Emergency Reduction of Lake Manitoba & Lake St. Martin Water Levels

Aquatic Environment Monitoring - January - August 2012

REPORT

Prepared for Manitoba Infrastructure and Transportation · March 2013
By North/South Consultants Inc. · 83 Scurfield Blvd. · Winnipeg, MB · R3Y 1G4

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By:

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EXECUTIVE SUMMARY

Due to widespread record flooding throughout southern Manitoba during 2011, water levels in Lake Manitoba and Lake St. Martin were several feet higher than desirable, resulting in significant damage to hundreds of properties, restricted road access to several communities, and long-term evacuation of four First Nations communities. As part of emergency relief measures, the Province of Manitoba, through Manitoba Infrastructure and Transportation (MIT), constructed an emergency channel (Reach 1 Emergency Outlet Channel) to increase water flow from Lake St. Martin to Lake Winnipeg. Reach 1 allows water to flow from Lake St. Martin through the Buffalo Creek Drainage System and into the lower Dauphin River, immediately upstream of Lake Winnipeg. Water began to flow along the diversion route on 01 November, 2011.

Concurrent with construction and operation of Reach 1, MIT initiated environmental studies and monitoring to help describe and assess environmental effects arising from operation of Reach 1. A review of existing information pertinent to aquatic environments in Lake Manitoba, Fairford River, Lake St. Martin, Dauphin River and the Sturgeon Bay area of Lake Winnipeg was conducted and used to provide a preliminary assessment of project-related effects on affected water bodies in the area. During this process, data deficiencies were identified and a monitoring work plan was developed to:

- Identify studies that would provide information to fill data gaps to better understand aquatic impacts and plan appropriate mitigation strategies; and,
- Collect information to fill identified information deficiencies to provide a background against which post-project changes can be measured. Where possible, studies were designed to provide information to help assess aquatic impacts, as well as provide a baseline against which post-project changes could be measured.

Field investigations were conducted through fall 2011 and results were presented in North/South Consultants Inc. (2013).

The need for an additional drainage channel to protect the community of Dauphin River from anticipated flooding due to ice jamming at the river mouth during spring break up was identified in fall 2011. The second channel (Reach 3 Emergency Channel) was constructed through winter 2012, and was oriented to deflect flow from Reach 1 and Buffalo Creek to Sturgeon Bay, thereby reducing flow along the lower Dauphin River.

At MIT's request, a second work plan was developed to collect aquatic environment baseline information prior to operation of Reach 3, as well as to collect additional monitoring information related to operation and closure of Reach 1 and, once it became operational, Reach 3. At the time the work plan was prepared, it was anticipated that operation of Reach 1 and Reach 3 would cease at the end of August 2012. Thus, the second work plan included all necessary studies required to document potential operational and closure-related effects on affected water bodies. Emphasis of the studies was placed on water quality, sedimentation, and fish and fish habitat, and included the period extending from January

to August, 2012 (the study period). This report provides results of field programs conducted during that time.

While Reach 3 was constructed but not operated, operation of Reach 1 continued into November 2012, and monitoring associated with operation of the channel was continued through fall 2012. Data collections will be ongoing throughout the post-operational phase of Reach 1. Ultimately, the data presented in this report and collected subsequently will be used to produce an environmental effects assessment related to the operation of Reach 1.

Results of monitoring information collected from January to August 2012 are presented in the following sections. Emphasis is placed on describing information collected during that period. Detailed examination of Reach 1 operational effects will be provided in subsequent reports, following collection of post-operational data.

Water Quality Monitoring

Water quality monitoring was conducted to document potential changes in water quality during operation of Reach 1, and to help determine the spatial extent over which any changes to water quality may have occurred. Water quality data were collected from upstream of Lake Manitoba and throughout Lake St. Martin, the Reach 1 Emergency Outlet Channel System, and Sturgeon Bay during operation of Reach 1. Water quality data collections consisted of several components, each with discrete objectives. Water quality monitoring consisted of the following programs:

- Regional Water Quality Monitoring Program (RWQMP);
- Operational EMP Monitoring; and,
- *In situ* and TSS Monitoring in Sturgeon Bay.

RWQMP

During the conduct of the RWQMP, water quality information was collected from all major waterbodies and waterways within the study area that were affected by flooding and encompassed the major inputs to the north basin of Lake Manitoba (i.e., Waterhen River and at the Lake Manitoba Narrows) downstream to and including Sturgeon Bay on Lake Winnipeg. The objectives of the program were to:

- monitor water quality conditions on a regional level during Reach 1 operation;
- supplement data sets at sites within the study area where Manitoba Conservation and Water Stewardship, Water Quality Management Branch (MCWS) conducts water quality monitoring; and,
- evaluate spatial differences in water quality within the study area.

An assessment of potential effect(s) of the operation of Reach 1 on the water quality on potentially affected waterbodies has not been undertaken for this report. A brief assessment will be included with the presentation of the results from the fall 2012 monitoring program with a thorough assessment including historical and project-related water quality data to follow.

RWQMP results indicate that water quality within the study area can be generally described as moderately nutrient-rich, low to moderately turbid, slightly alkaline, hard to very hard, and well-oxygenated.

Lake St. Martin was consistently isothermal and *in situ* parameters, including DO, turbidity, pH, and specific conductance were consistent across depth. Molar ratios of N:P indicated that the lake was phosphorus limited in 2012. All routine water quality variables for which there are MWQSOGs and CCME guidelines, including phosphorus, DO, pH, ammonia, nitrate and nitrite were within PAL objectives and guidelines.

Buffalo Creek and the Dauphin River were also phosphorus limited and all routine water quality variables for which there are MWQSOGs and CCME PAL guidelines, including phosphorus, DO, pH, ammonia, nitrate and nitrite were within PAL objectives and guidelines.

Sturgeon Bay was consistently isothermal and DO, turbidity, pH and specific conductance were fairly consistent across depth. Based on N:P molar ratios, the bay was phosphorus limited during all seasons. The water quality of Sturgeon Bay was influenced by the Dauphin River such that sites closest to the river mouth exhibited water quality similar to upstream sites, including: higher alkalinity; higher conductivity and TDS; higher total nitrogen; lower carbon concentrations and, higher chlorophyll *a*. This trend was particularly evident during the open-water season. The MWQSOGs narrative guideline for phosphorus in lakes was exceeded at the mouth of the Dauphin River during May and four sites in Sturgeon Bay during July. DO concentrations near the bottom were below the MWQSOGs for the protection of cold water aquatic life at the mouth of the river in July.

Concentrations of the major ions (i.e., calcium, chloride, magnesium, potassium, sodium, and sulphate) tended to be higher at sites closer to the Dauphin River outflow than at the other sites sampled in Sturgeon Bay, reflecting the higher concentration of these substances at upstream waterbodies in the region relative to Lake Winnipeg. Aluminum, cadmium, chloride, fluoride, iron, selenium, and silver all exceeded PAL guidelines or objectives on at least one occasion within the study area. All other metals and major ions were within MWQSOGs and CCME guidelines for PAL.

Of the 63 pesticides analysed for, only glyphosate and 2,4-D were detected in the study area; both were below the federal and provincial guidelines for PAL.

Operational EMP Monitoring

Operational EMP monitoring was conducted from January to Reach 1 closure in November 2012. The objective was to monitor potential changes to water quality in Buffalo Creek and the lower Dauphin River during operation of Reach 1, and was a continuation of Construction EMP monitoring conducted during fall 2011.

Construction EMP monitoring indicated that TSS concentrations had returned to near baseline conditions following an initial increase measured in November 2011 (AECOM 2012). During the spring freshet in 2012, TSS concentrations increased at all sites, but particularly in Reach 1 and Buffalo Creek where values were above the estimated long-term CCME guideline. TSS concentrations at these locations had returned to near baseline conditions by the April sampling period. Dissolved oxygen concentrations were below the CCME lowest allowable limit for cold water ecosystems in Lake St. Martin, Buffalo Creek, and the Dauphin River downstream of the confluence with Buffalo Creek in March 2012. All other DO measurements taken from March to June were within applicable CCME guidelines for PAL. Nutrient concentrations in Lake St. Martin and in the Dauphin River upstream of Buffalo Creek were typically higher or similar to concentrations measured within Reach 1 and Buffalo Creek, and in the Dauphin River downstream of Buffalo Creek.

In situ and TSS Monitoring

In situ and TSS monitoring were conducted in Sturgeon Bay during February and March 2012. Objectives were to:

- supplement data collected during fall 2011;
- collect baseline water quality information in the vicinity of the proposed Reach 3 outlet;
- help delineate the spatial extent over which suspended sediment inputs from the Reach 1 and the Dauphin River may be distributed in Sturgeon Bay; and,
- develop a reliable turbidity/TSS relationship to assist in the future analysis of turbidity data.

Results indicated that the water in Sturgeon Bay was clear in winter, 2012. In general, TSS concentrations were below the analytical detection limit (2 mg/L and 5 mg/L). However, higher concentrations (up to 8.8 mg/L) were measured within the mixing zone of the Dauphin River. A small number of laboratory samples were used to establish a TSS/turbidity relationship for Sturgeon Bay. Additional samples will subsequently be used to strengthen the relationship.

Erosion, Sedimentation, and Habitat

It was anticipated that a large amount of organic and mineral sediments could be introduced to Sturgeon Bay due to operation of Reach 1 and Reach 3. Deposition of sediments eroded from Reach 1 and Reach 3 could potentially alter existing substrate conditions and, therefore, fish habitat and, ultimately, fish populations in Sturgeon Bay.

To address this potential effect, several studies were conducted or initiated during fall 2011. These included the collection of water quality and bed load samples to document sediment transport into Sturgeon Bay, installation of sediment traps to document sedimentation rates in Sturgeon Bay, and the collection of substrate information to support the understanding of sedimentation as well as support fish habitat descriptions. Results of these studies are presented in North/South Consultants Inc. (2013) or, in the case of the sedimentation rate study, here.

Numerous studies were subsequently proposed to collect additional information during operation of Reach 1, prior to and during operation of Reach 3, and following closure of both reaches during 2012 (see Appendix 1-1). These included the following:

- sedimentation Rates in Sturgeon Bay (Study ESH-1);

- collection of Supplemental Substrate Information in Relation to the Reach 3 Outlet and Northwest Side of Sturgeon Bay (Study ESH-2);
- collection of Supplemental Habitat Information in Relation to the Reach 3 Outlet and Northwest Side of Sturgeon Bay (Study ESH-3);
- post-Project Dauphin River Habitat Assessment (Study ESH-4);
- post-Project Substrate Assessment (Study ESH-5);
- post-Project Sturgeon Bay Habitat Assessment (Study ESH-6); and,
- post-Project Habitat Assessment of the Buffalo Creek Watershed (Study ESH-7).

As previously discussed, operation of Reach 1 continued into November 2012 and, consequently, all programs related to post-project assessments were deferred. Sedimentation studies were continued and will be ongoing into the future. While Reach 3 was not operated, sedimentation studies were continued and supplemental substrate and habitat studies related to operation of Reach 3 were completed prior to the decision to not use Reach 3.

Results of sedimentation investigations and supplemental substrate and habitat studies are provided in the following sections.

Sedimentation Rates in Sturgeon Bay

Sedimentation rates were monitored in Sturgeon Bay from October 2011 through August 2012. Sedimentation data were collected from a series of sediment traps deployed throughout Sturgeon Bay. Numerous traps were deployed, retrieved and re-deployed between October 2011 and August 2012 to provide insight into sedimentation during winter and summer periods while Reach 1 was in operation. The data will be compared with similar information to be collected following operation of Reach 1.

Sampling periods reported here include the following:

- deployment of 30 sediment traps in October 2011, 23 of which were retrieved in August 2012;
- deployment of 34 sediment traps in February 2012, all which were retrieved in March 2012; and,
- deployment of 31 sediment traps in March 2012, 19 of which were retrieved August 2012.

Sediment trap data indicate spatial and temporal variability in sedimentation rates in Sturgeon Bay. Available data suggest:

- sedimentation rates in Sturgeon Bay are minimal during periods of ice cover when wind and wave-induced sediment re-suspension does not occur;
- sedimentation rates were higher in the immediate vicinity of the Dauphin River, relative to areas north and southeast of the river; and
- sites located in nearshore areas generally have higher sedimentation rates than offshore sites during open water periods.

The latter spatial pattern may reflect actual higher rates of sedimentation in these areas, due, for example, to suspended sediment loads introduced from the Dauphin River, but may also reflect effects of shoreline erosion and/or sediment re-suspension. Effects of wind-induced sediment re-suspension would be greatest in shallow areas and results here suggest that sedimentation rate was significantly decreased with increasing water depth.

The collection of additional sediment data in upcoming years will provide additional information that will help understand the effects that operation of Reach 1 may have had on aquatic environments in Sturgeon Bay.

Supplemental Substrate and Habitat Information

Supplemental substrate and fish habitat were collected to supplement existing baseline information for Sturgeon Bay by collecting additional water depth and substrate data from the vicinity of the proposed Reach 3 outlet near Willow Point, and between Willow Point and the Dauphin River. The intent was to collect additional information describing those habitat features prior to operation of Reach 3.

Water depth was measured, an underwater digital camera to provide *in situ* assessments of substrate characteristics at sample locations, and substrate samples were collected from areas where sands, silts, and clays where the predominant substrate. Substrate samples were analyzed for particle size composition in a laboratory.

Data was collected from 33 sites from 25-27 March 2012. Water depths ranged from 1.0-6.5 m, generally increasing further from shore. In general, the proportion of smaller substrates (silt/clay, sand, and gravel) increased with increasing distance from shore while boulders and cobbles were more abundant in nearshore areas. The softest substrates (silt/clay dominant) were found almost exclusively offshore at depths greater than 5.0 m where forces that transport and re-suspend sediment (e.g., wind, currents) are reduced by water depth.

Data collected here will be used to supplement previously collected data and, in conjunction with data to be collected following closure of Reach 1 help understand the effects that operation of Reach 1 may have had on aquatic environments in Sturgeon Bay.

Spring Fisheries Investigations

Spring fisheries investigations were identified in the work plan (North/South Consultants Inc. 2012a; see Appendix 1-1) as study *FS-2 - Spring Fisheries Surveys in the Dauphin River and Sturgeon Bay*. The objectives of the spring fisheries investigations as stated were to:

- provide information on fish use of habitat within the Dauphin River between its confluence with Buffalo Creek and Sturgeon Bay in early spring (emphasis on spring spawning fish and identification of spawning grounds, particularly Walleye and Northern Pike);
- provide information on fish utilization of nearshore habitats in Sturgeon Bay during early spring (emphasis on spring spawning fish and identification of spawning grounds, particularly Walleye and Northern Pike);

- determine whether fish move upstream from Sturgeon Bay into Reach 3 during spring;
- provide information on fish utilization of habitats within the lower extent of Buffalo Creek during spring and following the closure of Reach 1;
- determine if Lake Whitefish eggs spawned in the Dauphin River and lower-most reaches of Buffalo Creek during fall 2011 successfully hatched in spring 2012;
- determine if Lake Whitefish successfully spawned in nearshore areas of Sturgeon Bay during fall 2011 (emphasis on nearshore habitats in Sturgeon Bay near Willow Point and the proposed Reach 3 outlet); and,
- monitor debris accumulation in gill nets set in Sturgeon Bay in the vicinity of the Dauphin River and Willow Point.

Subsequent to delivery of the workplan to DFO and following discussion with MIT, the proposed study was expanded to include fisheries investigations in Lake St. Martin and limited investigations at Grand Rapids. The intent of the Lake St. Martin work was to determine whether Lake Whitefish successfully spawned in Lake St. Martin during fall 2011 (i.e., did their eggs successfully incubate through the winter of 2011/2012 and hatch during spring 2012), document the movement of larval fish out of Lake St. Martin and into Reach 1 and/or the Dauphin River, and to attempt to locate concentrations of spring spawning fish (emphasis on Walleye and Northern Pike). Grand Rapids was added as a reference location against which information regarding the abundance and density of larval Lake Whitefish collected in Sturgeon Bay and Lake St. Martin might be compared.

Although Reach 3 was constructed, an exceptionally mild winter allowed sufficient drainage from Lake Manitoba and Lake St. Martin to reduce water levels to a point where risk of ice jamming and flooding at Dauphin River became negligible. Consequently, Reach 3 was not operated and field investigations related to fish movements into Reach 3 were not conducted.

The nature of the study objectives and the timing of the biological activities to be documented dictated that field investigations be conducted at specific and different times during the course of the spring. Consequently, numerous short-duration field campaigns (sampling periods) were conducted which provided snapshots of biological activity over a broader time period and allowed field investigations to target specific biological occurrences, as well as document general spring fish activity and habitat use as spring progressed.

Field activities focused on four general study areas. These included:

- Lake St. Martin, including entrance to the Dauphin River and the entrance to Reach 1;
- the lower reach of the Dauphin River, extending from approximately 2 km upstream of the Buffalo Creek confluence downstream to Sturgeon Bay, and including the lowermost reach of Buffalo Creek;
- nearshore areas of Sturgeon Bay with particular emphasis on areas in the immediate vicinity of the Dauphin River and Willow Point; and,
- Lake Winnipeg at Grand Rapids.

In general, field activities focused on documenting the occurrence and timing of fish spawning activity, the occurrence, distribution and abundance of larval fish, and the occurrence, distribution and abundance of adult fish and their status with respect to spawning activity. A suite of fisheries sampling methods were used within each study area to collect information or document conditions to address specific questions. These included the use of larval drift traps, a neuston sampler, and egg mats to document the presence, distribution and abundance of fish eggs and larval fish, and the use of standard experimental gillnets and boat electrofishing to document the presence, distribution, abundance, and spawning status of adult fish. In particular, emphasis was placed on attempting to locate aggregations of spring spawning fish such as Walleye.

Warm weather conditions during winter 2011 and spring 2012 resulted in an earlier than normal ice break up on lakes and rivers in the study area. The first field campaign was initiated in mid-April, and sampling sessions continued into mid-June. There were a total of eight sampling periods including two summer neuston sampling periods that were exclusive to Sturgeon Bay. The additional Sturgeon Bay sampling was opportunistically continued into early July as part of a debris monitoring program (North/South Consultants Inc. 2012b). A description of the timing of each sampling period, as well as the tasks conducted in each general area is provided in Table 1.

Data collected here will be used to supplement previously collected data and, in conjunction with data to be collected following closure of Reach 1 help understand the effects that operation of Reach 1 may have had on fish populations in Sturgeon Bay. The following sections provide a summary of fisheries investigation results for each general area, followed by a brief discussion of results pertinent to Lake Whitefish and Walleye spawning in the area.

Lake St. Martin

In Lake St. Martin, larval drift traps set in the entrance to the Dauphin River and the entrance to Reach 1 documented the movement of larval fish out of Lake St. Martin, the presence of juvenile or adult small-bodied fish species, and, through the capture of fish eggs, provided direct evidence of spawning by suckers. The capture of larval Lake Whitefish and Cisco (both fall spawning species) in neuston tows indicate that some portion of eggs spawned during fall 2011 successfully incubated through winter 2011/2012. Larvae from several spring-spawning fish species (including suckers, Yellow Perch, as well as minnow and darter species) were also captured. Experimental gillnetting documented the presence of several fish species in pre-spawn condition (Longnose Sucker, Northern Pike, Walleye, White Sucker, and Yellow Perch) and helped provide information to identify a spawning area for White Sucker at the entrance to Reach 1 and pre-spawning staging areas for White Suckers near the mouth of a creek entering Lake St. Martin to the south of the Reach 1 entrance.

Table 1. Summary of tasks completed as part of fisheries investigations conducted during spring 2012.

Location and Sample Period	Egg Mats	Larval Drift	Neuston Tows	Boat-based Electrofishing	Experimental Gillnetting
<u>Lake St. Martin</u>					
14-17 April	-	✓	✓	-	✓
24-26 April	-	✓	✓	-	✓
07-09 May	-	✓	✓	-	✓
16-18 May	-	✓	✓	-	✓
28-30 May	-	✓	✓	-	✓
<u>Dauphin River and Buffalo Creek</u>					
16-19 April	✓	✓	-	✓	-
27-30 April	✓	✓	-	✓	-
08-11 May	✓	✓	-	✓	-
17-21 May	✓	✓	-	✓	-
30 May - 03 June	✓	✓	-	✓	-
13-15 June [1]		✓	-	-	-
<u>Sturgeon Bay</u>					
16-19 April	-	-	✓	-	✓
27-30 April	✓	-	✓	-	✓
08-11 May	✓	-	✓	-	✓
17-21 May	✓	-	✓	-	✓
30 May - 03 June	✓	-	✓	-	✓
13-15 June	✓	-	✓	-	-
26-27 June [2]	-	-	✓	-	-
03-05 July [2]	-	-	✓	-	-
<u>Grand Rapids</u>					
31 May - 01 June	-	-	✓	-	-

1 - Drift traps set Buffalo Creek only.

2 - Neuston tows conducted opportunistically during the conduct of a debris monitoring program (North/South Consultants Inc. 2012b).

<u>Dauphin River and Buffalo Creek</u>

The capture of eggs on egg mats and larvae in drift traps illustrated that White Sucker spawning occurred during spring 2012 in the Dauphin River immediately upstream and downstream of the confluence of Buffalo Creek, as well as within the lower reaches of Buffalo Creek. The same areas were utilized for spawning by Lake Whitefish during fall 2011. The capture of larval Lake Whitefish in drift traps set in spring 2012 indicate that some portion of eggs spawned during fall 2011 successfully incubated through winter 2011/2012. Larval Lake Whitefish were captured in drift traps set upstream and downstream of the confluence of Buffalo Creek, as well as within Buffalo Creek. Aside from whitefish and suckers, numerous other species were captured. Larval Cisco, Yellow Perch, Northern

Pike, unidentified Percids, and small bodied species such as sculpins and minnows were captured in traps set in both Buffalo Creek and the Dauphin River. White Bass larvae were captured in Buffalo Creek during mid-June, when drift traps ere not set in the Dauphin River.

Boat-based electrofishing provided a chronology of use of the lower reaches of the Dauphin River by fish through spring and documented the presence of large numbers of White Sucker in pre-spawn condition. Smaller numbers of Carp, Longnose Sucker, Northern Pike, and Shorthead Redhorse in pre-spawn condition were also observed. Few Walleye were captured.

Sturgeon Bay

Egg mats set in Sturgeon Bay did not provide evidence to indicate Walleye spawning locations, but did identify areas where Yellow Perch and White Bass spawning occurred. Neuston tow data showed that larval Lake Whitefish and Cisco were distributed along nearshore areas of Sturgeon Bay in most areas sampled, including to the east and west of Willow Point. Because larvae were distributed throughout the approximately even concentrations, it is difficult to determine whether these fish were spawned and hatched locally, or had drifted into the area from the Dauphin River. Larval Yellow Perch, suckers, and White Bass were also captured, indicating successful egg incubation by those species.

In Sturgeon Bay, experimental gillnetting documented fish use of nearshore areas during spring 2012 and documented the presence Longnose Sucker, Northern Pike, Sauger, Walleye, White Sucker, and Yellow Perch that were in a pre-spawn condition. However, large concentrations of fish in a particular area that could be indicative of spawning locations were documented. Few Walleye were captured.

Lake Winnipeg at Grand Rapids

At Grand Rapids, field investigations focused on conducting neuston tows to capture larval Lake Whitefish to provide information to compare against similar information collected in Sturgeon Bay. Local knowledge suggested that Lake Whitefish may spawn in the vicinity of Horsehead Island, located approximately 13 km north of the Saskatchewan River, so sampling efforts were focused in that area. Larval Lake Whitefish were captured in six of 12 tows, but were most abundant in catches nearest to the mouth of the Saskatchewan River, suggesting that spawning either occurred in the immediate area or the larvae were transported downstream from Cedar Lake.

Lake Whitefish Spawning

Lake Whitefish are locally and regionally important as a targeted commercial species. Large numbers of Lake Whitefish migrate up the Dauphin River from Lake Winnipeg each fall to spawn on extensive gravel bars in the northeast basin of Lake St. Martin before returning to Lake Winnipeg (Stone 1965; Cook and MacKenzie 1979; Kristofferson and Clayton 1990). Local knowledge has suggested that Lake Whitefish spawning may also occur in the Dauphin River between Lake St. Martin and Sturgeon Bay, but the extent to which this occurs has not been well documented.

Aquatic monitoring conducted during fall 2011 documented large numbers of Lake Whitefish moving into the Dauphin River during late fall. Extensive spawning by whitefish occurred in the lower reaches of the Dauphin River, particularly in the vicinity of the confluence of Buffalo Creek including the lower reach of the creek itself (North/South Consultants Inc. 2011c). The capture of larval Lake Whitefish in Lake St. Martin during spring 2012 suggests that at least some Whitefish were able to access the lake during fall 2011. The recapture of a Lake Whitefish tagged at the mouth of the Dauphin River during late fall 2011 and recaptured in Lake St. Martin during winter 2012 suggests that at least some Lake Whitefish were able to move into Lake St. Martin from Sturgeon Bay during fall 2011.

Results from monitoring conducted during spring 2012 and presented here reveal that some portion of Lake Whitefish eggs spawned in fall 2011 successfully incubated through the winter and hatched in spring 2012. Larval Lake Whitefish were captured in Lake St. Martin, the Dauphin River, and Sturgeon Bay.

With respect to assessing the effects of Reach 1 operation, it is of interest that large numbers of larval Lake Whitefish were captured immediately at, and downstream of, the confluence of Buffalo Creek and the Dauphin River, where spawning occurred during fall 2011. At the onset of spring monitoring in 2012, the size of larval whitefish captured at this location indicated that they had only recently hatched. This provides some evidence to suggest that those fish had hatched in the immediate vicinity of the drift traps, further suggesting that at least some of the Lake Whitefish eggs spawned near the Buffalo Creek confluence during fall 2011 successfully incubated and hatched.

Larval Whitefish and Cisco were captured drifting out of Buffalo Creek at the onset of spring monitoring during 2012. However, spawning Cisco (also a fall spawning species) were not documented moving into the Dauphin River or Buffalo Creek during fall 2011, but larval Lake Whitefish as well as Cisco were captured drifting into Reach 1 from Lake St. Martin during this study. It is possible that larval Whitefish and Cisco captured drifting out of Buffalo Creek may have originated in Lake St. Martin, and drifted downstream through the system to the lower reaches of Buffalo Creek.

Walleye Spawning

Walleye are locally and regionally important as a targeted commercial species. Doan (1945) reported that large numbers of spawning Walleye enter the Dauphin River at spring break-up. Adult Walleye gather in the lower part of the river during late winter, remaining there until the ice begins to break up. Pollard (1973) indicated that the Dauphin River is an important Walleye spawning area. Commercial fishers have also indicated that Walleye spawn on a large reef that extends from Hay Point to Willow Point (see Figure 2) and in nearshore areas of Sturgeon Bay to the east and south of Dauphin River. Local knowledge has also suggested that Walleye used to winter in some areas of the Dauphin River, but it is not certain whether this still occurs.

Fisheries investigations conducted during spring 2012 did not reveal large aggregations of Walleye at the mouth of the Dauphin River in early spring, and Walleye composed only a very small component of the electrofishing catch. As the Dauphin River was ice free at the onset on spring monitoring, it is possible that Walleye may have moved up the Dauphin River prior to the onset of monitoring.

Walleye in a pre-spawn condition were captured in Sturgeon Bay during spring monitoring, but the location of spawning areas was not identified. Examination of Walleye captured during the spring spawning program and during a summer debris monitoring program conducted with commercial gill nets (North/South Consultants Inc. 2012c) suggests that spawning took place during early to late May. No larval Walleye were confirmed from the drift and neuston catches, but the unidentified percids in these samples may have included some Walleye.

TABLE OF CONTENTS

Page

Page

Page

LIST OF TABLES

Page

Page

Page

LIST OF FIGURES

Page

Page

Page

LIST OF APPENDICES

1.0 INTRODUCTION

Due to widespread record flooding throughout southern Manitoba during 2011, water levels in Lake Manitoba and Lake St. Martin were several feet higher than desirable, resulting in significant damage to hundreds of properties, restricted road access to several communities, and long-term evacuation of four First Nations. As part of emergency relief measures, the Province of Manitoba, through Manitoba Infrastructure and Transportation (MIT), constructed an emergency channel (Reach 1 Emergency Outlet Channel) to increase water flow from Lake St. Martin to Lake Winnipeg. Reach 1 allows water to flow from Lake St. Martin through the Buffalo Creek Drainage System and into the lower Dauphin River, immediately upstream of Lake Winnipeg (Figures 1-1 and 1-2). Water began to flow along this diversion route on 01 November, 2011.

