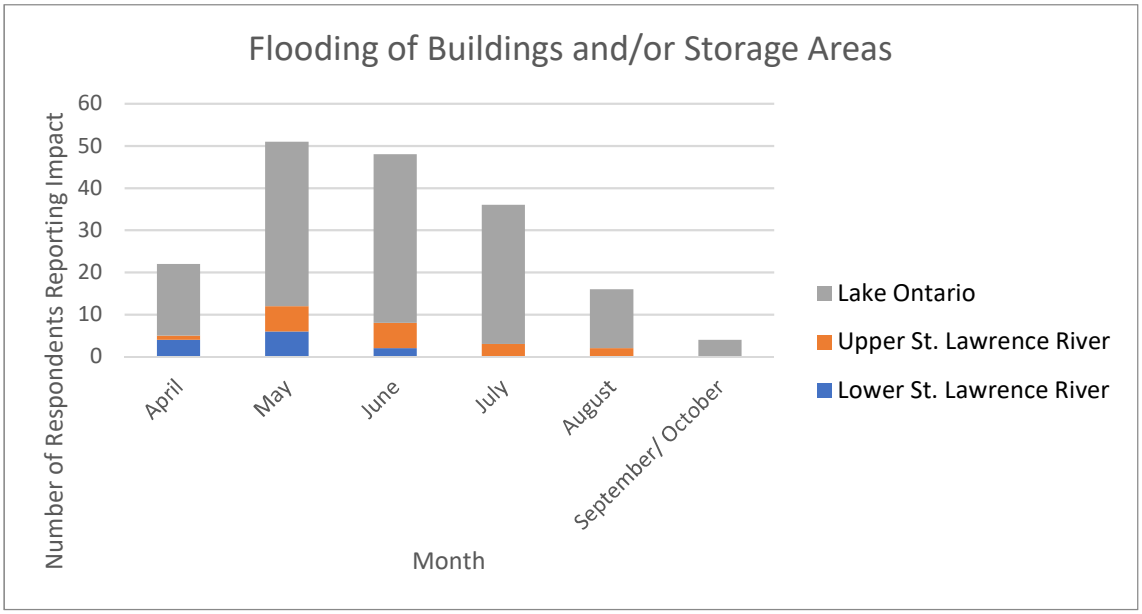

Figure 18: Flooding of buildings and/or storage areas per month (n=86)

Image 5: Flooding within store building. (Photo Credit: Allison C. Mayer, Mayer's Marina Inc.)

5.2.6. Submerged Electrical Boxes

Submerged electrical boxes were observed most often in May, June and July. Of the 85 respondents answering this question, 54 reported impacts in one or more months and, 31 reported no impacts associated with submerged electrical boxes.

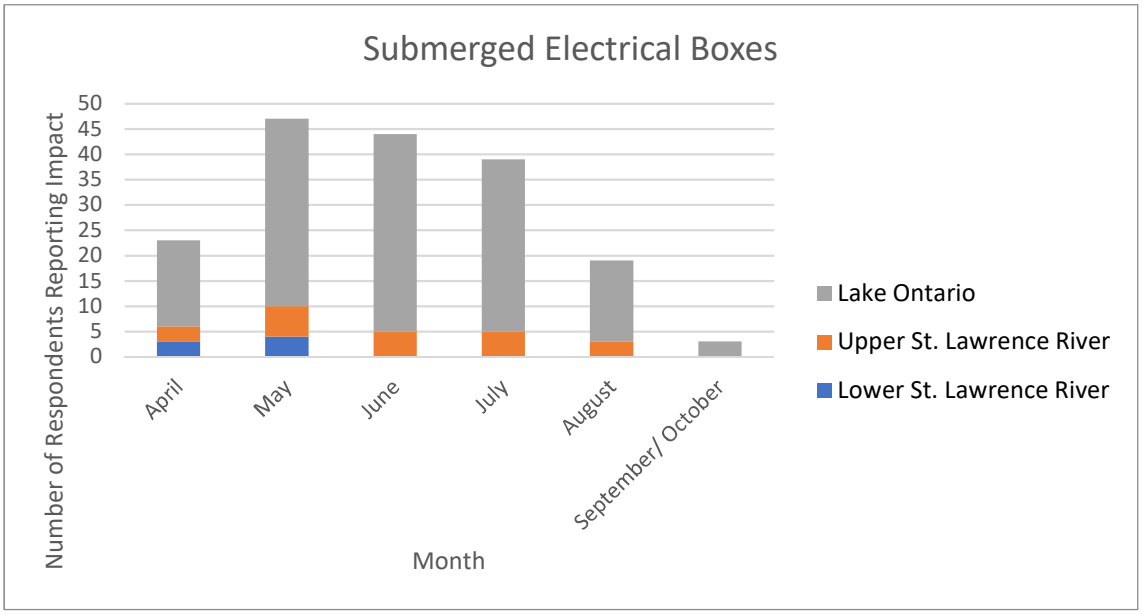

Figure 19: Submerged electrical boxes per month (n=85)

Image 6: Submerged electrical system. (Photo Credit: Anonymous, Club de Voile Deux-Montagnes)

5.2.7. Damage to Breakwalls

Damage to breakwalls was also most cited during May and June, followed by July. Of the 79 respondents answering this question, 51 reported impacts in one or more months and, 28 reported no impacts associated with damage to breakwalls.

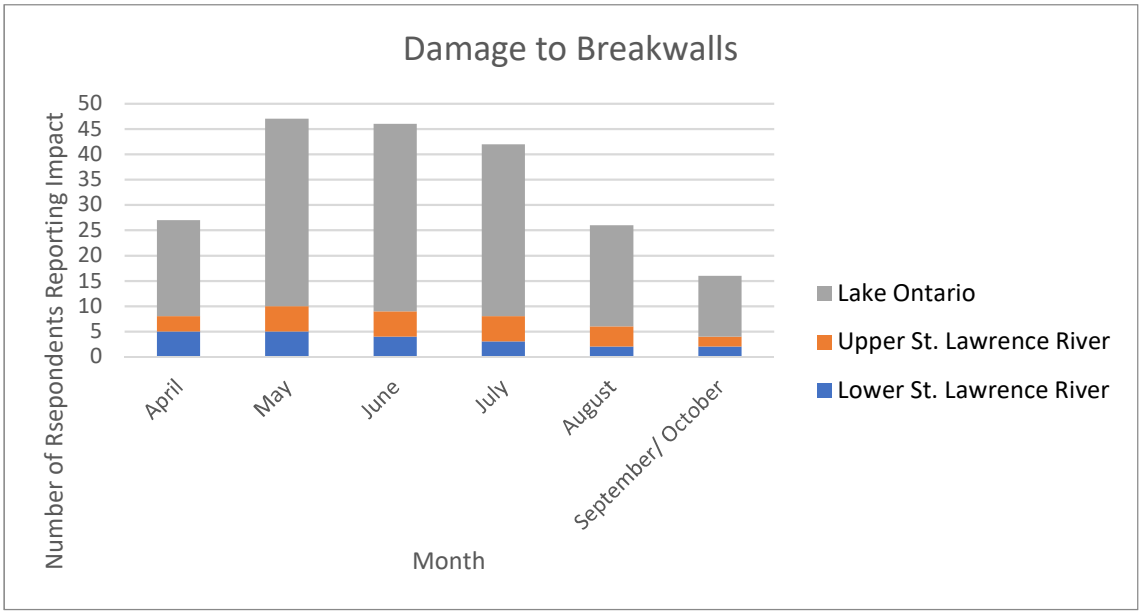

Figure 20: Damage to breakwalls per month (n=79)

Image 7: Breakwall completely submerged, providing no protection of the docks and grounds from waves. (Photo Credit: The Boulevard Club).

5.2.8. Damage to Floating Docks

Damage to floating docks was cited most often in May, followed by June and April. Of the 78 respondents answering this question, 50 reported impacts in one or more months and, 28 reported no impacts associated with damage to floating docks.

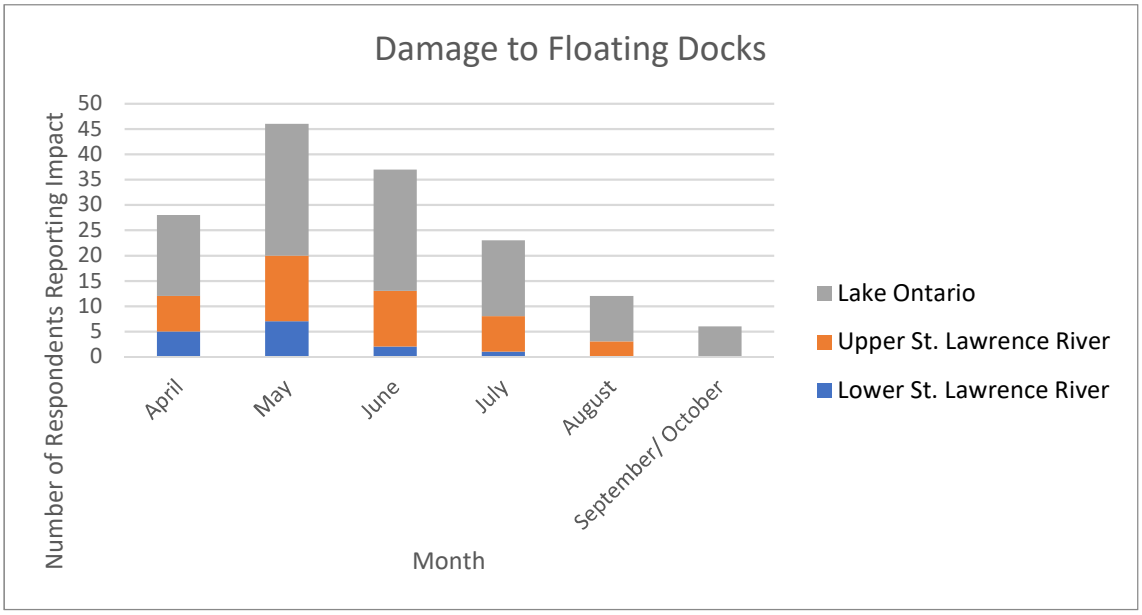

Figure 21: Damage to floating docks per month (n=78)

Image 8: Very tight anchorage on floating pontoons (Photo Credit: Anonymous, Yacht Club Montréal)

5.2.9. Parking Lot Flooded or Inaccessible

Parking lot flooding or inaccessible parking lots were most often reported in May, followed by June and July. Of the 81 respondents answering this question, 44 reported impacts in one or more months and, 37 reported no impacts associated with parking lot flooding or inaccessible parking lots.

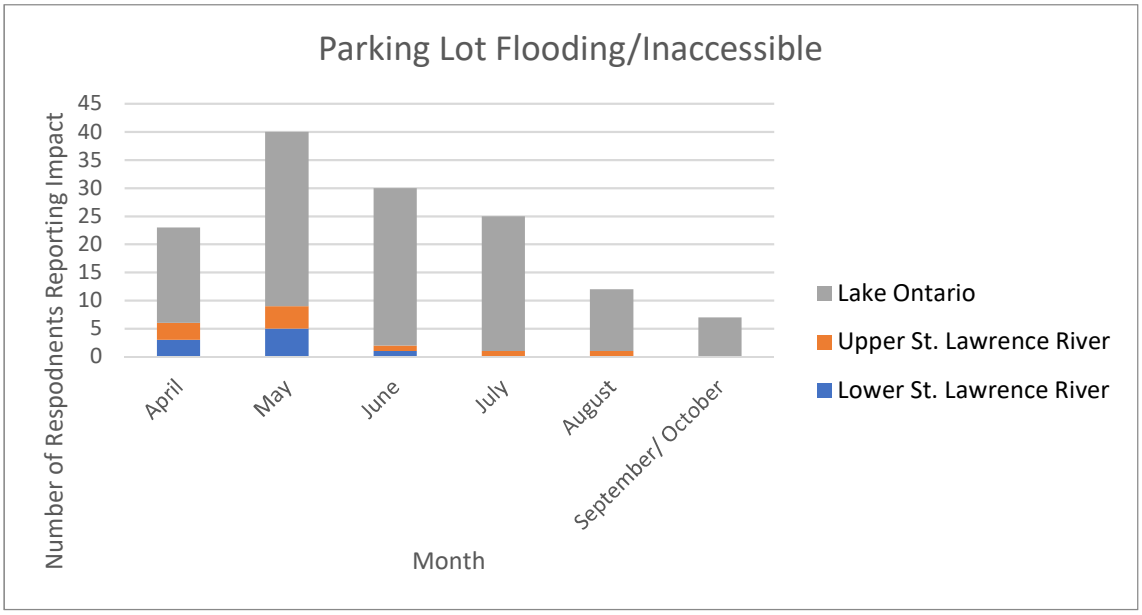

Figure 22: Parking lot flooding/inaccessible per month (n=81)

Image 9: Parking lot (flooded) extends to the gas tank, as seen to the left of the truck. (Photo Credit: Anonymous, Bay Bridge Sport Shop)

5.2.10. Damage to Buildings

Damage to buildings was most reported in May, followed by June and July. Of the 74 respondents answering this question, 29 reported impacts in one or more months and, 45 reported no impacts associated with damage to buildings.

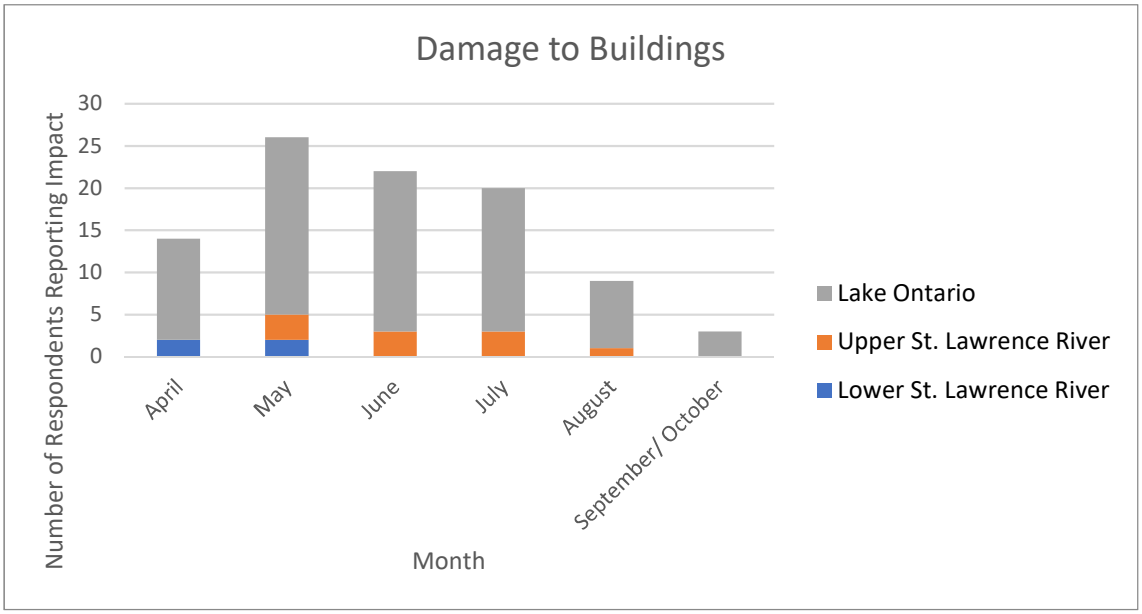

Figure 23: Damage to buildings per month (n=74)

Image 10: Marina seawall underwater. The waves from boats kept hitting building. (Photo Credit: Allison C. Mayer, Mayer's Marina Inc.)

5.2.11. Submerged Access to Gas Pumps

Submerged access to gas pumps was most reported in May and June, followed by July. Of the 48 respondents answering this question, 28 reported impacts in one or more months and, 20 reported no impacts associated with submerged access to gas pumps.

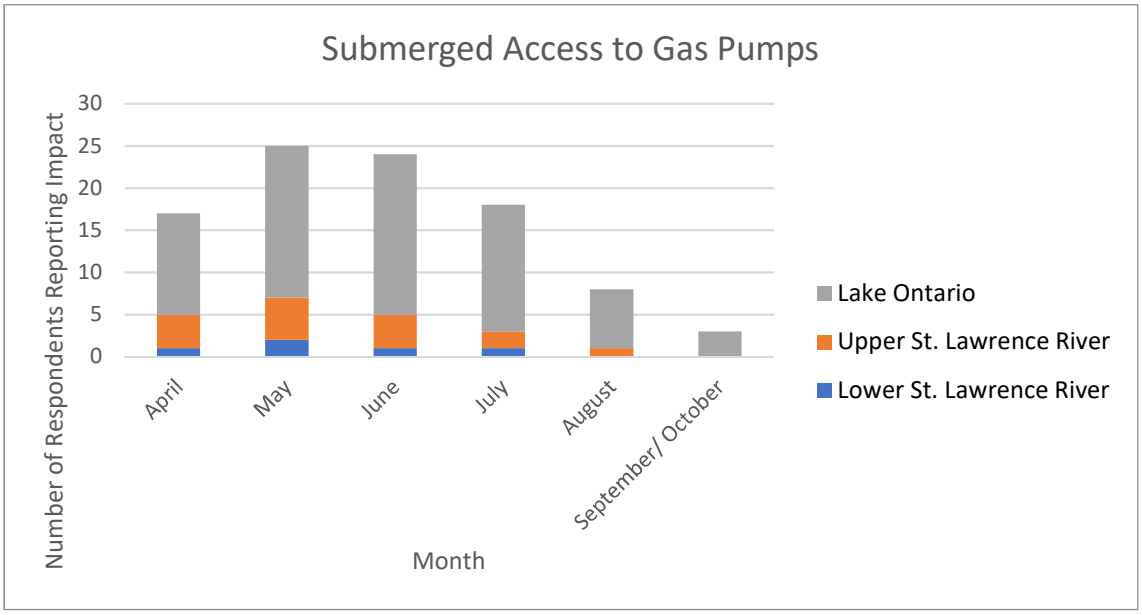

Figure 24: Submerged access to gas pumps per month (n=48)

Image 11: Damage to public gas dock (Photo Credit: Anonymous, Chippewa Yacht Club)

5.2.12. Septic Systems or Fields Flooded

Flooding of septic systems or fields was equally reported in May and June. Of the 58 respondents answering this question, 20 reported impacts in one or more months and, 38 reported no impacts associated with septic systems or fields flooding.

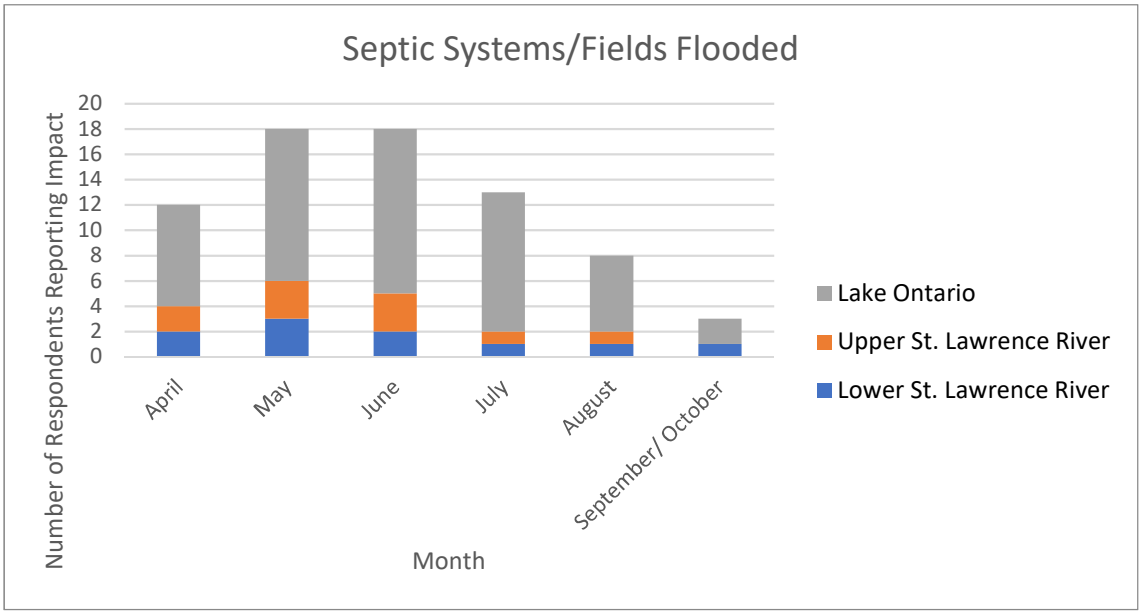

Figure 25: Septic systems and or fields flooded per month (n=58)

No images were provided for this impact.

5.2.13. Bathrooms Flooded or Inaccessible

Flooding of bathrooms or lack of bathroom access due to flooding was most commonly cited in May, followed by April and June. Of the 67 respondents answering this question, 16 reported impacts in one or more months and, 51 reported no impacts associated with bathroom flooding or accessibility.

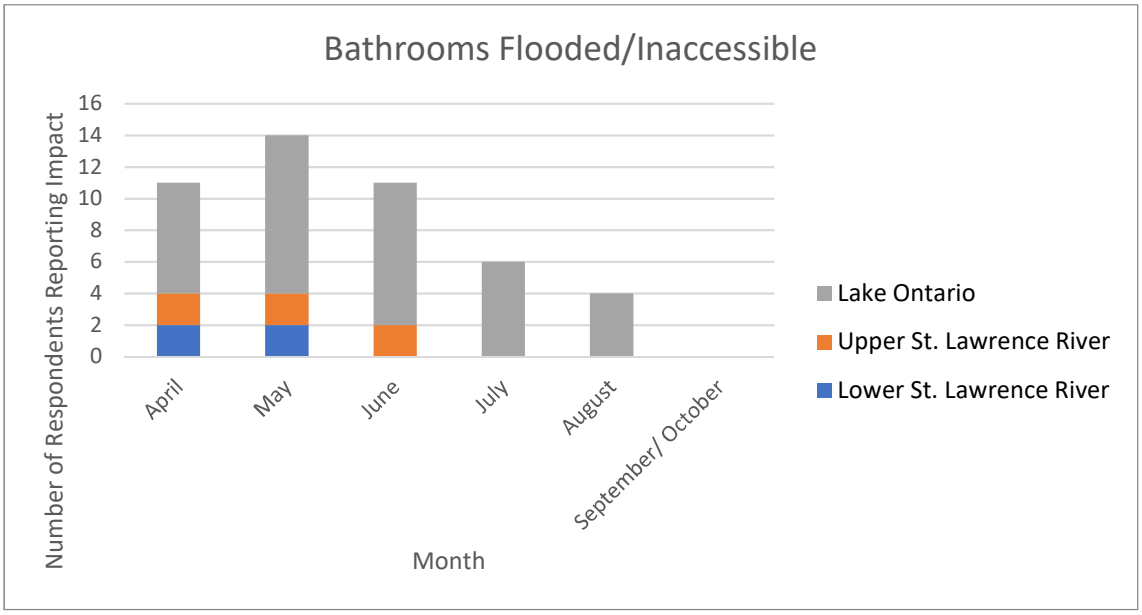

Figure 26: Bathrooms flooded and/or inaccessible per month (n=67)

No images were provided for this impact.

5.2.14. Other Physical Impacts

Other physical impacts were cited most often in June and May, followed by July. Of the 67 respondents answering this question, 51 reported other impacts in one or more months and, 16 reported no other impacts associated with the 2017 high water levels.