Concurrent with construction and operation of Reach 1, MIT initiated environmental studies and monitoring to help describe and assess environmental effects arising from operation of Reach 1. North/South Consultants Inc. (NSC) was retained by KGS Group to assist in assessing the potential project-related effects to aquatic environments that may be affected by the project. A review of existing information pertinent to aquatic environments in Lake Manitoba, Fairford River, Lake St. Martin, Dauphin River and the Sturgeon Bay area of Lake Winnipeg was conducted and used to provide a preliminary assessment of project-related effects on affected waterbodies in the area. During this process, data deficiencies were identified and a monitoring work plan was developed to:

- Identify studies that would provide information to fill data gaps to better understand aquatic impacts and plan appropriate mitigation strategies; and,
- Collect information to fill identified information deficiencies to provide a background against which post-project changes can be measured. Where possible, studies were designed to provide information to help assess aquatic impacts, as well as provide a baseline against which post-project changes could be measured.

The initial assessment and proposed work plan was presented to MIT in September, 2011 (North/South Consultants Inc. 2011a), and a baseline data collection and monitoring plan was presented to MIT and Department of Fisheries and Oceans Canada (DFO) shortly thereafter (North/South Consultants Inc. 2011b). Field investigations were conducted through fall 2011 and a preliminary presentation of results specific to Lake Whitefish spawning activity was provided for presentation to DFO in December 2011 (North/South Consultants Inc. 2011c). More detailed presentation of fall 2011 monitoring activities are presented in North/South Consultants Inc. (2013).

The need for an additional drainage channel to protect the community of Dauphin River from anticipated flooding due to ice jamming at the river mouth during spring break up was identified in fall 2011. The second channel (Reach 3 Emergency Channel) was constructed through winter 2012, and was oriented to deflect flow from Reach 1 and Buffalo Creek to Sturgeon Bay. Flow was to enter Sturgeon Bay near Willow Point (see Figure 1-2 for location of Willow Point).

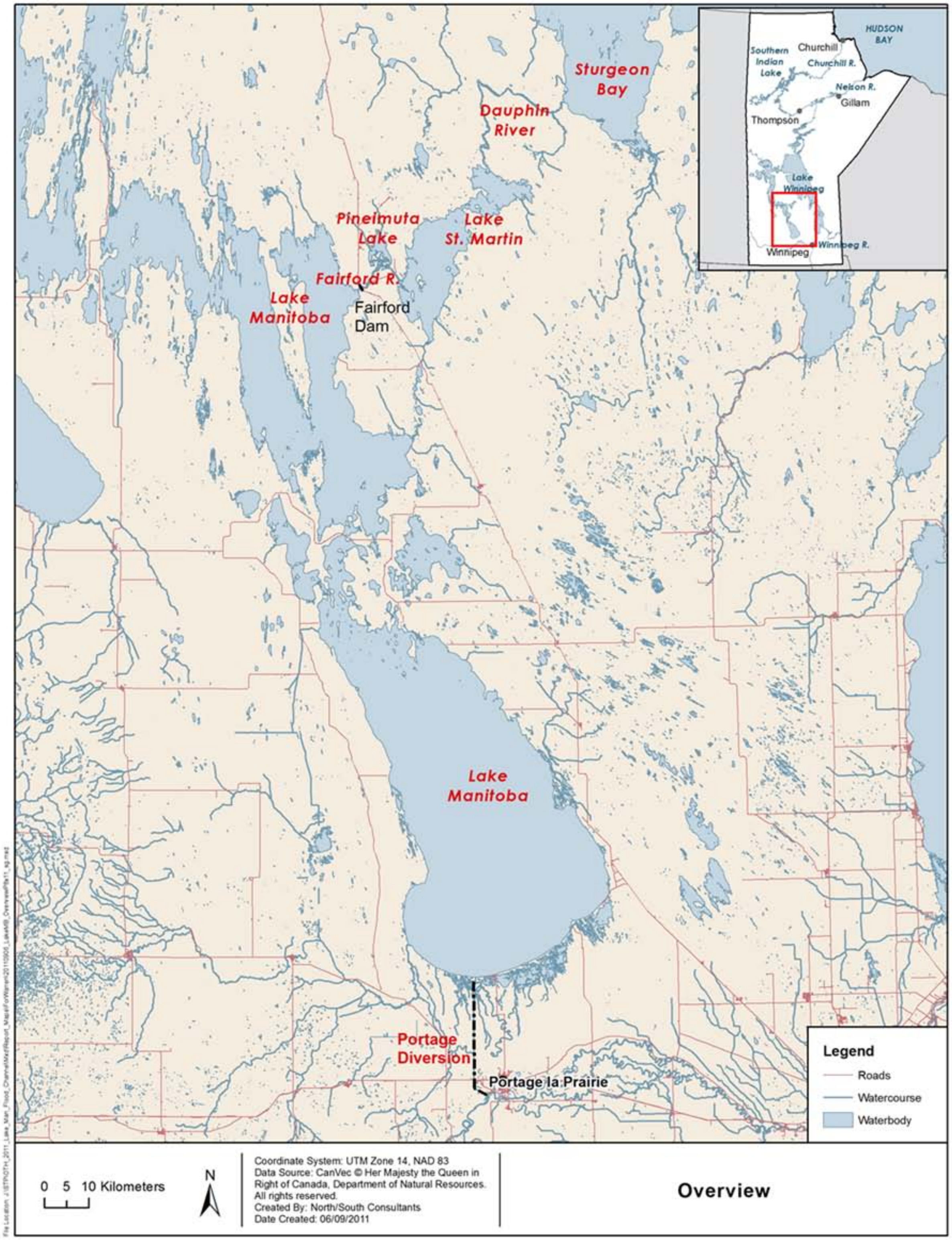

Figure 1-1. The location of major waterbodies and waterways affected by flooding in southern Manitoba during spring 2011.

Figure 1-2. Location of the Reach 1 Emergency Outlet Channel and Reach 3 Emergency Channel and the Buffalo Creek Drainage System in relation to Lake St. Martin, the Dauphin River and Sturgeon Bay.

At MIT's request, NSC developed a work plan in late December that described continued aquatic monitoring through to August 2012, after which it was expected that the requirement for emergency drainage through Reach 1 and Buffalo Creek would no longer exist. The work plan anticipated operation of Reach 3 and included components to monitor effects of Reach 3 operation on the surrounding aquatic environments, and was presented to DFO on 16 February, 2012 (North/South Consultants Inc. 2012a; also see Appendix 1-1). Studies detailed in the work plan focused on water quality, fish habitat, and fish community investigations in the Dauphin River and Sturgeon Bay. The objectives of the work plan studies were as follows:

- To conduct water quality monitoring to document changes (if any) in water quality during operation of Reach 1, and to help determine the spatial extent over which any changes to water quality may have occurred;
- To collect sedimentation rate data in Sturgeon Bay during the winter and summer months prior to operation of Reach 3 and during operation and immediately following cessation of diversion flows through Reach 1 and Reach 3;
- To describe substrate conditions in Sturgeon Bay in the context of fish habitat;
- To provide information on fish use of habitat within the Dauphin River between its confluence with Buffalo Creek and Sturgeon Bay in early spring (emphasis on spring spawning fish and identification of spawning grounds, particularly Walleye and Northern Pike);
- To provide information on fish utilization of nearshore habitats in Sturgeon Bay during early spring (emphasis on spring spawning fish and identification of spawning grounds, particularly Walleye and Northern Pike);
- To determine whether fish move upstream from Sturgeon Bay into Reach 3 during spring;
- To provide information on fish utilization of habitats within the lower extent of Buffalo Creek during spring and following the closure of Reach 1;
- To determine if Lake Whitefish eggs spawned in the Dauphin River and lower-most reaches of Buffalo Creek during fall 2011 successfully hatched in spring 2012;
- To determine if Lake Whitefish successfully spawned in nearshore areas of Sturgeon Bay during fall 2011 (emphasis on nearshore habitats in Sturgeon Bay near Willow Point and the proposed Reach 3 Emergency Channel); and

Subsequent to delivery of the work plan to DFO and following discussion with MIT, the proposed study was expanded to include fisheries investigations in Lake St. Martin and limited investigations at Grand Rapids. The intent of the Lake St. Martin work was to determine whether Lake Whitefish successfully spawned in Lake St. Martin during fall 2011 (i.e., did their eggs successfully incubate through the winter of 2011/2012 and hatch during spring 2012), document the movement of larval fish out of Lake St. Martin and into Reach 1 and the Dauphin River, and to attempt to locate concentrations of spring spawning fish (emphasis on Walleye). Grand Rapids was added as a reference location against which information regarding the abundance and density of larval Lake Whitefish collected in Sturgeon Bay and Lake St. Martin might be compared.

Although Reach 3 was constructed, an exceptionally mild winter allowed sufficient drainage from Lake Manitoba and Lake St. Martin to reduce water levels to a point where risk of ice jamming and flooding at Dauphin River became negligible. Consequently, Reach 3 was not operated and field investigations related to fish movements into Reach 3 were therefore not conducted.

In addition to the studies described above, the amount and type of debris that accumulated in gill nets was documented during the conduct of aquatic monitoring initiatives conducted in Lake St. Martin and Sturgeon Bay during fall 2011 and spring 2012. Following additional discussions with MIT and Manitoba Conservation and Water Stewardship, an expanded debris monitoring program was conducted in Sturgeon Bay (North/South Consultants Inc. 2012b). The objective of the program was to document the amount and type of debris that occurred in commercial gill nets, to illustrate the presence of commercially valuable fish species (especially Walleye) in Sturgeon Bay during spring 2012, and to provide by-catch information from the Sturgeon Bay spring fishery. Results from the debris monitoring program are presented and discussed in North/South Consultants Inc. (2012c).

This report presents the results of aquatic monitoring conducted in Lake St. Martin, the lower reaches of the Dauphin River, and Sturgeon Bay from January – August 2012.

2.0 STUDY AREA AND PROJECT DESCRIPTION

2.1 STUDY AREA

Construction and operation of Reach 1 and operation of the Fairford River Water Control Structure (FRWCS) at full capacity through the winter of 2011/2012 had the potential to affect aquatic environments in upstream waterbodies such as Lake Manitoba, the Fairford River, and Pineimuta Lake. However, the greatest potential impacts are expected on waterbodies in the vicinity and downstream of Reach 1, including Lake St. Martin, the Dauphin River, the Buffalo Creek Drainage System, and the Sturgeon Bay area of Lake Winnipeg (Figure 1-2). The emphasis of aquatic studies is on the area from Lake St. Martin downstream to Lake Winnipeg. Collectively, these waterways will be referred to as the "study area" throughout the remainder of this document.

The main water inflows into Lake Manitoba are from the Whitemud River, the Waterhen River (including Lake Winnipegosis and Dauphin Lake), and the Portage Diversion, which routes excess flows from the Assiniboine River into the south end of Lake Manitoba (Figure 1-1). Water flows out of Lake Manitoba through the Fairford River and Lake Pineimuta to Lake St. Martin, and then through the Dauphin River to Lake Winnipeg.

Big Buffalo Lake is a small lake (0.55 km^2) located in a large wetland approximately 7 km north east of Lake St. Martin. The lake drains into Buffalo Creek, a small creek that discharges into the Dauphin River approximately 4 km upstream of Lake Winnipeg. Collectively, this area is referred to as the Buffalo Creek Drainage System. Prior to the construction and operation of Reach 1, the Buffalo Creek Drainage System did not receive water from the Lake Manitoba/Lake St. Martin watershed.

Construction of the Fairford Dam in 1961 allowed for the regulation of Lake Manitoba levels and in 1984 the Fairford Fishway was incorporated to provide passage of fish between Lake St. Martin, the Dauphin and Fairford rivers and Lake Manitoba. Dam design did not take into account impacts on downstream waterbodies and consequently, the Fairford River, Pineimuta Lake, Lake St. Martin, and the Dauphin River are subject to flooding during periods of high water levels in Lake Manitoba and levels lower than natural during low level periods. Following a study conducted by the Lake Manitoba Regulation Review Advisory Committee, it was decided that Lake Manitoba would be allowed to fluctuate closer to its pre-regulation state in order to sustain aquatic habitat along the lake shore (MWS 2010). However, downstream waterbodies continue to be impacted in extremely high water level years. Following construction of the Portage Diversion in 1970, water levels on Lake Manitoba rose higher than what was originally projected before the Fairford Dam was constructed. Consequently, its operation compounded the negative effects to downstream habitat that were produced by the Fairford Dam.

Additional descriptions of the biophysical environments and flow regulation on Lake Manitoba, Fairford River, Pineimuta Lake, Lake St. Martin, Dauphin River and Sturgeon Bay are provided in North/South Consultants Inc. (2011a).

2.2 PROJECT DESCRIPTION

The emergency reduction of Lake Manitoba and Lake St. Martin water levels includes the following project components.

2.2.1 Reach 1 Emergency Outlet Channel

The Reach 1 Emergency Outlet Channel is approximately 6 km in length, extending from Lake St. Martin to the bog area approximately 1.5 km south of Big Buffalo Lake to improve drainage from Lake St. Martin. The Reach 1 inlet is situated along the northeast shore of the north basin of Lake St. Martin. After flooding the bog area around Big Buffalo and Little Buffalo lakes, the drainage water will eventually flow into and follow Buffalo Creek for 14 km and discharge into the Dauphin River 3.8 km upstream of Sturgeon Bay. Buffalo Creek flows through a wide valley with relatively flat valley wall slopes. Buffalo Creek was not excavated to expand its capacity; therefore, the drainage water is expected overflow the natural banks of the creek in some areas.

In order to construct Reach 1, an access road, flanked by ditching to drain water from the peat, was constructed along each side of the channel. The area between the access road/ditches was cleared of trees and organic material prior to excavation.

The inlet of Reach 1 was constructed by widening and raising the invert to create a sill near the edge of the north basin of Lake St. Martin that water flows over into Reach 1. The sill was originally designed to be 120 m in length and have a bottom width of 60 m and 3:1 side slopes to convey the desired flow of 142 m^3/s at a water level of 244.1 m. The invert of the inlet sill was designed to be at 243.1 m above sea level which is 0.3 m above the lower end of the desirable water level range for the lake at approximately the existing shoreline elevation. The original estimated flow upon initial operation of Reach 1 was approximately 255 m^3/s based on Lake St. Martin water levels at an elevation substantially higher than 244.1 m.

2.2.2 Reach 3 Emergency Outlet Channel

As the Project developed, computer modeling of potential water levels at the mouth of the Dauphin River indicated that there was a substantial risk of major flooding of the Dauphin River communities in the spring of 2012 due to ice jam formations and unprecedented flows. It was determined that the construction of a Reach 3 Emergency Channel would divert flows away from the Dauphin River prior to the spring break up and, in combination with the dikes being constructed along the banks of the Dauphin River, substantially reduce the risk of flooding for the Dauphin River communities.

Five versions (3A to 3E) of the Reach 3 Emergency Channel were initially examined. Reach 3E was determined to be the most feasible option and is referred to simply as Reach 3 throughout the remainder of this report. The excavated Reach 3 would be terminated at an outlet approximately 3 km short of Lake Winnipeg as the slope of the natural ground surface increases fairly significantly at this point. The outlet and a length of approximately 300 m of Reach 3 leading up to the outlet would be overlaid with a riprap blanket to minimize erosion as the water exits the excavated channel. From the outlet of Reach 3 the water would flow along the ground and through the natural ground cover before entering Lake Winnipeg. It was anticipated that the flow would initially be shallow and widespread over land west of Willow Point. It was expected that Reach 3 would only operate for a short period of time to effectively remove the threat of flooding during the freshet. However, an exceptionally mild winter allowed sufficient drainage from Lake Manitoba and Lake St. Martin to reduce water levels to a point where risk of ice jamming and flooding at Dauphin River became negligible. Consequently, Reach 3 was not operated and field investigations related to fish movements into Reach 3 were therefore not conducted.

3.0 WATER QUALITY

Changes in flow regimes (rate and seasonality of flow), flooding along the diversion route, and erosion and mobilization of sediments due to operation of Reach 1 and enhanced flow in Buffalo Creek may result in potential temporary impacts to water quality in water bodies from Lake Manitoba downstream to Sturgeon Bay. Water quality monitoring was conducted to document changes (if any) in water quality during operation of Reach 1, and to help determine the spatial extent over which any changes to water quality may have occurred. Water quality monitoring consisted of the following programs:

- Regional Water Quality Monitoring Program (RWQMP);
- Operational EMP Monitoring; and,
- *In situ* and total suspended solids monitoring in Sturgeon Bay.

3.1 REGIONAL WATER QUALITY MONITORING

During the conduct of the RWQMP, water quality information was collected from all major waterbodies and waterways within the study area that were affected by flooding and encompassed the major inputs to the north basin of Lake Manitoba (i.e., Waterhen River and at the Lake Manitoba Narrows) downstream to and including Sturgeon Bay on Lake Winnipeg. The objectives of the program were to:

- monitor water quality conditions during Reach 1 operation;
- supplement data sets at sites within the study area where Manitoba Water Stewardship, Water Quality Management Branch (MWS) conducts water quality monitoring; and,
- evaluate spatial differences in water quality within the study area.

Monitoring during operation was comprised of three sampling events, as follows: January, May, and, July, 2012. Each sampling event included *in situ* water quality measurements and the collection of water samples for laboratory analysis. Detailed methods and results are provided below.

3.1.1 Methods

3.1.1.1 Sampling Sites

Water quality samples and *in situ* measurements were collected at 17 sites throughout area, including the following:

- Waterhen River - one site at the bridge on PTH # 328 (MWS site MB05LHS002);
- Lake Manitoba - one site at Lake Manitoba Narrows (MWS site MB05LKS009);
- Fairford River - one site at or near the PTH # 6 bridge (MWS site MB05LMS001);
- Lake St. Martin - one site in the north basin;
- Dauphin River - four sites; including one site at or near the outflow from Lake St. Martin, one site at or near the existing MWS site (MWS Site MB05LMS003); one site upstream of the confluence of Buffalo Creek, and one site in the mouth of the Dauphin River and upstream of Sturgeon Bay;

- Buffalo Creek - one site upstream of the confluence with the Dauphin River; and,
- Sturgeon Bay - eight sites, including one near the existing MWS site (MWS Site MB05SES012).

A list of all sampling sites and locations are provided in Table 3-1 and illustrated in Figure 3-1.

3.1.1.2 Water Quality Parameters

Water quality parameters included in the RWQMP were identified based on the potential linkages between the Project and water quality, including potential effects on total suspended solids (TSS; and related variables), effects related to diversion, and potential effects of flooding and/or diversion on water quality (i.e., nutrients, dissolved oxygen [DO], pH and metals), and/or variables that provide supporting information for interpretation of other data. Ultra-trace mercury and methyl-mercury were included to facilitate comparison to the newly revised Manitoba Water Quality Standards, Objectives, and Guidelines (MWQSOGs; MWS 2011) and because both may be affected by flooding. A complete list of water quality parameters selected for laboratory analysis and *in situ* measurements are provided in Table 3-2.

Additionally, samples for the analysis of pesticides and *E. coli* were collected from selected sites during the July sampling period. These parameters were included based on consultation with Manitoba Conservation and Water Stewardship, Water Management Section. A full list of pesticide parameters is provided in Table 3-3. This list is consistent with those measured by MCWS in their current water quality monitoring programs in southern/central Manitoba.

3.1.1.3 Field Methods

Sampling sites were accessed by truck, boat, helicopter, or snowmobile depending on site accessibility and season. In January, where necessary, holes were drilled through the ice using a Stihl power auger. Measurements of ice thickness and effective water depth (using a handheld depth sounder) were recorded at each site. Sample locations were recorded using a handheld Garmin GPS receiver. Sampling date and time were noted for each sampling site.

In situ measurements of water quality parameters including pH, specific conductance, DO, turbidity, and water temperature were collected at all sampling sites. Measurements were taken using either a Horiba® W22-XD water quality meter, or a combination of YSI handheld meters (either a YSI 63 [temperature, pH and conductivity] and a YSI 550 [DO], or a YSI 85 [temperature, specific conductance and DO] and a YSI 60 [pH]) plus an Analite turbidity meter. At river sites and those accessed from shore, *in situ* parameters were measured at approximately 0.3 m below the water surface. At lake sites, *in situ* profiles were taken, such that measurements were recorded near the surface (i.e., at 0.3 m) and at either 0.5 m (if total water depth was less than 5m) or 1 m increments. In January, *in situ* measurements were recorded both near the surface (about 0.3 m beneath the bottom surface of the ice) and at approximately 0.3 m above the lake bottom.

At each sampling site, grab samples were collected from approximately 0.3 m below the water surface into clean sample bottles supplied by ALS Laboratories. If thermal stratification was evident (based on *in* *situ* temperature measurements) at lake sampling sites, the sampling protocol included the collection water samples from approximately 0.3 m above the sediments using a Kemmerer sampler. However, as thermal stratification was not observed, the collection of bottom samples did not occur. Where necessary, samples were preserved according to instructions provided by the analytical laboratory. After collection, samples were placed in a cooler and kept cool using ice packs until submission (within 48 hours) to ALS Laboratories in Winnipeg, MB (a Canadian Association for Laboratory Accreditations, Inc. [CALA] accredited laboratory) for analysis.

3.1.1.4 Quality Assurance and Quality Control (QA/QC)

Standard QA/QC measures were followed during sample collection (e.g., use of latex gloves, standard labelling practices, meter calibration, etc.). Additionally, QA/QC samples were collected, including a field blank, a trip blank, and replicate samples.

Field Blanks

Field blanks are intended to provide information on sample contamination from atmospheric exposure and sample handling techniques (i.e., cleanliness of sampling equipment, carry-over contamination from site to site), as well as potential laboratory contamination and/or error (British Columbia Ministry of Environment, Lands, and Parks (BCMELP 1998). Field blanks were prepared by filling sample bottles with deionized water (both provided by the analytical laboratory) in the field and submitting the blanks along with the environmental samples.

Trip Blanks

Trip blanks are used for evaluating the potential for sample contamination that may occur from the container or preservatives through transport and storage of the sample, as well as laboratory precision (BCMELP 1998). Trip blanks were prepared in the laboratory by filling sample bottles with deionized water. Trip blanks were transported to the field sampling sites, but remained sealed, and were then submitted to the analytical laboratory in conjunction with environmental samples for analysis.

Replicate Samples

Triplicate samples were collected at randomly selected sites to provide a measure of variability of environmental conditions and the overall precision associated with field methods and laboratory analyses.

QA/QC Assessment

All water quality data were examined qualitatively for potential outliers and/or transcription or analytical errors. Where one replicate sample differed notably from the others, the measurement was flagged as “suspect”.

QA/QC samples were assessed according to standard criteria to evaluate precision and identify potential sample contamination issues (BCMELP 1998). Percent relative standard deviation (PRSD) was calculated for triplicate samples as follows:

PRSD (%) = standard deviation of the triplicate values / mean of the triplicate values x 100

The relative percent mean difference (RPMD) was calculated for duplicate samples as follows:

RPMD (%) = | (value 1 – value 2) / ((value 1 + value 2) / 2) | x 100

Precision of replicate samples was evaluated using the "rule of thumb" criteria for precision of 18% for triplicate samples and 25% for duplicate samples (BCMELP 1998). Where one or more of the replicate values were less than five times the analytical detection limit (DL), an analysis of precision was not undertaken, in accordance with guidance provided in BCMELP (1998).

Field and trip blank results were also evaluated for evidence of sample contamination. Values for any parameter that exceeded five times the DL were considered to be indicative of sample contamination and/or laboratory error.

3.1.1.5 Comparison to Water Quality Objectives and Guidelines

Results were compared to the Manitoba Water Quality Standards, Objectives and Guidelines (MWQSOGs; MWS 2011) for the protection of aquatic life (PAL) as well as the Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of freshwater aquatic life (CCME 1999; updated to 2012). In general, the MWQSOGs for PAL are similar to the CCME guidelines for PAL for parameters measured; however, there are CCME guidelines for some parameters which lack a provincial guideline/objective and others for which the CCME guideline is different from the provincial one; typically the CCME guideline is more stringent than the MWQSOGs.

Drinking water quality objectives and guidelines are intended to be applied to treated or finished water as it emerges from the tap and "are not intended to be applied directly to source waters" (CCME 1999, updated to 2012). However, comparison of water quality in the study area to drinking water quality objectives and guidelines is included here to provide context. The MWQSOGs indicate that "all surface waters…are susceptible to uncontrolled microbiological contamination... [and] it is therefore assumed that all raw surface water supplies will be disinfected as the minimum level of treatment prior to consumption" (MWS 2011). Furthermore, it is indicated that the MWQSOGs "apply to finished drinking water, but can be extrapolated to provide protection to raw drinking water sources."

In general, water quality objectives and guidelines are more stringent for the protection of aquatic life and wildlife, relative to those established to protect various human usages (e.g., drinking water). A summary of relevant water quality objectives and guidelines is presented in Appendix 3-1.

3.1.2 Results

Water quality sampling for the RWQMP was conducted during January, May and July, 2012. Data from the collections are provided in the following appendices:

Appendix 3-2: Laboratory Certificates of Analyses provided by ALS Laboratories;
Appendix 3-3: *In situ* Water Quality Data – January 2012 (see below); and,
Appendix 3-4: Quality Assurance/Quality Control Results.

Extremely cold air temperatures during January sampling caused the Horiba® W22-XD water quality meter to malfunction; as a result, all *in situ* measurements collected during that sampling trip are suspect. These data are therefore not discussed in this report, but are presented in Appendix 3-3.

Additionally, all turbidity measurements taken with the Horiba® W22-XD are considered to be invalid because this sensor was damaged by the cold and needed to be replaced. The Horiba® W22-XD was used at all sites in January and at sites accessed by helicopter in May. These data have not been reported for January and have been identified as suspect for May.

3.1.2.1 Routine Variables and Limnology

Results for routine water quality parameters are presented in Table 3-4, 3-5, and Table 3-6.

Water quality of the study area can be generally described as moderately nutrient-rich, low to moderately turbid, slightly alkaline, hard to very hard, and well-oxygenated. Both Lake St. Martin and Sturgeon Bay were isothermal during each sampling period in 2012. Other *in situ* variables, including DO, turbidity, pH, and specific conductance, were relatively consistent across depth in both waterbodies.

Total phosphorus (TP) concentrations in the study area were composed of a mix of dissolved and particulate forms with the proportions varying by site and sampling period (Figure 3-3). Generally, in January much of the TP was present in dissolved form, whereas in July, the majority of the TP was in particulate form; the dominant form varied by site in May. The majority of total nitrogen was present in organic form at all sites, with ammonia generally comprising a greater amount of dissolved inorganic nitrogen than nitrate/nitrite. On the basis of TN:TP molar ratios, all waterbodies sampled were phosphorus limited (i.e., TN:TP ratio > 20; Kalff 2002).

The water quality of Sturgeon Bay was influenced by the Dauphin River such that sites closest to the mouth exhibited routine water quality similar to upstream sites, including: higher alkalinity; higher conductivity and TDS; higher total nitrogen; lower carbon concentrations and, higher chlorophyll *a* (e.g., Figure 3-4). This trend was particularly evident during the open-water season.

TP exceeded the MWQSOGs narrative guideline for phosphorus for lakes (i.e., 0.025 mg/L) in Sturgeon Bay near the mouth of the Dauphin River (LKW3B and LKW3) in May, and at four sites in Sturgeon Bay in July (LKW4, 5, 6 and 7). Additionally, TP exceeded this guideline at LKW7 in January (0.108 mg/L);

however, this result is considered suspect. All applicable measurements were within the narrative guideline for streams (0.050 mg/L).

DO was below the MWQSOGs for PAL 30 day averaging objective for the protection of cold water aquatic life (6.5 mg/L) and the CCME lowest acceptable concentration for the protection of cold-water aquatic life (6.5 mg/L) in Sturgeon Bay near the Dauphin River mouth (LKW3 and LKW3B) within the lower 2 m of the water column during the July sampling period. DO measurements taken in January, 2012 are considered suspect, therefore adherence to the MWQSOGs objectives and CCME guidelines for PAL for DO were not assessed for this sampling period. All other DO measurements were within applicable MWQSOGs and CCME guidelines.

All other routine water quality variables for which there are MWQSOGs and CCME guidelines, including pH, ammonia, nitrate and nitrite were within PAL objectives and guidelines.

Colour exceeded the MWQSOGs aesthetic objective for drinking water (≤ 15 TCU) at Buffalo Creek in July and at three sites in Lake Winnipeg; two in January (LKW6 and LKW7) and one in May (LKW1). The MWQSOGs aesthetic objective for drinking water for TDS was exceeded at the Waterhen River, Lake Manitoba Narrows, the Fairford River, Lake St. Martin, the Dauphin River, Buffalo Creek and at most sites and times in Sturgeon Bay. Additionally, laboratory measured pH was above the range for the aesthetic objective for drinking water at Lake Manitoba Narrows, the Fairford River, Lake St. Martin, and at all sites sampled in the Dauphin River in May and July; and, at the Waterhen River and most sites in Sturgeon Bay (LKW1, 2, 3, 3B, 4 and 6) in July. All other routine water quality variables for which there are MWQSOGs, including nitrate, nitrite, and nitrate/nitrite were within guidelines for drinking water. As discussed in Appendix 3-1, an assessment of the maximum acceptable concentration for drinking water for turbidity was not conducted.

3.1.2.2 Metals and Major Ions

Metal and major ion concentrations measured in the study area in 2012 are presented in Table 3-7. Cesium (total and dissolved forms) was not detected at any site. Additionally, several metals were not detected in dissolved form at any site, including: beryllium, bismuth, silver, tellurium, thallium, thorium, and tungsten. Barium, calcium, chloride, fluoride, lithium, magnesium, total manganese, potassium, rubidium, silicon, sodium, strontium, sulphate, and total uranium were consistently detected; the remaining metals and major ions were detected in some samples.

Concentrations of the major ions (i.e., calcium, chloride, magnesium, potassium, sodium, and sulphate) tended to be higher at sites closer to the Dauphin River outflow (LKW3B, LKW3 and LKW2) than at the other sites sampled in Sturgeon Bay, reflecting the higher concentration of these substances at upstream waterbodies in the region relative to Lake Winnipeg (e.g., Figure 3-5). Additionally, total iron concentrations were typically high in Sturgeon Bay relative to the rest of the study area. However, iron concentrations similar to Sturgeon Bay were measured at Lake Manitoba Narrows and Buffalo Creek in January and July and at Fairford River in July.

Mercury concentrations well above the analytical detection limit (1.0 ng/L) were measured in Sturgeon Bay in May as well as at most sites upstream of Lake Winnipeg and in Sturgeon Bay at the sites closest to the mouth of the Dauphin River in July (Figure 3-6). Particularly high concentrations of total mercury were measured at LKW2 in May (13.0 ng/L) and at Buffalo Creek in July (4.2 ng/L). Methyl mercury was typically near or below analytical detection limits. However, methyl mercury concentrations well above the analytical detection limit (0.1 ng/L) were measured at Buffalo Creek, the mouth of the Dauphin River and at sites near the river mouth in Sturgeon Bay in July (Figure 3-7). Both mercury and methyl-mercury were below analytical detection limits at all sites sampled in January. All concentrations of total mercury and methyl-mercury were below the MWQSOGs for PAL of 26 ng/L and 4 ng/L, respectively.

Aluminum exceeded the MWQSOGs and CCME guideline for PAL (0.1 mg/L) at Lake Manitoba Narrows in May 2012, at Buffalo Creek and two sites on the Dauphin River (DR1 (NOTE 2) and DR2C) upstream and downstream of Buffalo Creek in May and July 2012, and at all sites in Sturgeon Bay on at least one occasion. Cadmium concentrations exceeded the CCME guideline for PAL at Waterhen River, Lake Manitoba Narrows, and the Fairford River in July. At the majority of sites and times, chloride concentrations exceeded the CCME long-term guideline for PAL (120 mg/L), the exceptions were LKW3, 4, and 7 in January, and LKW7 in July. Chloride concentrations were well below the CCME short-term guideline for PAL (640 mg/L) at all sites and times sampled. Fluoride concentrations exceeded the CCME guideline for PAL (0.12 mg/L) at most sites and times, the exception was the Waterhen River in July. Iron concentrations were above the MWQSOGs and CCME guideline for PAL (0.3 mg/L) at two sites in Sturgeon Bay (LKW3 and LKW3B) during the May sampling period; iron concentrations were below these guidelines in all other samples collected. The selenium concentrations in the samples collected at the mouth of Buffalo Creek (BC3) and at site one in Sturgeon Bay (LKW1) in January and the samples collected at the Waterhen River, Lake Manitoba Narrows, the Fairford River, the inlet (DR1.1) and the mouth (DR2C) of the Dauphin River, the mouth of Buffalo Creek (BC3) and at two sites in Sturgeon Bay (LKW2 and LKW4) in May were above the MWQSOG and CCME guideline for PAL. Silver concentrations were above the MWQSOGs and CCME guideline for PAL (0.0001 mg/L) in at all but two sites in Sturgeon Bay (LKW3 and LKW3B) in May. The analytical detection limits for selenium (0.001 mg/L) and silver (0.0001 mg/L) are equal to the guidelines, therefore exceedances for these parameters should be viewed with caution. All other metals and major ions for which there are MWQSOGs or CCME guidelines for PAL were within objectives and guidelines at all other sites and times sampled in 2012.

Iron concentrations exceeded the MWQSOGs aesthetic objective for drinking water (0.3 mg/L) at two sites in Sturgeon Bay (LKW3 and LKW7) during the May sampling period. All other metals and major ions for were within the existing MWQSOGs for drinking water.

3.1.2.3 Pesticides

Pesticides were measured at selected sites in July, including: the Fairford River (FR1), Dauphin River (DR1.1 and DR2C) and Sturgeon Bay (LKW7). The results of this analysis are presented in Table 3-8.

Glyphosate was measured at concentrations above the analytical detection limit (0.20 µg/L) at all sites sampled and, 2,4-D was measured at a concentration equal to the analytical detection limit (0.050 µg/L) at the mouth of the Dauphin River (DR1.1). All other pesticides were below analytical detection limits. Glyphosate concentrations did not exceed the MWQSOGs or CCME guideline for PAL, or the MWQSOGs for drinking water in any samples collected in July 2012. Additionally, the concentration of 2,4-D measured at DR1.1 was well below all applicable provincial and CCME guidelines.

3.1.2.4 QA/QC

Field and Trip Blanks

Field and trip blank results generally indicate high precision and no sample contamination. The concentrations of dissolved and total methyl-mercury were reported to be greater than five times the detection limit in one of three field blanks submitted to the analytical laboratory in January. Additionally, TP was reported to be greater than five times the detection limit in one of three field blanks submitted in May. Measurements for all other parameters (metals, dissolved metals and routine parameters) were below the threshold of five times the detection limit (Appendix 3-4).

Replicate Samples

PRSD values were not derived for several parameters due to low concentrations (i.e., concentrations less than five times the DL). In general, the results indicate good agreement between samples and acceptable levels of precision. The PRSD exceeded threshold values (18%) for thirteen parameters including: ammonia; TP; dissolved phosphorus; TSS; chlorophyll *a*; pheophytin *a*; aluminum; arsenic; boron; copper; silicon; titanium; and, vanadium (Appendix 3-4).

Table 3-1. Location of sites sampled as part of the RWQMP conducted during Reach 1 operation 2012.

Water body	Location Description	Site ID	MWS Site	Sample Period(s)	Location [1]	
					Easting	Northing
Waterhen River	at PTH #328	WHR1	MB05LHS002	Jan/May/July	462204	5742368
Lake Manitoba	at Lake Manitoba Narrows	NARR1	MB05LKS009	Jan/May/July	515348	5658969
Fairford River	near PTH #6	FR1	MB05LMS001	Jan/May/July	518838	5715229
Lake St. Martin	North basin	LSM1	-	Jan	548960	5738247
			-	May/July	550136	5736730
Buffalo Creek		BC3	-	Jan/May/July	562318	5454770
Dauphin River	River inlet at Lake St. Martin	DR1.1	-	May/July	547332	5741774
		DR1.2	-	Jan	546956	5750488
	Between Gypsumville and Anama Bay	DR1.3	MB05LMS003	May/July	546106	5757242
		DR1(Note 2)	-	May/July	561756	5754788
	River mouth at Lake Winnipeg	DR2C	-	May/July	564697	5757098
Sturgeon Bay		LKW1	-	Jan/May/July	578400	5750390
		LKW2	-	Jan/May/July	571480	5754215
		LKW3	-	Jan/May/July	569032	5759095
		LKW3B	-	May/July	567174	5757504
		LKW4	-	Jan/May/July	566327	5765369
		LKW5	-	Jan/May/July	577144	5758612
		LKW6	-	Jan/May/July	573290	5762611
		LKW7	MB05SES012	Jan/May/July	574055	5771081

1 - UTM coordinates; Datum NAD 83, Zone 14U.

2 - Sample collected as part of the construction EMP program.

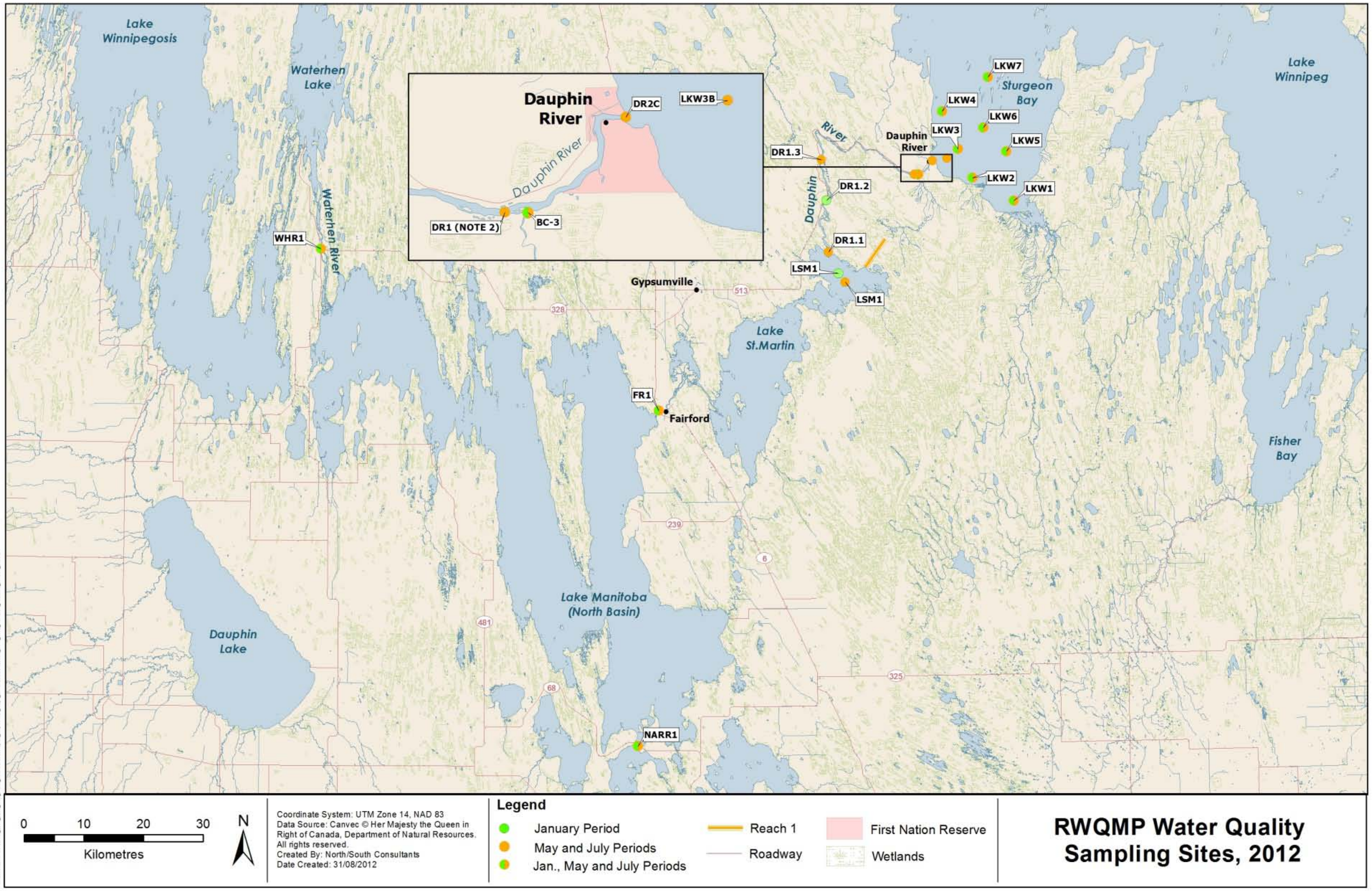

Figure 3-1. Location of sites sampled as part of the RWQMP in 2012.

Table 3-2. Water quality parameters measured as part of the RWQMP conducted during Reach 1 operation 2012.

Routine Parameters	**Metals and Major Ions**
Alkalinity	Metals (Total and Dissolved)
Dissolved Organic Carbon	Antimony (Sb)
Total Inorganic Carbon	Arsenic (As)
Total Organic Carbon	Barium (Ba)
Colour, True	Beryllium (Be)
Conductivity (at 25°C)	Bismuth (Bi)
Hardness (Calculated from metals)	Boron (B)
Total Kjeldahl Nitrogen	Cadmium (Cd)
Ammonia-N	Calcium (Ca)
Nitrate+Nitrite- N	Cesium (Cs)
Nitrite-N	Chromium (Cr)
Nitrate-N	Chloride (dissolved)
Phosphorus, Total	Cobalt (Co)
Phosphorus, Total Dissolved	Copper (Cu)
Phosphorus Total Particulate (Calculated)	Fluoride (dissolved)
pH	Iron (Fe)
Total Dissolved Solids	Lead (Pb)
Total Suspended Solids	Lithium (Li)
Turbidity	Magnesium (Mg)
	Manganese (Mn)
In Situ Parameters	Molybdenum (Mo)
pH	Mercury (Hg)
Temperature	Nickel (Ni)
Dissolved oxygen	Potassium (K)
Turbidity	Rubidium (Rb)
Specific Conductance	Selenium (Se)
	Silicon (Si)
	Silver (Ag)
	Sodium (Na)
	Strontium (Sr)
	Tellurium (Te)
	Sulphate (dissolved)
	Thallium (Tl)
	Thorium (Th)
	Tin (Sn)
	Titanium (Ti)
	Tungsten (W)
	Uranium (U)
	Vanadium (V)
	Zinc (Zn)
	Zirconium (Zr)
	Methylmercury

Table 3-3. Pesticide parameters analyzed from selected sites as part of the RWQMP conducted during July 2012.

Parameter	
2,4,6-Tribromophenol	Eptam
2,4-D	Ethalfluralin
2,4-DB	Fenoxaprop
2,4-Dichlorophenylacetic Acid	g-chlordane
2,4-DP	Glyphosate
2-Fluorobiphenyl	Imazamethabenz-methyl
2-Fluorobiphenyl	Lindane
a-chlordane	Malathion
Alachlor	MCPA
alpha-BHC	Mecoprop
Atrazine	Methoxychlor
Atrazine Desethyl	Methyl Parathion
Azinphos-methyl	Metribuzin
Benomyl	Metsulfuron-methyl
beta-BHC	Parathion
Bromacil	Pentachlorophenol
Bromoxynil	Picloram
Carbofuran	Propachlor
Carboxin	Propanil
Chlorothalonil	Propoxur
Chlorpyrifos	Quizalofop
Cyanazine	Sethoxydim
d14-Terphenyl	Simazine
d14-Terphenyl	Terbufos
delta-BHC	Thifensulfuron-methyl
Deltamethrin	Tralkoxydim
Diazinon	Triallate
Dicamba	Tribenuron-methyl
Diclofop-methyl	Triclopyr
Dimethoate	Trifluralin
Dinoseb	Trifluralin
Diuron	

Table 3-4. *In situ* water quality measurements recorded as part of the RWQMP during May 2012. Values in blue italics are considered suspect.

Location	Location ID [1]	Sample Date	Sample Time	Water Depth (m)	Sample Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH	Secchi Depth (m)
Waterhen River	WHR1	16-May-12	15:16	-	0.3	14.80	10.13	100	858	7.0	8.01	-
Lake Manitoba	NARR1	16-May-12	10:30	-	0.3	14.10	10.76	103	1114	15.4	7.84	-
Fairford River	FR1	16-May-12	12:48	-	0.3	14.90	10.99	109	1134	9.81	8.38	-
Lake St. Martin	LSM1	17-May-12	11:25	2.5	0.3	13.40	10.4	101	1134	5.38	8.41	-
					0.5	13.30	10.5	100	1135	5.49	8.45	
					1.0	12.70	10.6	101	1135	5.82	8.41	
					1.5	12.70	10.7	101	1135	5.84	8.36	
					2.0	12.60	10.7	101	1137	4.59	8.34	
Buffalo Creek	BC3	16-May-12	14:10	-		14.26	7.12	70	1200	***93.1***	7.70	-
Dauphin River	DR1.1	17-May-12	9:40	1.90	0.3	13.10	10.37	99	1115	6.37	8.26	1.40
Dauphin River	DR1.3	17-May-12	15:00	1.20	0.3	15.20	10.12	101	1133	6.56	8.28	-
Dauphin River	DR1 (NOTE 2)	16-May-12	10:50	-	0.3	14.26	8.70	86	1290	***69.2***	8.27	-
Dauphin River	DR2C	16-May-12	10:25	-	0.3	14.15	8.80	87	1220	***62.5***	8.06	-
Sturgeon Bay	LKW1	21-May-12	8:40	4.3	0.3	12.20	9.51	89	917	11.0	8.73	1.9
					0.5	12.30	8.89	86	916	11.1	8.72	
					1.0	12.30	9.19	86	918	10.5	8.69	
					1.5	12.30	8.92	85	917	10.9	8.65	
					2.0	12.30	9.04	86	918	11.5	8.63	
					2.5	12.30	9.08	85	915	11.7	8.62	
					3.0	12.30	9.02	85	918	11.3	8.64	
					3.5	12.30	8.60	80	918	11.6	8.62	
					4.0	12.30	8.92	84	917	11.2	8.60	

Table 3-4. (continued).

Location	Location ID [1]	Sample Date	Sample Time	Water Depth (m)	Sample Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH	Secchi Depth (m)
Sturgeon Bay	LKW2	21-May-12	7:43	4.2	0.3	12.60	8.67	82	1098	8.93	8.33	2.25
					0.5	12.60	8.71	81	1098	9.06	8.33	
					1.0	12.60	8.59	81	1098	9.07	8.32	
					1.5	12.60	8.59	84	1098	8.86	8.32	
					2.0	12.60	8.69	82	1097	9.27	8.31	
					2.5	12.60	8.56	80	1097	9.01	8.31	
					3.0	12.60	8.52	81	1097	9.25	8.30	
					3.5	12.60	8.49	81	1098	9.00	8.29	
					4.0	12.60	8.48	81	1098	9.50	8.29	
Sturgeon Bay	LKW3	19-May-12	11:10	6.7	0.3	12.40	8.98	86	1007	15.4	8.51	0.65
					1.0	12.40	8.70	81	1007	15.3	8.51	
					2.0	12.40	8.53	81	1008	15.5	8.44	
					3.0	12.40	8.44	80	1008	15.0	8.45	
					4.0	12.40	8.82	84	1008	17.6	8.45	
					5.0	12.40	8.94	81	1007	17.8	8.47	
					6.0	12.40	8.93	86	1007	18.8	8.46	
Sturgeon Bay	LKW3B	19-May-12	-	5.3	0.3	13.00	8.97	85	1079	25.3	8.20	0.45
					1.0	13.00	8.89	85	1081	24.8	8.24	
					2.0	13.00	8.83	85	1079	24.9	8.24	
					3.0	13.00	8.81	84	1079	24.8	8.25	
					4.0	13.00	8.78	83	1078	24.7	8.25	
					5.0	13.00	8.67	83	1079	25.4	8.24	
Sturgeon Bay	LKW4	21-May-12	11:00	7.0	0.3	12.10	8.89	83	914	6.29	8.93	1.40
					1.0	12.00	8.51	80	913	6.36	8.77	
					2.0	11.90	8.65	81	913	6.72	8.68	
					3.0	11.70	8.75	81	914	6.68	8.61	
					4.0	11.70	8.88	81	916	6.84	8.6	
					5.0	11.70	8.52	80	916	7.13	8.51	
					6.0	11.70	8.43	78	916	6.79	8.49	

Table 3-4. (continued).

Location	Location ID	Sample Date	Sample Time	Water Depth (m)	Sample Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH	Secchi Depth (m)
Sturgeon Bay	LKW4	21-May-12			6.5	11.70	8.20	77	917	6.78	8.48	
Sturgeon Bay	LKW5	21-May-12	9:15	7.2	0.3	12.10	8.83	83	961	9.40	8.94	1.10
					1.0	12.10	8.79	82	961	8.84	8.32	
					2.0	12.10	8.52	80	961	9.55	8.79	
					3.0	12.10	8.45	80	961	8.76	8.63	
					4.0	12.10	8.70	82	961	9.30	8.65	
					5.0	12.10	8.78	82	968	9.60	8.64	
					6.0	12.10	8.63	81	970	9.31	8.61	
					7.0	12.10	7.92	80	970	9.30	8.58	
Sturgeon Bay	LKW6	21-May-12	9:45	8.1	0.3	11.40	8.94	82	852	6.95	8.79	1.25
					1.0	11.40	8.91	82	852	6.87	8.71	
					2.0	11.40	8.87	81	853	7.02	8.61	
					3.0	11.40	8.75	81	857	7.01	8.57	
					4.0	11.30	8.77	81	855	7.23	8.54	
					5.0	11.30	8.62	80	855	7.35	8.53	
					6.0	11.30	8.73	80	856	7.37	8.54	
					7.0	11.30	8.56	80	857	7.38	8.54	
					8.0	11.30	8.62	80	857	7.60	8.53	
Sturgeon Bay	LKW7	21-May-12	10:20	6.5	0.3	11.30	8.66	79	848	6.45	8.73	1.50
					1.0	11.30	8.62	79	848	6.67	8.54	
					2.0	11.00	8.67	79	844	7.12	8.22	
					3.0	10.90	8.63	80	841	7.10	8.34	
					4.0	10.90	8.55	78	842	7.50	8.37	
					5.0	10.90	8.76	79	842	7.36	8.29	
					6.0	10.80	8.79	79	840	7.34	8.30	

1 - UTM coordinates; Datum NAD 83, Zone 14U.

Table 3-5. *In situ* water quality measurements recorded as part of the RWQMP in July, 2012.

Location	Location ID [1]	Sample Date	Sample Time	Water Depth (m)	Sample Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH	Secchi Depth (m)
Waterhen River	WHR-1	16-Jul-12	15:55	-	0.3	23.20	8.30	97	1071	1.40	7.85	-
Lake Manitoba	NARR2	16-Jul-12	10:02	-	0.3	23.20	7.01	83	1102	7.80	8.32	-
Fairford River	FR1	16-Jul-12	13:00	-	0.3	23.30	8.22	97	1069	9.09	8.42	-
Lake St. Martin	LSM1	17-Jul-12	10:30	2.4	0.3	21.80	8.17	93	1097	15.4	8.33	0.80
					0.5	21.80	8.13	92	1033	16.1	8.34	
					1.0	21.90	8.17	93	1035	15.3	8.32	
					1.5	21.90	8.10	93	1037	15.3	8.29	
					2.0	22.00	8.19	93	1103	14.9	8.31	
					2.5	21.90	8.23	94	1106	14.4	8.29	
Buffalo Creek	BC3	17-Jul-12	18:40	-	0.3	23.60	7.46	87	1096	12.8	8.06	-
Dauphin River	DR1.1	17-Jul-12	11:40	1.9	0.3	22.00	8.22	94	1103	13.0	8.43	1.10
					0.5	22.00	7.99	91	1097	12.8	8.38	
					1.0	22.00	8.13	93	1094	13.0	8.37	
					1.5	22.00	8.29	95	1096	11.4	8.37	
Dauphin River	DR1.3	17-Jul-12	13:30	-	0.3	23.10	9.08	106	1084	15.3	8.36	-
Dauphin River	DR1 (NOTE 2)	17-Jul-12	18:00	-	0.3	23.40	8.80	104	1089	16.4	8.39	-
Dauphin River	DR2C	17-Jul-12	16:08	-	0.3	23.40	8.43	99	1089	13.8	8.38	-
Sturgeon Bay	LKW1	17-Jul-12	11:46	4.5	0.3	23.20	7.90	91	972	8.86	8.39	0.85
					1.0	23.20	7.76	91	972	9.39	8.23	
					1.5	23.20	7.78	91	972	9.97	8.22	
					2.0	23.20	7.75	91	973	9.26	8.19	
					2.5	23.10	7.76	91	972	9.97	8.14	
					3.0	23.10	7.72	90	972	9.65	8.11	

Table 3-5. (continued).

Location	Location ID [1]	Sample Date	Sample Time	Water Depth (m)	Sample Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH	Secchi Depth (m)
Sturgeon Bay	LKW1				3.5	23.00	7.65	90	971	9.52	8.07	
					4.0	22.90	7.52	88	971	9.12	8.03	
Sturgeon Bay	LKW2	17-Jul-12	12:37	4.2	0.3	23.40	7.27	86	975	9.30	8.34	1.00
					1.0	23.40	7.31	86	976	10.5	8.29	
					1.5	23.30	7.37	87	975	9.47	8.26	
					2.0	23.30	7.31	86	976	9.56	8.23	
					2.5	23.10	7.20	84	974	9.62	8.18	
					3.0	23.10	7.16	84	975	10.0	8.13	
					3.5	22.80	7.17	84	976	9.45	8.11	
					4.0	22.80	7.03	82	976	10.3	8.06	
Sturgeon Bay	LKW3	17-Jul-12	13:12	6.6	0.3	23.40	7.44	88	964	5.56	8.45	1.50
					1.0	23.20	7.37	86	964	5.14	8.28	
					2.0	22.70	6.93	81	963	5.69	8.17	
					3.0	22.70	6.85	79	965	5.77	8.10	
					4.0	22.70	6.75	78	967	-	8.01	
					5.0	22.50	6.40	75	957	-	7.79	
					6.0	22.40	6.31	73	956	-	7.71	
Sturgeon Bay	LKW3B	17-Jul-12	14:05	5.6	0.3	23.10	7.25	85	1011	-	8.39	0.65
					1.0	23.00	7.17	84	1012	-	8.28	
					2.0	22.90	7.14	84	1033	-	8.12	
					3.0	22.80	6.74	78	1045	-	8.03	
					4.0	22.50	6.25	72	1065	-	7.86	
					5.0	22.40	6.18	72	1068	-	7.75	
Sturgeon Bay	LKW4	17-Jul-12	8:20	7.0	0.3	22.50	7.32	85	957	6.37	8.25	1.50
					1.0	22.50	7.31	86	959	6.85	8.09	
					2.0	22.50	7.37	85	958	6.31	8.02	
					3.0	22.50	7.38	85	958	7.11	7.93	
					4.0	22.50	7.33	85	958	7.16	7.87	

Table 3-5. (continued).