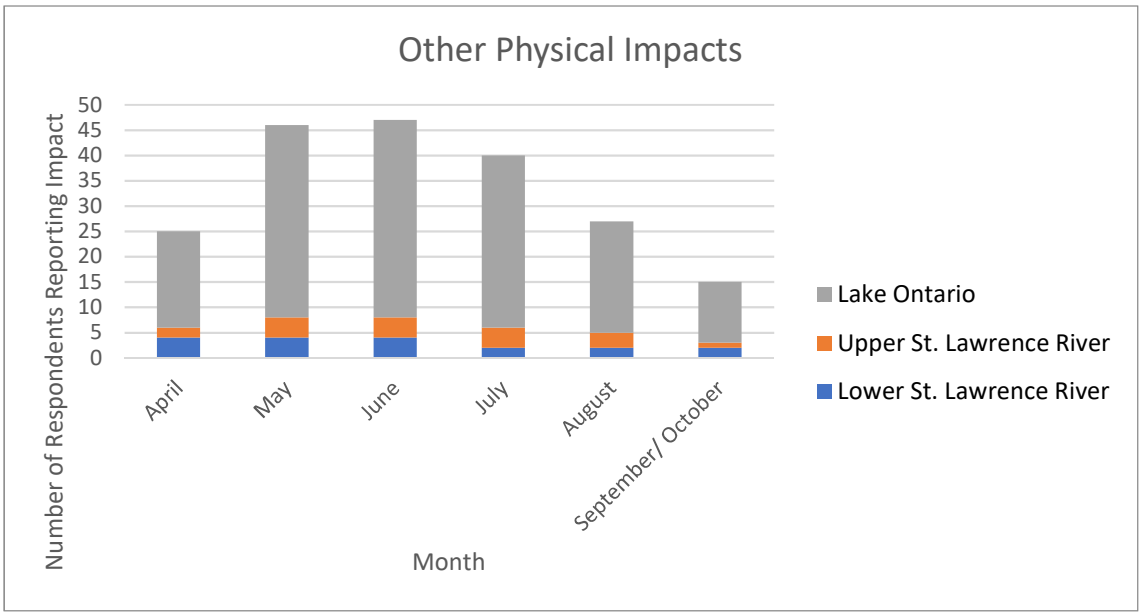

Figure 27: Other physical impacts per month (n=67)

Fifty-one respondents (n=51) identified "other" impacts to their facility. As identified through qualitative analysis, the most commonly cited physical impacts were damage to infrastructure (i.e. docks, ramps, parking lots, buildings) and other equipment (i.e. electrical, mooring systems, hoists), resulting in decreased access and usage of respondents. In many cases, this led to a delay in bringing boats out of storage and/or launching boats at the beginning of the season.

A number of respondents made repairs or temporary modifications to restore service and/or protect against future high water events, often resulting in additional costs. Some respondents reported that reduced/delayed usage had a negative impact on their revenue. A number of respondents reported health and safety concerns for visitors and staff due to hazardous conditions and mold. Shoreline damage and damage to trees and other vegetation was also mentioned.

Many respondents reported decreased attendance at their facility from both members and visitors, associated with a decrease in rental fees. Respondents reported a decrease in boating and attendance at events and activities. In some cases, the high water levels were seen as contributing to members cancelling their memberships, moving elsewhere or not renewing for future years. Some respondents reported difficulty in attracting new members as well. In some cases, respondents experiencing little or no impact received more visitors than normal, due to the lack of access at nearby facilities.

5.3. Total Impacts by Month

When reviewing the total number of impacts reported by respondents by month, the highest number of impacts were reported in May (590 impacts reported), followed by June (562 impacts reported) and July (456 impacts reported). The overall number of impacts reported decreases throughout the late summer and into fall.

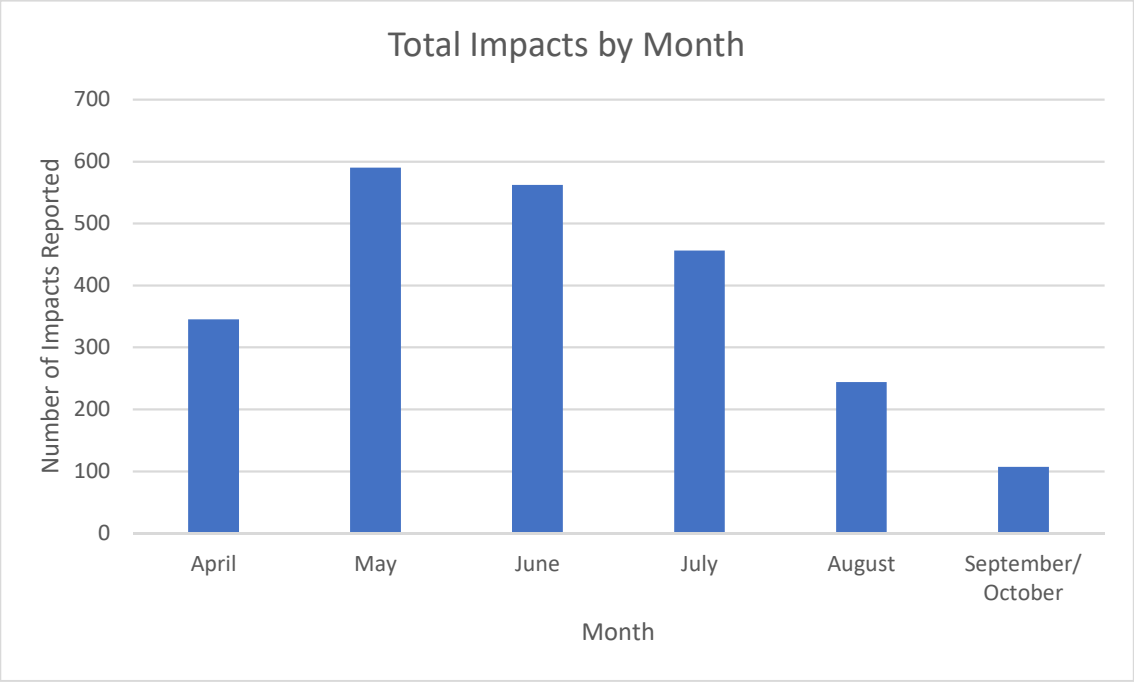

Figure 28: Total impacts per month (n=100)

The number of unique respondents reporting impacts varied by month and shoreline location, as shown in Table 4 below. For example, 92 individual respondents reported some impact during the month of May, and 66 of those were from Lake Ontario.

Table 4: Number of unique respondents reporting impacts per month

	April	May	June	July	August	September/ October
Lake Ontario	38	66	71	63	43	23
Upper St. Lawrence River	11	17	16	17	11	5
Lower St. Lawrence River	7	9	6	4	4	3
Total Number of Unique Respondents	**56**	**92**	**93**	**84**	**58**	**31**

Table 5: Number of unique respondents reporting at least one impact, by shoreline zone

	Lake Ontario	Upper St. Lawrence River	Lower St. Lawrence River
Number of Unique Respondents	72	18	10

5.4. Comparison to Typical Year

Next, respondents were asked to identify how the high water level in 2017 affected the use of their facility compared to a typical year. Comparisons were made in six areas:

- Number of boat slips used;
- Number of member boats/boats moored at facility;
- Total revenue;
- Revenue from fuel sales;
- Number of visiting (non-member) vessels; and,
- Number of social events at facility.

5.4.1. Number of Boat Slips Used

As shown in Figure 29 (below), the largest number of respondents used as the same number of boat slips as in a typical year, followed by ¾ of the slips used in a typical year. The number of respondents reporting typical usage increases over the course of the summer and into fall. Ninety-eight (98) respondents reported one or more boat slip(s) at their facility; while eighty-nine (89) respondents completed this question regarding usage compared to a typical year.

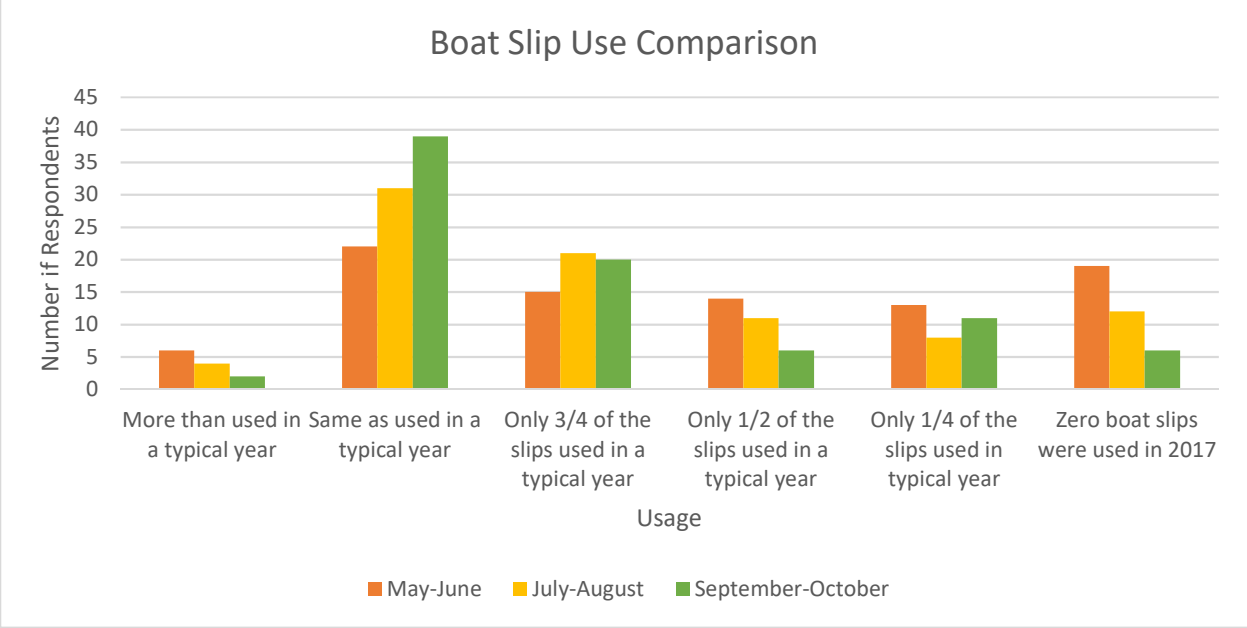

Figure 29: Boat slip use comparison (n=89)

Looking at boat slip usage by shoreline zone in May and June, the largest number of respondents on Lake Ontario reported zero boat slips used during these months. For respondents on the Upper St. Lawrence River, the largest number reported using ¼ of the slips used in a typical year. For respondents on the Lower St. Lawrence River, the largest number reported the same use as a typical year.

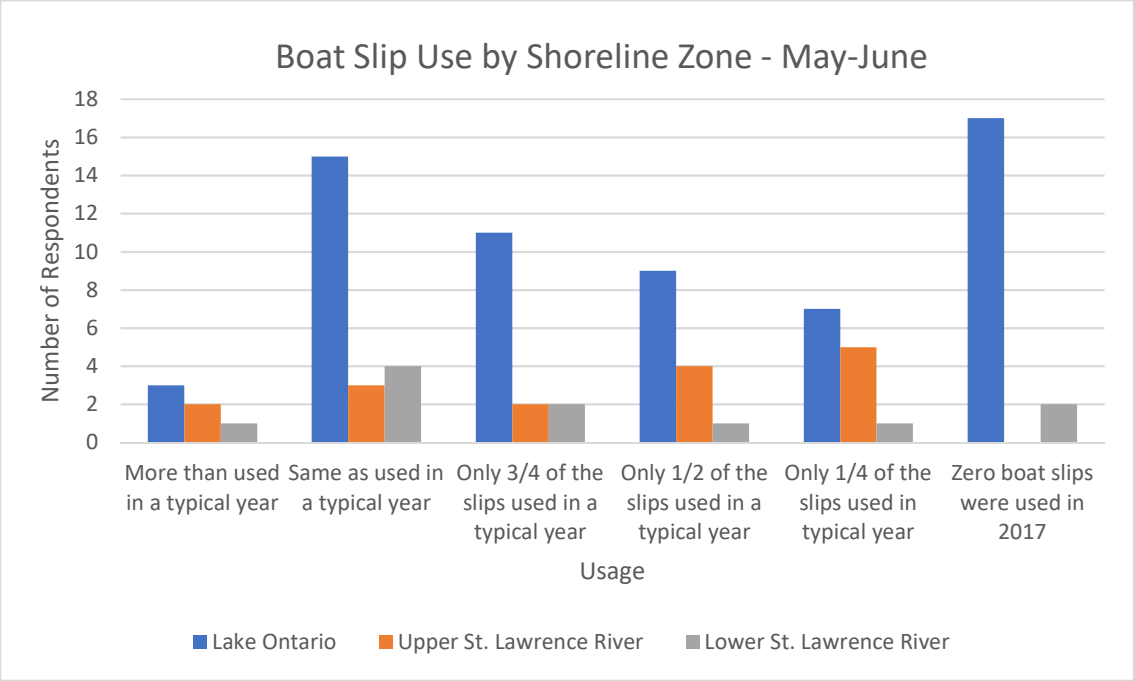

Figure 30: Boat slip use comparison May-June (n=89)

Looking at boat slip usage by shoreline zone in July and August, the largest number of respondents on Lake Ontario reported using the same or ¾ of the slips used in a typical year. For respondents on the Upper and Lower St. Lawrence River, the largest number reported using the same number of slips as a typical year.

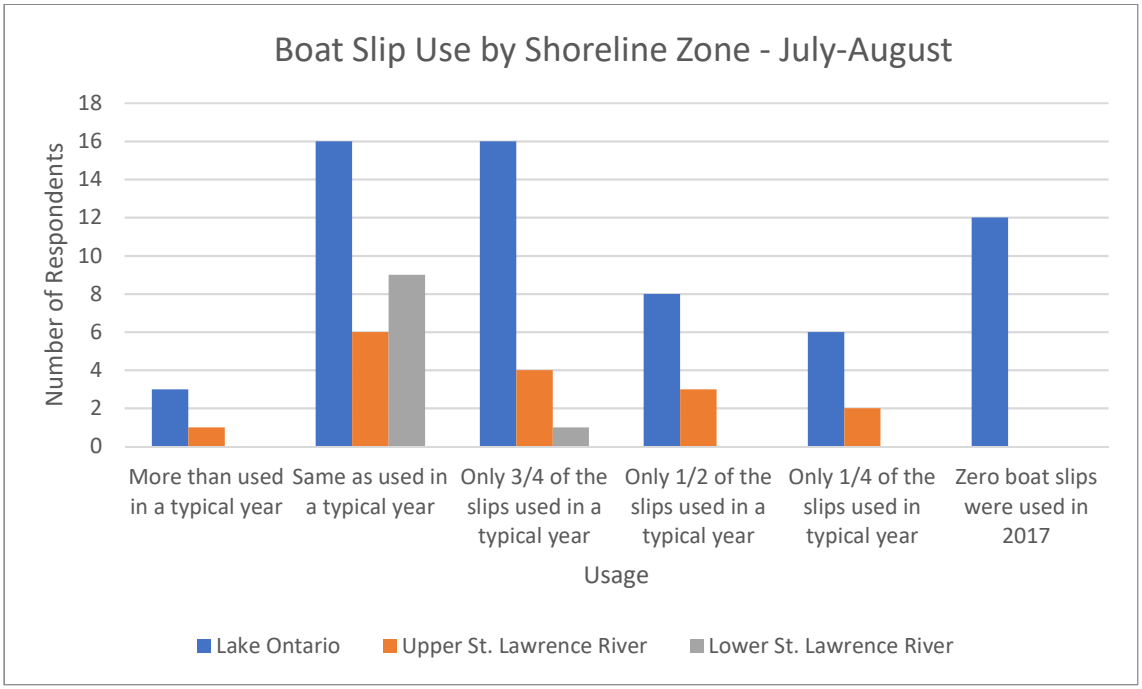

Figure 31: Boat slip use comparison July-August (n=87)

In September and October, the largest number of respondents from all shoreline locations reported usage the same as a typical year.

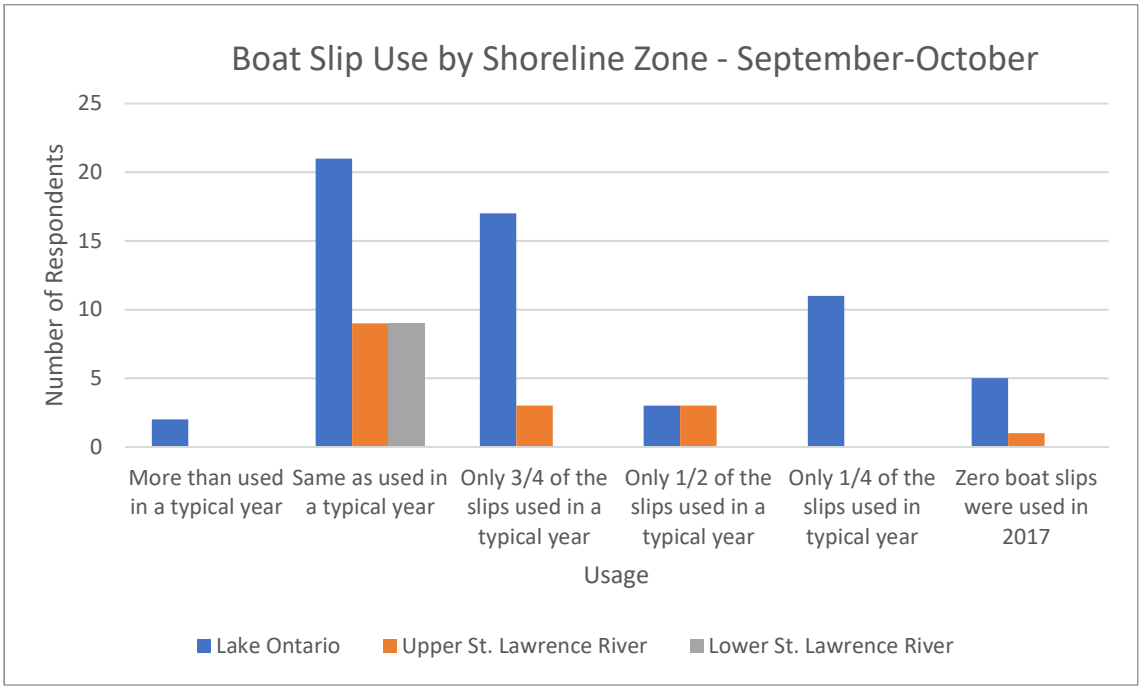

Figure 32: Boat slip use comparison September-October (n=84)

5.4.2. Number of Member Boats and Boats Moored

As shown in Figure 33 (below), the largest number of respondents in May and June had fewer boats moored compared to a typical year. The number of respondents reporting usage the same as in a typical year increased throughout the season. Ninety-eight (98) respondents reported one or more boat(s) moored at their facility; while eighty (80) respondents responded to this question regarding number of boats moored compared to a typical year.

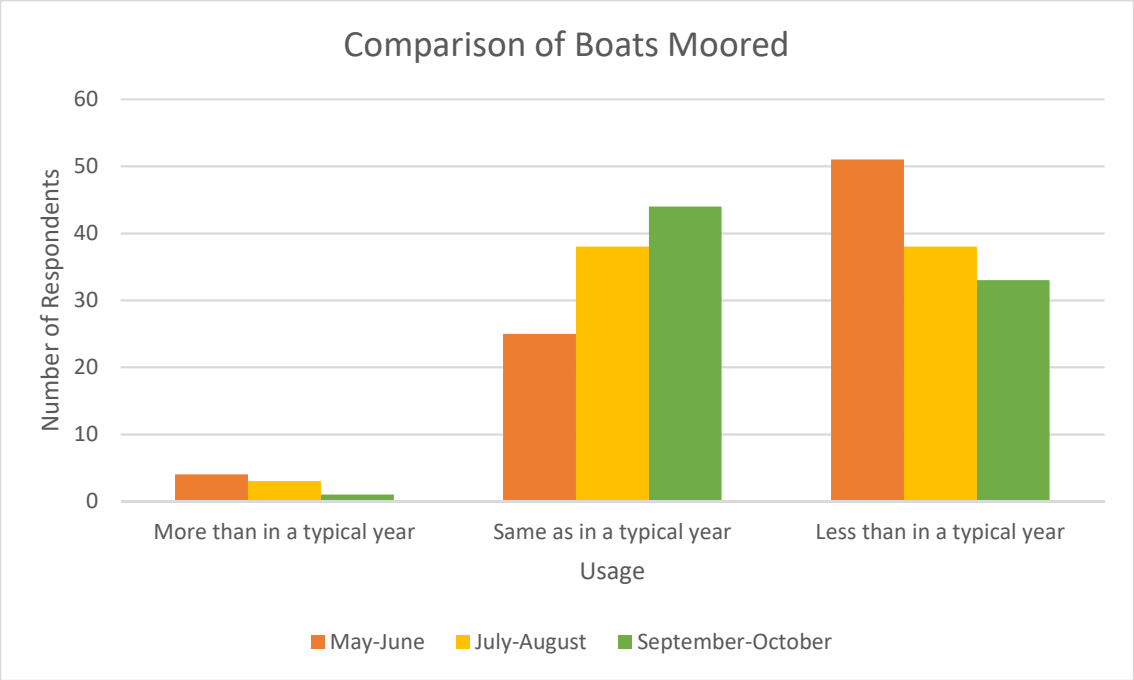

Figure 33: Boats moored comparison (n=80)

Looking at boats moored by shoreline zone in May and June, the largest number of respondents from all three shoreline zones reported fewer boats moored than in a typical year.

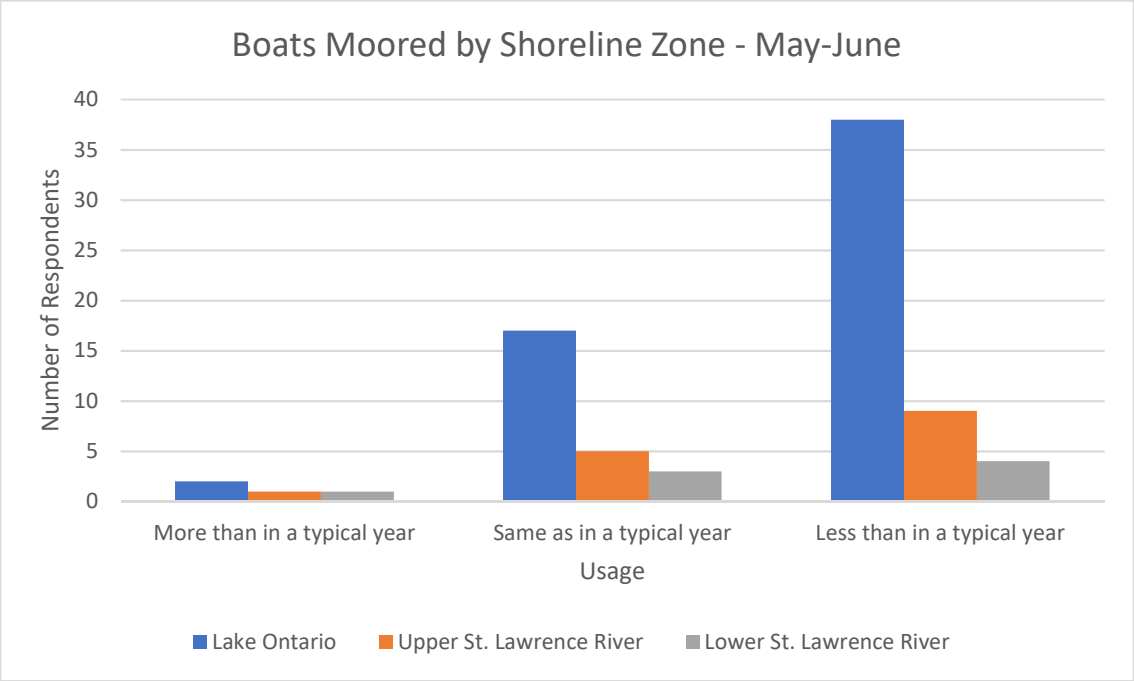

Figure 34: Boats moored comparison May-June (n=80)

Looking at the number of boats moored by shoreline zone in May and June, the largest number of respondents on Lake Ontario reported less than typical usage. For respondents on the Upper and Lower St. Lawrence River, the largest number reported the same number of boats moored as compared to a typical year.

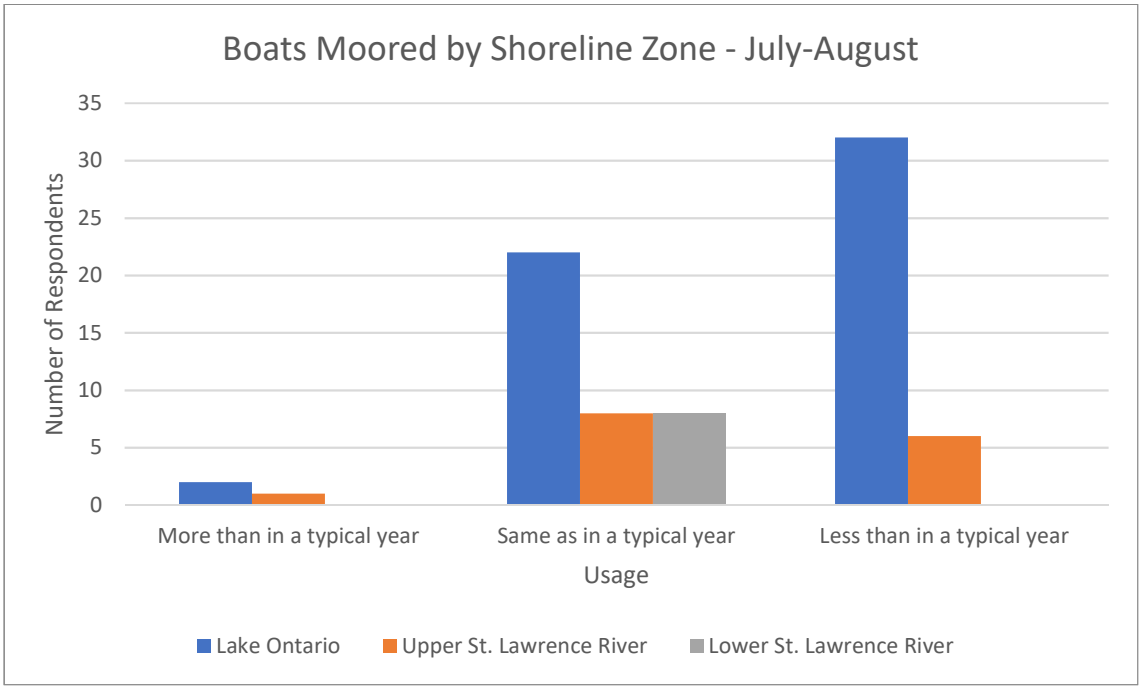

Figure 35: Boats moored comparison July-August (n=79)

Consistent with the above, the largest number of respondents on Lake Ontario reported less than typical usage during September and October. For respondents on the Upper and Lower St. Lawrence River, the largest number reported the same number of boats moored as compared to a typical year.

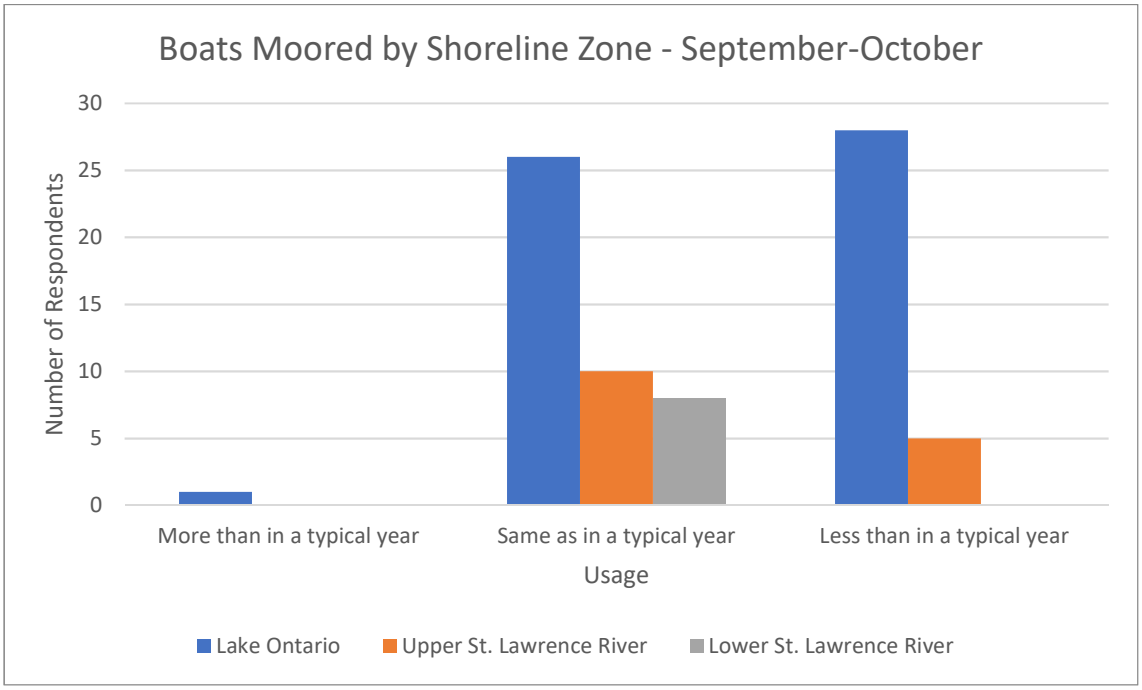

Figure 36: Boats moored comparison September-October (n=78)

5.4.3. Total Revenue

In terms of total revenue (Figure 37), the largest number of respondents reported ¾ of typical revenue earned during May/June. The number of respondents reporting the same amount of revenue as a typical year grew in July/August and again in September/October, representing the highest number of responses in both time periods.

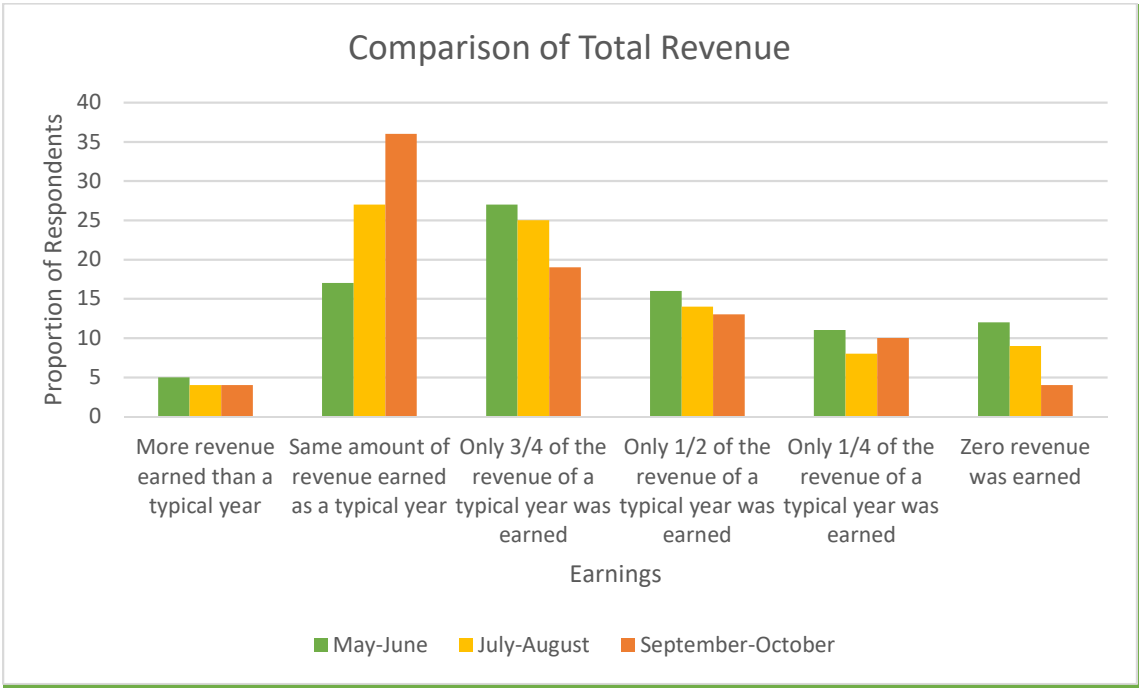

Figure 37: Total revenue comparison (n=88)

Looking at the total revenue for May and June for those located on Lake Ontario, ¾ of the typical revenue was the most commonly reported response. Those reporting zero revenue were all located on Lake Ontario. Of those, four respondents from Lake Ontario reported zero revenue for all three time periods studied. Among respondents located on the Upper St. Lawrence River, ¾ and ¼ of typical revenues were the most common responses. Among those located on the Lower St. Lawrence River, the most common response indicated typical revenues.

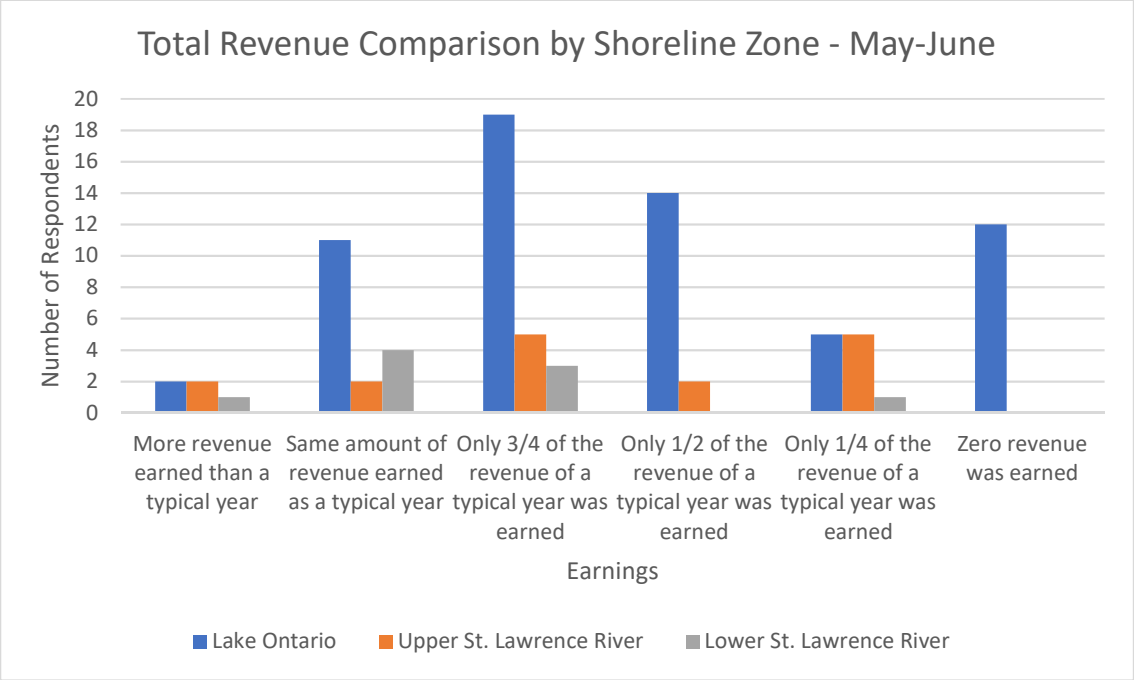

Figure 38: Revenue comparison May-June (n=88)

Looking at total revenue by shoreline zone in July and August, the largest number of respondents on Lake Ontario and the Upper St. Lawrence reported ¾ of the earnings compared to a typical year. For respondents on the Lower St. Lawrence River, the largest number reported revenues the same as a typical year.

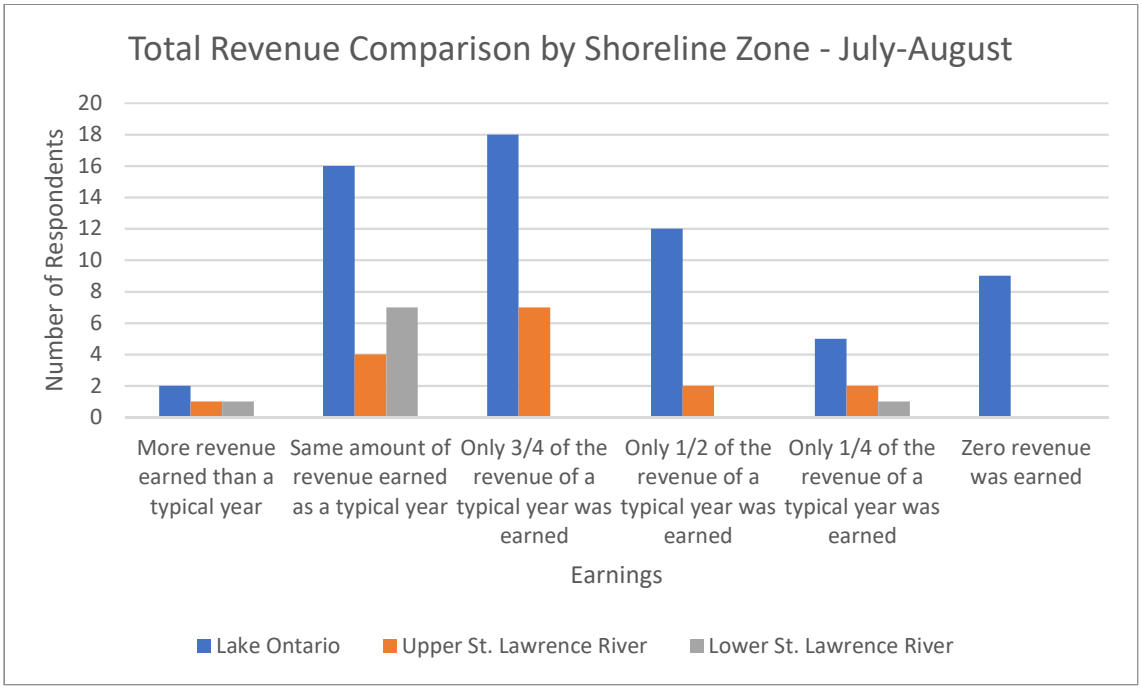

Figure 39: Revenue comparison July-August (n=87)

Looking at total revenue by shoreline zone in September and October, the largest number of respondents on all three shoreline zones reported revenues the same as a typical year.

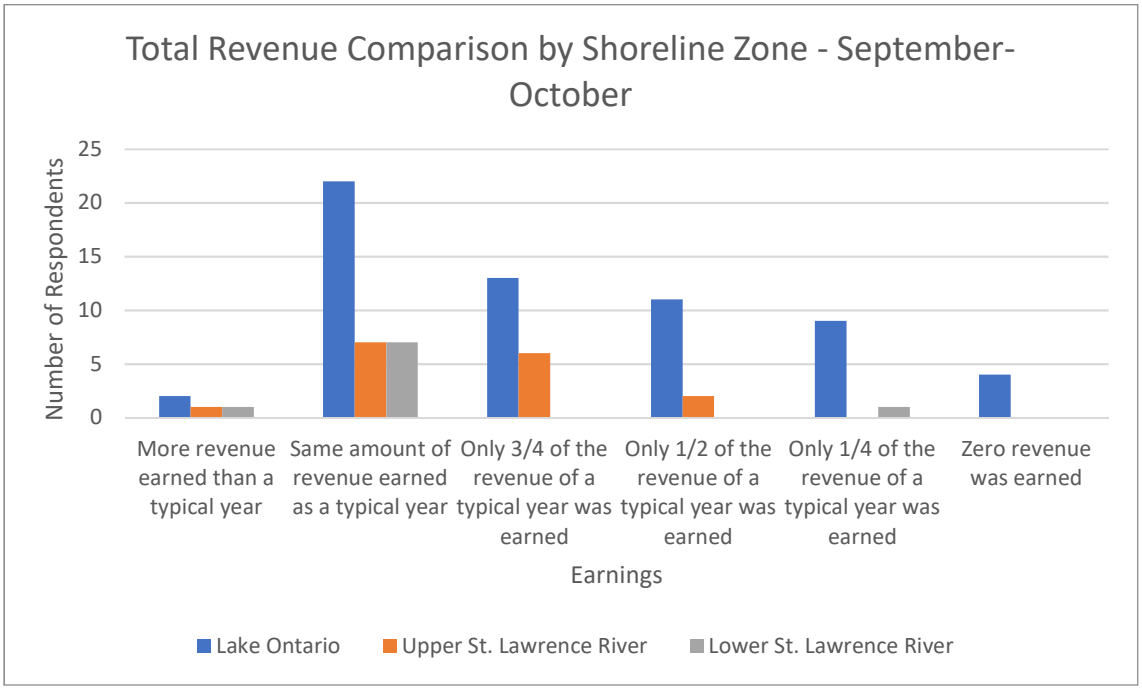

Figure 40: Revenue comparison September-October (n=87)

5.4.4. Revenue from Fuel Sales

With respect to revenue from fuel sales (Figure 41), the largest number of respondents reported ¼ of typical revenue during May/June. The largest number of respondents reported ½ of typical revenue during July/August, shifting to typical revenues in September/October. The number of respondents reporting zero revenue from fuel sales declines throughout the season. Forty-six (46) respondents reported offering gas services for boaters; thirty-nine (39) provided a response to this question comparing revenue from fuel sales.

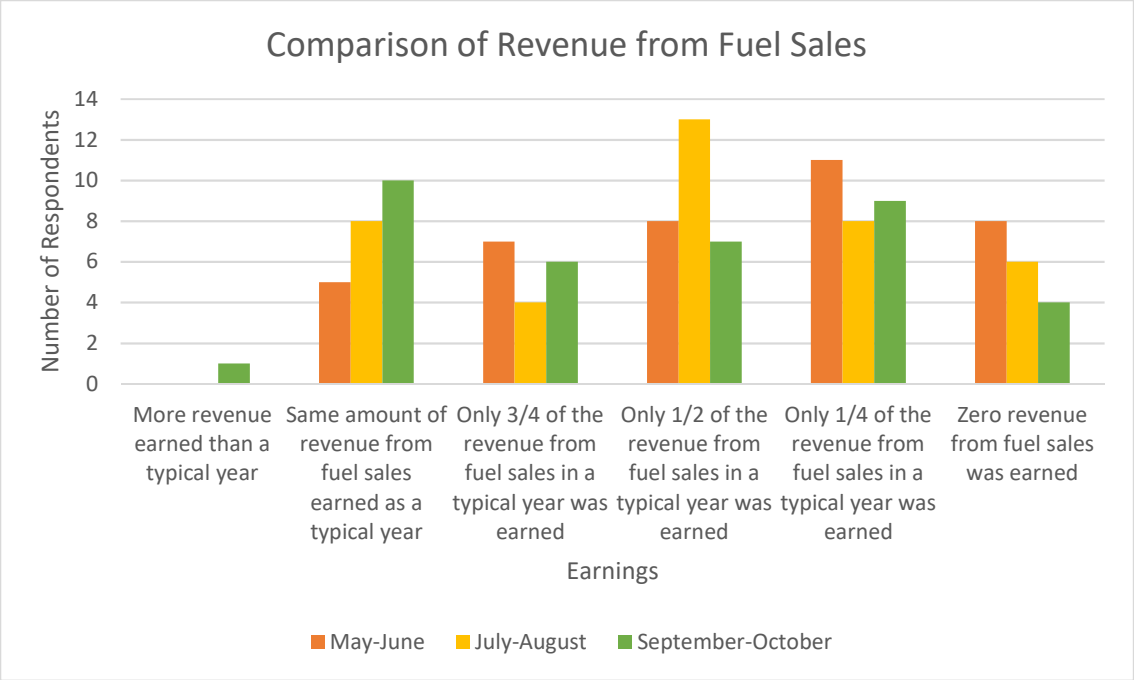

Figure 41: Revenue from fuel sales comparison (n=39)

Looking at fuel revenue by shoreline zone in May and June, the largest number of respondents on Lake Ontario reported zero revenue or ¼ of typical revenues. The largest number of respondents from the Upper St. Lawrence River reported ¼ of fuel revenues compared to a typical year. For respondents on the Lower St. Lawrence River, the largest number reported ¾ of the fuel revenue compared to a typical year.

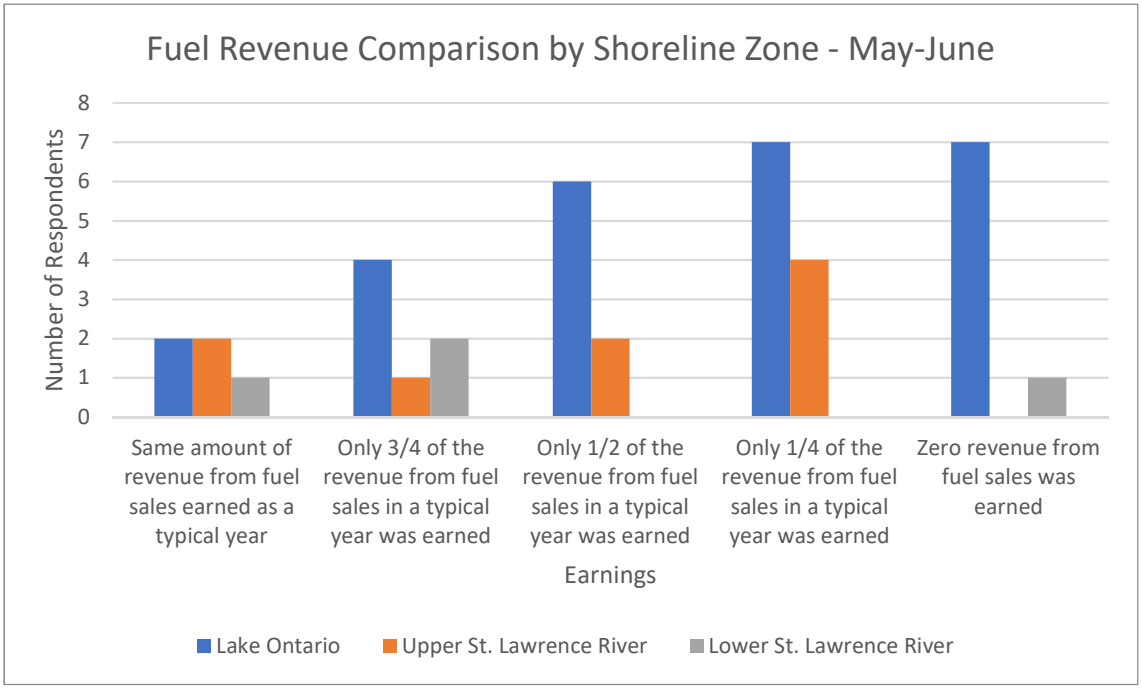

Figure 42: Fuel revenue comparison May-June (n=39)

Looking at fuel revenue by shoreline zone in July and August, the largest number of respondents on Lake Ontario and the Upper St. Lawrence River reported ½ the revenue from fuel sales compared to a typical year. For respondents on the Lower St. Lawrence River, the largest number reported the same fuel revenue compared to a typical year.

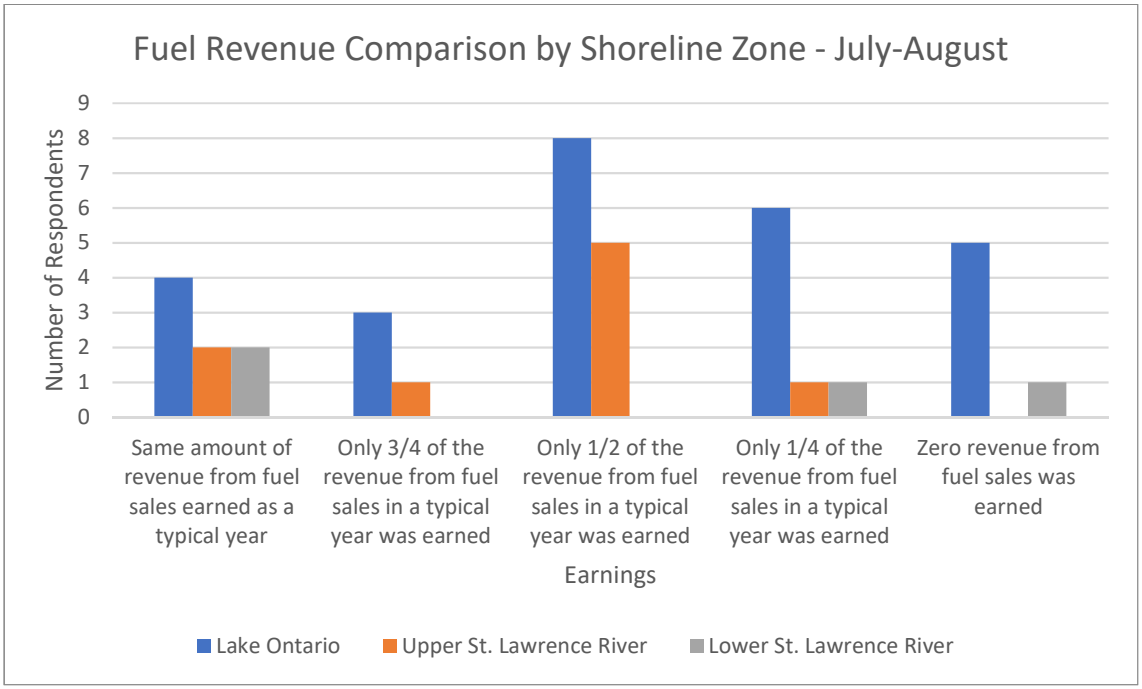

Figure 43: Fuel revenue comparison July-August (n=39)

In September and October, the largest number of respondents on Lake Ontario reported revenues ¼ of typical fuel sales. Responses from those on the Upper and Lower St. Lawrence River were few, and spread across various earning categories.