Location	Location ID [1]	Sample Date	Sample Time	Water Depth (m)	Sample Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH	Secchi Depth (m)
Sturgeon Bay	LKW4				5.0	22.50	7.32	85	958	7.22	7.80	
					6.0	22.50	7.31	85	958	7.31	7.62	
Sturgeon Bay	LKW5	17-Jul-12	11:07	7.3	0.3	22.70	7.86	91	924	12.9	8.18	1.05
					1.0	22.60	7.89	92	923	11.1	8.11	
					2.0	22.60	7.87	91	922	11.2	8.07	
					3.0	22.60	7.71	90	920	11.8	7.99	
					4.0	22.50	7.77	90	919	12.1	7.93	
					5.0	22.50	7.63	88	919	11.7	7.85	
					6.0	22.50	7.65	88	923	11.1	7.78	
Sturgeon Bay	LKW6	17-Jul-12	10:12	9.0	0.3	22.70	7.22	82	933	16.9	8.12	0.65
					1.0	22.60	7.08	82	932	17.0	8.09	
					2.0	22.60	7.00	83	929	17.1	8.03	
					3.0	22.50	7.05	84	927	18.1	7.97	
					4.0	22.50	7.01	83	928	17.6	7.91	
					5.0	22.50	7.06	82	926	17.7	7.85	
					6.0	22.50	7.16	84	923	17.7	7.78	
					7.0	22.50	7.25	84	918	17.9	7.74	
					8.0	22.50	7.15	83	898	17.9	7.65	
Sturgeon Bay	LKW7	17-Jul-12	9:22	6.6	0.3	21.60	7.29	83	712	20.1	8.11	0.50
					1.0	21.60	7.06	81	713	20.7	8.04	
					2.0	21.60	7.12	80	712	21.1	7.96	
					3.0	21.60	7.02	80	713	21.0	7.88	
					4.0	21.60	7.12	80	712	22.0	7.81	
					5.0	21.60	7.09	80	712	21.0	7.72	

1 - UTM coordinates; Datum NAD 83, Zone 14U.

Table 3-6. Laboratory results for routine water quality parameters at RWQMP sites during Reach 1 operation, 2012. Values in blue italics are considered suspect.

Location	Location ID [1]	Sample Date	Lab pH	Alkalinity: Total, as CaCO3 (mg/L)	Alkalinity: as Bicarbonate (HCO3-) (mg/L)	Alkalinity: as Carbonate (CO32-) (mg/L)	Alkalinity: as Hydroxide (OH-) (mg/L)	Nitrogen: Ammonia (mg N/L)	Nitrogen: Nitrate/nitrite (mg N/L)	Nitrogen: Nitrate-N (mg N/L)
Analytical Detection Limits			*0.10*	*1.0*	*1.2/2*	*0.60*	*0.34/0.4/6.8*	*0.010*	*0.0051*	*0.0050*
Waterhen River	WHR1	16-Jan-12	7.95	166	203	<0.60	<0.40	0.088	0.0168	0.0154
		16-May-12	8.37	173	204	<12.0	<6.80	0.012	<0.0051	<0.0050
		16-Jul-12	8.52	154	181	<12	<6.8	0.011	<0.0051	<0.0050
Lake Manitoba	NARR1	16-Jan-12	8.38	233	272	4.04	<0.40	0.039	<0.0051	0.0051
		16-May-12	8.55	203	229	<12.0	<6.80	0.017	<0.0051	<0.0050
		16-Jul-12	8.65	202	223	<12	<6.8	0.043	0.0053	0.0053
Fairford River	FR1	16-Jan-12	8.46	219	250	6.28	<0.40	0.04	0.0092	0.0073
		16-May-12	8.59	208	232	<12.0	<6.80	0.025	<0.0051	<0.0050
		16-Jul-12	8.63	177	194	<12	<6.8	0.017	<0.0051	<0.0050
Lake St. Martin	LSM1	19-Jan-12	8.36	225	264	2.95	<0.40	0.093	0.020	0.0184
		17-May-12	8.55	207	235	<12.0	<6.80	0.013	<0.0051	<0.0050
		17-Jul-12	8.57	192	215	<12	<6.8	0.014	<0.0051	<0.0050
Buffalo Creek	BC3	17-Jan-12	8.24	226	275	<0.60	<0.40	0.065	0.0253	0.0241
		16-May-12	8.35	206	246	<12.0	<6.80	0.001	<0.0051	<0.0050
		17-Jul-12	8.32	194	231	<12	<6.8	0.030	0.0091	0.0091
Dauphin River	DR1.1	17-May-12	8.56	206	233	<12.0	<6.80	0.012	<0.0051	<0.0050
		17-Jul-12	8.55	192	216	<12	<6.8	0.021	<0.0051	<0.0050
	DR1.2	19-Jan-12	8.26	229	280	<0.60	<0.40	0.114	0.0285	0.0257
	DR1.3	17-May-12	8.54	207	237	<12.0	<6.80	0.018	<0.0051	<0.0050
		17-Jul-12	8.56	189	213	<12	<6.8	0.017	<0.0051	<0.0050
	DR1 (NOTE 2)	16-May-12	8.53	207	235	<12.0	<6.80	0.016	<0.0051	<0.0050
		17-Jul-12	8.57	188	211	<12	<6.8	0.022	<0.0051	<0.0050

Table 3-6. (continued).

Location	Location ID [1]	Sample Date	Lab pH	Alkalinity: Total, as CaCO3 (mg/L)	Alkalinity: as Bicarbonate (HCO3-) (mg/L)	Alkalinity: as Carbonate (CO32-) (mg/L)	Alkalinity: as Hydroxide (OH-) (mg/L)	Nitrogen: Ammonia (mg N/L)	Nitrogen: Nitrate/nitrite (mg N/L)	Nitrogen: Nitrate-N (mg N/L)
Dauphin River	DR2C	16-May-12	8.52	206	235	<12.0	<6.80	0.018	<0.0051	<0.0050
		17-Jul-12	8.51	189	216	<12	<6.8	0.019	<0.0051	<0.0050
Sturgeon Bay	LKW1	18-Jan-12	8.15	213	260	<0.60	<0.40	0.026	0.0359	0.0339
		21-May-12	8.48	178	206	<12	<6.8	0.013	<0.0051	<0.0050
		17-Jul-12	8.56	186	207	<12	<6.8	0.012	<0.0051	<0.0050
	LKW2	18-Jan-12	8.18	228	278	<0.60	<0.40	0.076	0.0301	0.0283
		21-May-12	8.47	206	239	<12	<6.8	0.013	<0.0051	<0.0050
		17-Jul-12	8.58	188	208	<12	<6.8	0.014	<0.0051	<0.0050
	LKW3	18-Jan-12	8.38	173	201	3.21	<0.40	0.016	<0.0051	<0.0050
		19-May-12	8.42	191	225	<12.0	<6.80	0.013	<0.0051	<0.0050
		17-Jul-12	8.56	183	204	<12	<6.8	0.014	0.0218	0.0208
	LKW3B	19-May-12	8.41	203	239	<12.0	<6.80	0.015	<0.0051	<0.0050
		17-Jul-12	8.56	187	209	<12	<6.8	0.014	0.0177	0.0177
	LKW4	18-Jan-12	8.19	172	210	<0.60	<0.40	0.015	0.0057	0.0057
		21-May-12	8.45	177	206	<12	<6.8	0.012	<0.0051	<0.0050
		17-Jul-12	8.52	182	205	<12	<6.8	0.019	<0.0051	<0.0050
	LKW5	18-Jan-12	8.31	207	246	1.64	<0.40	0.033	0.0091	0.0091
		21-May-12	8.44	166	195	<12	<6.8	0.011	<0.0051	<0.0050
		17-Jul-12	8.50	178	202	<12	<6.8	0.027	<0.0051	0.0050
	LKW6	18-Jan-12	8.34	198	233	2.55	<0.40	0.033	0.0062	0.0062
		21-May-12	8.44	167	196	<12	<6.8	0.01	<0.0051	<0.0050
		17-Jul-12	8.52	180	203	<12	<6.8	0.021	0.0070	0.0070
	LKW7	18-Jan-12	8.29	163	198	<0.60	<0.40	0.031	0.0171	0.0171
		21-May-12	8.43	166	195	<12	<6.8	<0.010	<0.0051	<0.0050
		17-Jul-12	8.46	150	172	<12	<6.8	0.018	0.0103	0.0103

Table 3-6. (continued).

Location	Location ID [1]	Sample Date	Nitrogen				Phosphorus			
			Nitrite-N (mg N/L)	Dissolved Inorganic N (mg/L)	Total Kjeldahl N (mg/L)	Total N (mg/L)	Total P (mg/L)	Dissolved P (mg/L)	Total Particulate (mg/L)	Dissolved Fraction (%)
Analytical Detection Limits			*0.0010*	-	*0.20*	-	*0.010/0.0010*	*0.0010/0.0020/0.010*	*0.010/0.014*	-
Waterhen River	WHR1	16-Jan-12	0.0014	0.105	0.87	0.89	0.014	0.012	<0.014	86
		16-May-12	<0.0010	0.015	0.81	0.81	0.015	0.011	<0.014	73
		16-Jul-12	<0.0010	0.014	0.82	0.82	0.016	0.0034	0.013	21
Lake Manitoba	NARR1	16-Jan-12	<0.0010	0.042	1.08	1.08	0.021	0.009	<0.014	43
		16-May-12	<0.0010	0.020	0.94	0.94	0.025	0.011	0.014	44
		16-Jul-12	<0.0010	0.048	1.04	1.05	0.021	0.0041	0.017	20
Fairford River	FR1	16-Jan-12	0.0019	0.049	0.96	0.97	0.014	0.010	<0.014	71
		16-May-12	<0.0010	0.027	0.92	0.93	0.013	0.0110	<0.014	83
		16-Jul-12	<0.0010	0.020	0.85	0.85	0.012	0.0037	<0.010	31
Lake St. Martin	LSM1	19-Jan-12	0.0016	0.113	1.04	1.06	0.012	0.012	<0.014	100
		17-May-12	0.0012	0.049	0.99	0.99	0.019	0.0033	0.0152	17
		17-Jul-12	<0.0010	0.016	0.92	0.93	0.016	0.0039	0.012	25
Buffalo Creek	BC3	17-Jan-12	0.0012	0.090	0.97	1.00	0.014	0.012	<0.014	86
		16-May-12	<0.0010	0.026	0.91	0.94	0.011	0.0110	<0.014	97
		17-Jul-12	<0.0010	0.039	0.97	0.98	0.021	0.0055	0.015	26
Dauphin River	DR1.1	17-May-12	0.0017	0.015	0.98	0.98	0.028	0.003	0.0253	11
		17-Jul-12	<0.0010	0.024	1.05	1.05	0.019	0.0038	0.015	20
	DR1.2	19-Jan-12	0.0028	0.143	1.07	1.10	0.022	0.014	<0.014	64
	DR1.3	17-May-12	0.0010	0.021	0.98	0.98	0.021	0.0033	0.0179	16
		17-Jul-12	<0.0010	0.020	1.02	1.02	0.018	0.0053	0.013	29
	DR1 (NOTE 2)	16-May-12	<0.0010	0.019	1.01	1.01	0.013	0.0038	0.0096	29
		17-Jul-12	<0.0010	0.025	1.06	1.06	0.019	0.0050	0.014	26

Table 3-6. (continued).

Location	Location ID [1]	Sample Date	Nitrogen: Nitrite-N (mg N/L)	Nitrogen: Dissolved Inorganic N (mg/L)	Nitrogen: Total Kjeldahl N (mg/L)	Nitrogen: Total N (mg/L)	Phosphorus: Total P (mg/L)	Phosphorus: Dissolved P (mg/L)	Phosphorus: Total Particulate (mg/L)	Phosphorus: Dissolved Fraction (%)
Dauphin River	DR2C	16-May-12	<0.0010	0.043	1.00	1.00	0.018	0.0034	0.0144	19
		17-Jul-12	<0.0010	0.022	0.99	0.99	0.018	0.0054	0.013	30
Sturgeon Bay	LKW1	18-Jan-12	0.002	0.062	0.95	0.99	0.013	0.0028	0.011	21
		21-May-12	<0.0010	0.016	0.70	0.70	0.016	0.011	<0.014	69
		17-Jul-12	<0.0010	0.015	0.74	0.74	0.020	0.0048	0.015	24
	LKW2	18-Jan-12	0.0018	0.106	1.01	1.04	0.012	0.011	<0.014	92
		21-May-12	<0.0010	0.016	0.90	0.90	0.016	0.008	0.009	51
		17-Jul-12	<0.0010	0.017	0.76	0.76	0.018	0.0042	0.014	23
	LKW3	18-Jan-12	<0.0010	0.019	0.71	0.71	0.013	0.0099	<0.010	76
		19-May-12	<0.0010	0.016	1.19	1.19	0.028	0.011	0.017	39
		17-Jul-12	0.0010	0.036	0.79	0.81	0.019	0.0043	0.015	23
	LKW3B	19-May-12	<0.0010	0.018	1.38	1.38	0.031	0.011	0.020	35
		17-Jul-12	<0.0010	0.032	0.83	0.85	0.021	0.0048	0.016	23
	LKW4	18-Jan-12	<0.0010	0.021	0.75	0.76	0.013	0.003	0.01	23
		21-May-12	<0.0010	0.015	0.73	0.73	0.015	0.011	<0.014	73
		17-Jul-12	<0.0010	0.022	0.77	0.77	0.028	0.0056	0.023	20
	LKW5	18-Jan-12	<0.0010	0.042	1.09	1.10	0.025	0.011	<0.014	44
		21-May-12	<0.0010	0.014	0.84	0.84	0.014	0.011	<0.014	79
		17-Jul-12	<0.0010	0.030	0.77	0.77	0.029	0.0110	0.018	38
	LKW6	18-Jan-12	<0.0010	0.039	0.84	0.85	0.017	0.011	<0.014	68
		21-May-12	<0.0010	0.013	0.74	0.74	0.016	0.011	<0.014	69
		17-Jul-12	<0.0010	0.028	0.71	0.72	0.027	0.0087	0.018	32
	LKW7	18-Jan-12	<0.0010	0.048	0.7	0.72	***0.108***	0.019	0.089	18
		21-May-12	<0.0010	<0.001	0.68	0.68	0.015	0.011	<0.014	73
		17-Jul-12	<0.0010	0.028	0.55	0.56	0.030	0.0134	0.017	45

Table 3-6. (continued).

Location	Location ID [1]	Sample Date	N:P Molar Ratios			Carbon			C:N Molar Ratios	
			TN:TP	DIN:DP	DIN:TP	Total Inorganic C (mg/L)	Total Organic C (mg/L)	Dissolved Organic C (mg/L)	TOC:ON	TOC:TN
Analytical Detection Limits			-	-	-	*1.0*	*1.0*	*1.0*	-	-
Waterhen River	WHR1	16-Jan-12	140	19.3	16.6	45.3	13.2	11.9	19.7	17.4
		16-May-12	120	2.9	2.1	39.9	12.6	11.8	18.4	18.1
		16-Jul-12	114	8.8	1.9	38.3	12.3	12.4	17.7	17.4
Lake Manitoba	NARR1	16-Jan-12	112	10.0	4.3	61.0	13.5	12.4	15.2	14.6
		16-May-12	83	3.9	1.7	45.9	13.7	12.2	17.3	17.0
		16-Jul-12	110	26.1	5.1	48.0	11.9	11.6	13.9	13.3
Fairford River	FR1	16-Jan-12	153	10.9	7.8	47.3	14.0	12.5	17.8	16.9
		16-May-12	154	5.5	4.5	47.0	13.7	12.5	17.7	17.2
		16-Jul-12	43	11.8	1.0	41.5	12.1	11.7	17.0	16.6
Lake St. Martin	LSM1	19-Jan-12	196	20.9	20.9	51.1	15.4	14.1	19.0	16.9
		17-May-12	120	32.5	5.7	47.1	13.9	12.5	16.6	15.8
		17-Jul-12	131	9.3	2.3	43.4	12.7	11.7	16.3	16.0
Buffalo Creek	BC3	17-Jan-12	157	16.7	14.3	52.0	14.7	13.9	19.0	17.2
		16-May-12	183	5.1	5.0	48.1	13.3	12.9	17.0	16.5
		17-Jul-12	103	15.7	4.1	45.0	13.1	11.9	16.3	15.6
Dauphin River	DR1.1	17-May-12	78	10.7	1.2	47.3	14.1	13	17.0	16.7
		17-Jul-12	123	13.7	2.7	43.1	12.9	11.9	14.6	14.3
	DR1.2	19-Jan-12	111	22.5	14.3	52.6	15.7	13.4	19.2	16.7
	DR1.3	17-May-12	104	13.8	2.2	47.7	14.1	12.8	17.1	16.7
		17-Jul-12	126	8.2	2.4	43.0	13.1	12.0	15.2	14.9
	DR1 (NOTE 2)	16-May-12	172	10.8	3.2	46.8	13.2	12.9	15.5	15.2
		17-Jul-12	124	10.9	2.9	43.0	13.3	12.3	14.9	14.6
	DR2C	16-May-12	126	28.0	5.3	47.2	13.8	12.5	16.4	15.7
		17-Jul-12	122	8.8	2.7	43.1	12.7	12.5	15.3	14.9

Table 3-6. (continued).

Location	Location ID [1]	Sample Date	N:P Molar Ratios TN:TP	DIN:DP	DIN:TP	Carbon Total Inorganic C (mg/L)	Total Organic C (mg/L)	Dissolved Organic C (mg/L)	C:N Molar Ratios TOC:ON	TOC:TN
Sturgeon Bay	LKW1	18-Jan-12	163	49.0	10.2	48.4	13.6	13.3	17.2	16.1
		21-May-12	97	3.1	2.2	41.2	10.9	10.2	18.5	18.1
		17-Jul-12	82	6.7	1.6	42.4	11.4	11.2	18.3	17.9
	LKW2	18-Jan-12	192	21.4	19.6	51.8	14.9	14.2	18.6	16.7
		21-May-12	127	4.3	2.2	47.4	12.6	11.9	16.7	16.4
		17-Jul-12	94	8.7	2.0	43.2	11.6	10.9	18.1	17.7
	LKW3	18-Jan-12	121	4.1	3.2	38.7	12.4	11.6	20.8	20.3
		19-May-12	94	3.1	1.2	44.8	13.1	12.2	13.0	12.8
		17-Jul-12	95	18.4	4.2	42.3	11.2	11.0	16.8	16.1
	LKW3B	19-May-12	99	3.5	1.3	47.3	13.5	12.8	11.5	11.4
		17-Jul-12	89	14.6	3.3	43.0	12.6	11.5	18.0	17.3
	LKW4	18-Jan-12	129	15.3	3.5	39.1	12.5	12.9	19.8	19.3
		21-May-12	108	2.9	2.1	40.9	11.4	10.4	18.5	18.2
		17-Jul-12	61	8.5	1.7	42.2	11.2	10.8	17.4	16.9
	LKW5	18-Jan-12	97	8.5	3.7	46.7	14.6	13.9	16.1	15.5
		21-May-12	133	2.7	2.1	42.0	11.1	10.5	15.6	15.4
		17-Jul-12	59	5.9	2.3	40.8	10.7	10.1	16.8	16.2
	LKW6	18-Jan-12	112	7.7	5.2	44.9	13.7	13.0	19.9	18.9
		21-May-12	103	2.5	1.7	39.0	10	9.8	16.0	15.7
		17-Jul-12	59	7.1	2.3	41.4	11.0	9.9	18.6	17.9
	LKW7	18-Jan-12	15	5.6	1.0	36.2	11.6	11.1	20.2	18.9
		21-May-12	101	0.1	0.1	38.6	10.2	9.7	17.6	17.4
		17-Jul-12	41	4.7	2.1	34.8	9.2	8.6	20.2	19.2

Table 3-6. (continued).

Location	Location ID [1]	Sample Date	Conductivity (µmhos/cm)	TDS (mg/L)	Water Clarity			Algal Pigments	
					TSS (mg/L)	Turbidity (NTU)	True Colour (CU)	Chlorophyll *a* (µg/L)	Phaeophytin *a* (µg/L)
Analytical Detection Limits			*1/20*	*5.0*	*2.0*	*0.10*	*5.0*	*0.10*	*0.10*
Waterhen River	WHR1	16-Jan-12	946	702	<2.0	1.09	<5.0	2.64	1.69
		16-May-12	1050	568	8.8	4.54	8.8	3.83	1.52
		16-Jul-12	1030	599	3.3	1.77	10.8	2.07	1.51
Lake Manitoba	NARR1	16-Jan-12	1000	733	3.1	5.03	12.7	4.30	1.63
		16-May-12	1090	630	17.2	10.9	7.2	7.93	1.46
		16-Jul-12	1050	648	16.2	6.05	<5.0	5.44	2.35
Fairford River	FR1	16-Jan-12	1090	700	14.0	2.70	8.4	6.71	2.39
		16-May-12	1110	661	10.1	6.71	8.5	3.80	0.55
		16-Jul-12	1023	604	11.6	6.90	<5.0	2.16	0.63
Lake St. Martin	LSM1	19-Jan-12	1090	744	<2.0	1.34	9.9	4.29	1.94
		17-May-12	1100	672	8.0	33.6	6.3	3.48	0.64
		17-Jul-12	1027	687	12.5	8.37	6.1	4.53	0.94
Buffalo Creek	BC3	17-Jan-12	1170	732	4.8	2.20	10.3	3.20	1.73
		16-May-12	1090	635	7.7	3.78	11.7	1.94	0.82
		17-Jul-12	1020	670	11.8	5.75	15.2	1.54	1.09
Dauphin River	DR1.1	17-May-12	1100	670	9.6	4.72	6.7	4.66	1.50
		17-Jul-12	1020	725	13.2	7.64	6.1	3.98	1.40
	DR1.2	19-Jan-12	1110	744	<2.0	1.95	10.6	3.75	1.81
	DR1.3	17-May-12	1110	668	7.6	3.39	7.9	4.03	0.80
		17-Jul-12	1030	686	14.3	8.78	8.3	3.81	0.59
	DR1 (NOTE 2)	16-May-12	1110	660	12.8	4.87	8.1	4.22	1.04
		17-Jul-12	1020	640	14.7	8.55	6.3	4.22	0.86
	DR2C	16-May-12	1110	640	13.2	4.72	8.7	4.41	1.15
		17-Jul-12	1020	670	13.3	7.99	9.5	4.16	0.83

Table 3-6. (continued).

Location	Location ID [1]	Sample Date	Conductivity (µmhos/cm)	TDS (mg/L)	Water Clarity			Algal Pigments	
					TSS (mg/L)	Turbidity (NTU)	True Colour (CU)	Chlorophyll *a* (µg/L)	Phaeophytin *a* (µg/L)
Sturgeon Bay	LKW1	18-Jan-12	1010	694	8.8	4.17	10.5	3.18	1.30
		21-May-12	921	504	5.2	7.36	18.5	3.59	0.82
		17-Jul-12	931	598	7.6	5.36	9.8	3.64	1.15
	LKW2	18-Jan-12	1100	720	3.2	2.59	10.9	3.20	1.70
		21-May-12	1100	756	8.1	6.50	11.1	3.43	0.97
		17-Jul-12	934	605	8.4	5.38	12.5	3.53	0.68
	LKW3	18-Jan-12	718	448	<2.0	2.96	14.4	2.29	1.05
		19-May-12	1010	600	17.2	10.8	8.8	5.88	1.35
		17-Jul-12	925	590	6.2	3.50	7.1	5.12	1.33
	LKW3B	19-May-12	1080	654	28.4	17.5	10.3	6.52	1.71
		17-Jul-12	971	621	11.4	7.17	9.3	3.39	0.90
	LKW4	18-Jan-12	728	470	<2.0	3.24	13.8	2.73	1.16
		21-May-12	920	560	5.2	4.62	11.4	2.88	0.58
		17-Jul-12	921	571	4.7	4.63	9.1	3.17	1.25
	LKW5	18-Jan-12	902	608	4.4	3.49	14.6	3.68	1.07
		21-May-12	855	564	7.2	6.26	9.9	3.81	0.83
		17-Jul-12	886	553	6.3	8.07	9.1	2.35	0.97
	LKW6	18-Jan-12	861	579	3.5	3.62	15.4	3.50	1.33
		21-May-12	858	446	3.6	4.77	9.9	2.77	0.54
		17-Jul-12	897	611	9.5	9.13	9.7	1.24	2.36
	LKW7	18-Jan-12	679	440	3.2	3.50	15.7	2.66	0.78
		21-May-12	855	552	4.4	4.93	9.8	3.33	0.70
		17-Jul-12	693	481	10.5	10.4	8.9	2.25	0.86

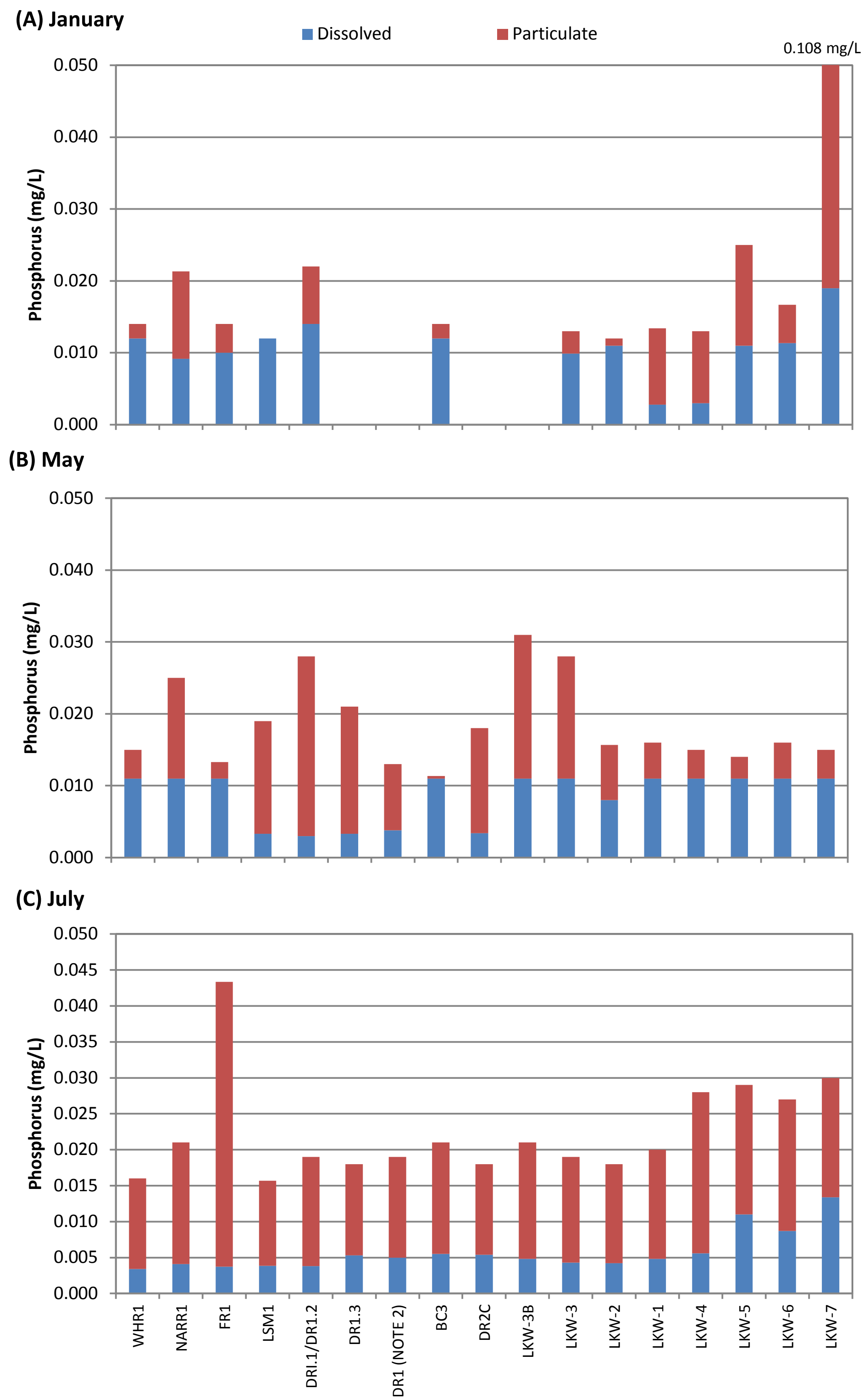

Figure 3-3. Phosphorus (P) concentrations (mg/L) measured at RWQMP sites during Reach 1 operation, 2012. Where particulate P concentrations were less than the analytical detection limit they are plotted as the difference between total P and dissolved P so that the bars shown in the graph represent total P concentrations.

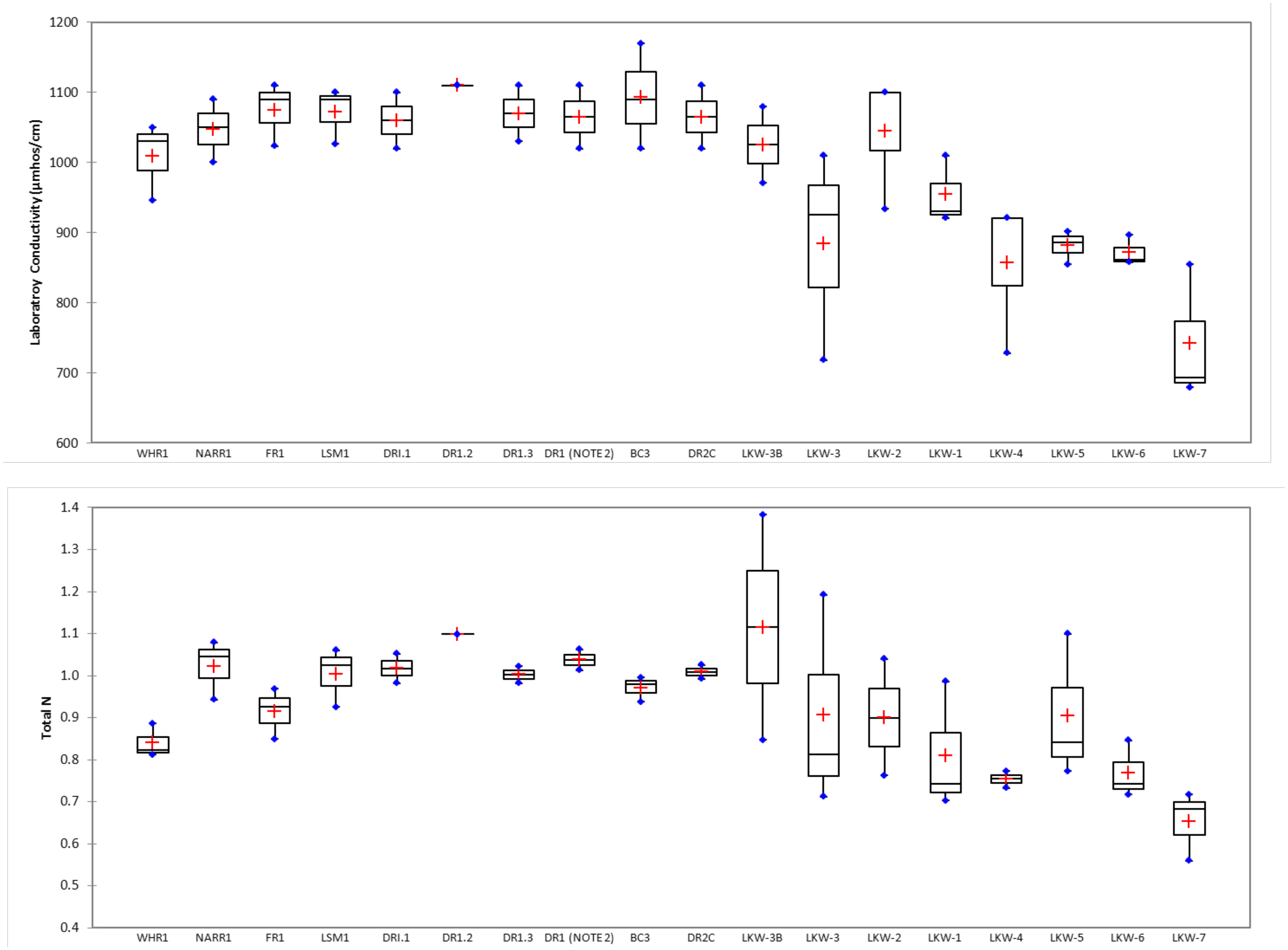

Figure 3-4. Boxplots of conductivity and total nitrogen measured in the study area, 2012.

Table 3-7. Concentrations of metals and major ions measured as part of the RWQMP during Reach 1 operation, 2012. Units are mg/L unless otherwise indicated.

Location	Location ID	Sample Date	Hardness, as $CaCO_3$	Aluminum		Antimony		Arsenic	
				Dissolved	Total	Dissolved	Total	Dissolved	Total
Analytical Detection Limits			*0.30*	*0.0020 /0.020*	*0.0030/ 0.005/ 0.050*	*0.000050/ 0.00020 /0.0020*	*0.000050/ 0.0002/ 0.0020*	*0.000060/ 0.00020/ 0.0020*	*0.000060 /0.00020/ 0.0020*
Waterhen River	WHR1	16-Jan-12	250	<0.0020	0.0077	<0.00020	<0.00020	0.00252	0.00212
		16-May-12	226	<0.0020	0.0762	<0.00020	0.000132	0.00152	0.00167
		16-Jul-12	235	<0.0020	0.0074	0.000131	<0.00020	0.00155	0.00161
Lake Manitoba	NARR1	16-Jan-12	365	0.0081	0.0856	0.00025	<0.00020	0.00407	0.00409
		16-May-12	261	<0.0020	0.123	<0.00020	0.000137	0.00224	0.00228
		16-Jul-12	317	0.0039	0.0217	0.000211	0.00021	0.00317	0.00323
Fairford River	FR1	16-Jan-12	287	<0.0020	0.0094	<0.00020	<0.00020	0.00251	0.00233
		16-May-12	282	<0.0020	0.0976	<0.00020	0.00013	0.00248	0.00251
		16-Jul-12	274	0.0032	0.0280	0.00017	<0.00020	0.00166	0.00229
Lake St. Martin	LSM1	18-Jan-12	294	<0.0020	0.0198	<0.00020	<0.00020	0.00281	0.00275
		17-May-12	291	<0.0020	0.0259	<0.00020	<0.00020	0.00238	0.00214
		17-Jul-12	296	0.0048	0.0763	<0.00020	<0.00020	0.00281	0.00250
Buffalo Creek	BC3	17-Jan-12	306	0.0023	0.0617	<0.00020	<0.00020	0.00372	0.00312
		16-May-12	277	<0.0020	0.1190	<0.00020	0.00014	0.00203	0.00203
		17-Jul-12	308	<0.0020	0.318	<0.00020	<0.00020	0.00251	0.00254
Dauphin River	DR1.1	17-May-12	276	<0.0020	0.04	<0.00020	0.000141	0.00218	0.00163
		17-Jul-12	303	<0.0020	0.0552	<0.00020	<0.00020	0.00278	0.00247
Dauphin River	DR1.2	18-Jan-12	301	<0.0020	0.0188	<0.00020	<0.00020	0.00292	0.00279
Dauphin River	DR1.3	17-May-12	267	<0.0020	0.0417	<0.00020	0.000156	0.00231	0.0016
		17-Jul-12	285	<0.0020	0.133	<0.00020	<0.00020	0.0026	0.00269
Dauphin River	DR1 (NOTE 2)	16-May-12	276	<0.0020	0.11	<0.00020	0.000139	0.00242	0.00259
		17-Jul-12	302	<0.0020	0.134	<0.00020	<0.00020	0.00272	0.00254

Table 3-7. (continued).

Location	Location ID	Sample Date	Hardness, as $CaCO_3$	Aluminum		Antimony		Arsenic	
				Dissolved	Total	Dissolved	Total	Dissolved	Total
Dauphin River	DR2C	16-May-12	282	<0.0020	0.133	<0.00020	0.000159	0.0023	0.00225
		17-Jul-12	282	<0.0020	0.144	<0.00020	<0.00020	0.00265	0.00252
Sturgeon Bay	LKW1	18-Jan-12	297	0.0091	0.0752	<0.00020	<0.00020	0.00288	0.00241
		21-May-12	224	0.0056	0.191	<0.00020	0.000118	0.00171	0.00199
		17-Jul-12	256	0.0029	0.38	<0.00020	<0.00020	0.00268	0.00248
Sturgeon Bay	LKW2	18-Jan-12	308	0.002	0.0553	<0.00020	<0.00020	0.00307	0.00277
		21-May-12	263	0.0030	0.1593	<0.00020	0.00016	0.00183	0.00231
		17-Jul-12	264	0.0023	0.473	<0.00020	<0.00020	0.00256	0.00233
Sturgeon Bay	LKW3	18-Jan-12	263	0.015	0.175	<0.00020	<0.00020	0.00257	0.00246
		19-May-12	273	0.109	0.377	<0.00020	<0.00020	0.00216	0.0023
		17-Jul-12	247	0.0027	0.245	<0.00020	<0.00020	0.00259	0.00214
Sturgeon Bay	LKW3B	19-May-12	288	0.18	0.531	<0.00020	<0.00020	0.00223	0.00236
		17-Jul-12	245	0.0059	0.486	<0.00020	<0.00020	0.00256	0.00236
Sturgeon Bay	LKW4	18-Jan-12	270	0.0171	0.162	<0.00020	<0.00020	0.00243	0.00226
		21-May-12	246	0.0032	0.152	<0.00020	0.00015	0.00156	0.00218
		17-Jul-12	255	0.0041	0.334	<0.00020	<0.00020	0.00279	0.00243
Sturgeon Bay	LKW5	18-Jan-12	318	0.0076	0.132	<0.00020	<0.00020	0.00284	0.00268
		21-May-12	228	0.0047	0.183	<0.00020	0.000127	0.00148	0.00195
		17-Jul-12	260	0.0043	0.712	<0.00020	<0.00020	0.00253	0.00225
Sturgeon Bay	LKW6	18-Jan-12	293	0.0113	0.1470	<0.00020	<0.00020	0.00284	0.00256
		21-May-12	197	0.0043	0.141	<0.00020	0.000143	0.00167	0.0018
		17-Jul-12	257	0.0031	0.753	<0.00020	<0.00020	0.00232	0.00212
Sturgeon Bay	LKW7	18-Jan-12	221	0.0123	0.169	<0.00020	<0.00020	0.00245	0.00232
		21-May-12	194	0.0049	0.104	<0.00020	0.000123	0.00151	0.00169
		17-Jul-12	203	0.0062	0.941	<0.00020	<0.00020	0.00185	0.00179

Table 3-7. (continued).

Location	Location ID	Sample Date	Barium		Beryllium		Bismuth		Boron	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Analytical Detection Limits			*0.000080/ 0.00020/ 0.0020*	*0.00020/ 0.0020*	*0.00020*	*0.0002*	*0.000040/ 0.00020*	*0.000040/ 0.00020*	*0.0040/ 0.010*	*0.0050/ 0.010*
Waterhen River	WHR1	16-Jan-12	0.037	0.0402	<0.00020	<0.00020	<0.00020	<0.00020	0.073	0.074
		16-May-12	0.0355	0.0345	<0.00020	<0.00020	<0.00020	<0.000040	0.079	0.099
		16-Jul-12	0.035	0.0364	<0.00020	<0.00020	<0.000040	<0.00020	0.055	0.083
Lake Manitoba	NARR1	16-Jan-12	0.07700	0.07700	<0.00020	<0.00020	<0.00020	<0.00020	0.124	0.128
		16-May-12	0.0488	0.0479	<0.00020	<0.00020	<0.00020	<0.000040	0.101	0.116
		16-Jul-12	0.0601	0.068	<0.00020	<0.00020	<0.000040	<0.00020	0.105	0.12
Fairford River	FR1	16-Jan-12	0.0515	0.046	<0.00020	<0.00020	<0.00020	<0.00020	0.097	0.09
		16-May-12	0.04907	0.04863	<0.00020	<0.00020	<0.00020	<0.000040	0.108	0.128
		16-Jul-12	0.04363	0.05170	<0.00020	<0.00020	<0.000040	<0.00020	0.067	0.103
Lake St. Martin	LSM1	18-Jan-12	0.0492	0.056	<0.00020	<0.00020	<0.00020	<0.00020	0.092	0.081
		17-May-12	0.0487	0.0528	<0.00020	<0.00020	<0.00020	<0.00020	0.11	0.095
		17-Jul-12	0.04623	0.05037	<0.00020	<0.00020	<0.00020	<0.00020	0.119	0.135
Buffalo Creek	BC3	17-Jan-12	0.0469	0.0504	<0.00020	<0.00020	<0.00020	<0.00020	0.091	0.093
		16-May-12	0.04817	0.04673	<0.00020	<0.00020	<0.00020	<0.000040	0.114	0.131
		17-Jul-12	0.0455	0.0501	<0.00020	<0.00020	<0.00020	<0.00020	0.125	0.126
Dauphin River	DR1.1	17-May-12	0.0487	0.0538	<0.00020	<0.00020	<0.00020	<0.000040	0.111	0.118
		17-Jul-12	0.0455	0.0482	<0.00020	<0.00020	<0.00020	<0.00020	0.129	0.149
Dauphin River	DR1.2	18-Jan-12	0.0533	0.0567	<0.00020	<0.00020	<0.00020	<0.00020	0.137	0.141
Dauphin River	DR1.3	17-May-12	0.0492	0.0522	<0.00020	<0.00020	<0.00020	<0.000040	0.109	0.105
		17-Jul-12	0.0446	0.0484	<0.00020	<0.00020	<0.00020	<0.00020	0.112	0.132
Dauphin River	DR1 (NOTE 2)	16-May-12	0.0521	0.0464	<0.00020	<0.00020	<0.00020	<0.000040	0.114	0.127
		17-Jul-12	0.0428	0.0538	<0.00020	<0.00020	<0.00020	<0.00020	0.106	0.117

Table 3-7. (continued).

Location	Location ID	Sample Date	Barium		Beryllium		Bismuth		Boron	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Dauphin River	DR2C	16-May-12	0.0497	0.0495	<0.00020	<0.00020	<0.00020	<0.000040	0.106	0.135
		17-Jul-12	0.0443	0.0485	<0.00020	<0.00020	<0.00020	<0.00020	0.115	0.121
Sturgeon Bay	LKW1	18-Jan-12	0.0499	0.0537	<0.00020	<0.00020	<0.00020	<0.00020	0.083	0.070
		21-May-12	0.045	0.0523	<0.00020	0.00027	<0.00020	0.000079	0.081	0.089
		17-Jul-12	0.0465	0.0499	<0.00020	<0.00020	<0.00020	<0.00020	0.100	0.103
Sturgeon Bay	LKW2	18-Jan-12	0.0496	0.0554	<0.00020	<0.00020	<0.00020	<0.00020	0.093	0.089
		21-May-12	0.05343	0.06100	<0.00020	0.00039	<0.00020	0.00007	0.090	0.113
		17-Jul-12	0.0447	0.0487	<0.00020	<0.00020	<0.00020	<0.00020	0.100	0.091
Sturgeon Bay	LKW3	18-Jan-12	0.044	0.0498	<0.00020	<0.00020	<0.00020	<0.00020	0.059	0.051
		19-May-12	0.0502	0.0501	<0.00020	<0.00020	<0.00020	<0.00020	0.09	0.081
		17-Jul-12	0.044	0.0506	<0.00020	<0.00020	<0.00020	<0.00020	0.099	0.095
Sturgeon Bay	LKW3B	19-May-12	0.0536	0.0545	<0.00020	<0.00020	<0.00020	<0.00020	0.095	0.087
		17-Jul-12	0.0458	0.0513	<0.00020	<0.00020	<0.00020	<0.00020	0.102	0.104
Sturgeon Bay	LKW4	18-Jan-12	0.0452	0.0476	<0.00020	<0.00020	<0.00020	<0.00020	0.057	0.049
		21-May-12	0.0457	0.0571	<0.00020	0.00021	<0.00020	<0.000040	0.072	0.111
		17-Jul-12	0.0432	0.0507	<0.00020	<0.00020	<0.00020	<0.00020	0.101	0.094
Sturgeon Bay	LKW5	18-Jan-12	0.0501	0.0567	<0.00020	<0.00020	<0.00020	<0.00020	0.072	0.072
		21-May-12	0.0474	0.0553	<0.00020	<0.00020	<0.00020	0.000079	0.079	0.105
		17-Jul-12	0.0445	0.0526	<0.00020	<0.00020	<0.00020	<0.00020	0.098	0.092
Sturgeon Bay	LKW6	18-Jan-12	0.04977	0.05330	<0.00020	<0.00020	<0.00020	<0.00020	0.066	0.059
		21-May-12	0.0448	0.0482	<0.00020	<0.00020	<0.00020	0.000077	0.075	0.088
		17-Jul-12	0.0483	0.0546	<0.00020	<0.00020	<0.00020	<0.00020	0.100	0.087
Sturgeon Bay	LKW7	18-Jan-12	0.0449	0.0484	<0.00020	<0.00020	<0.00020	<0.00020	0.072	0.058
		21-May-12	0.0432	0.0481	<0.00020	<0.00020	<0.00020	0.000074	0.069	0.100
		17-Jul-12	0.0353	0.0516	<0.00020	<0.00020	<0.00020	<0.00020	0.063	0.062

Table 3-7. (continued).

Location	Location ID	Sample Date	Cadmium Dissolved	Cadmium Total	Calcium Dissolved	Calcium Total	Cesium Dissolved	Cesium Total	Chloride Dissolved
Analytical Detection Limits			*0.0000050/ 0.000010*	*0.0000070/ 0.000010*	*0.030/ 0.050/ 0.50*	*0.040/ 0.10/ 1.0*	*0.000040/ 0.00010*	*0.000030/ 0.00010*	*0.20*
Waterhen River	WHR1	16-Jan-12	0.000013	<0.000010	52.7	56.1	<0.00010	<0.00010	246
		16-May-12	<0.000010	<0.0000070	48.3	47.5	<0.00010	<0.000030	197
		16-Jul-12	0.0000146	0.000161	41.3	49.4	<0.000040	<0.00010	205
Lake Manitoba	NARR1	16-Jan-12	0.000016	<0.000010	53.9	55.2	<0.00010	<0.00010	159
		16-May-12	0.000013	0.0000085	48.5	46.1	<0.00010	<0.000030	178
		16-Jul-12	0.0000125	0.00012	42.4	49.9	<0.000040	<0.00010	156
Fairford River	FR1	16-Jan-12	<0.000010	<0.000010	49.4	44.8	<0.00010	<0.00010	208
		16-May-12	<0.000010	0.000020	48.6	47.9	<0.00010	<0.000030	177
		16-Jul-12	0.000023	0.000089	38.1	48.5	<0.000040	<0.00010	178
Lake St. Martin	LSM1	18-Jan-12	<0.000010	0.00001	45.6	52.5	<0.00010	<0.00010	220
		17-May-12	<0.000010	0.000011	48.7	50.8	<0.00010	<0.00010	179
		17-Jul-12	<0.000010	<0.000010	51.8	47.8	<0.00010	<0.00010	178
Buffalo Creek	BC3	17-Jan-12	0.000013	<0.000010	48.8	48.9	<0.00010	<0.00010	222
		16-May-12	<0.000010	0.000011	48.3	46.8	<0.00010	<0.000030	174
		17-Jul-12	<0.000010	<0.000010	54.2	44.7	<0.00010	<0.00010	175
Dauphin River	DR1.1	17-May-12	<0.000010	0.0000118	48.6	49.0	<0.00010	<0.000030	179
		17-Jul-12	<0.000010	<0.000010	53.6	49.5	<0.00010	<0.00010	178
Dauphin River	DR1.2	18-Jan-12	0.00001	0.000011	48.4	53.1	<0.00010	<0.00010	224
Dauphin River	DR1.3	17-May-12	<0.000010	0.0000247	50.3	47.1	<0.00010	<0.000030	180
		17-Jul-12	<0.000010	<0.000010	48.5	49.0	<0.00010	<0.00010	177
Dauphin River	DR1 (NOTE 2)	16-May-12	<0.000010	<0.0000070	49.5	46.3	<0.00010	<0.000030	178
		17-Jul-12	<0.000010	<0.000010	51.1	43.7	<0.00010	<0.00010	177

Table 3-7. (continued).

Location	Location ID	Sample Date	Cadmium		Calcium		Cesium		Chloride
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Dauphin River	DR2C	16-May-12	<0.000010	<0.0000070	49.1	47.7	<0.00010	<0.000030	177
		17-Jul-12	<0.000010	<0.000010	48.6	44.5	<0.00010	<0.00010	177
Sturgeon Bay	LKW1	18-Jan-12	<0.000010	0.000013	51.6	50.3	<0.00010	<0.00010	196
		21-May-12	<0.000010	0.0000141	42.8	46.5	<0.00010	<0.000030	141
		17-Jul-12	<0.000010	0.000011	48.6	49.3	<0.00010	<0.00010	150
Sturgeon Bay	LKW2	18-Jan-12	<0.000010	0.000013	53.1	53.7	<0.00010	<0.00010	222
		21-May-12	<0.000010	0.000017	48.9	48.6	<0.00010	<0.000030	174
		17-Jul-12	<0.000010	<0.000010	48.6	43.9	<0.00010	<0.00010	150
Sturgeon Bay	LKW3	18-Jan-12	<0.000010	0.000011	45.9	43.5	<0.00010	<0.00010	114
		19-May-12	<0.000010	0.000013	46.0	47.5	<0.00010	<0.00010	161
		17-Jul-12	<0.000010	<0.000010	43.7	44.3	<0.00010	<0.00010	149
Sturgeon Bay	LKW3B	19-May-12	<0.000010	0.000015	48.1	51.0	<0.00010	<0.00010	174
		17-Jul-12	<0.000010	<0.000010	44.3	43.4	<0.00010	<0.00010	161
Sturgeon Bay	LKW4	18-Jan-12	<0.000010	0.000015	45.9	52.3	<0.00010	<0.00010	113
		21-May-12	<0.000010	0.0000151	42.5	43.9	<0.00010	<0.000030	141
		17-Jul-12	<0.000010	0.000013	48.1	44.6	<0.00010	<0.00010	148
Sturgeon Bay	LKW5	18-Jan-12	<0.000010	0.000013	52.1	51.9	<0.00010	<0.00010	159
		21-May-12	<0.000010	0.0000099	42.8	47.2	<0.00010	<0.000030	151
		17-Jul-12	<0.000010	0.000012	48.3	44.6	<0.00010	<0.00010	140
Sturgeon Bay	LKW6	18-Jan-12	<0.000010	0.000013	52.8	46.2	<0.00010	<0.00010	149
		21-May-12	<0.000010	0.0000151	41.2	41.1	<0.00010	<0.000030	130
		17-Jul-12	<0.000010	0.000013	48.3	44.7	<0.00010	<0.00010	142
Sturgeon Bay	LKW7	18-Jan-12	<0.000010	0.000013	45.5	39.8	<0.00010	<0.00010	101
		21-May-12	<0.000010	0.0000089	39.7	40.8	<0.00010	<0.000030	128
		17-Jul-12	<0.000010	0.000013	40.6	40.0	<0.00010	<0.00010	95.7

Table 3-7. (continued).

Location	Location ID	Sample Date	Chromium		Cobalt		Copper		Fluoride	Iron	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Dissolved	Total
Analytical Detection Limits			*0.00050/ 0.0020*	*0.0010*	*0.000050/ 0.00020*	*0.000050 /0.00020*	*0.00010/ 0.00020*	*0.00010/ 0.00020*	*0.020*	*0.010/ 0.10*	*0.010/ 0.10*
Waterhen River	WHR1	16-Jan-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00038	0.00073	0.150	<0.010	0.01
		16-May-12	<0.0020	<0.0010	<0.00020	<0.000050	0.00044	0.0009	0.141	0.016	0.031
		16-Jul-12	<0.00050	<0.0010	0.000096	<0.00020	0.00061	0.0004	0.116	0.022	0.03
Lake Manitoba	NARR1	16-Jan-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00093	0.00123	0.198	<0.010	0.16
		16-May-12	<0.0020	<0.0010	<0.00020	0.000093	0.00051	0.00072	0.151	0.012	0.046
		16-Jul-12	0.0009	<0.0010	0.000124	<0.00020	0.00115	0.00073	0.145	0.017	0.078
Fairford River	FR1	16-Jan-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00043	0.00061	0.165	<0.010	0.011
		16-May-12	<0.0020	<0.0010	<0.00020	0.000105	0.00073	0.00101	0.155	0.014	0.04
		16-Jul-12	0.0011	<0.0010	0.00011	<0.00020	0.00087	0.00064	0.130	0.015	0.07
Lake St. Martin	LSM1	18-Jan-12	0.0022	<0.0010	<0.00020	<0.00020	0.00061	0.00064	0.155	<0.010	0.01
		17-May-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00049	0.00081	0.170	<0.010	0.022
		17-Jul-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00036	0.00054	0.133	<0.010	0.02
Buffalo Creek	BC3	17-Jan-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00042	0.00062	0.173	<0.010	0.15
		16-May-12	<0.0020	<0.0010	<0.00020	0.000099	0.00050	0.00078	0.153	<0.010	0.05
		17-Jul-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00039	0.00054	0.146	0.014	0.087
Dauphin River	DR1.1	17-May-12	<0.0020	<0.0010	<0.00020	<0.000050	0.00044	0.00089	0.162	0.011	0.033
		17-Jul-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00075	0.00052	0.147	<0.010	0.016
Dauphin River	DR1.2	18-Jan-12	0.0021	<0.0010	<0.00020	<0.00020	0.00065	0.0007	0.149	<0.010	0.013
Dauphin River	DR1.3	17-May-12	0.0028	<0.0010	<0.00020	<0.000050	0.00044	0.00058	0.165	0.013	0.044
		17-Jul-12	<0.0020	<0.0010	<0.00020	<0.00020	0.0003	0.00068	0.147	0.012	0.035
Dauphin River	DR1 (NOTE 2)	16-May-12	<0.0020	<0.0010	<0.00020	0.000135	0.00055	0.00076	0.155	0.011	0.043
		17-Jul-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00026	0.00099	0.139	0.014	0.034

Table 3-7. (continued).

Location	Location ID	Sample Date	Chromium		Cobalt		Copper		Fluoride	Iron	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Dissolved	Total
Dauphin River	DR2C	16-May-12	<0.0020	<0.0010	<0.00020	0.000128	0.00056	0.00099	0.152	0.015	0.04
		17-Jul-12	<0.0020	<0.0010	<0.00020	<0.00020	<0.00020	0.00054	0.139	0.012	0.035
Sturgeon Bay	LKW1	18-Jan-12	<0.0020	<0.0010	<0.00020	<0.00020	0.0013	0.00133	0.143	<0.010	0.11
		21-May-12	<0.0020	<0.0010	<0.00020	0.000175	0.00074	0.00174	0.138	<0.010	0.215
		17-Jul-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00067	0.0012	0.139	0.016	0.097
Sturgeon Bay	LKW2	18-Jan-12	0.0024	<0.0010	<0.00020	<0.00020	0.001	0.00086	0.142	<0.010	0.11
		21-May-12	<0.0020	0.0016	<0.00020	0.000187	0.00057	0.00193	0.156	<0.010	0.18
		17-Jul-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00071	0.00109	0.141	0.016	0.089
Sturgeon Bay	LKW3	18-Jan-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00168	0.00191	0.128	<0.010	0.13
		19-May-12	<0.0020	<0.0010	<0.00020	0.00025	0.00066	0.00127	0.138	<0.010	0.36
		17-Jul-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00068	0.001	0.129	<0.010	0.056
Sturgeon Bay	LKW3B	19-May-12	<0.0020	0.0010	<0.00020	0.00036	0.00073	0.00148	0.158	<0.010	0.55
		17-Jul-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00065	0.001	0.130	0.015	0.087
Sturgeon Bay	LKW4	18-Jan-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00173	0.00164	0.122	<0.010	0.12
		21-May-12	<0.0020	0.0033	<0.00020	0.000201	0.00072	0.00189	0.134	<0.010	0.164
		17-Jul-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00071	0.00109	0.129	0.016	0.12
Sturgeon Bay	LKW5	18-Jan-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00126	0.00149	0.16	<0.010	0.12
		21-May-12	<0.0020	<0.0010	<0.00020	0.00018	0.00076	0.00182	0.141	<0.010	0.053
		17-Jul-12	<0.0020	<0.0010	<0.00020	0.00022	0.00087	0.00166	0.124	0.018	0.171
Sturgeon Bay	LKW6	18-Jan-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00156	0.00172	0.142	<0.010	0.14
		21-May-12	<0.0020	<0.0010	<0.00020	0.000132	0.00079	0.00153	0.130	<0.010	0.133
		17-Jul-12	<0.0020	0.0011	<0.00020	0.00027	0.00082	0.00152	0.135	0.012	0.162
Sturgeon Bay	LKW7	18-Jan-12	<0.0020	<0.0010	<0.00020	<0.00020	0.00102	0.00139	0.120	<0.010	0.15
		21-May-12	<0.0020	<0.0010	<0.00020	0.000122	0.00081	0.00171	0.128	<0.010	0.06
		17-Jul-12	<0.0020	0.0016	<0.00020	0.00033	0.00101	0.00188	0.122	0.019	0.218

Table 3-7. (continued).