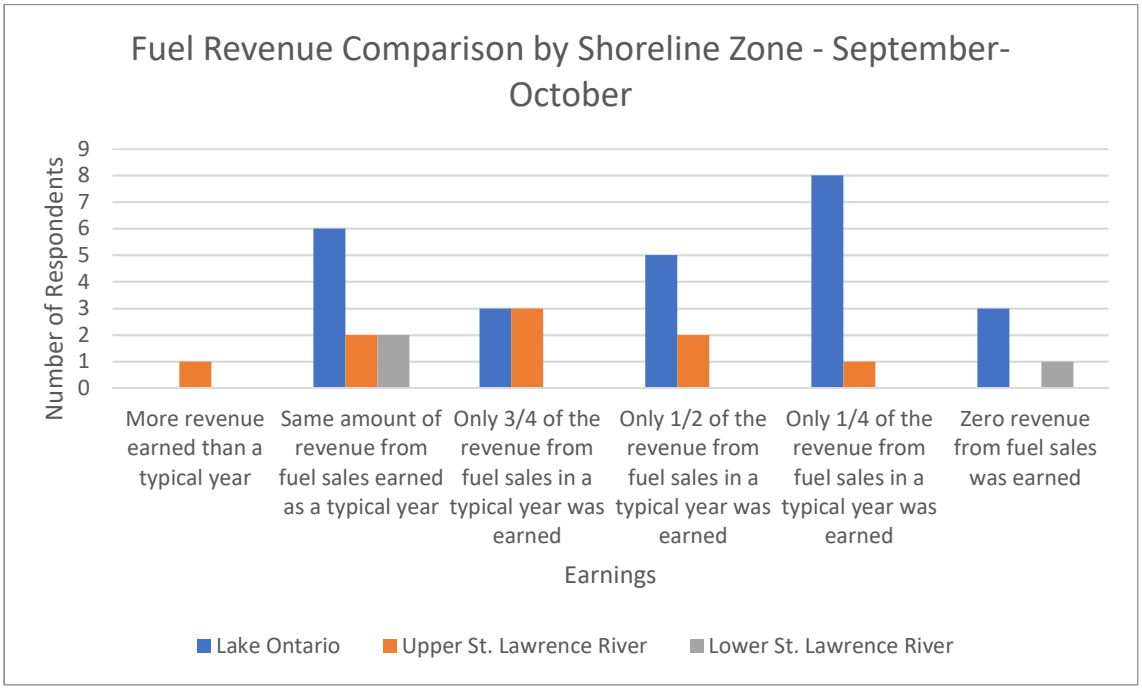

Figure 44: Fuel revenue comparison September-October (n=37)

5.4.5. Number of Visiting Vessels

In all months studied, the number of visiting vessels was reported as less than in a typical year (Figure 45). The situation improved only slightly throughout the season. Only two respondents reported receiving more visiting vessels than a typical year for all three time periods. These respondents rated the overall impact as 1 and 2, these respondents were located on the Lower St. Lawrence and Lake Ontario, respectively.

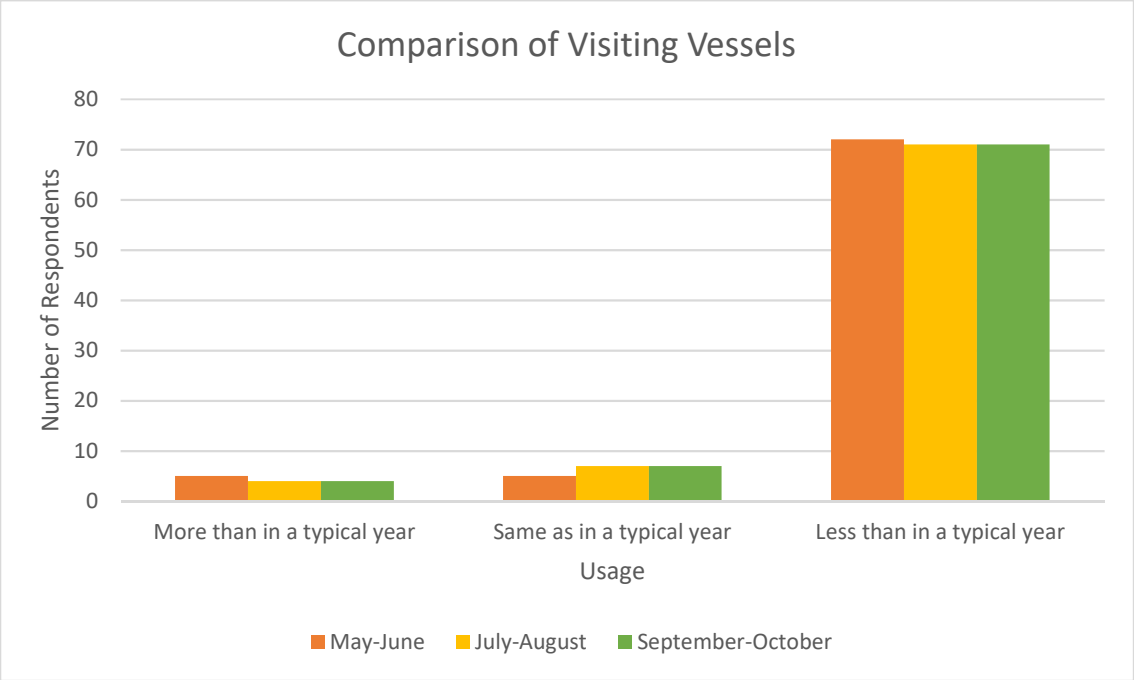

Figure 45: Visiting vessels comparison (n=82)

Looking at the number of visiting vessels in May and June, the largest number of respondents on Lake Ontario and the Upper St. Lawrence River reported fewer visiting vessels than in a typical year. Responses from those on the Lower St. Lawrence River were spread across all three usage categories.

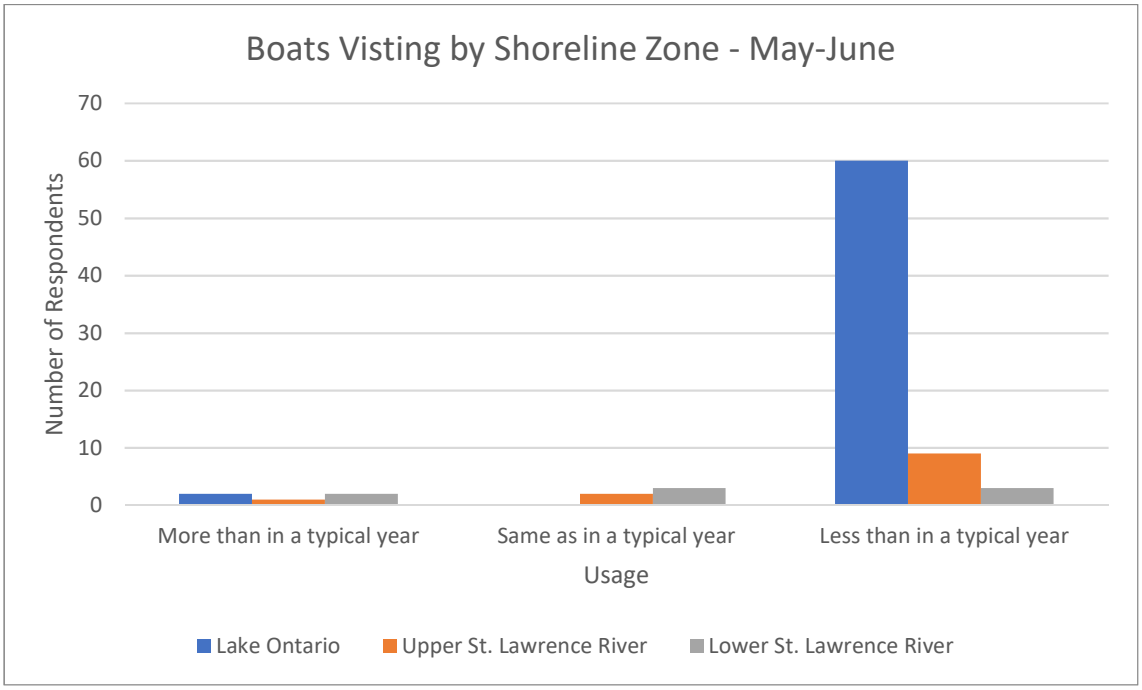

Figure 46: Visiting vessels comparison May-June (n=82)

Continuing into July and August, the largest number of respondents on Lake Ontario and the Upper St. Lawrence River reported fewer visiting vessels than in a typical year. Responses from those on the Lower St. Lawrence River were spread across all three usage categories, with slightly more reporting the same number of visiting vessels as compared to a typical year.

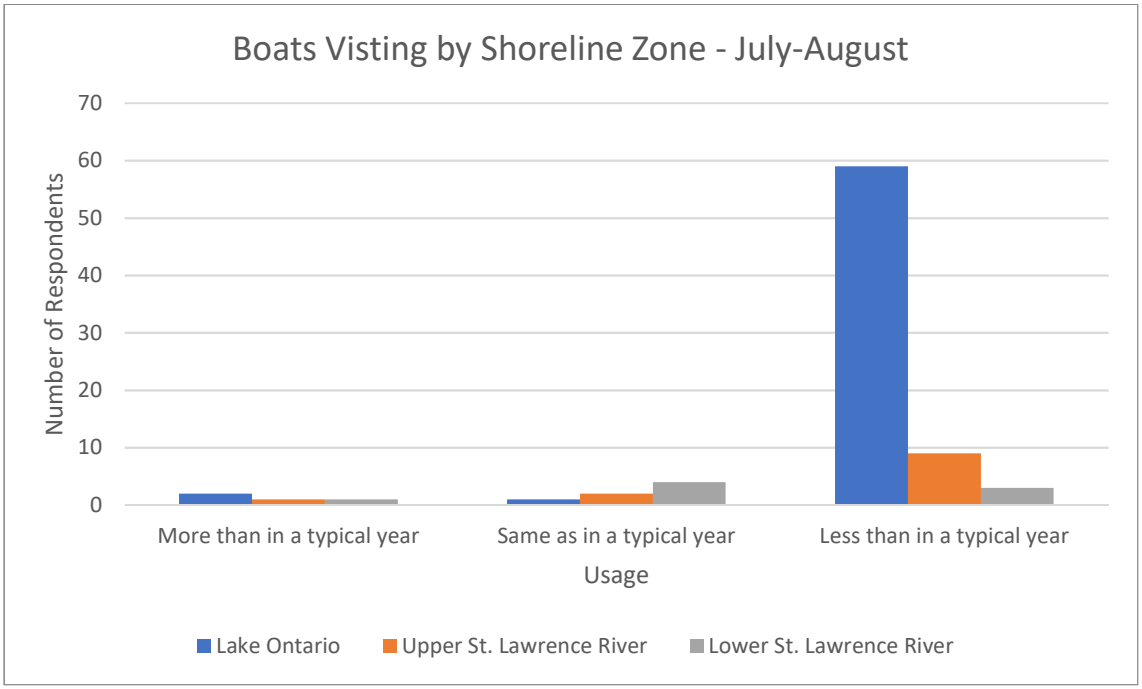

Figure 47: Visiting vessels comparison July-August (n=82)

Looking at the number of visiting vessels in September and October, the largest number of respondents on Lake Ontario and the Upper St. Lawrence River reported fewer than in a typical year. Responses from those on the Lower St. Lawrence River were spread across all three usage categories. Slightly more of the respondents from the Upper and Lower St. Lawrence River reported the same number of visiting vessels as compared to a typical year.

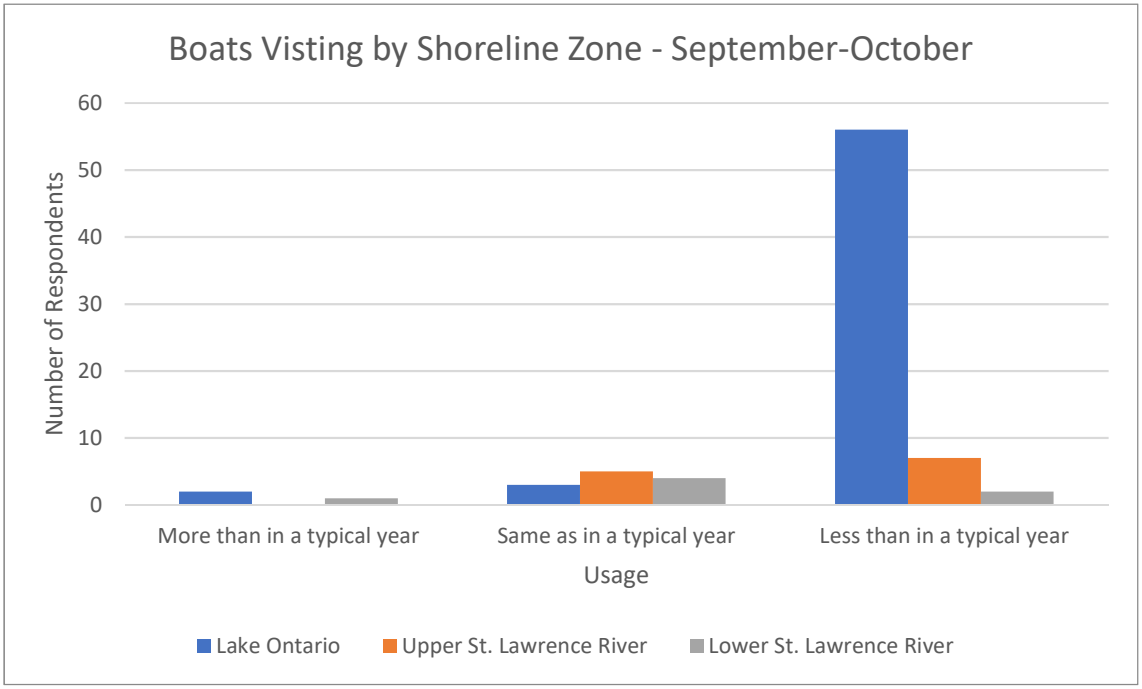

Figure 48: Visiting vessels comparison September-October (n=80)

5.4.6. Number of Social Events

The number of social events were reported to be less than in a typical year for May/June and July/August, with the situation improving slightly in September/October (Figure 49). Seventy-three (73) respondents provided a response to this question regarding the number of social events held in 2017 compared to a typical year.

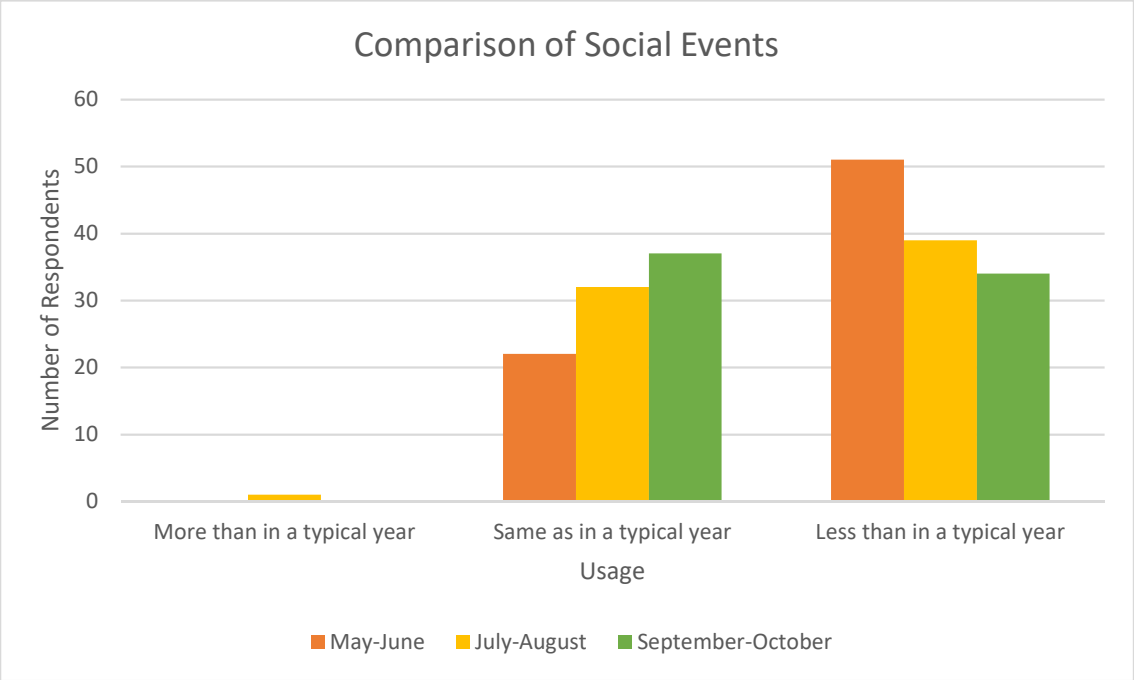

Figure 49: Social events comparison (n=73)

When comparing the number of social events by shoreline zone in May and June, those respondents on Lake Ontario and the Upper St. Lawrence reported having a less than typical number of social events, this difference was slight for Upper St. Lawrence respondents. A slightly higher number of respondents on the Lower St. Lawrence River reported the same number of social events as compared to a typical year. No respondents reported hosting more social events than a typical year.

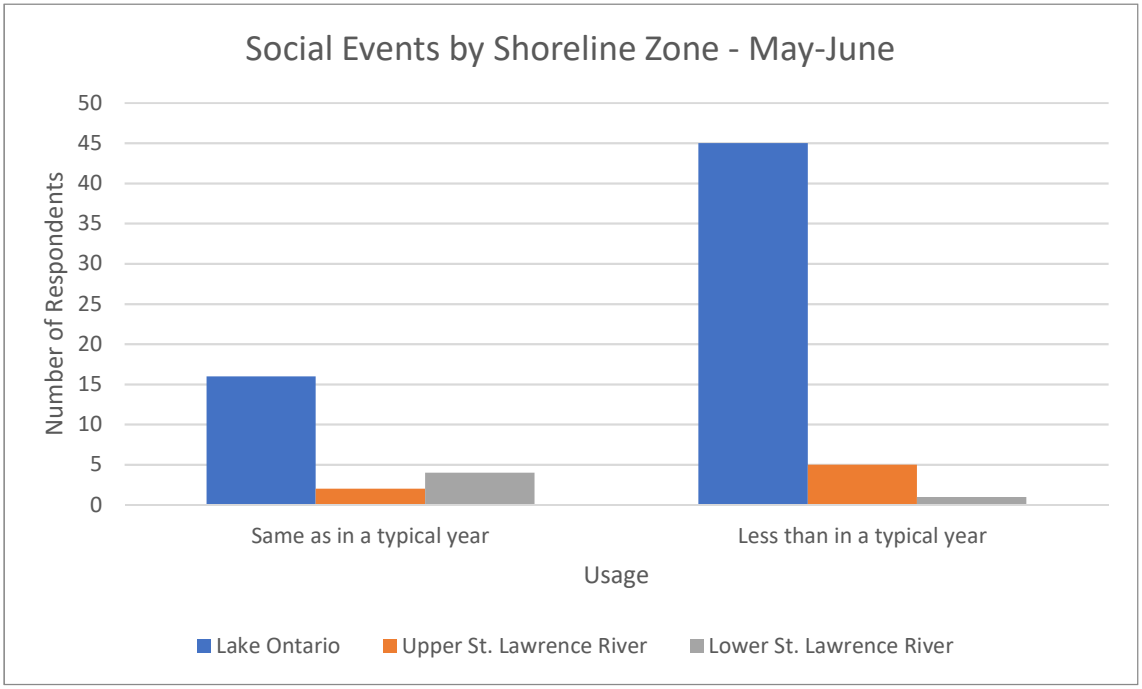

Figure 50: Social events comparison May-June (n=73)

In July and August, those respondents on Lake Ontario and the Upper St. Lawrence reported having a less than typical number of social events, this difference was slight for Upper St. Lawrence respondents. All respondents on the Lower St. Lawrence River reported the same number of social events as compared to a typical year.

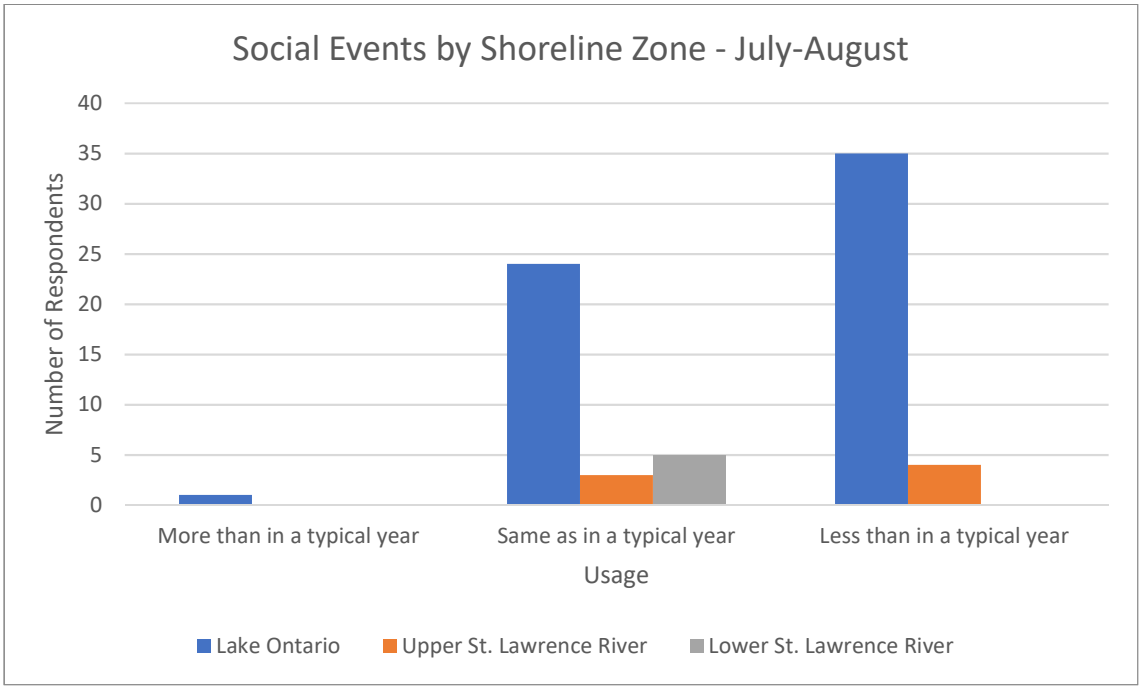

Figure 51: Social events comparison July-August (n=72)

When comparing the number of social events by shoreline zone in September and October, an equal number of those respondents on Lake Ontario reported having the same number of events and having fewer events compared to a typical year. Slightly more respondents on the Upper St. Lawrence reported having a less than typical number of social events, while the remainder reported the same number as a typical year. All respondents on the Lower St. Lawrence River reported the same number of social events as compared to a typical year. No respondents reported hosting more social events than a typical year.