Location	Location ID	Sample Date	Lead		Lithium		Magnesium		Manganese	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Analytical Detection Limits			*0.000090/ 0.000050*	*0.000090/ 0.000060*	*0.0020/ 0.020*	*0.00020/ 0.0020/ 0.020*	*0.0070/ 0.010/0.10*	*0.0080/ 0.010/0.10*	*0.00090 0.00010/ 0.0010*	*0.00020/ 0.00030 /0.0030*
Waterhen River	WHR1	16-Jan-12	<0.000090	0.000124	0.0273	0.0268	28.8	27.8	0.00123	0.00627
		16-May-12	<0.000090	0.000114	0.0247	0.029	23.7	26.2	0.00222	0.018
		16-Jul-12	<0.000050	<0.000090	0.0289	0.0233	25.9	27.2	0.000498	0.0163
Lake Manitoba	NARR1	16-Jan-12	<0.000090	0.000164	0.0589	0.0538	55.9	54.3	0.00090	0.00438
		16-May-12	<0.000090	0.000196	0.0358	0.0366	34.7	35.5	0.00031	0.0082
		16-Jul-12	0.000071	0.000139	0.0459	0.0408	44.3	46.7	0.000142	0.0112
Fairford River	FR1	16-Jan-12	<0.000090	<0.000090	0.0395	0.0332	39.7	35.0	0.00049	0.00212
		16-May-12	<0.000090	0.000225	0.0376	0.0399	37.0	39.5	0.00031	0.00559
		16-Jul-12	<0.000050	0.000104	0.0347	0.0317	34.4	37.2	<0.000090	0.00446
Lake St. Martin	LSM1	18-Jan-12	<0.000090	<0.000090	0.034	0.0338	40.3	39.6	0.00016	0.00386
		17-May-12	<0.000090	<0.000090	0.0357	0.0373	34.6	39.8	0.00036	0.00609
		17-Jul-12	<0.000090	0.000105	0.0393	0.0377	40.6	36.2	<0.00010	0.00723
Buffalo Creek	BC3	17-Jan-12	<0.000090	<0.000090	0.0361	0.0385	44.7	47.3	0.0149	0.021
		16-May-12	<0.000090	0.000150	0.0362	0.0388	35.6	38.9	0.00343	0.01260
		17-Jul-12	<0.000090	0.00012	0.0404	0.0386	41.9	36.3	0.0002	0.0363
Dauphin River	DR1.1	17-May-12	<0.000090	0.000138	0.0352	0.0368	34.7	37.3	0.0004	0.0059
		17-Jul-12	<0.000090	0.000092	0.0422	0.0359	41.0	39.0	0.00177	0.0075
Dauphin River	DR1.2	18-Jan-12	<0.000090	<0.000090	0.0365	0.0358	44.4	40.9	0.0006	0.00566
Dauphin River	DR1.3	17-May-12	<0.000090	0.000119	0.035	0.0347	34.9	36.2	0.00038	0.00815
		17-Jul-12	<0.000090	0.000117	0.0388	0.0357	39.9	41.0	<0.00010	0.0101
Dauphin River	DR1 (NOTE 2)	16-May-12	<0.000090	0.000394	0.0372	0.0376	36.2	39.0	0.00024	0.00827
		17-Jul-12	<0.000090	0.000117	0.0396	0.0373	42.4	39.1	<0.00010	0.0115

Table 3-7. (continued).

Location	Location ID	Sample Date	Lead		Lithium		Magnesium		Manganese	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Dauphin River	DR2C	16-May-12	<0.000090	0.000185	0.0361	0.0374	36.5	39.6	0.00019	0.00896
		17-Jul-12	<0.000090	0.000117	0.0402	0.0354	38.9	37.7	0.00015	0.0144
Sturgeon Bay	LKW1	18-Jan-12	<0.000090	0.000095	0.0286	0.0266	35.0	41.7	0.00024	0.00311
		21-May-12	<0.000090	0.000193	0.0253	0.0376	29.3	26.3	0.0002	0.00774
		17-Jul-12	<0.000090	0.000157	0.0354	0.0335	32.8	36.3	0.00045	0.0272
Sturgeon Bay	LKW2	18-Jan-12	<0.000090	0.000106	0.0404	0.0355	45.8	42.2	0.00353	0.0113
		21-May-12	<0.000090	0.000262	0.0290	0.0398	32.7	34.4	0.00034	0.01273
		17-Jul-12	<0.000090	0.000136	0.0348	0.0286	34.6	34.8	0.00019	0.0223
Sturgeon Bay	LKW3	18-Jan-12	<0.000090	0.000093	0.0225	0.0204	26.9	37.5	0.00018	0.00147
		19-May-12	0.000151	0.00023	0.0321	0.031	31.4	37.5	0.0137	0.0163
		17-Jul-12	<0.000090	<0.000090	0.0368	0.0302	33.6	32.3	0.00024	0.0204
Sturgeon Bay	LKW3B	19-May-12	0.000223	0.000328	0.0355	0.0345	33.7	38.9	0.0145	0.0211
		17-Jul-12	<0.000090	0.000171	0.0354	0.034	32.7	34.6	0.00017	0.0219
Sturgeon Bay	LKW4	18-Jan-12	<0.000090	<0.000090	0.022	0.0207	28.1	33.9	0.00022	0.002
		21-May-12	<0.000090	0.00017	0.0231	0.0256	25.8	33.1	0.00029	0.00843
		17-Jul-12	<0.000090	0.000106	0.0363	0.0319	32.7	34.2	0.00051	0.0464
Sturgeon Bay	LKW5	18-Jan-12	<0.000090	0.000142	0.0284	0.0304	35.0	45.8	0.00043	0.00335
		21-May-12	<0.000090	0.00018	0.0249	0.0374	29.6	26.8	0.0002	0.00854
		17-Jul-12	<0.000090	0.00016	0.0328	0.0292	33.9	35.3	0.00018	0.0221
Sturgeon Bay	LKW6	18-Jan-12	<0.000090	0.000220	0.0259	0.0248	33.7	43.2	0.00043	0.00293
		21-May-12	<0.000090	0.000169	0.0241	0.0346	26.6	23.0	0.00022	0.00668
		17-Jul-12	<0.000090	0.000203	0.0348	0.0302	33.2	35.1	<0.00010	0.0129
Sturgeon Bay	LKW7	18-Jan-12	<0.000090	<0.000090	0.0285	0.0244	31.9	29.6	0.00023	0.00375
		21-May-12	<0.000090	0.000128	0.0226	0.0296	25.5	22.3	0.00018	0.00473
		17-Jul-12	<0.000090	0.000236	0.024	0.022	24.7	27.3	0.00017	0.0109

Table 3-7. (continued).

Location	Location ID	Sample Date	Mercury (ng/L)		Methyl Mercury (ng/L)		Molybdenum		Nickel	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Analytical Detection Limits			*1.0*	*1.0*	*0.050*	*0.050*	*0.000080/ 0.00010*	*0.000080/ 0.00020*	*0.00020/ 0.0010*	*0.00030/ 0.002*
Waterhen River	WHR1	16-Jan-12	<1.0	<1.0	<0.050	<0.050	0.00187	0.00186	0.0027	<0.0020
		16-May-12	1.2	<1.0	0.051	0.088	0.00196	0.00186	<0.0010	0.0011
		16-Jul-12	1.5	1.4	0.108	0.147	0.00139	0.00159	0.00223	<0.0020
Lake Manitoba	NARR1	16-Jan-12	<1.0	<1.0	<0.050	<0.050	0.00320	0.00293	0.0037	<0.0020
		16-May-12	1.5	<1.0	<0.050	<0.050	0.00213	0.00179	<0.0010	0.00129
		16-Jul-12	1.9	1.9	<0.050	<0.050	0.00213	0.00232	0.00228	<0.0020
Fairford River	FR1	16-Jan-12	<1.0	<1.0	<0.050	<0.050	0.00243	0.00225	0.0028	<0.0020
		16-May-12	<1.0	<1.0	<0.050	<0.050	0.00214	0.00203	<0.0010	0.0016
		16-Jul-12	1.2	1.5	<0.050	0.087	0.00187	0.00208	0.0021	<0.0020
Lake St. Martin	LSM1	18-Jan-12	<1.0	<1.0	<0.050	<0.050	0.00234	0.00234	<0.0010	<0.0020
		17-May-12	<1.0	<1.0	<0.050	<0.050	0.00241	0.00216	<0.0010	<0.0020
		17-Jul-12	<1.0	1.4	<0.050	0.077	0.00190	0.00206	<0.0010	<0.0020
Buffalo Creek	BC3	17-Jan-12	<1.0	<1.0	<0.050	<0.050	0.00212	0.00214	0.003	<0.0020
		16-May-12	<1.0	1.0	0.076	0.116	0.00222	0.00220	<0.0010	0.0010
		17-Jul-12	2.3	4.2	0.793	1.100	0.00164	0.00185	<0.0010	<0.0020
Dauphin River	DR1.1	17-May-12	<1.0	<1.0	<0.050	<0.050	0.0024	0.00186	<0.0010	<0.00030
		17-Jul-12	<1.0	1.1	<0.050	0.063	0.00196	0.00209	<0.0010	<0.0020
Dauphin River	DR1.2	18-Jan-12	<1.0	<1.0	<0.050	<0.050	0.00248	0.00224	<0.0010	<0.0020
Dauphin River	DR1.3	17-May-12	<1.0	<1.0	<0.050	0.077	0.00238	0.00184	<0.0010	<0.00030
		17-Jul-12	<1.0	1.3	<0.050	0.086	0.0018	0.00208	<0.0010	<0.0020
Dauphin River	DR1 (NOTE 2)	16-May-12	<1.0	1.1	<0.050	0.073	0.0023	0.00229	<0.0010	0.00094
		17-Jul-12	1.1	1.5	<0.050	0.080	0.00187	0.00227	<0.0010	<0.0020

Table 3-7. (continued).

Location	Location ID	Sample Date	Mercury (ng/L)		Methyl Mercury (ng/L)		Molybdenum		Nickel	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Dauphin River	DR2C	16-May-12	<1.0	1.2	<0.050	0.061	0.00224	0.00222	<0.0010	0.00107
		17-Jul-12	1.1	1.9	0.115	0.259	0.00174	0.00202	<0.0010	<0.0020
Sturgeon Bay	LKW1	18-Jan-12	<1.0	<1.0	<0.050	<0.050	0.00196	0.00185	<0.0010	<0.0020
		21-May-12	2.9	1.6	<0.050	<0.050	0.00162	0.00183	<0.0010	0.00135
		17-Jul-12	<1.0	<1.0	<0.050	0.094	0.00176	0.00195	<0.0010	<0.0020
Sturgeon Bay	LKW2	18-Jan-12	<1.0	<1.0	<0.050	<0.050	0.00239	0.00232	<0.0010	<0.0020
		21-May-12	2.1	13.0	<0.050	0.073	0.00208	0.00218	<0.0010	0.0016
		17-Jul-12	1.3	1.3	<0.050	0.096	0.00183	0.00178	<0.0010	<0.0020
Sturgeon Bay	LKW3	18-Jan-12	<1.0	<1.0	<0.050	<0.050	0.00153	0.00156	<0.0010	<0.0020
		19-May-12	<1.0	1.3	<0.050	<0.050	0.00173	0.00205	<0.0010	<0.0020
		17-Jul-12	<1.0	2	0.053	0.147	0.00189	0.00183	<0.0010	<0.0020
Sturgeon Bay	LKW3B	19-May-12	<1.0	2.5	-	0.088	0.00186	0.00223	<0.0010	0.0021
		17-Jul-12	1.4	1.5	0.160	0.364	0.00184	0.0019	<0.0010	<0.0020
Sturgeon Bay	LKW4	18-Jan-12	<1.0	<1.0	<0.050	<0.050	0.00156	0.00156	<0.0010	<0.0020
		21-May-12	2.2	2.4	<0.050	<0.050	0.00165	0.00146	<0.0010	0.00176
		17-Jul-12	<1.0	<1.0	0.050	0.098	0.0018	0.0018	<0.0010	<0.0020
Sturgeon Bay	LKW5	18-Jan-12	<1.0	<1.0	<0.050	<0.050	0.00193	0.00189	<0.0010	<0.0020
		21-May-12	<1.0	<1.0	<0.050	<0.050	0.00175	0.00183	<0.0010	0.00158
		17-Jul-12	<1.0	<1.0	<0.050	<0.050	0.00179	0.00189	<0.0010	<0.0020
Sturgeon Bay	LKW6	18-Jan-12	<1.0	<1.0	<0.050	<0.050	0.00189	0.00179	<0.0010	<0.0020
		21-May-12	1.4	2.2	<0.050	<0.050	0.00144	0.00161	<0.0010	0.00134
		17-Jul-12	<1.0	<1.0	<0.050	<0.050	0.00176	0.00181	<0.0010	<0.0020
Sturgeon Bay	LKW7	18-Jan-12	<1.0	<1.0	<0.050	<0.050	0.00184	0.00177	<0.0010	<0.0020
		21-May-12	<1.0	1.7	<0.050	<0.050	0.00144	0.00143	<0.0010	0.00152
		17-Jul-12	<1.0	1.1	<0.050	<0.050	0.00136	0.00144	<0.0010	<0.0020

Table 3-7. (continued).

Location	Location ID	Sample Date	Potassium		Rubidium		Selenium		Silicon	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Analytical Detection Limits			*0.020/0.20*	*0.020/0.20*	*0.000050/ 0.00020*	*0.000050/ 0.00020*	*0.00090/ 0.0010*	*0.00060/ 0.0010*	*0.050/0.50*	*0.050/0.50*
Waterhen River	WHR1	16-Jan-12	9.90	8.74	0.00419	0.00392	<0.0010	<0.0010	4.64	5.13
		16-May-12	7.36	7.55	0.00325	0.00348	<0.0010	0.00323	2.94	2.47
		16-Jul-12	7.51	7.39	0.00358	0.00383	0.00314	<0.0010	5.38	5.32
Lake Manitoba	NARR1	16-Jan-12	16.1	15.8	0.00431	0.00386	<0.0010	<0.0010	2.45	2.62
		16-May-12	10.5	10.2	0.00331	0.00345	<0.0010	0.0028	3.28	2.95
		16-Jul-12	13.0	12.6	0.00366	0.00391	0.00187	<0.0010	3.72	3.33
Fairford River	FR1	16-Jan-12	11.4	10.5	0.00393	0.00353	<0.0010	<0.0010	4.76	4.27
		16-May-12	11.2	11.3	0.00342	0.00362	<0.0010	0.0021	3.13	2.79
		16-Jul-12	9.6	10.0	0.00332	0.00377	0.0038	<0.0010	3.50	3.43
Lake St. Martin	LSM1	18-Jan-12	10.1	10.1	0.00438	0.00418	<0.0010	<0.0010	4.88	4.98
		17-May-12	10.7	11.8	0.00355	0.00366	<0.0010	<0.0010	2.45	2.65
		17-Jul-12	10.2	11.0	0.00369	0.00380	<0.0010	<0.0010	4.88	4.40
Buffalo Creek	BC3	17-Jan-12	10.9	10.5	0.00434	0.00441	0.0012	0.0015	4.45	4.75
		16-May-12	10.5	10.9	0.00347	0.00377	<0.0010	0.0032	3.08	2.42
		17-Jul-12	10.9	11.8	0.00382	0.00456	<0.0010	<0.0010	5.01	4.82
Dauphin River	DR1.1	17-May-12	10.7	10.2	0.00357	0.00325	<0.0010	0.0018	2.95	2.56
		17-Jul-12	10.2	11.3	0.00376	0.00396	<0.0010	<0.0010	4.92	4.53
Dauphin River	DR1.2	18-Jan-12	11.1	9.75	0.00443	0.00404	<0.0010	<0.0010	5.04	4.94
Dauphin River	DR1.3	17-May-12	10.9	10.0	0.0036	0.00324	<0.0010	<0.00060	3.04	2.28
		17-Jul-12	10.1	11.8	0.00349	0.00428	<0.0010	<0.0010	4.56	4.88
Dauphin River	DR1 (NOTE 2)	16-May-12	10.9	10.9	0.0035	0.00368	<0.0010	0.00085	2.72	2.41
		17-Jul-12	10.5	12.3	0.0037	0.00403	<0.0010	<0.0010	5.6	4.84

Table 3-7. (continued).

Location	Location ID	Sample Date	Potassium		Rubidium		Selenium		Silicon	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Dauphin River	DR2C	16-May-12	11.1	10.7	0.00347	0.00353	<0.0010	0.00109	2.7	2.65
		17-Jul-12	10.3	11.7	0.00355	0.00387	<0.0010	<0.0010	5	4.71
Sturgeon Bay	LKW1	18-Jan-12	9.02	9.88	0.00343	0.00313	<0.0010	0.0011	4.43	4.16
		21-May-12	8.18	8.78	0.00267	0.00353	<0.0010	<0.00060	2.51	2.27
		17-Jul-12	8.70	11.0	0.00334	0.00408	<0.0010	<0.0010	4.05	4.88
Sturgeon Bay	LKW2	18-Jan-12	12.4	10.70	0.00445	0.00419	<0.0010	<0.0010	5.69	5.56
		21-May-12	10.0	10.37	0.00335	0.00409	<0.0010	0.0037	2.55	3.11
		17-Jul-12	8.69	9.55	0.00343	0.00396	<0.0010	<0.0010	3.9	4.45
Sturgeon Bay	LKW3	18-Jan-12	6.79	8.88	0.00268	0.00269	<0.0010	<0.0010	2.65	2.88
		19-May-12	8.73	10.4	0.00309	0.00431	<0.0010	<0.0010	3.78	3.63
		17-Jul-12	8.90	9.40	0.00351	0.00348	<0.0010	<0.0010	4.26	4.18
Sturgeon Bay	LKW3B	19-May-12	9.69	11.6	0.00335	0.00475	<0.0010	<0.0010	3.68	3.82
		17-Jul-12	8.56	10.3	0.00351	0.00427	<0.0010	<0.0010	4.31	5.21
Sturgeon Bay	LKW4	18-Jan-12	7.16	8.56	0.00273	0.00258	<0.0010	<0.0010	2.66	2.8
		21-May-12	7.91	8.86	0.00271	0.00327	<0.0010	0.00285	2.51	3.78
		17-Jul-12	8.85	10.0	0.00347	0.00376	<0.0010	<0.0010	4.46	4.86
Sturgeon Bay	LKW5	18-Jan-12	9.12	7.76	0.00349	0.00339	<0.0010	<0.0010	3.61	4.02
		21-May-12	8.46	8.93	0.0028	0.00362	<0.0010	<0.00060	2.44	2.24
		17-Jul-12	8.35	9.65	0.00333	0.00454	<0.0010	<0.0010	4.16	5.45
Sturgeon Bay	LKW6	18-Jan-12	8.51	10.4	0.00329	0.00316	<0.0010	<0.0010	3.15	3.54
		21-May-12	7.42	7.67	0.00246	0.0031	<0.0010	<0.00060	2.49	2.35
		17-Jul-12	8.74	10.2	0.00323	0.00469	<0.0010	<0.0010	3.99	5.67
Sturgeon Bay	LKW7	18-Jan-12	8.51	7.79	0.00342	0.00306	<0.0010	<0.0010	3.55	3.59
		21-May-12	7.21	7.05	0.00238	0.00301	<0.0010	<0.00060	2.5	2.05
		17-Jul-12	5.84	7.34	0.00239	0.00444	<0.0010	<0.0010	2.87	4.82

Table 3-7. (continued).

Location	Location ID	Sample Date	Silver		Sodium		Strontium		Sulphate
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Analytical Detection Limits			*0.000040 /0.00010*	*0.000040 /0.00010*	*0.010/ 0.020/ 0.20*	*0.030/ 0.30/ 3.0*	*0.000060 /0.00010 /0.0010*	*0.000070 /0.00010 /0.0010*	*0.50*
Waterhen River	WHR1	16-Jan-12	<0.00010	<0.00010	149	152	0.290	0.302	65.0
		16-May-12	<0.00010	<0.000040	128	132	0.248	0.239	56.9
		16-Jul-12	<0.000040	<0.00010	127	135	0.245	0.271	54.1
Lake Manitoba	NARR1	16-Jan-12	<0.00010	<0.00010	127	124	0.384	0.375	188
		16-May-12	<0.00010	<0.000040	133	122	0.272	0.261	94.0
		16-Jul-12	<0.000040	<0.00010	115	118	0.282	0.323	119
Fairford River	FR1	16-Jan-12	<0.00010	<0.00010	145	123	0.336	0.284	105
		16-May-12	<0.00010	<0.000040	129	130	0.281	0.282	104
		16-Jul-12	<0.000040	<0.00010	114	127	0.250	0.298	84.5
Lake St. Martin	LSM1	18-Jan-12	<0.00010	<0.00010	142	135	0.342	0.334	103
		17-May-12	<0.00010	<0.00010	125	123	0.281	0.276	102
		17-Jul-12	<0.00010	<0.00010	111	118	0.254	0.272	93.2
Buffalo Creek	BC3	17-Jan-12	<0.00010	<0.00010	139	137	0.304	0.318	107
		16-May-12	<0.00010	<0.000040	130	125	0.275	0.261	97
		17-Jul-12	<0.00010	<0.00010	111	103	0.241	0.263	88.3
Dauphin River	DR1.1	17-May-12	<0.00010	<0.000040	132	124	0.277	0.278	102
		17-Jul-12	<0.00010	<0.00010	111	122	0.256	0.282	92.8
Dauphin River	DR1.2	18-Jan-12	<0.00010	<0.00010	142	134	0.357	0.325	105
Dauphin River	DR1.3	17-May-12	<0.00010	<0.000040	126	118	0.283	0.276	101
		17-Jul-12	<0.00010	<0.00010	111	120	0.237	0.277	92.7
Dauphin River	DR1 (NOTE 2)	16-May-12	<0.00010	<0.000040	124	126	0.292	0.259	100
		17-Jul-12	<0.00010	<0.00010	110	109	0.251	0.276	92.1

Table 3-7. (continued).

Location	Location ID	Sample Date	Silver		Sodium		Strontium		Sulphate
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Dauphin River	DR2C	16-May-12	<0.00010	<0.000040	116	125	0.287	0.268	100
		17-Jul-12	<0.00010	<0.00010	109	115	0.238	0.269	91.7
Sturgeon Bay	LKW1	18-Jan-12	<0.00010	<0.00010	126	107	0.276	0.261	93.9
		21-May-12	<0.00010	0.000346	99.6	80.8	0.212	0.264	78.8
		17-Jul-12	<0.00010	<0.00010	95.3	97.7	0.240	0.255	82.7
Sturgeon Bay	LKW2	18-Jan-12	<0.00010	<0.00010	162	142	0.344	0.320	106
		21-May-12	<0.00010	0.00023	126	106	0.262	0.310	97.4
		17-Jul-12	<0.00010	<0.00010	94.4	89.2	0.243	0.238	82.7
Sturgeon Bay	LKW3	18-Jan-12	<0.00010	<0.00010	82.5	72	0.241	0.228	67.8
		19-May-12	<0.00010	<0.00010	112	119	0.238	0.278	90.0
		17-Jul-12	<0.00010	<0.00010	96.1	92.6	0.243	0.235	82.6
Sturgeon Bay	LKW3B	19-May-12	<0.00010	<0.00010	125	130	0.256	0.287	97.7
		17-Jul-12	<0.00010	<0.00010	103	99.4	0.235	0.250	85.8
Sturgeon Bay	LKW4	18-Jan-12	<0.00010	<0.00010	78.4	70.1	0.236	0.223	67.2
		21-May-12	<0.00010	0.000323	111	102	0.218	0.255	78.1
		17-Jul-12	<0.00010	<0.00010	98.8	96.8	0.243	0.244	81.2
Sturgeon Bay	LKW5	18-Jan-12	<0.00010	<0.00010	121	99.5	0.294	0.287	87.2
		21-May-12	<0.00010	0.00033	104	84.7	0.223	0.275	84.2
		17-Jul-12	<0.00010	<0.00010	83.1	94.7	0.234	0.242	79.4
Sturgeon Bay	LKW6	18-Jan-12	<0.00010	<0.00010	97	90	0.280	0.263	80.9
		21-May-12	<0.00010	0.00034	89.3	71	0.194	0.235	72.7
		17-Jul-12	<0.00010	<0.00010	92	94.1	0.228	0.242	80.3
Sturgeon Bay	LKW7	18-Jan-12	<0.00010	<0.00010	96.3	81.8	0.261	0.241	63.1
		21-May-12	<0.00010	0.00034	85.5	67.8	0.194	0.232	71.3
		17-Jul-12	<0.00010	<0.00010	58.4	64.6	0.176	0.197	63.7

Table 3-7. (continued).

Location	Location ID	Sample Date	Tellurium		Thallium		Thorium		Tin	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Analytical Detection Limits			*0.00020*	*0.00020*	*0.000020/ 0.00010*	*0.000020/ 0.00010*	*0.000030/ 0.00010*	*0.000040/ 0.00010*	*0.000080/ 0.00020*	*0.00010/ 0.00020*
Waterhen River	WHR1	16-Jan-12	<0.00020	<0.00020	<0.00010	0.00033	<0.00010	<0.00010	<0.00020	<0.00020
		16-May-12	<0.00020	<0.00020	<0.00010	<0.000020	<0.00010	<0.000040	<0.00020	<0.00010
		16-Jul-12	<0.00020	<0.00020	<0.000020	<0.00010	<0.000030	<0.00010	<0.000080	<0.00020
Lake Manitoba	NARR1	16-Jan-12	<0.00020	<0.00020	<0.00010	0.00011	<0.00010	<0.00010	<0.00020	<0.00020
		16-May-12	<0.00020	<0.00020	<0.00010	<0.000020	<0.00010	<0.000040	<0.00020	0.00012
		16-Jul-12	<0.00020	<0.00020	<0.000020	<0.00010	<0.000030	<0.00010	0.000184	<0.00020
Fairford River	FR1	16-Jan-12	<0.00020	<0.00020	<0.00010	0.00025	<0.00010	<0.00010	<0.00020	<0.00020
		16-May-12	<0.00020	<0.00020	<0.00010	<0.000020	<0.00010	<0.000040	<0.00020	<0.00010
		16-Jul-12	<0.00020	<0.00020	<0.000020	<0.00010	<0.000030	<0.00010	0.00012	<0.00020
Lake St. Martin	LSM1	18-Jan-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
		17-May-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
		17-Jul-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
Buffalo Creek	BC3	17-Jan-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
		16-May-12	<0.00020	<0.00020	<0.00010	<0.000020	<0.00010	<0.000040	<0.00020	<0.00010
		17-Jul-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
Dauphin River	DR1.1	17-May-12	<0.00020	<0.00020	<0.00010	<0.000020	<0.00010	<0.000040	<0.00020	<0.00010
		17-Jul-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
Dauphin River	DR1.2	18-Jan-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
Dauphin River	DR1.3	17-May-12	<0.00020	0.0003	<0.00010	<0.000020	<0.00010	<0.000040	<0.00020	<0.00010
		17-Jul-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
Dauphin River	DR1 (NOTE 2)	16-May-12	<0.00020	<0.00020	<0.00010	<0.000020	<0.00010	<0.000040	<0.00020	<0.00010
		17-Jul-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020

Table 3-7. (continued).