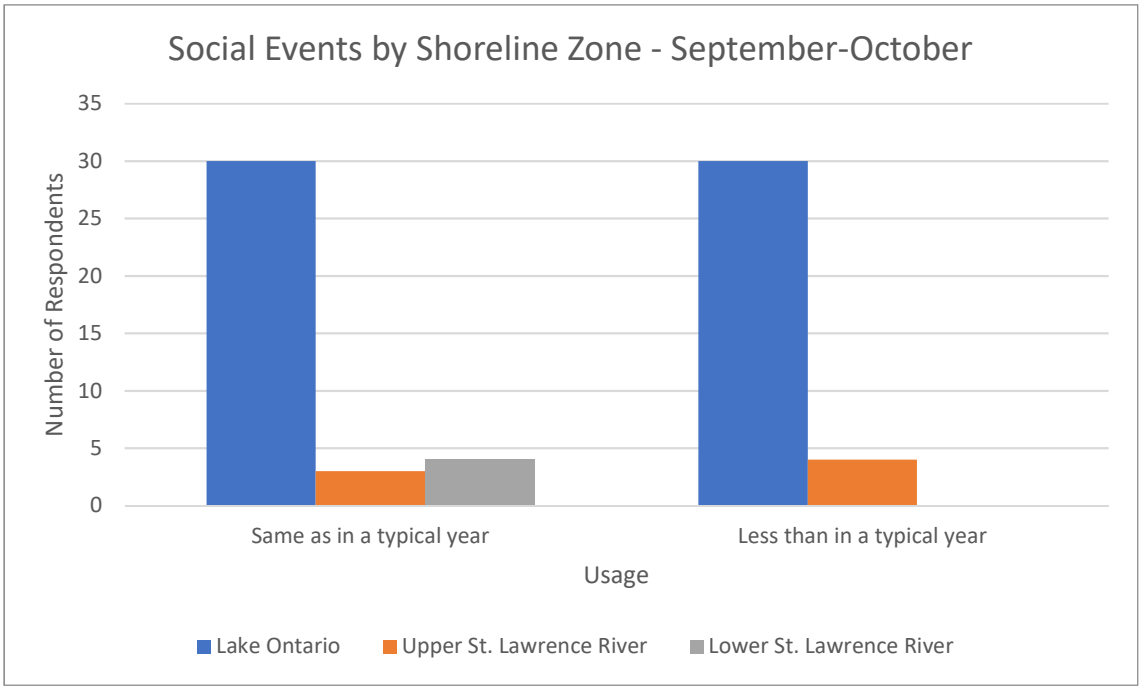

Figure 52: Social events comparison September-October (n=71)

5.5. Earliest Date of Boats in Water

In this portion of the survey, respondents were asked to identify the earliest date boats were able to be put in for the years 2016, 2017 and 2018[8].

5.5.1. Earliest Date in 2016

In 2016, early May was the most commonly cited "earliest date" for all three shoreline zones, followed by early April and late April (Figure 53).

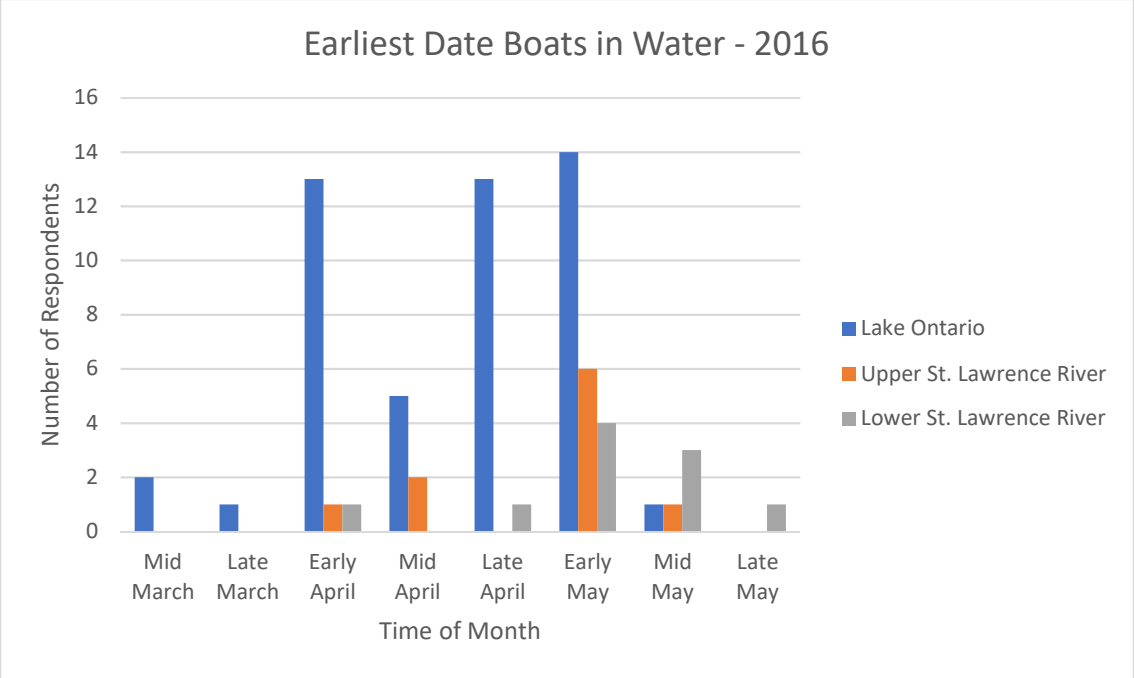

Figure 53: Earliest date of boats in water in 2016 (n=69)

[8] Respondents provided date information in the form of MM/DD/YYYY. Dates were categorized as "early" (days 1-10), "mid" (days 11-20), or "late" (days 21-end).

5.5.2. Earliest Date in 2017

For all three shoreline zones combined in 2017, early May was the most commonly cited “earliest date”, followed by late April and early April (Figure 54). Late April was the most commonly cited “earliest date” for those on Lake Ontario. It is noted that there was a wider distribution of “earliest dates” in 2017 compared to 2016 or 2018, extending throughout the summer, with the latest launch dates occurring in Lake Ontario.

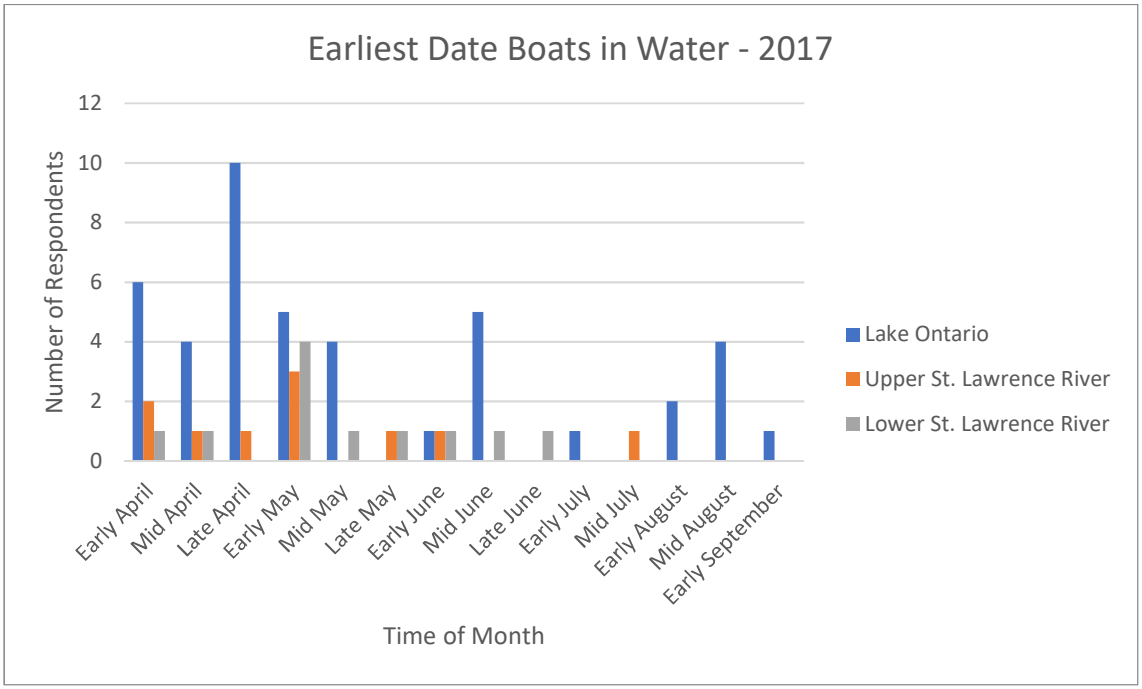

Figure 54: Earliest date of boats in water in 2017 (n=64)

5.5.3. Earliest Date in 2018

Similar to 2016, in 2018, early May was the most commonly cited “earliest date” for all three shoreline zones combined, followed by late April and early April (Figure 55). Late April was tied as the most commonly cited “earliest date” for those on Lake Ontario.

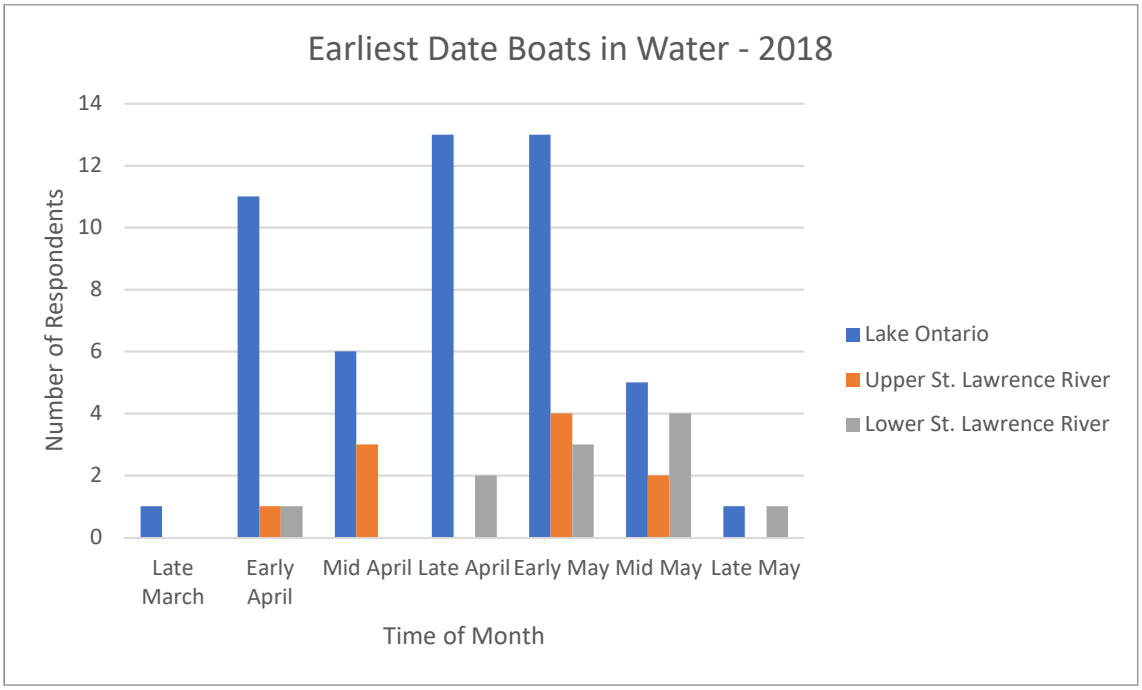

Figure 55: Earliest date of boats in water in 2018 (n=71)

5.5.4. Comparison of Boat Launch Dates by Year

As outlined above, May and April were the most commonly cited "earliest dates" for all three years. In 2017, "earliest dates" peaked in April/May but extended into the summer months for some respondents (Figure 56).

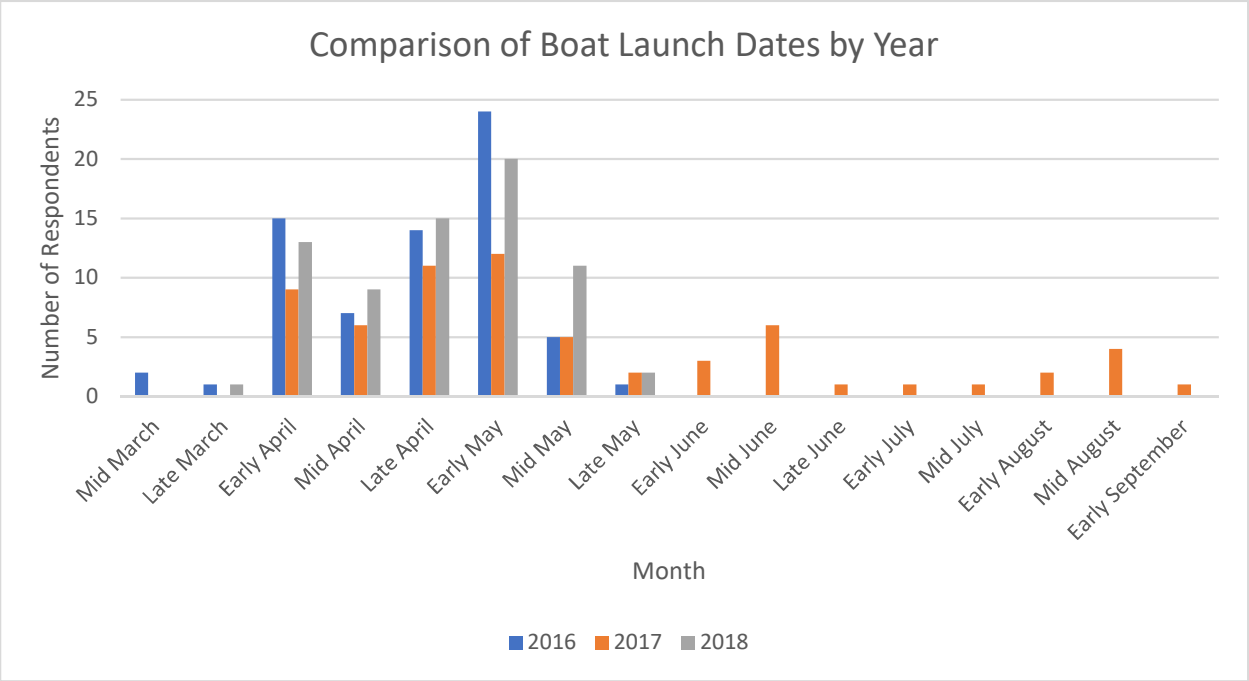

Figure 56: Comparison of boat launch dates by year (n=71)

5.6. Other Factors Influencing Impacts

Respondents were asked to identify other factors they felt influenced the impacts described above during the 2017 high water levels. The most commonly identified factors were: high precipitation; wind; and, closed boat launches along the waterway. Thirty-five (n=35) respondents indicated other factors.

Of those indicating other factors influencing impacts, a handful of respondents felt that the impacts were due to poor management of water levels and flows, with some referencing IJC's Plan 2014. The majority of such comments came from respondents on Lake Ontario. Some respondents also referenced higher volume of water than normal, due to winter snow melt and/or spring precipitation. It was felt that high water levels were aggravated by wave action, storms/swells and wind.

Communication was also seen as an issue, potential visitors and members received mixed messaging in terms of the impacts experienced by each facility. For example, some might have thought that certain respondents were closed, when they were not. The media also provided reports of debris in Lake Ontario, which some felt made boaters wary of damage to their vessels.

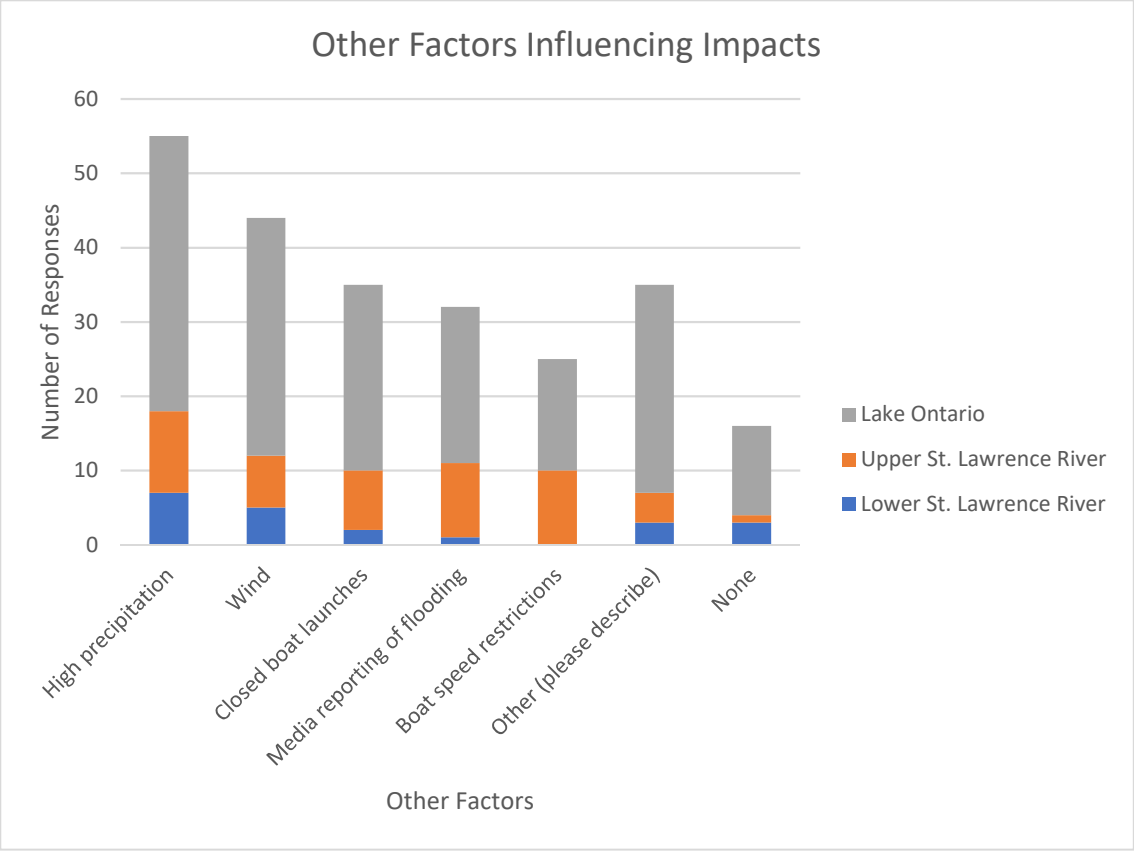

Figure 57: Other factors influencing impacts (n=98)

5.7. Operations Impacted by Year

Next, respondents were asked to identify which recent years their operations were affected by high or low water levels. As shown in Figure 58 (below), the largest number of respondents reported impacted operations during 2017. Considerably fewer reported impacted operations in 2018 and 2016.

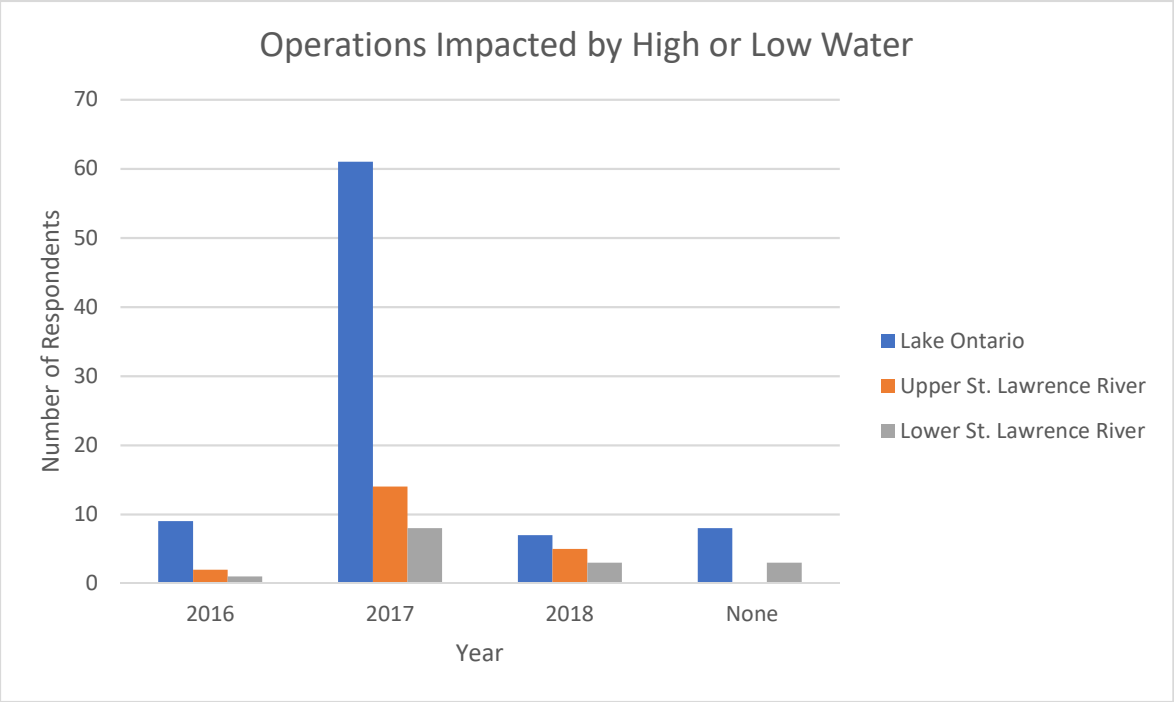

Figure 58: Operations impacted by high or low water (n=98)

5.8. Impacts in 2018

Respondents were asked to report any impacts experienced during 2018 that would not have been captured when reporting on those experienced in 2017. Some respondents reported continued decline in membership and attendance, having residual impacts on overall revenue. In some cases, members are required to pay up front and were not refunded for 2017. After a negative experience in 2017, some members did not return in 2018, according to respondents.

Four respondents noted impacts from low water levels were experienced in the fall of 2017 and/or in 2018. Of these respondents, three were located on the Upper St. Lawrence, and one was located on Lake Ontario. Other impacts include: ecosystem changes (flora and fauna) and, continued repairs to docks and other infrastructure.

5.9. High Water Levels

There were two questions in the survey that asked respondents the following:

- Before 2017, what was considered the highest water level above chart datum at which you could maintain operations and services at your facility?
- After the 2017 season, what is now considered the highest water level above chart datum at which you could maintain operations and services at your facility?

Due to how these questions were worded, respondents interpreted them differently and thus answered them differently, resulting in considerable variability in responses. Some respondents provided an *absolute* water level (e.g. 76 metres), others provided an *increase* above typical water levels (e.g. 1 metre), and others did not answer at all.

Given the variability in responses, representatives from the GLAM Committee reviewed individual responses to these questions to establish a methodology for interpreting the results. For those that provided an increase above typical water levels, the number they provided was then added to chart datum to provide comparability and consistency with those who reported an absolute water level. Some individual responses to both questions were noted as being uncertain (i.e., the reported water levels were not realistic/logical relative to chart datum) and have been excluded from this analysis at the advice of the GLAM Committee. It is suggested that the GLAM Committee follow-up with respondents in the future to collect standardized responses to these questions.

5.9.1. High Water Level Before 2017

The results from respondents on Lake Ontario were grouped together, as there is a reasonable level of comparability across the Lake. For those qualifying respondents on Lake Ontario (n=24), the average highest water level above chart datum at which they could maintain operations and services prior to 2017 was 75.44 metres (with values ranging from 74.98 to 76 metres). For reference, chart datum for Lake Ontario is 74.2 metres. The results suggest that prior to 2017, most qualifying respondents on Lake Ontario typically felt they could maintain operations and services at their facilities with an increase above chart datum of one (1) metre or more, with 22 out of 24 qualifying respondents reporting a value ≥75.2 metres.

The values from those respondents located on the Upper and Lower St. Lawrence River are more difficult to analyze together, as the point of reference (elevation) changes over the course of the river (upstream to downstream). As such, qualifying responses have been compared to nearby chart datum reference points along the River, and results have been presented as increase in water level. The average increase in water level at which qualifying respondents on the Upper and Lower St. Lawrence River felt they would maintain operations and services at their facilities prior to 2017 was 1.34 metres (n=12, with values ranging from 0.91 metres to 2.74 metres).

5.9.2. High Water Level After 2017

As with the responses for the water level before 2017, the results for responses from Lake Ontario were grouped together, as there is a reasonable level of comparability across the Lake. For those qualifying respondents on Lake Ontario (n=24), the average highest water level above chart datum at which they could maintain operations and services after 2017 was 75.62 metres (with values ranging from 75.2 to

77 metres). For reference, chart datum for Lake Ontario is 74.2 metres. The results suggest that after 2017, all qualifying respondents on Lake Ontario typically felt they could maintain operations and services at their facilities with an increase above chart datum of one (1) metre or more.

Again, the responses for the Upper and Lower St. Lawrence River are however more difficult to analyze together, as the point of reference (elevation) changes over the course of the river (upstream to downstream). As such, no average response is presented for respondents from these two shoreline zones for reported values after 2017. However, when comparing responses to nearby chart datum reference points along the River, the average increase in water level at which respondents felt they would maintain operations and services at their facilities after 2017 was 1.48 metres (n=12, with values ranging from 0.91 metres to 3.35 metres), slightly higher than the value reported before 2017.