Location	Location ID	Sample Date	Tellurium		Thallium		Thorium		Tin	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Dauphin River	DR2C	16-May-12	<0.00020	<0.00020	<0.00010	<0.000020	<0.00010	<0.000040	<0.00020	<0.00010
		17-Jul-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
Sturgeon Bay	LKW1	18-Jan-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
		21-May-12	<0.00020	<0.00020	<0.00010	<0.000020	<0.00010	0.000073	<0.00020	<0.00010
		17-Jul-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
Sturgeon Bay	LKW2	18-Jan-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
		21-May-12	<0.00020	<0.00020	<0.00010	<0.000020	<0.00010	0.00004	<0.00020	<0.00010
		17-Jul-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	0.00022
Sturgeon Bay	LKW3	18-Jan-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
		19-May-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	0.00011	<0.00020	<0.00020
		17-Jul-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
Sturgeon Bay	LKW3B	19-May-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	0.00016	<0.00020	<0.00020
		17-Jul-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
Sturgeon Bay	LKW4	18-Jan-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
		21-May-12	<0.00020	<0.00020	<0.00010	<0.000020	<0.00010	<0.000040	<0.00020	<0.00010
		17-Jul-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
Sturgeon Bay	LKW5	18-Jan-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
		21-May-12	<0.00020	<0.00020	<0.00010	<0.000020	<0.00010	0.000076	<0.00020	<0.00010
		17-Jul-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
Sturgeon Bay	LKW6	18-Jan-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
		21-May-12	<0.00020	<0.00020	<0.00010	<0.000020	<0.00010	0.000044	<0.00020	<0.00010
		17-Jul-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	0.00011	<0.00020	<0.00020
Sturgeon Bay	LKW7	18-Jan-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020
		21-May-12	<0.00020	<0.00020	<0.00010	<0.000020	<0.00010	<0.000040	<0.00020	<0.00010
		17-Jul-12	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	0.00012	<0.00020	<0.00020

Table 3-7. (continued).

Location	Location ID	Sample Date	Titanium		Tungsten		Uranium	
			Dissolved	Total	Dissolved	Total	Dissolved	Total
Analytical Detection Limits			*0.00020/ 0.00050*	*0.00020/ 0.00050*	*0.000060 /0.00010 /0.00020*	*0.000060 /0.00010 /0.0010*	*0.000020 /0.00010*	*0.000020 /0.00010*
Waterhen River	WHR1	16-Jan-12	<0.00020	0.00061	<0.00020	<0.0010	0.00134	0.0013
		16-May-12	<0.00020	0.00275	<0.00010	<0.000060	0.00134	0.00124
		16-Jul-12	0.00208	0.00127	<0.000060	<0.00010	0.000942	0.0008
Lake Manitoba	NARR1	16-Jan-12	0.00077	0.00241	<0.00020	<0.0010	0.00306	0.00272
		16-May-12	0.00157	0.00523	<0.00010	<0.000060	0.00174	0.00162
		16-Jul-12	0.00305	0.00282	<0.000060	<0.00010	0.00213	0.00171
Fairford River	FR1	16-Jan-12	0.00021	0.0008	<0.00020	<0.0010	0.00169	0.00167
		16-May-12	0.00149	0.00415	<0.00010	<0.000060	0.00178	0.00164
		16-Jul-12	0.00258	0.00258	<0.000060	<0.00010	0.00154	0.00146
Lake St. Martin	LSM1	18-Jan-12	0.0003	0.00026	<0.00020	<0.0010	0.00196	0.00194
		17-May-12	0.00105	0.00203	<0.00010	<0.00010	0.00187	0.00176
		17-Jul-12	0.00170	0.00420	<0.00010	<0.00010	0.00159	0.00198
Buffalo Creek	BC3	17-Jan-12	0.00047	0.00292	<0.00020	<0.0010	0.00167	0.00165
		16-May-12	0.00171	0.00576	<0.00010	<0.000060	0.00143	0.00139
		17-Jul-12	0.00161	0.0142	<0.00010	<0.00010	0.00107	0.00112
Dauphin River	DR1.1	17-May-12	0.00174	0.00212	<0.00010	<0.000060	0.0019	0.0018
		17-Jul-12	0.00165	0.00335	<0.00010	<0.00010	0.00156	0.00199
Dauphin River	DR1.2	18-Jan-12	0.00022	0.00037	<0.00020	<0.0010	0.00198	0.00196
Dauphin River	DR1.3	17-May-12	0.00176	0.00194	<0.00010	<0.000060	0.00189	0.00176
		17-Jul-12	0.00149	0.00733	<0.00010	<0.00010	0.00156	0.00183
Dauphin River	DR1 (NOTE 2)	16-May-12	0.00029	0.00564	<0.00010	<0.000060	0.00176	0.00174
		17-Jul-12	0.00166	0.00616	<0.00010	<0.00010	0.0016	0.00199

Table 3-7. (continued).

Location	Location ID	Sample Date	Titanium		Tungsten		Uranium	
			Dissolved	Total	Dissolved	Total	Dissolved	Total
Dauphin River	DR2C	16-May-12	<0.00020	0.0049	<0.00010	<0.000060	0.0018	0.00172
		17-Jul-12	0.00163	0.0064	<0.00010	<0.00010	0.00146	0.00178
Sturgeon Bay	LKW1	18-Jan-12	0.00032	0.00201	<0.00020	<0.0010	0.0016	0.00155
		21-May-12	0.00162	0.0144	<0.00010	0.000329	0.00142	0.00165
		17-Jul-12	0.00159	0.0161	<0.00010	<0.00010	0.00132	0.0015
Sturgeon Bay	LKW2	18-Jan-12	<0.00020	0.00222	<0.00020	<0.0010	0.0019	0.00185
		21-May-12	0.00203	0.01427	<0.00010	0.0003	0.00169	0.00187
		17-Jul-12	0.00162	0.0156	<0.00010	<0.00010	0.00132	0.00131
Sturgeon Bay	LKW3	18-Jan-12	0.00046	0.00313	<0.00020	<0.0010	0.00136	0.00138
		19-May-12	0.00214	0.0191	<0.00010	<0.00010	0.00154	0.00147
		17-Jul-12	0.00165	0.00753	<0.00010	<0.00010	0.00127	0.00152
Sturgeon Bay	LKW3B	19-May-12	0.00543	0.0279	<0.00010	<0.00010	0.00165	0.00162
		17-Jul-12	0.00154	0.0178	<0.00010	<0.00010	0.00127	0.00148
Sturgeon Bay	LKW4	18-Jan-12	0.00046	0.00352	<0.00020	<0.0010	0.00136	0.00135
		21-May-12	0.00162	0.0197	<0.00010	<0.000060	0.00137	0.00155
		17-Jul-12	0.00143	0.0102	<0.00010	<0.00010	0.00133	0.00132
Sturgeon Bay	LKW5	18-Jan-12	0.00044	0.0032	<0.00020	<0.0010	0.0017	0.00161
		21-May-12	0.00165	0.0144	<0.00010	0.00032	0.00144	0.00173
		17-Jul-12	0.00155	0.0217	<0.00010	<0.00010	0.00127	0.00126
Sturgeon Bay	LKW6	18-Jan-12	0.00037	0.00357	<0.00020	<0.0010	0.00160	0.00152
		21-May-12	0.00155	0.011	<0.00010	0.000314	0.00133	0.00139
		17-Jul-12	0.00146	0.0291	<0.00010	<0.00010	0.0013	0.00131
Sturgeon Bay	LKW7	18-Jan-12	0.00034	0.00356	<0.00020	<0.0010	0.00153	0.00146
		21-May-12	0.00137	0.00678	<0.00010	0.00033	0.00126	0.00138
		17-Jul-12	0.00113	0.0338	<0.00010	<0.00010	0.00115	0.0011

Table 3-7. (continued).

Location	Location ID	Sample Date	Vanadium		Zinc		Zirconium	
			Dissolved	Total	Dissolved	Total	Dissolved	Total
Analytical Detection Limits			*0.00020*	*0.00020*	*0.0010/0.0020*	*0.0020/0.0050*	*0.00010/0.00040*	*0.00010/0.00040*
Waterhen River	WHR1	16-Jan-12	0.00152	0.00149	<0.0020	<0.0050	<0.00040	<0.00040
		16-May-12	0.00118	0.00069	<0.0020	0.0081	<0.00040	0.000109
		16-Jul-12	0.00156	0.00075	0.0019	<0.0020	<0.00010	<0.00040
Lake Manitoba	NARR1	16-Jan-12	0.0026	0.0027	0.0022	<0.0050	<0.00040	<0.00040
		16-May-12	0.00145	0.00108	<0.0020	0.0021	<0.00040	0.000176
		16-Jul-12	0.00198	0.00163	0.0101	<0.0020	0.00012	<0.00040
Fairford River	FR1	16-Jan-12	0.002	0.0018	<0.0020	<0.0050	<0.00040	<0.00040
		16-May-12	0.0014	0.0010	<0.0020	<0.0020	<0.00040	0.000157
		16-Jul-12	0.0020	0.0014	0.0023	<0.0020	<0.00010	<0.00040
Lake St. Martin	LSM1	18-Jan-12	0.0017	0.00158	<0.0020	<0.0050	<0.00040	0.00089
		17-May-12	0.00088	0.00116	<0.0020	0.0034	<0.00040	<0.00040
		17-Jul-12	0.0014	0.0016	<0.0020	<0.0020	<0.00040	<0.00040
Buffalo Creek	BC3	17-Jan-12	0.0019	0.0017	<0.0020	<0.0050	<0.00040	<0.00040
		16-May-12	0.0013	0.0007	<0.0020	0.0054	<0.00040	0.000156
		17-Jul-12	0.00079	0.00144	<0.0020	<0.0020	<0.00040	<0.00040
Dauphin River	DR1.1	17-May-12	0.00101	0.00084	<0.0020	<0.0020	<0.00040	0.000081
		17-Jul-12	0.00128	0.0015	<0.0020	<0.0020	<0.00040	<0.00040
Dauphin River	DR1.2	18-Jan-12	0.0017	0.00171	<0.0020	<0.0050	<0.00040	<0.00040
Dauphin River	DR1.3	17-May-12	0.00115	0.00091	<0.0020	<0.0020	<0.00040	0.000078
		17-Jul-12	0.0012	0.00175	<0.0020	<0.0020	<0.00040	<0.00040
Dauphin River	DR1 (NOTE 2)	16-May-12	0.00148	0.00073	<0.0020	0.0022	<0.00040	0.000214
		17-Jul-12	0.00136	0.00176	<0.0020	<0.0020	<0.00040	<0.00040

Table 3-7. (continued).

Location	Location ID	Sample Date	Vanadium		Zinc		Zirconium	
			Dissolved	Total	Dissolved	Total	Dissolved	Total
Dauphin River	DR2C	16-May-12	0.00134	0.00082	<0.0020	0.0021	<0.00040	0.000226
		17-Jul-12	0.00114	0.00155	<0.0020	<0.0020	<0.00040	<0.00040
Sturgeon Bay	LKW1	18-Jan-12	0.0015	0.00158	<0.0020	<0.0050	<0.00040	<0.00040
		21-May-12	0.0012	0.00184	<0.0020	0.0032	<0.00040	0.000181
		17-Jul-12	0.00127	0.00189	<0.0020	<0.0020	<0.00040	<0.00040
Sturgeon Bay	LKW2	18-Jan-12	0.0016	0.00152	<0.0020	<0.0050	<0.00040	<0.00040
		21-May-12	0.0016	0.0026	<0.0020	0.0037	<0.00040	0.000214
		17-Jul-12	0.00127	0.00192	<0.0020	<0.0020	<0.00040	<0.00040
Sturgeon Bay	LKW3	18-Jan-12	0.0016	0.00199	<0.0020	<0.0050	<0.00040	<0.00040
		19-May-12	0.00124	0.00171	<0.0020	<0.0020	<0.00040	<0.00040
		17-Jul-12	0.00108	0.00144	<0.0020	<0.0020	<0.00040	<0.00040
Sturgeon Bay	LKW3B	19-May-12	0.00126	0.00222	<0.0020	<0.0020	<0.00040	0.00048
		17-Jul-12	0.00109	0.00194	<0.0020	<0.0020	<0.00040	<0.00040
Sturgeon Bay	LKW4	18-Jan-12	0.0014	0.00172	<0.0020	<0.0050	<0.00040	<0.00040
		21-May-12	0.00139	0.00384	<0.0020	0.0036	<0.00040	0.000152
		17-Jul-12	0.00102	0.00163	0.0022	<0.0020	<0.00040	<0.00040
Sturgeon Bay	LKW5	18-Jan-12	0.0016	0.00197	0.003	<0.0050	<0.00040	<0.00040
		21-May-12	0.00131	0.00183	<0.0020	0.0023	<0.00040	0.000179
		17-Jul-12	0.00135	0.00234	<0.0020	<0.0020	<0.00040	<0.00040
Sturgeon Bay	LKW6	18-Jan-12	0.0017	0.0020	0.0051	0.0064	<0.00040	<0.00040
		21-May-12	0.00107	0.00176	<0.0020	0.0028	<0.00040	0.000164
		17-Jul-12	0.00149	0.00258	<0.0020	<0.0020	<0.00040	<0.00040
Sturgeon Bay	LKW7	18-Jan-12	0.0014	0.00155	<0.0020	<0.0050	<0.00040	<0.00040
		21-May-12	0.00112	0.00159	<0.0020	0.0024	<0.00040	0.000115
		17-Jul-12	0.00126	0.00275	<0.0020	<0.0020	<0.00040	<0.00040

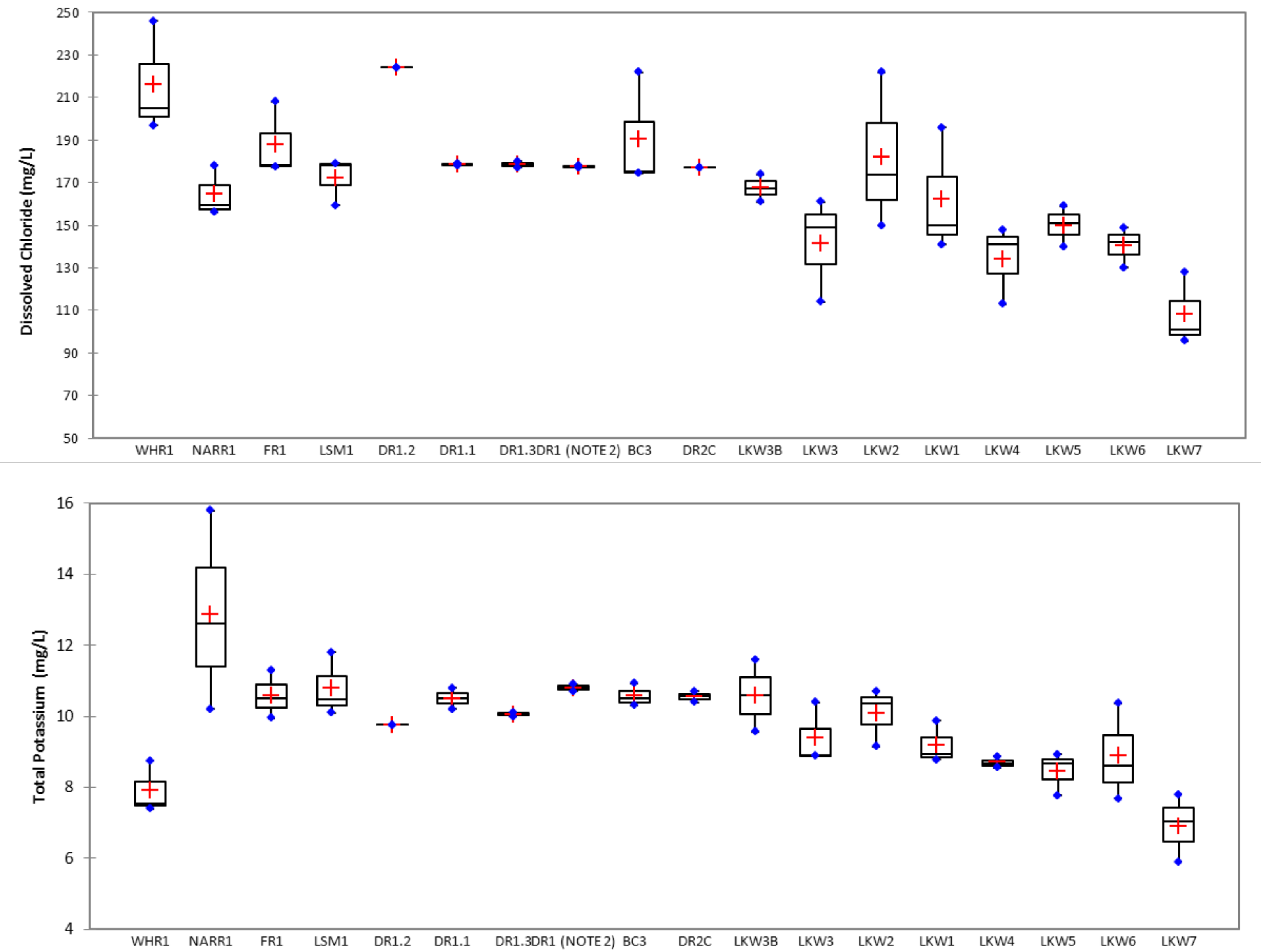

Figure 3-5. Boxplots of dissolved chloride and total potassium concentrations measured in the study area, 2012.

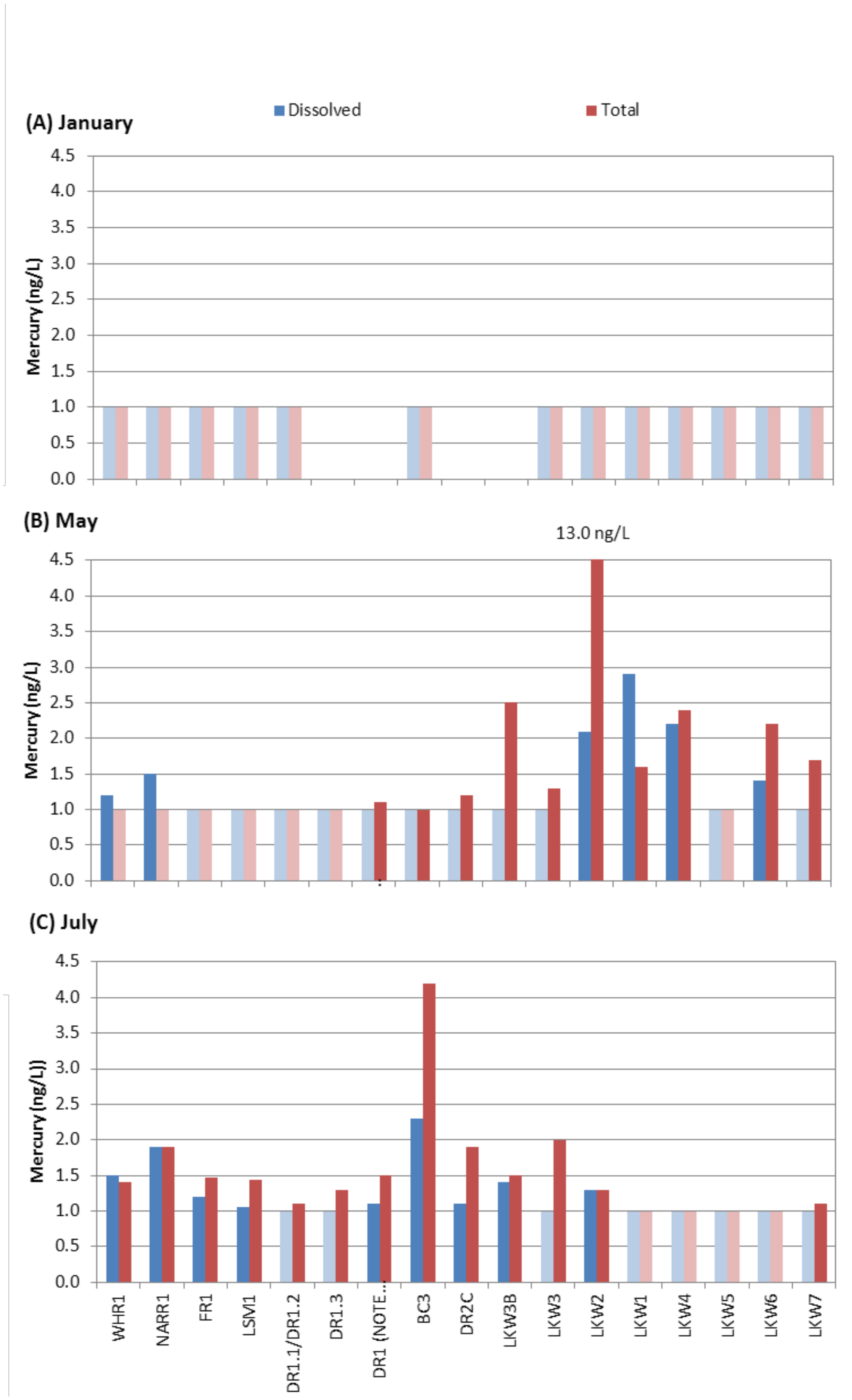

Figure 3-6. Mercury concentrations (ng/L) measured at RWQMP sites during Reach 1 operation, 2012. Values less than the analytical detection limit (DL) are plotted in a lighter colour at half the DL.

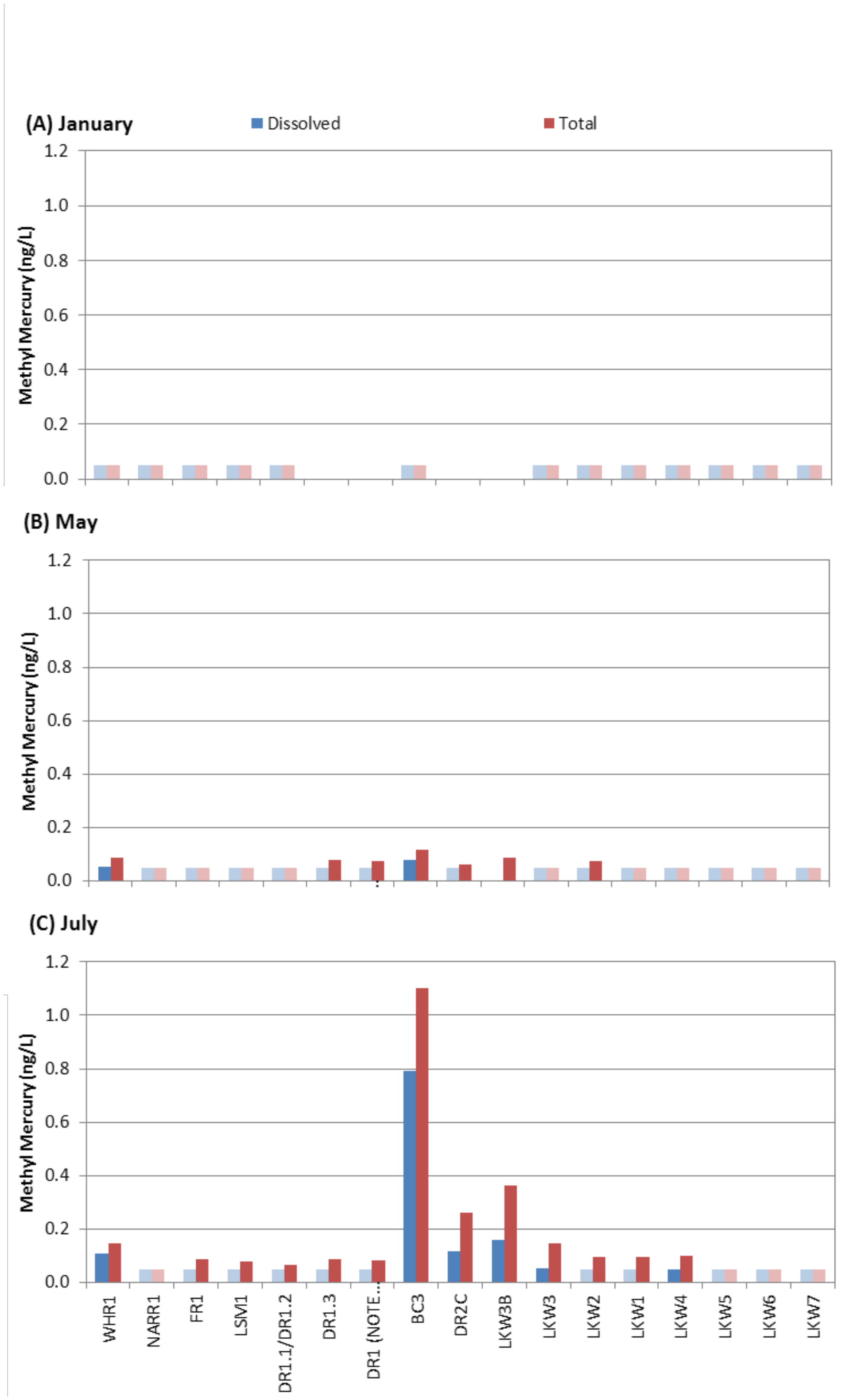

Figure 3-7. Methyl mercury concentrations (ng/L) measured at RWQMP sites during Reach 1 operation, 2012. Values less than the analytical detection limit (DL) are plotted in a lighter colour at half the DL.

Table 3-8. Pesticide concentrations (µg/L) measured at selected sites as part of the RWQMP during Reach 1 operation, 2012.

Location	Location ID	Date Sampled	Organochlorine Pesticides							Phenoxy Acid Herbicides		
			alpha-BHC	beta-BHC	delta-BHC	a-chlordane	g-chlordane	Lindane	Methoxychlor	2,4-D	2,4-DB	2,4-DP
Analytical Detection Limit			0.100	0.100	0.100	0.010	0.010	0.100	0.010	0.050	0.050	0.050
Fairford River	FR1	16-Jul-12	<0.10	<0.10	<0.10	<0.010	<0.010	<0.10	<0.010	<0.050	<0.050	<0.050
Dauphin River	DR1.1	17-Jul-12	<0.10	<0.10	<0.10	<0.010	<0.010	<0.10	<0.010	0.050	<0.050	<0.050
	DR2C	17-Jul-12	<0.10	<0.10	<0.10	<0.010	<0.010	<0.10	<0.010	<0.050	<0.050	<0.050
Sturgeon Bay	LKW7	17-Jul-12	<0.10	<0.10	<0.10	<0.010	<0.010	<0.10	<0.010	<0.050	<0.050	<0.050

Table 3-8. (continued).

Location	Location ID	Date Sampled	Phenoxy Acid Herbicides						Other Pesticides			
			Bromoxynil	Dicamba	Dinoseb	MCPA	Mecoprop	Picloram	Alachlor	AMPA	Atrazine	Azinphos-methyl
Analytical Detection Limit			0.020	0.0060	0.050	0.025	0.050	0.20	0.10	0.20	0.10	0.10
Fairford River	FR1	16-Jul-12	<0.020	<0.0060	<0.050	<0.025	<0.050	<0.20	<0.10	<0.20	<0.10	<0.10
Dauphin River	DR1.1	17-Jul-12	<0.020	<0.0060	<0.050	<0.025	<0.050	<0.20	<0.10	<0.20	<0.10	<0.10
	DR2C	17-Jul-12	<0.020	<0.0060	<0.050	<0.025	<0.050	<0.20	<0.10	<0.20	<0.10	<0.10
Sturgeon Bay	LKW7	17-Jul-12	<0.020	<0.0060	<0.050	<0.025	<0.050	<0.20	<0.10	<0.20	<0.10	<0.10

Table 3-8. (continued).

Location	Location ID	Date Sampled	Other Pesticides								
			Benomyl	Carbofuran	Carboxin	Chlorothalonil	Chlorpyrifos	Cyanazine	Deltamethrin	Diazinon	Dimethoate
Analytical Detection Limit			0.10	0.20	0.10	0.060	0.020	0.10	0.040	0.030	0.10
Fairford River	FR1	16-Jul-12	<0.10	<0.20	<0.10	<0.060	<0.020	<0.10	<0.040	<0.030	<0.10
Dauphin River	DR1.1	17-Jul-12	<0.10	<0.20	<0.10	<0.060	<0.020	<0.10	<0.040	<0.030	<0.10
	DR2C	17-Jul-12	<0.10	<0.20	<0.10	<0.060	<0.020	<0.10	<0.040	<0.030	<0.10
Sturgeon Bay	LKW7	17-Jul-12	<0.10	<0.20	<0.10	<0.060	<0.020	<0.10	<0.040	<0.030	<0.10

Table 3-8. (continued).