5.9.3. Comparing Responses for Before and After 2017

Table 6 below summarizes responses from those qualifying respondents on Lake Ontario, showing the average and range of responses for both before and after 2017, and the net difference between the two.

Table 6: Comparison of high water levels for Lake Ontario

	Before 2017	After 2017	Net Difference
Average (metres)	75.44	75.62	+0.18
Lowest Reported Value (metres)	74.98	75.2	+0.22
Highest Reported Value (metres)	76	77	+1

Table 7 below summarizes responses from those qualifying respondents on the Upper and Lower St. Lawrence River, reported as an increase in water level as compared to nearby reference points.

Table 7: Comparison of high water levels for the Upper and Lower St. Lawrence River

	Before 2017	After 2017	Net Difference
Average (metres)	1.34	1.48	+0.14
Lowest Reported Value (metres)	0.91	0.91	0
Highest Reported Value (metres)	2.74	3.35	+0.61

6. ADAPTIVE ACTIONS

6.1. Actions Taken in 2017

Respondents were next asked to identify actions taken during the high water level impacts to maintain services and/or minimize impacts. As shown below, ninety-four percent (94%) of respondents reported taking action(s) during the high water levels. Specific actions are outlined below, in Figure 59.

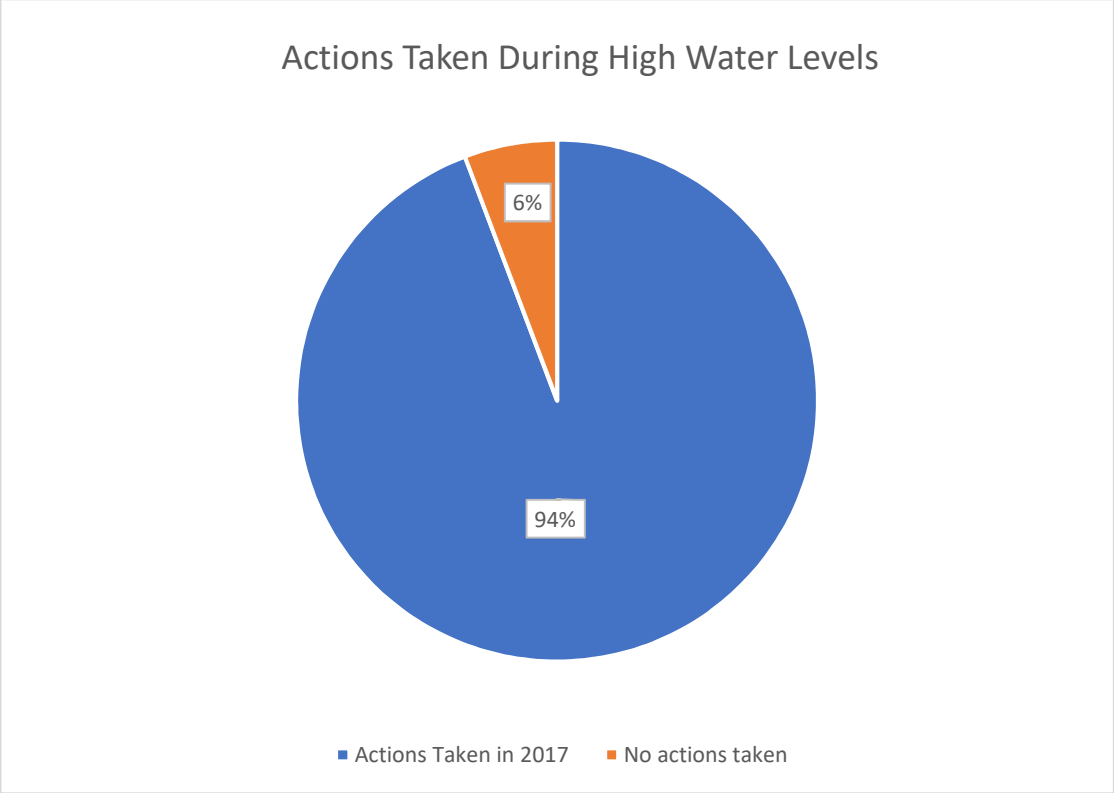

Figure 59: Actions taken during high water levels (n=87)

Of those respondents on Lake Ontario, the most common actions were: turning off power and/or water to docks; using sandbags to stop flooding; and, repairing docks.

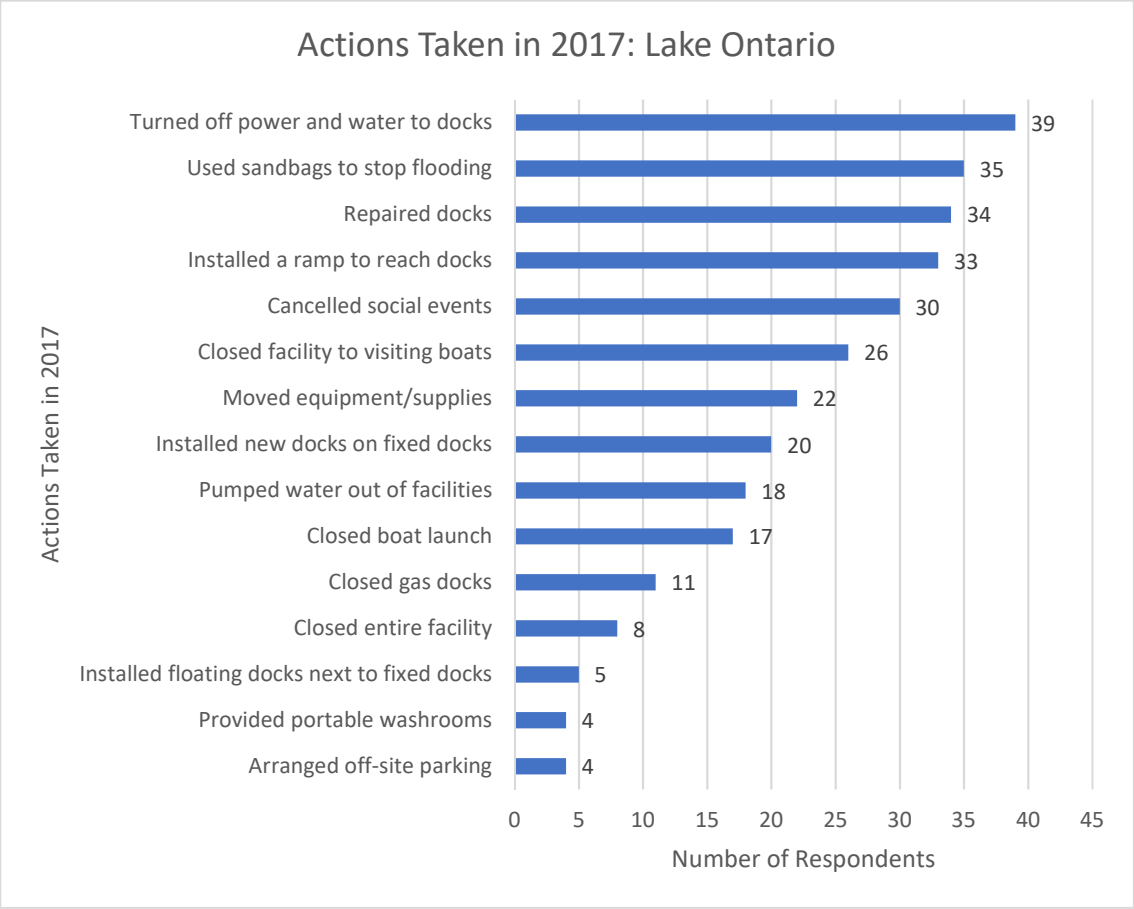

Figure 60: Actions taken in 2017 on Lake Ontario (n=60)

Similarly, amongst respondents on the Upper St. Lawrence River, the most common actions were: installing a ramp to reach docks; repairing docks; and, turning off power and/or water to docks.

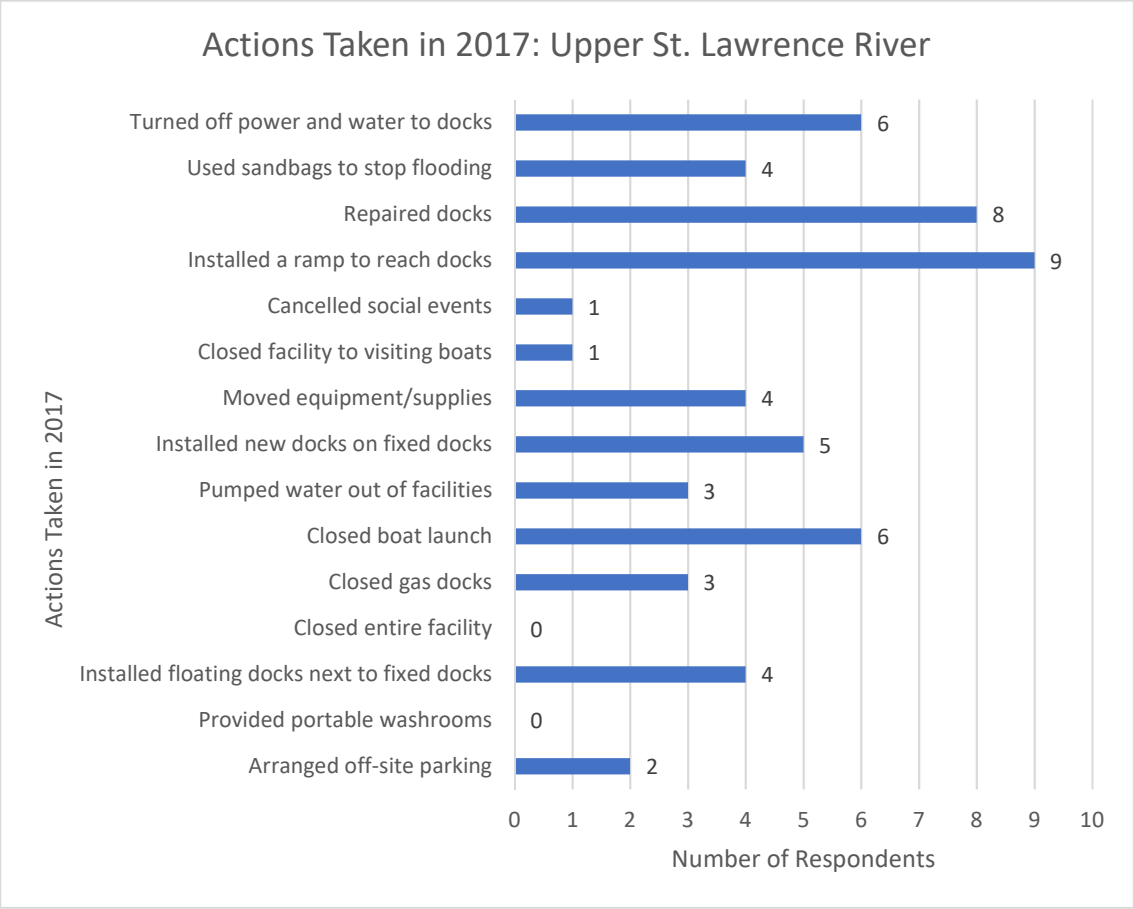

Figure 61: Actions taken in 2017 on Upper St. Lawrence River (n=13)

For respondents on the Lower St. Lawrence River, the most common actions were: repairing docks; turning off power and/or water to docks; and installing ramp to reach docks.

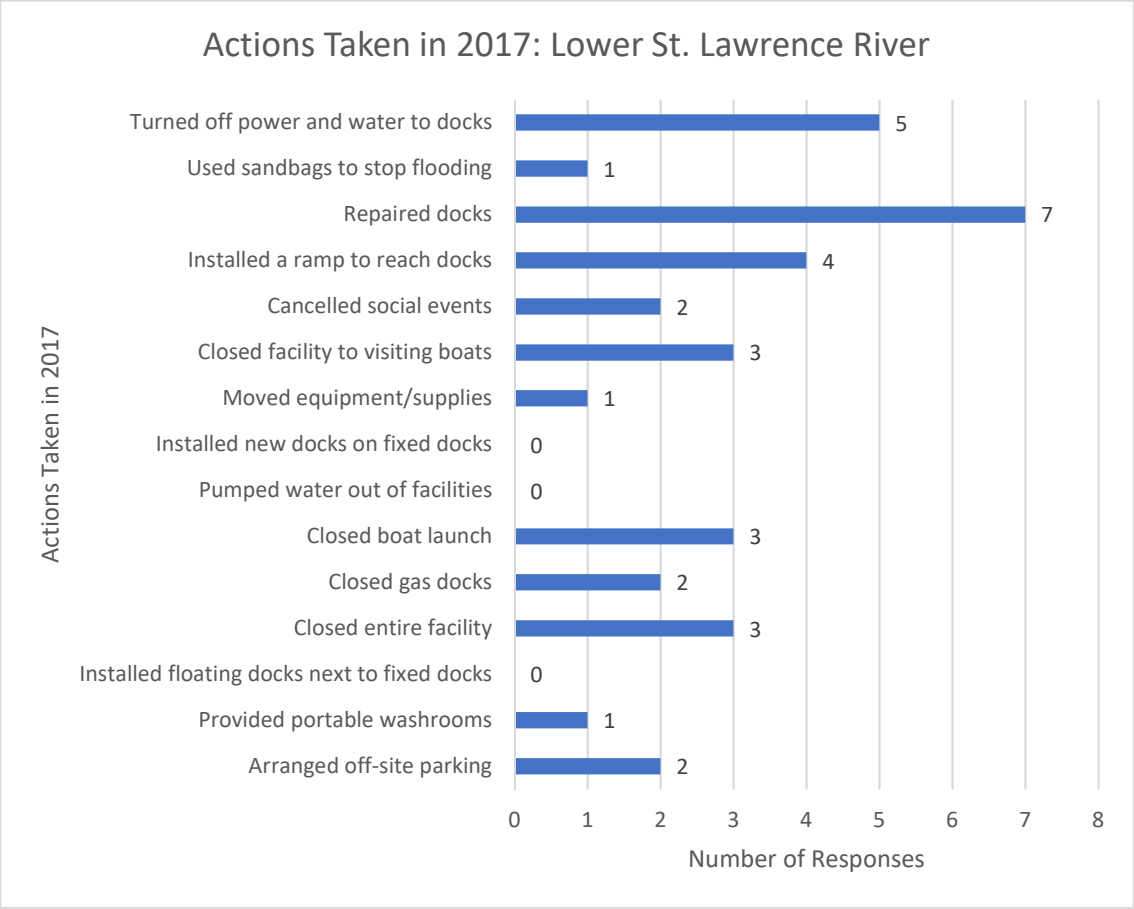

Figure 62: Actions taken in 2017 on Lower St. Lawrence River (n=9)

Thirty-four respondents reported taking other actions during 2017. The most common actions were those taken to improve access to facilities (i.e. adding ramps, elevating walkways, grading parking lots) and those to improve the boating experience (i.e. modifying shore tie/anchor systems, rerouting electrical power, installing temporary gasoline pumps). In some cases, activities and programs were relocated. One respondent mentioned a “Refugee Program”, extended to those without dock services at their home facility.

6.2. Actions Taken Since 2017

Next, respondents were asked if their facility has taken actions since the high water levels of 2017 to protect against future possible impacts. Seventy-nine percent of respondents reported taking action(s) since 2017 (Figure 63).

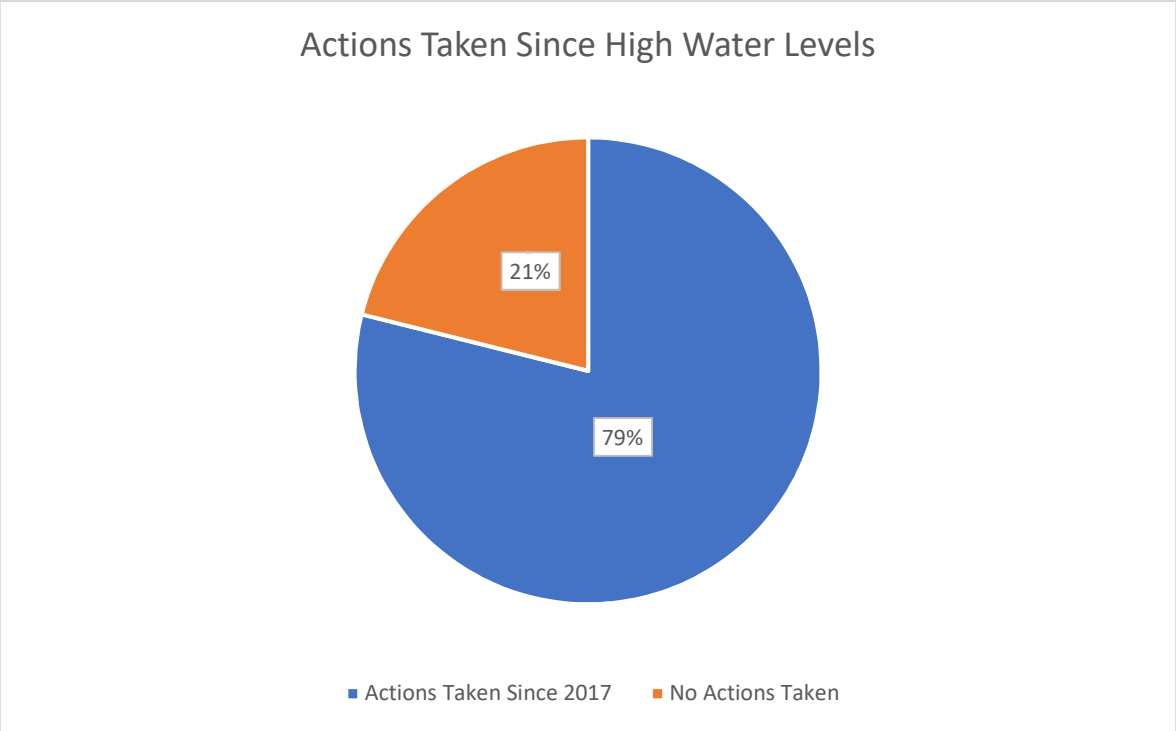

Figure 63: Actions taken since high water levels (n=90)

Of those respondents on Lake Ontario, the most common actions were: repairing damaged infrastructure; replacing or raising electricity hookups; repairing the shoreline with riprap; and, raising the height of fixed docks.

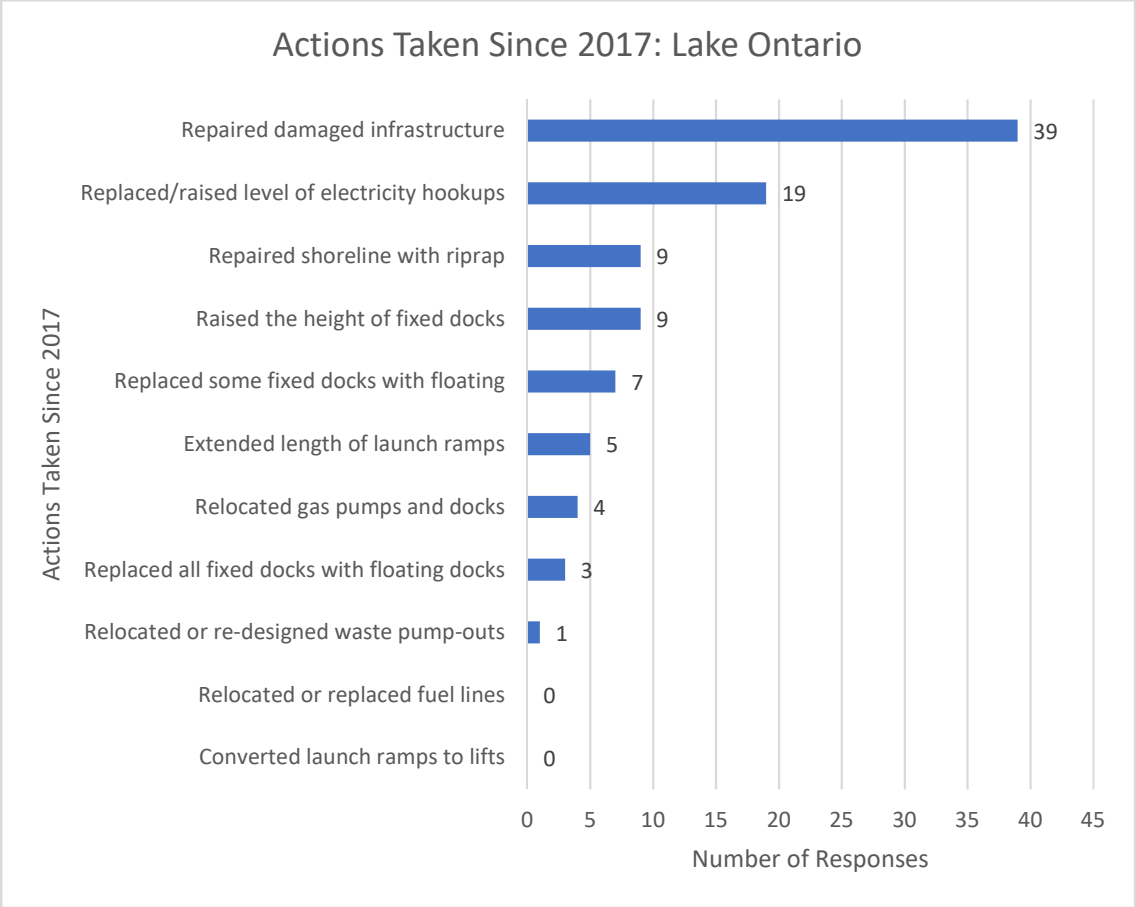

Figure 64: Actions taken since 2017 on Lake Ontario (n=55)

Repairing damaged infrastructure was the most common action taken by respondents on the Upper and Lower St. Lawrence River.

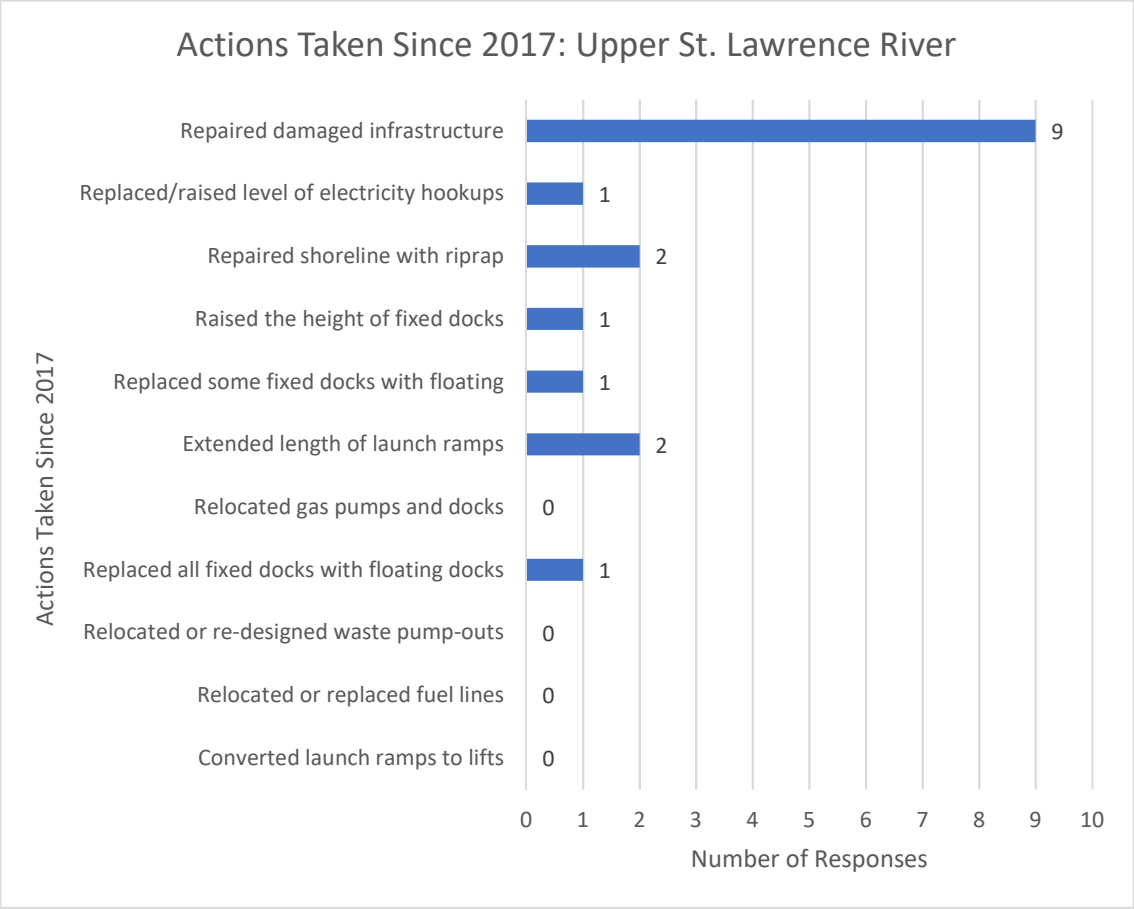

Figure 65: Actions taken since 2017 on Upper St. Lawrence River (n=10)

As above, repairing damaged infrastructure was the most common action taken by respondents on the Upper and Lower St. Lawrence River.

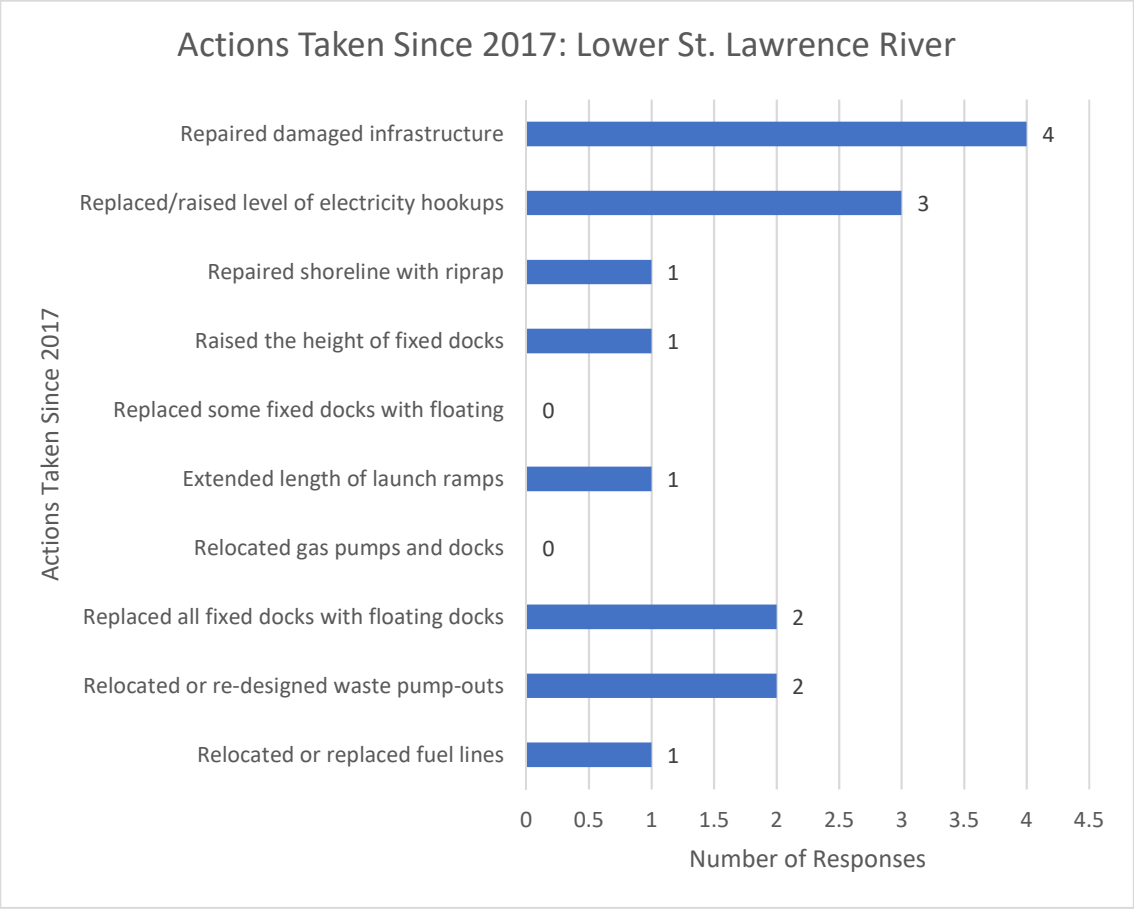

Figure 66: Actions taken since 2017 on Lower St. Lawrence River (n=6)

Across all three shoreline zones, thirty-eight respondents reported taking other actions since 2017. The most common actions were repairs to docks and other infrastructure, such as shoreline and breakwall improvements. In some cases, respondents are awaiting permits to complete these repairs. Similar to during 2017, improvements were made to walkways, parking lots and ramps to improve access.

6.3. Cost of Actions

Respondents were asked to report the cost of implementing the actions above, both during and after the 2017 high water event[9]. Seventy-four (74) respondents reported costs associated with actions taken in 2017, while 32 reported no cost. The average cost of actions taken in 2017 was $27,912.89, with cited costs ranging from $50 to $200,000.

Sixty-six (66) respondents reported costs associated with actions taken since 2017, while 40 reported no cost. In terms of actions taken since 2017, the average cost was $128,358.33. In this case, costs ranged from $200 to $3,000,000. This suggests that more costly actions and improvements were taken following the 2017 event.

As shown in Figures 67 and 68 (below), the highest number of respondents reported a medium-level cost in 2017. The largest number of respondents reported no cost since 2017. However, of those reporting a cost since 2017, high-level costs were the most common.

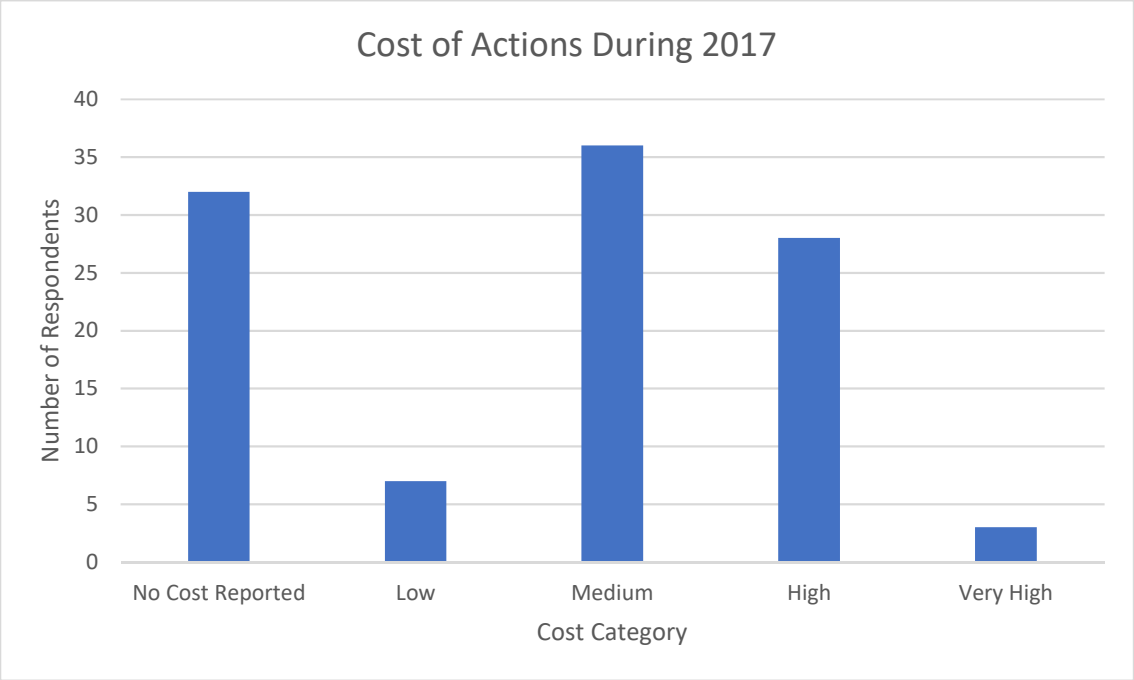

Figure 67: Cost of actions taken during 2017 (n=106)

[9] Costs were categorized as: "No Cost Reported" ($0 or blank); "Low" ($1 to $1,000); "Medium" ($1,001 to $10,000); "High" ($10,001 to $100,000); or, "Very High" (Over $100,000).

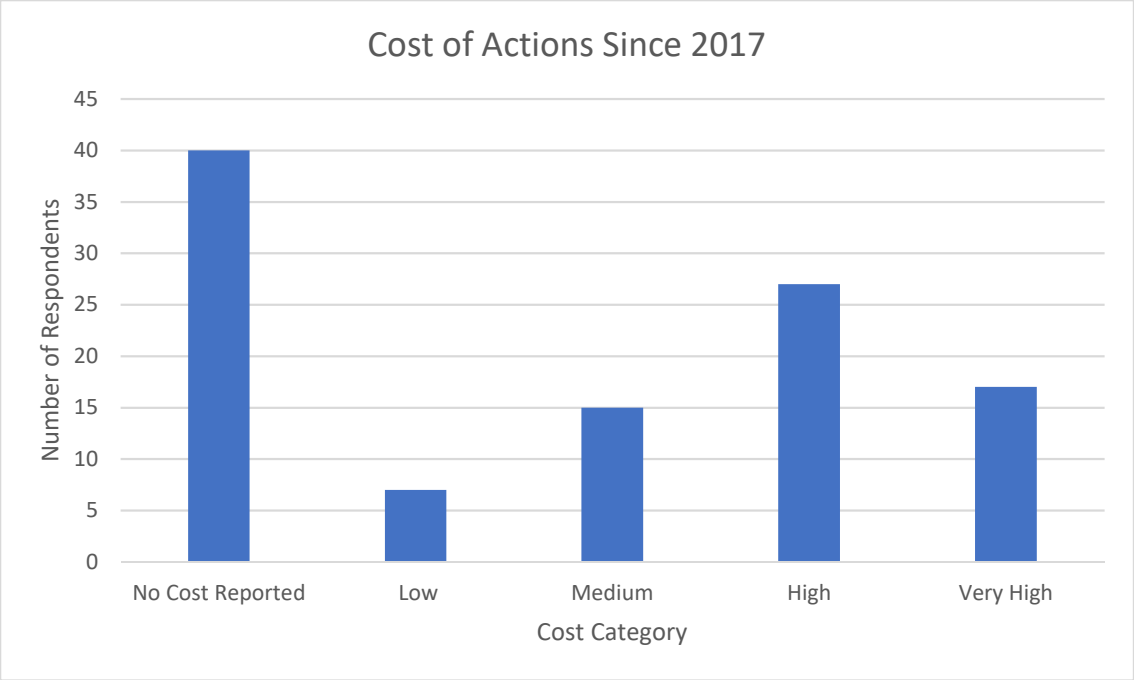

Figure 68: Cost of actions taken since 2017 (n=106)

7. OTHER COMMENTS AND CORRELATIONS

7.1. Comparison of Operations

Respondents were asked to compare their overall operations and business in 2018 compared to 2017. The largest percentage of respondents from all three shoreline zones felt that their operations and business was better in 2018 than in 2017 (74.4%). This was especially true amongst respondents from Lake Ontario, as shown in Figure 69 (below).

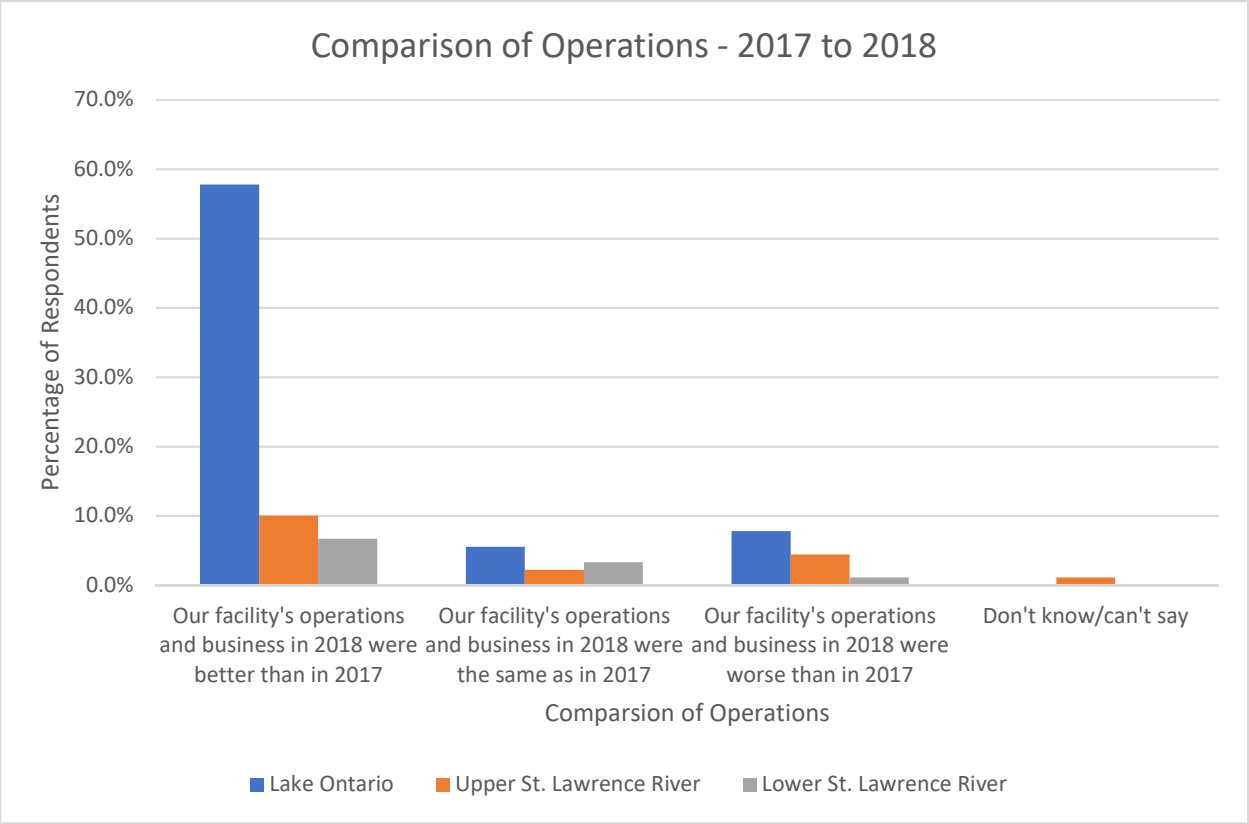

Figure 69: Comparison of operations and business 2017 to 2018 (n=90)

7.2. Scale of Impact

In closing, respondents were asked the following question: “On a scale of 1 to 10, 1 being very little impact and 10 being high degree of impact, how would you rate the overall impact of the 2017 high water levels on your facility and operations?”. As shown in Figure 70 (below), one-third of respondents (33.3%) rated the overall impact as a “10”. The average rating was 7.3. Over sixty percent of respondents (62.2%) rated the overall impact as an 8, 9 or 10. Respondents from Lake Ontario rated their impact as an 8 or above more often, whereas those from the St. Lawrence River were more evenly distributed across the scale. As a reminder, the majority of responses came from La

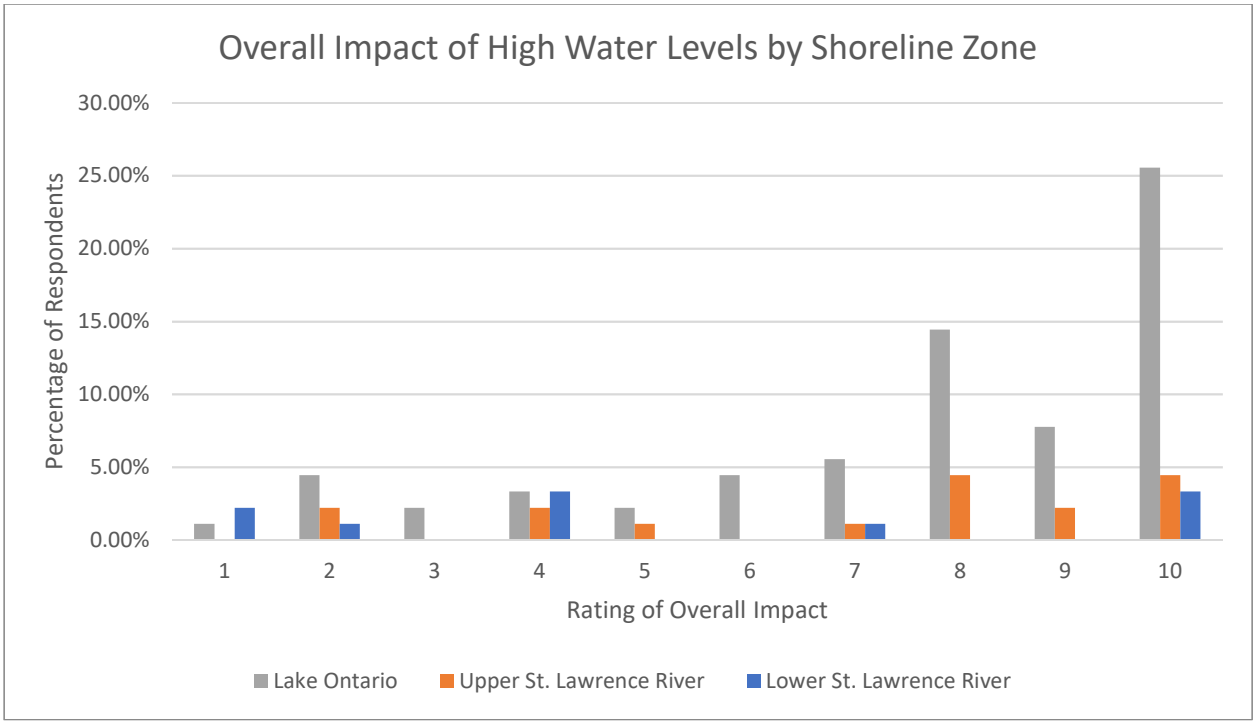

Figure 70: Overall impact of high water levels by shoreline zone (n=90)

Figure 70a (below) displays the overall impact rating by location. Respondents from New York rated their impact as an 8 or above most often. Those from Ontario most often rated their impact as an 8, while responses from Quebec were more evenly distributed across the scale. As a reminder, the majority of responses came from New York and Ontario.

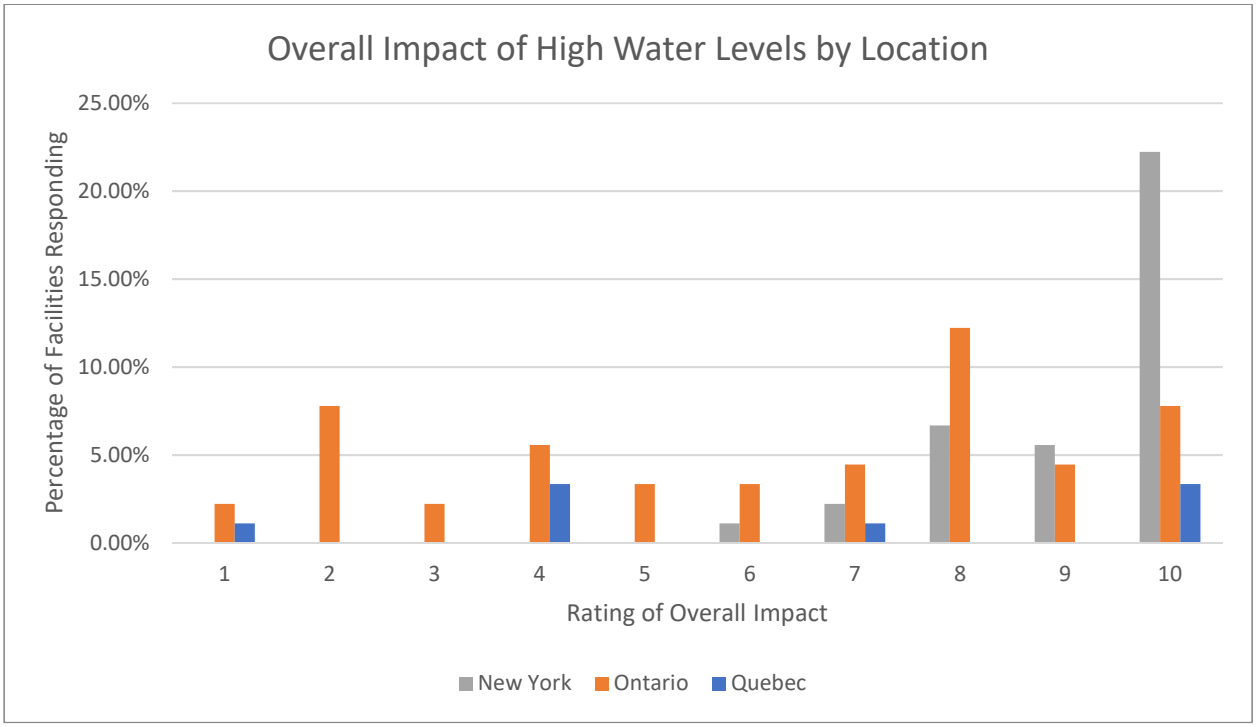

Figure 70a: Overall impact of high water levels by location (n=90)

Figure 71 (below) depicts the overall impact ratings geographically. A larger bar indicates a greater reported impact. Each facility is represented by its own bar. The respondents reporting a relatively high degree of impact were distributed throughout the system, both on Lake Ontario and the upper St. Lawrence River as well as below the dam on the lower St. Lawrence River. There is a cluster of respondents reporting relatively low impacts in the areas directly adjacent to the dam in Cornwall/Massena.

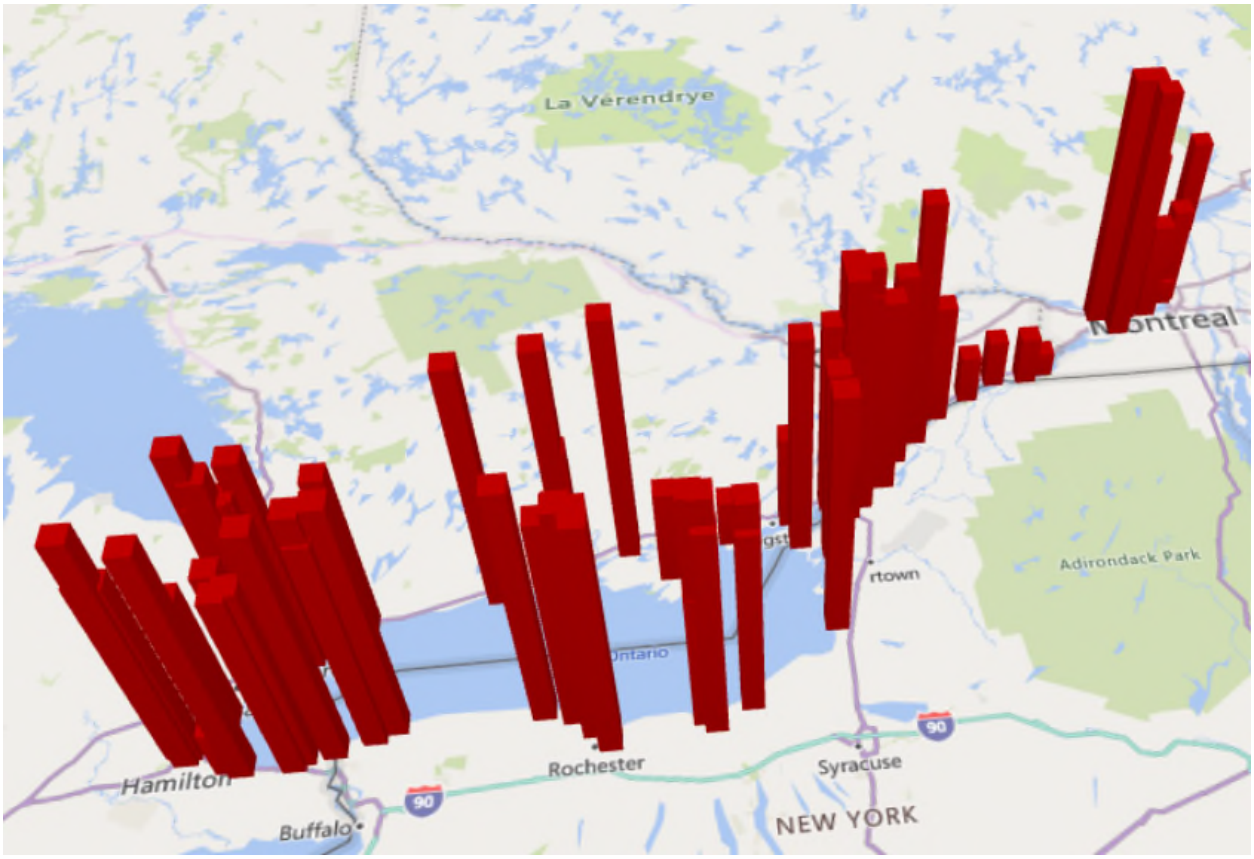

Figure 71: Map showing overall impact of high water levels by location and type

7.2.1. Impact by Shoreline Zone

Figure 72 displays the average reported impact (represented by the bars and referenced to the primary y-axis) and number of responses (represented by the dots and referenced to the secondary y-axis) by shoreline zone and facility type. The highest average reported impact (8.6) is seen amongst marinas on Lake Ontario, followed by marinas on the Upper St. Lawrence River (7.6). The lowest average reported impact (3.6) was seen amongst marinas on the Lower St. Lawrence River, however, this represents only a handful of respondents (n=5).

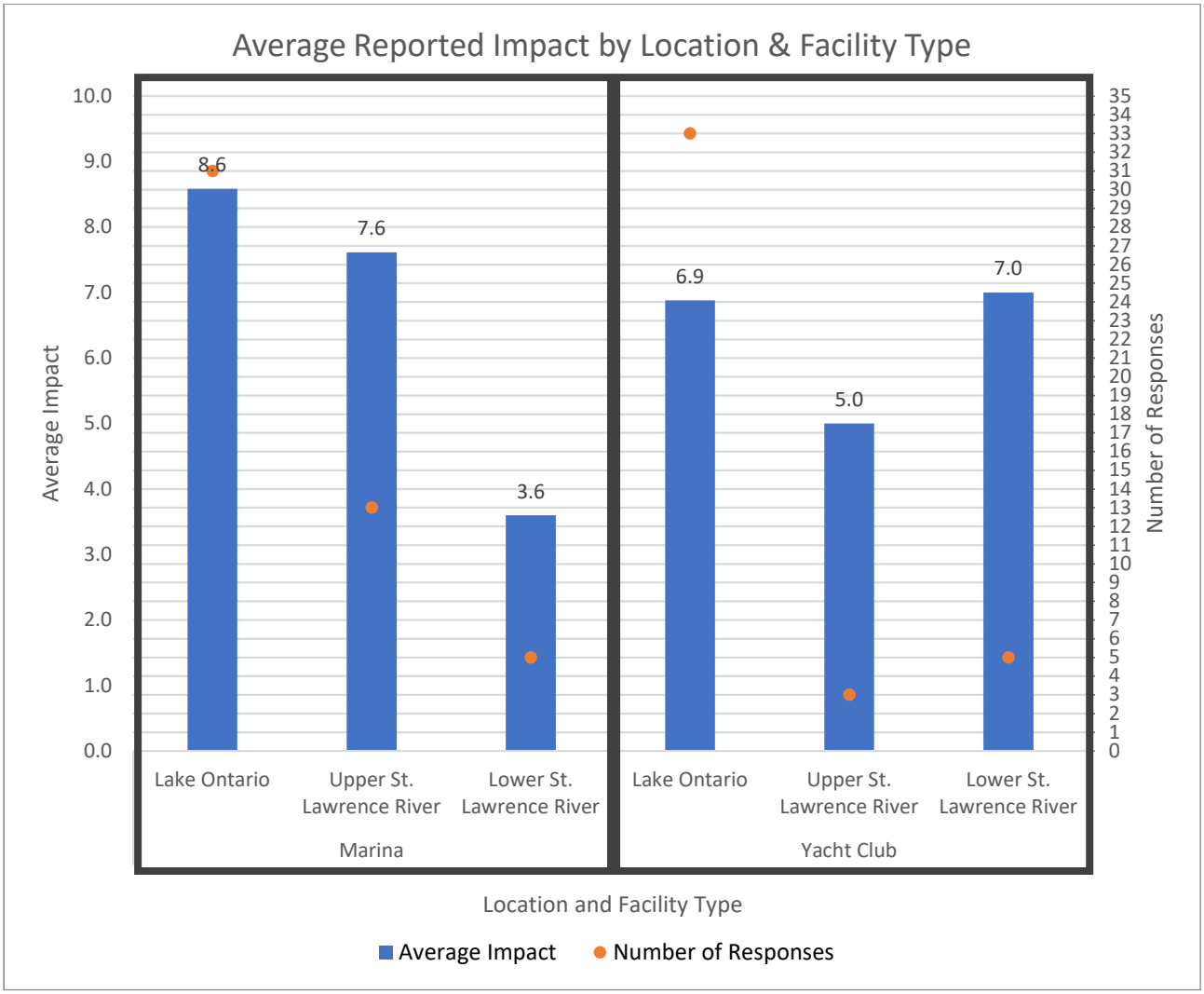

Figure 72: Average reported impact by shoreline zone and facility type (n=90)

7.2.2. Impact by Location

Figure 73 displays the average reported impact (represented by the bars and referenced to the primary y-axis) and number of responses (represented by the dots and referenced to the secondary y-axis) by location and facility type. The highest average reported impact (9.2) is seen amongst marinas and yacht clubs in New York. The lowest average reported impact (5.0) was seen amongst marinas in Quebec, however, this represents only three respondents.

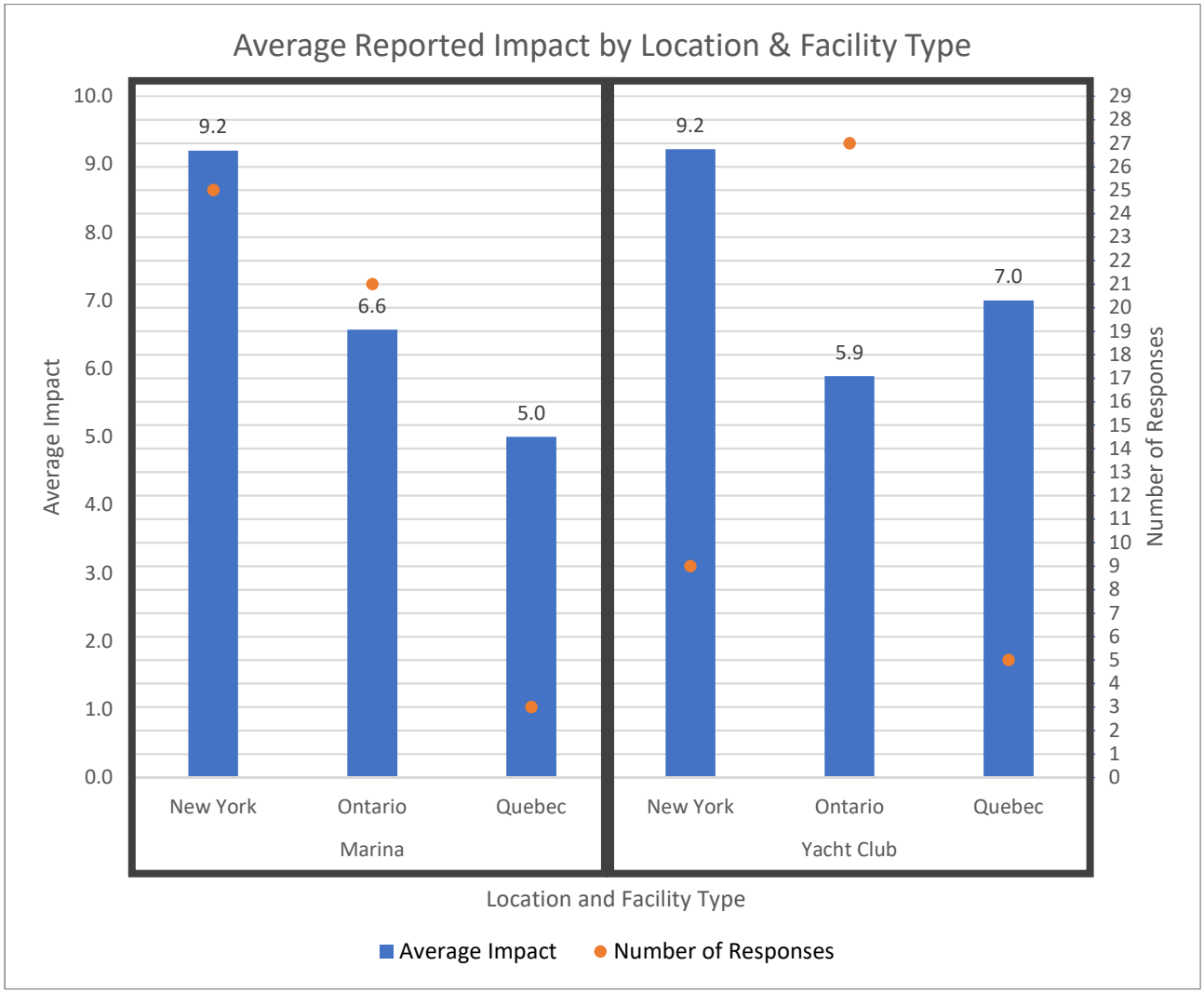

Figure 73: Average reported impact by location and facility type (n=90)

7.2.3. Impact by Actions Taken

Figure 74 and 75 (below) display respondents' rating of overall impact (from 1 to 10) compared to whether they reported taking action(s) in response to the 2017 high water levels, either during or after the event. As shown, there is a large number of respondents rating overall impact as an 8, 9, or 10, which reported having taken action either in 2017 (54 respondents taking action) or subsequently (51 respondents taking action).

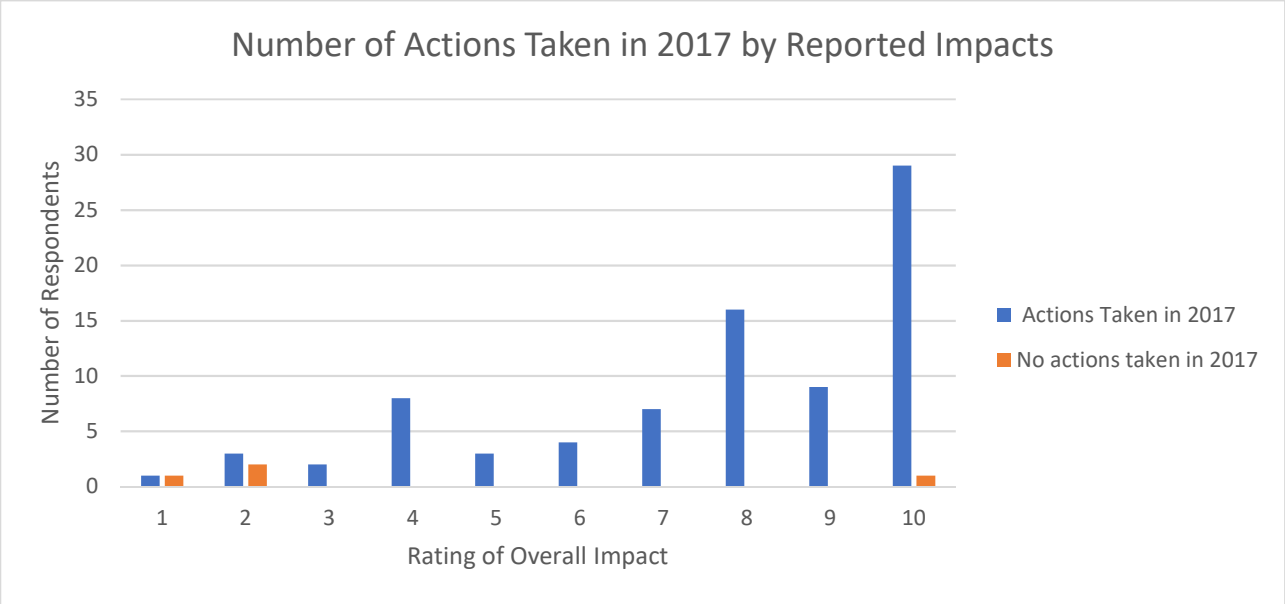

Figure 74: Actions taken by reported impacts (n=86)

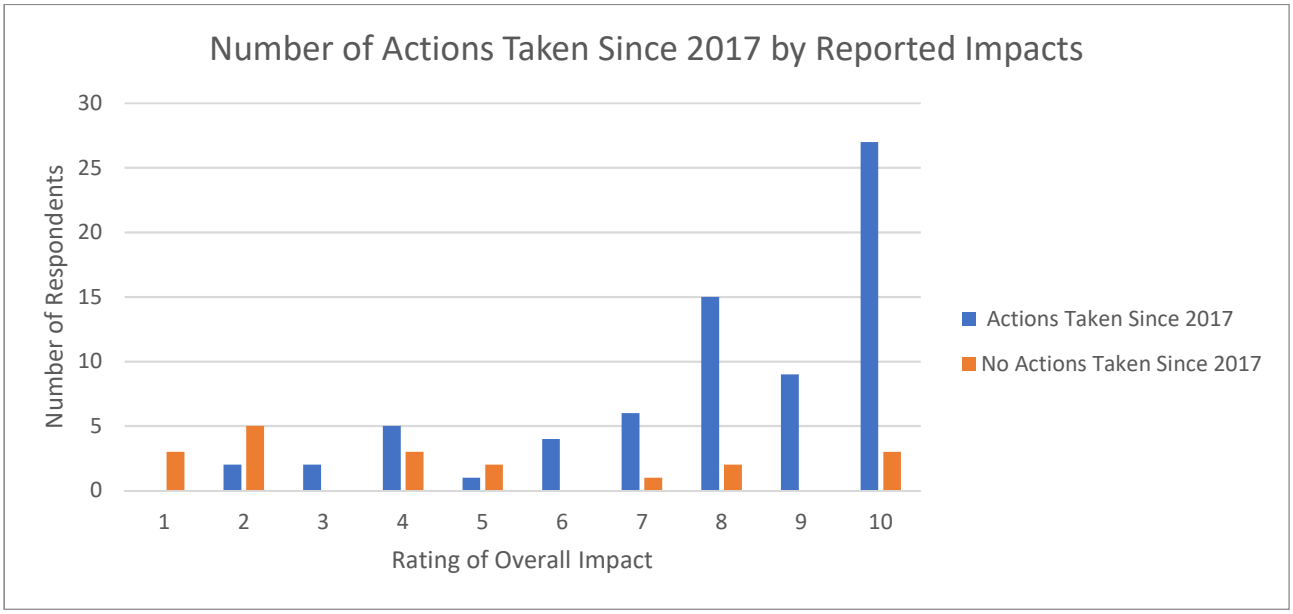

Figure 75: Actions taken by reported impacts (n=90)

7.2.4. Impact by Size

Figure 76 (below) displays respondents' reported impact (from 1 to 10) compared to their facility's size[10]. Most respondents felt they were very impacted, with 62% rating overall impact as an 8, 9 or 10. As shown below, there appears to be a range of impact ratings across all three facility sizes. It should also be noted that "small" facilities constitute 57% of the overall sample.

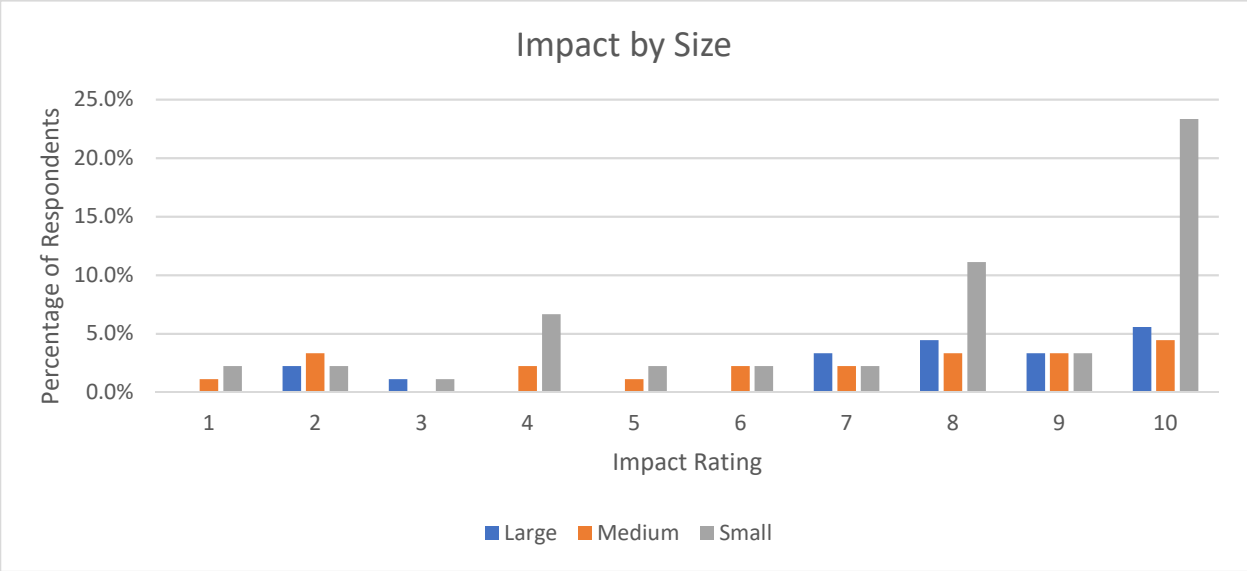

Figure 76: Impact by size (n=90)

[10] Facility size was based on number of boat slips. A facility with less than 100 slips was categorized as "small", a facility with 100 to 199 slips was categorized as "medium", and a facility with 200 or more slips was categorized as "large".

7.2.5. Impact by Dock Type

For the purpose of the graph below, respondents were categorized based on primary dock type – those with a majority of fixed docks or floating docks. As shown below, those with primarily fixed and floating docks both had large numbers of respondents reporting an overall impact of 8, 9, or 10. More than half (57.9%) of respondents with primary fixed docks reported their impact as a 10.

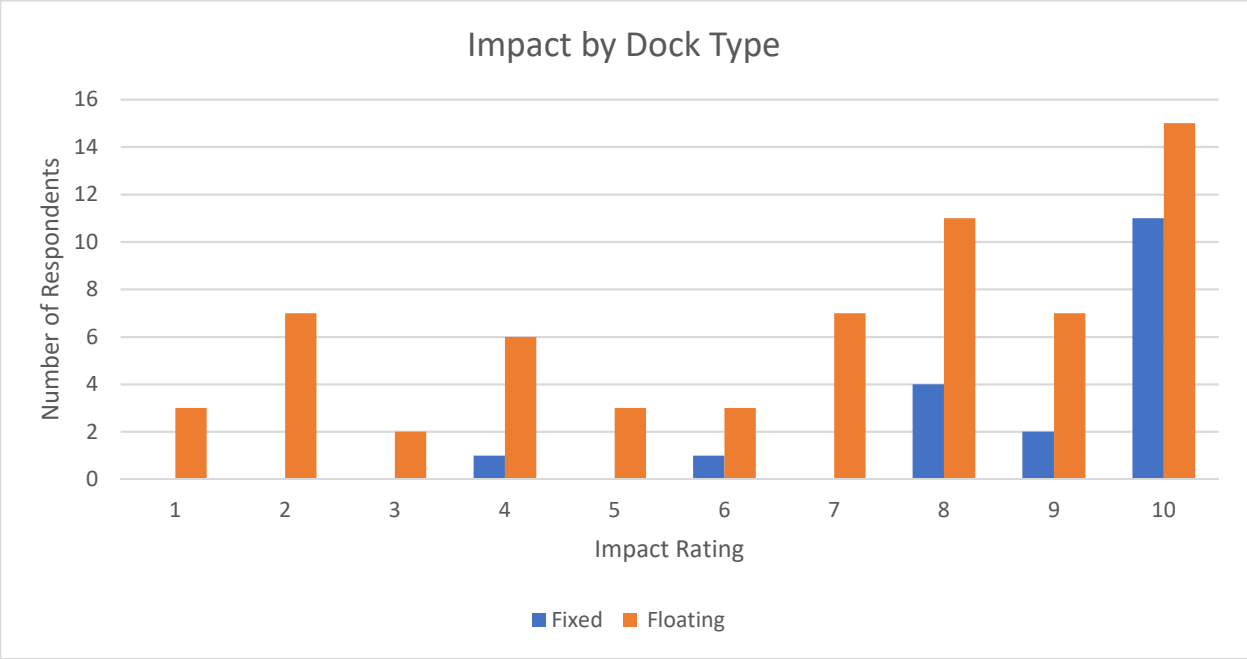

Figure 77: Impact by dock type (n=83)

7.3. Final Comments

In the final comments section, respondents reiterated the challenges they experienced during the 2017 high water levels. Many cited losses of members and revenue, with some continuing to experience negative impacts. Some respondents cited difficultly in covering the cost of repairs. A few participants highlighted the ongoing issue of shoreline erosion, resulting in reduced protection and sediment buildup.

A small number of respondents were critical of the IJC/Plan 2014 and felt that the IJC should take responsibility for the 2017 high water levels. One respondent suggested that more and improved communication is need regarding high water levels.

While recognizing that others were more severely impacted, some respondents noted that they experienced minimal impacts from the high water levels.

8. KEY FINDINGS

When reflecting on the 2017 high water levels, the majority of respondents from marinas and yacht clubs reported a negative impact on their facility's operations. One-third of respondents rated the overall impact as a "10". The average rating was 7.3. Over sixty percent of respondents rated the overall impact as an 8, 9 or 10.

Nearly all respondents (100/106) reported at least one impact to their facility in 2017, with "erosion of shorelines", "submerged boat launch ramps" and, "flooding of fixed docks" being the most commonly cited impacts. The highest number of impacts were reported during the month of May, with the overall number of impacts reported decreasing throughout the late summer and early fall.

Many respondents reported reduced usage (fewer boats moored, fewer visiting vessels, fewer social events) and reduced revenue (total revenue and revenue from fuel sales) early in the 2017 season (May/June). However, in most cases, usage and revenues returned to typical levels as the season progressed through the summer and fall. The usage of boat slips was reported as more typical throughout the duration of the 2017 season. Nearly three-quarters of all respondents felt that their operations and business was better in 2018 than in 2017.

Respondents reported taking a number of actions in response to the 2017 high water levels. Seventy-four (74) respondents reported costs associated with actions taken in 2017. For those 74, the average cost of actions taken in 2017 was $27,912.89, with cited costs ranging from $50 to $200,000. Sixty-six (66) respondents reported costs associated with actions taken since 2017, while 40 reported no cost. For those 66 respondents, the average cost was $128,358.33, with cited costs ranging from $200 to $3,000,000.

9. LESSONS LEARNED

With respect to the process for undertaking a survey of marinas and yacht clubs, the following lessons were learned and should be considered when undertaking future work of a similar nature:

- When undertaking outreach to invite these respondents to participate in the survey, the passive approach of letters and emails proved to be far more effective in soliciting responses than the active approach of phone calls. Given that research efforts were occurring during the boating offseason, it could be that many facility owners, managers, commodores, etc. were not in the office or near the phone, but still monitoring emails. The aforementioned is an assumption, and cannot be confirmed.
- Future research efforts should be undertaken before the boating season draws to a close, to ensure respondents' facilities are open when outreach efforts are made.
- Sample targets for yacht clubs were either nearly met (Upper St. Lawrence) or largely exceeded (Lake Ontario and Lower St. Lawrence), while sample targets for marinas fell short in all three zones (though Lake Ontario was nearly met). The exact reasons for this are unknown, though timing of the survey may have been a contributing factor.
- Given the nature of the survey and the questions within it, respondents found it valuable to be able to review the questions in advance. This allowed them to understand the types of information they needed for their responses, and to compile this information in advance of responding to the survey. Several respondents requested to see the questions.
- The questions regarding the highest water level above chart datum at which respondents could maintain operations and services were answered in a wide variety of ways by respondents. To have allowed for more consistency, it may have proved beneficial to provide them with more context and an example of the desired format of their response. This could likely apply to other questions as well that had an element of subjectivity in how they could be interpreted. It is suggested that the GLAM Committee follow-up with respondents at a future date and again pose this question, but do so in such a way so as to ensure consistency in responses.