Location	Location ID	Date Sampled	Other Pesticides							
			Diuron	Eptam	Ethalfluralin	Atrazine Desethyl	**Fenoxaprop**	**Glyphosate**	**Malathion**	**Diclofop-methyl**
Analytical Detection Limit			0.018	0.20	0.020	0.050	0.10	0.20	0.10	0.10
Fairford River	FR1	16-Jul-12	<0.018	<0.20	<0.020	<0.050	<0.10	2.35	<0.10	<0.10
Dauphin River	DR1.1	17-Jul-12	<0.018	<0.20	<0.020	<0.050	<0.10	0.47	<0.10	<0.10
	DR2C	17-Jul-12	<0.018	<0.20	<0.020	<0.050	<0.10	0.41	<0.10	<0.10
Sturgeon Bay	LKW7	17-Jul-12	<0.018	<0.20	<0.020	<0.050	<0.10	0.20	<0.10	<0.10

Table 3-8. (continued).

Location	Location ID	Date Sampled	Other Pesticides							
			Metsulfuron-methyl	Thifensulfuron-methyl	Tribenuron-methyl	Methyl Parathion	Metribuzin	Parathion	Pentachlorophenol	Propanil
Analytical Detection Limit			0.010	0.010	0.010	0.100	0.20	0.10	0.020	0.20
Fairford River	FR1	16-Jul-12	<0.010	<0.010	<0.010	<0.10	<0.20	<0.10	<0.020	<0.20
Dauphin River	DR1.1	17-Jul-12	<0.010	<0.010	<0.010	<0.10	<0.20	<0.10	<0.020	<0.20
	DR2C	17-Jul-12	<0.010	<0.010	<0.010	<0.10	<0.20	<0.10	<0.020	<0.20
Sturgeon Bay	LKW7	17-Jul-12	<0.010	<0.010	<0.010	<0.10	<0.20	<0.10	<0.020	<0.20

Table 3-8. (continued).

Location	Location ID	Date Sampled	Other Pesticides								
			Propoxur	Quizalofop	Sethoxydim	Simazine	Terbufos	Tralkoxydim	Triallate	Triclopyr	Trifluralin
Analytical Detection Limit			0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.050	0.030
Fairford River	FR1	16-Jul-12	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.050	<0.030
Dauphin River	DR1.1	17-Jul-12	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.050	<0.030
	DR2C	17-Jul-12	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.050	<0.030
Sturgeon Bay	LKW7	17-Jul-12	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.050	<0.030

3.2 OPERATIONAL EMP MONITORING

During operation of Reach 1, water quality was monitored at biweekly, monthly, and on demand as project milestones were achieved (e.g., closing of Reach 1) at sites along the diversion route and at its points of entry (i.e., Lake St. Martin) and exit (i.e., Dauphin River). The objective was to monitor potential effects to water quality in Buffalo Creek and the Dauphin River during operation of Reach 1. Details of this sampling program including sites sampled, parameters measured, methods used, and a discussion of the results are presented in KGS GROUP (2012), which has been included here as Appendix 3-5. A brief summary of this program as described in KGS GROUP (2012) is provided below.

3.2.1 Methods

As part of the Operational EMP Monitoring Program, water quality was monitored in Lake St. Martin, Reach 1, Buffalo Creek, and the Dauphin River from January to June, 2012. Water quality monitoring was conducted biweekly from January 17 to February 21 and monthly from March to June. Water quality parameters measured included: *in situ* measurements of turbidity, DO, pH, conductivity, total dissolved solids and temperature; and, laboratory analysis of water samples for TSS, turbidity and nutrients (ammonia, nitrate, nitrite, nitrate/nitrite, TKN, TN, dissolved P and TP). In addition, samples were collected for the laboratory analysis of total mercury, total methyl mercury and dissolved methyl mercury on January 17 and May 16, 2012 and samples for the laboratory analysis of petroleum hydrocarbons (benzene, toluene, ethyl-benzene, xylene [BTEX] and hydrocarbons F1-F4) were collected from Lake St. Martin and Buffalo Creek on February 9, 2012. Technical difficulties led to either no or unreliable *in situ* data being collected during winter. As a result, *in situ* data for January and February were not presented in KGS Group (2012).

3.2.2 Results

3.2.2.1 TSS

During initial operation of Reach 1 in November 2011 TSS concentrations increased at downstream sites (KGS Group 2012). However, monitoring conducted in January and February, 2012, indicated that TSS concentrations had returned to baseline conditions. Later, TSS concentrations increased at all sites during the spring freshet and TSS concentrations above the estimated long-term CCME guideline were observed in Reach 1 and Buffalo Creek during the March sampling period. TSS concentrations at these locations had returned to near baseline conditions by the April sampling period. TSS concentrations in the Dauphin River downstream of Buffalo Creek remained below CCME guidelines at all times sampled from March to June 2012.

3.2.2.2 Dissolved Oxygen

DO concentrations were below the CCME lowest allowable limit for cold water ecosystems in Lake St. Martin, Buffalo Creek, and the Dauphin River downstream of the confluence with Buffalo Creek in March 2012. All other DO measurements taken from March to June were within applicable CCME guidelines for PAL.

3.2.2.3 Nutrients

Nutrient concentrations in Lake St. Martin and in the Dauphin River upstream of Buffalo Creek were typically higher or similar to concentrations measured within Reach 1 and Buffalo Creek, and in the Dauphin River downstream of Buffalo Creek, respectively (KGS GROUP 2012). Nutrient concentrations were within applicable MWQSOGs and CCME guidelines in all samples collected.

3.2.2.4 Mercury

Total mercury and methyl mercury concentrations were above the analytical detection limit (0.1 ng/L and 0.05 ng/L, respectively) at all sites sampled in May, 2012, including: Buffalo Creek near the confluence of the Dauphin River; and, in the Dauphin River both upstream and downstream of Buffalo Creek. Mercury/methyl mercury were not detected at sites sampled in January 2012. All mercury and methyl mercury concentrations measured in May were below MWQSOGs and CCME guidelines for PAL.

3.2.2.5 Petroleum Hydrocarbons

Concentrations of petroleum hydrocarbons (BTEX and F1-F4) measured in water samples collected from Lake St. Martin and Buffalo Creek in February 2012 were below laboratory analytical detection limits.

3.3 *In situ* AND TSS MONITORING

In addition to the above programs, *in situ* and total suspended solids (TSS) water quality monitoring sampling was conducted in Sturgeon Bay in February and March, 2012. The objectives were:

- To measure *in situ* water quality parameters to supplement data collected during fall 2011;
- To collect baseline water quality information in the vicinity of the proposed Reach 3 outlet;
- To help delineate the spatial extent over which suspended sediment inputs may be distributed in Sturgeon Bay; and,
- To develop a reliable turbidity/TSS relationship for analysis of turbidity data.

3.3.1 Methods

From February 12 to 14, 2012, *in situ* measurements and water samples for the analysis of TSS and turbidity were collected from 34 sites in Sturgeon Bay (Figure 3-8). The water quality sampling conducted in February coincided with the deployment of sediment traps discussed in Section 4.1.

From March 25 to 27, 2012, *in situ* measurements were collected along nine transects extending out from the south-west shore of Sturgeon Bay (Figure 3-9). Additionally, water samples for the analysis of TSS/turbidity were collected from 9 of the 33 sites sampled.

Sampling sites were accessed by snowmobile and holes were drilled through the ice using a Stihl power auger. Measurements of ice thickness and effective water depth (using a handheld depth sounder) were recorded at each site. Sample locations were recorded using a handheld Garmin GPS receiver. Sampling date and time were noted for each sampling site.

In situ measurements of water quality parameters including pH, specific conductance, dissolved oxygen (DO), turbidity, and water temperature were collected at all sampling sites using a Horiba® W22-XD water quality meter. *In situ* measurements were recorded at 1.5 m below the ice surface and at 1.5 m increments to a depth of approximately 1 m from the sediments.

Water samples for the laboratory analysis of TSS and turbidity were collected from approximately 0.5-1.0 m below the ice surface using pole sampler then transferred into clean sample bottles supplied by ALS Laboratories. After collection, samples were kept cool (but prevented from freezing) until submission to ALS Laboratories in Winnipeg, MB for analysis. An attempt was made to deliver the samples to the laboratory for analysis within the specified hold-times; however, this was not always logistically feasible and the hold-time for turbidity (2-3 days) was occasionally exceeded.

Standard QA/QC measures were followed during sample collection (e.g., use of latex gloves, standard labelling practices, meter calibration, etc.). Additionally, triplicate samples were collected for laboratory analysis of TSS/turbidity. All water quality data were assessed as described in Section 3.1.2.4.

3.3.2 Results

Extremely cold air temperatures during sampling in both February and March caused the Horiba® W22-XD water quality meter to malfunction. Consequently, all *in situ* measurements collected are considered suspect. The data are presented in Appendix 3-3, but are not considered further in this report.

A total of 43 water samples collected in February (n = 34; Table 3-9; Figure 3-8) and March (n = 9; Table 3-10; Figure 3-9) were submitted were submitted to ALS Laboratories for TSS and turbidity analyses. Results indicate that the surface water in Sturgeon Bay was fairly clear in winter, 2012 (Table 3-9 and Table 3-10). TSS and turbidity measured in water samples collected in February typically ranged from < 2.0 mg/L to 2.8 mg/L and 1.6 NTU to 4.35 NTU, respectively. TSS and turbidity were higher at ST-13, which was the site located nearest the mouth of the Dauphin River, than at other sites sampled; in the water sample collected at this location TSS was 8.8 mg/L and turbidity was 5.80 NTU. In March 2012, laboratory measured TSS and turbidity ranged from < 5.0 mg/L to 10 mg/L and from 1.71 NTU to 6.18 NTU, respectively.

TSS values for a large portion of the water samples analyzed were below the laboratory detection limits (34 of 43 samples; Tables 3-8 and 3-9). Linear regression was used to establish a relationship between TSS and turbidity using only those samples for which TSS values were above the laboratory detection limit (n = 9). The relationship is presented in Figure 3-12.

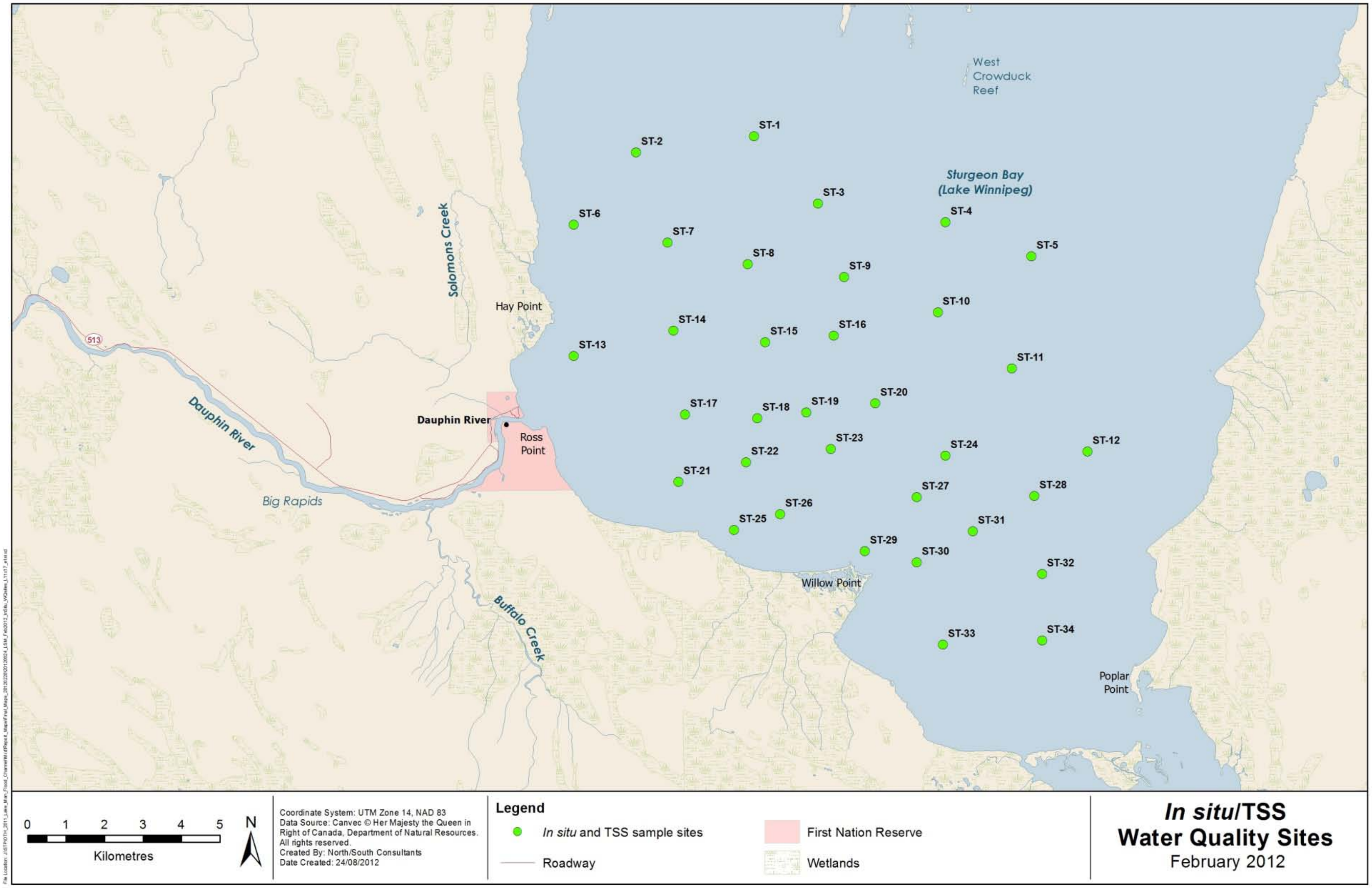

Figure 3-8. Location of *in situ* water quality measurements and TSS/turbidity samples collected in February, 2012.

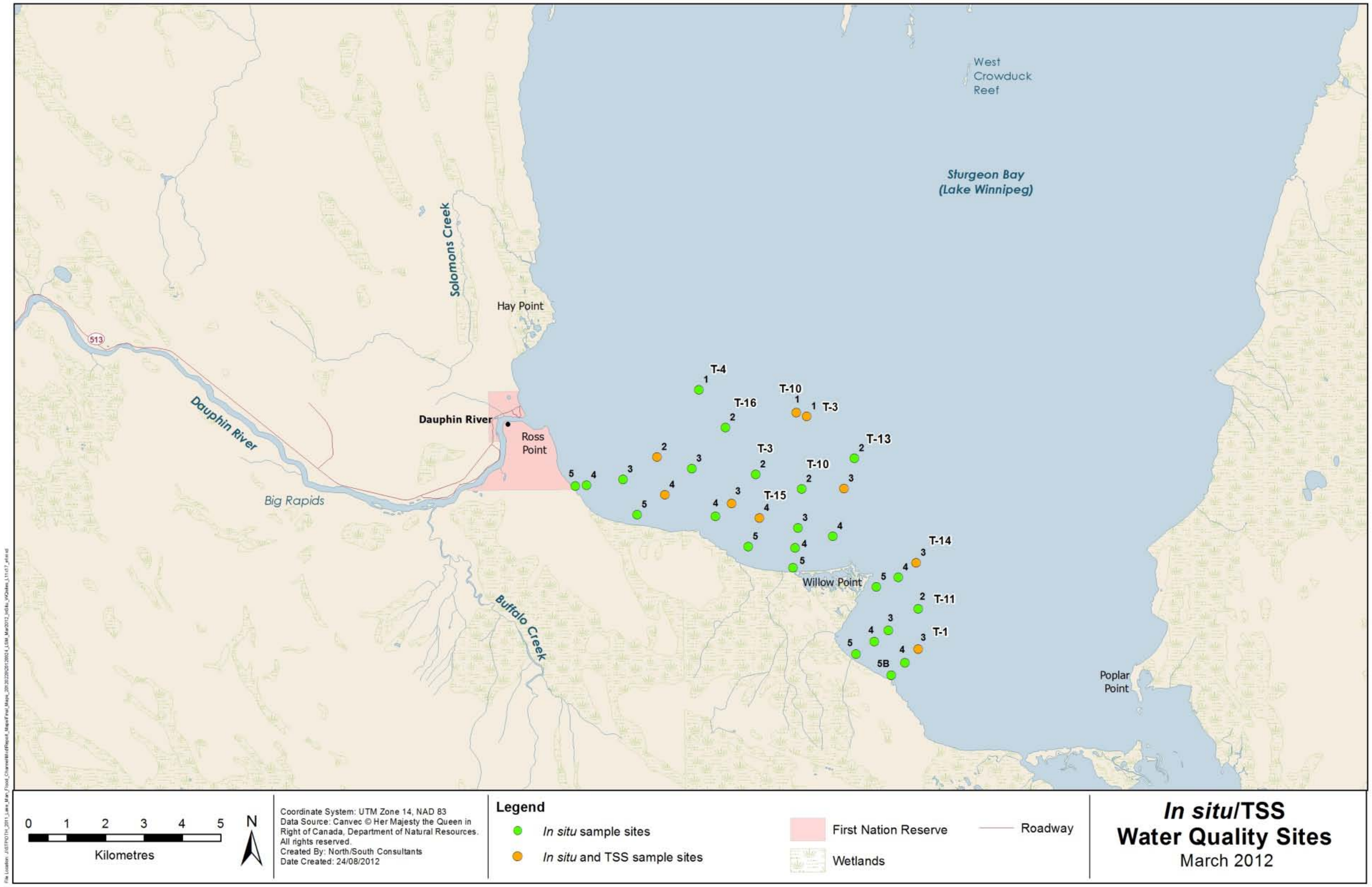

Figure 3-9. Location of *in situ* water quality measurements and TSS/turbidity samples collected in March, 2012.

Table 3-9. Total suspended solids and turbidity measured in water samples collected from Sturgeon Bay in February, 2012.

Location ID	Sample Date	TSS (mg/L)	Turbidity (NTU)
Analytical Detection Limit		*2.0*	*0.10*
ST-1	12-Feb-12	<2.0	2.25
ST-2	12-Feb-12	<2.0	2.62
ST-3	12-Feb-12	<2.0	1.61
ST-4	14-Feb-12	<2.0	1.82
ST-5	14-Feb-12	<2.0	2.31
ST-6	12-Feb-12	<2.0	1.96
ST-7	12-Feb-12	<2.0	1.78
ST-8	12-Feb-12	<2.0	2.09
ST-9	12-Feb-12	<2.0	1.88
ST-10	14-Feb-12	<2.0	2.33
ST-11	13-Feb-12	<2.0	1.89
ST-12	13-Feb-12	<2.0	2.48
ST-13	12-Feb-12	8.8	5.80
ST-14	12-Feb-12	<2.0	1.60
ST-15	12-Feb-12	<2.0	2.26
ST-16	14-Feb-12	<2.0	2.31
ST-17	14-Feb-12	2.0	2.74
ST-18	14-Feb-12	<2.0	2.41
ST-19	14-Feb-12	<2.0	2.53
ST-20	14-Feb-12	<2.0	3.34
ST-21	13-Feb-12	<2.0	3.24
ST-22	14-Feb-12	2.4	3.49
ST-23	14-Feb-12	<2.0	3.78
ST-24	14-Feb-12	<2.0	2.14
ST-25	13-Feb-12	<2.0	2.66
ST-26	13-Feb-12	2.0	3.29
ST-27	14-Feb-12	2.8	3.40
ST-28	13-Feb-12	<2.0	2.60
ST-29	13-Feb-12	<2.0	3.33
ST-30	13-Feb-12	<2.0	4.35
ST-31	13-Feb-12	<2.0	1.82
ST-32	13-Feb-12	<2.0	3.86
ST-33	13-Feb-12	<2.0	3.65
ST-34	13-Feb-12	<2.0	2.16

Table 3-10. Total suspended solids and turbidity measured in water samples collected from Sturgeon Bay in March, 2012.

Location ID	Sample Date	TSS (mg/L)	Turbidity (NTU)
Analytical Detection Limits		*5.0*	*0.10*
T1-3	25-Mar-12	<5.0	1.71
T3-1	25-Mar-12	<5.0	2.17
T3-3	25-Mar-12	10	6.03
T4-2	25-Mar-12	6.0	5.1
T10-1	25-Mar-12	<5.0	2.45
T13-3	25-Mar-12	10	6.18
T14-3	25-Mar-12	<5.0	1.62
T15-4	25-Mar-12	10	6.14
T16-4	25-Mar-12	9.0	5.89

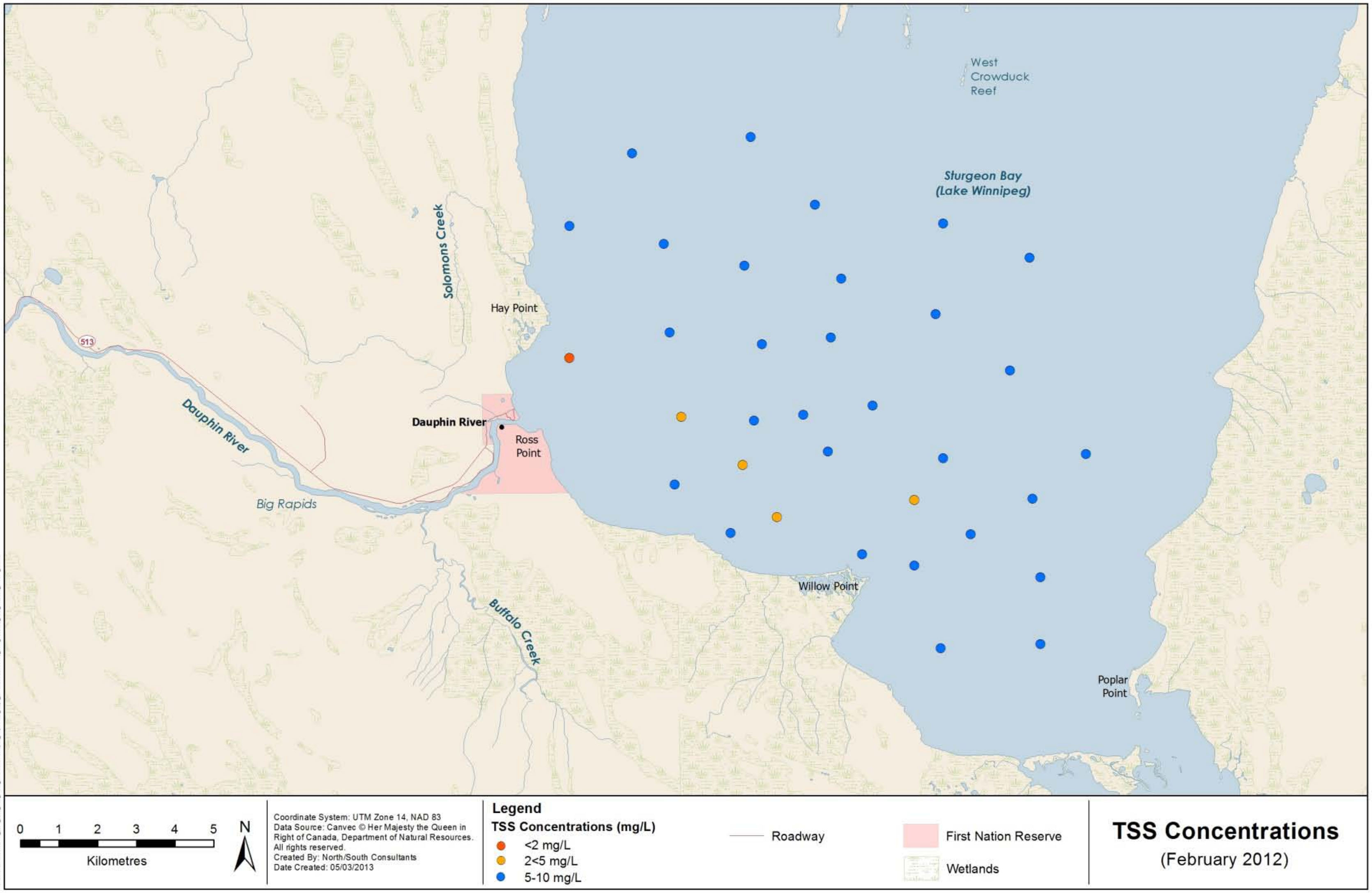

Figure 3-10. The distribution of TSS concentration from water samples collected in Sturgeon Bay during February 2012.

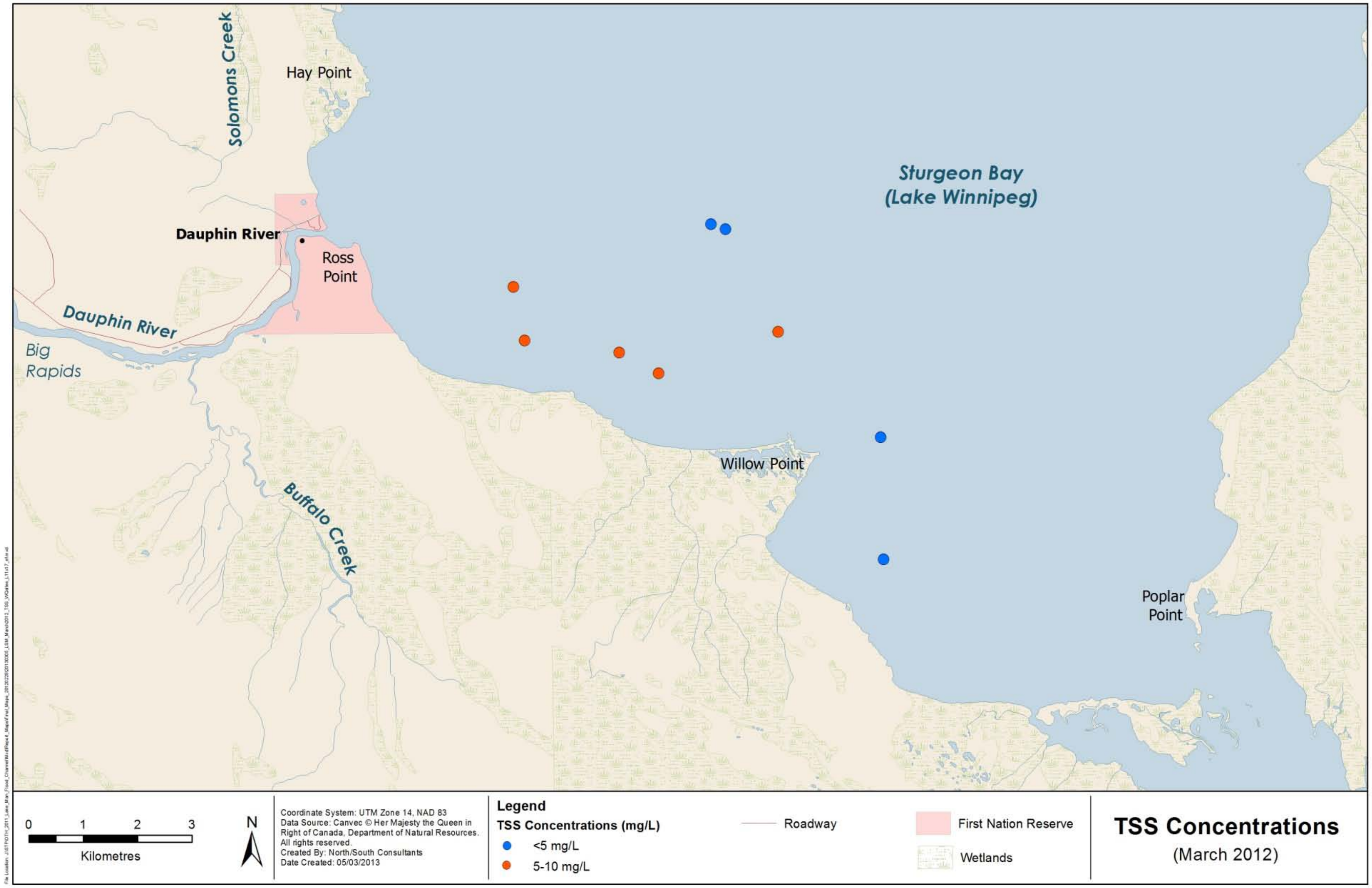

Figure 3-11. The distribution of TSS concentration from water samples collected in Sturgeon Bay during March 2012.

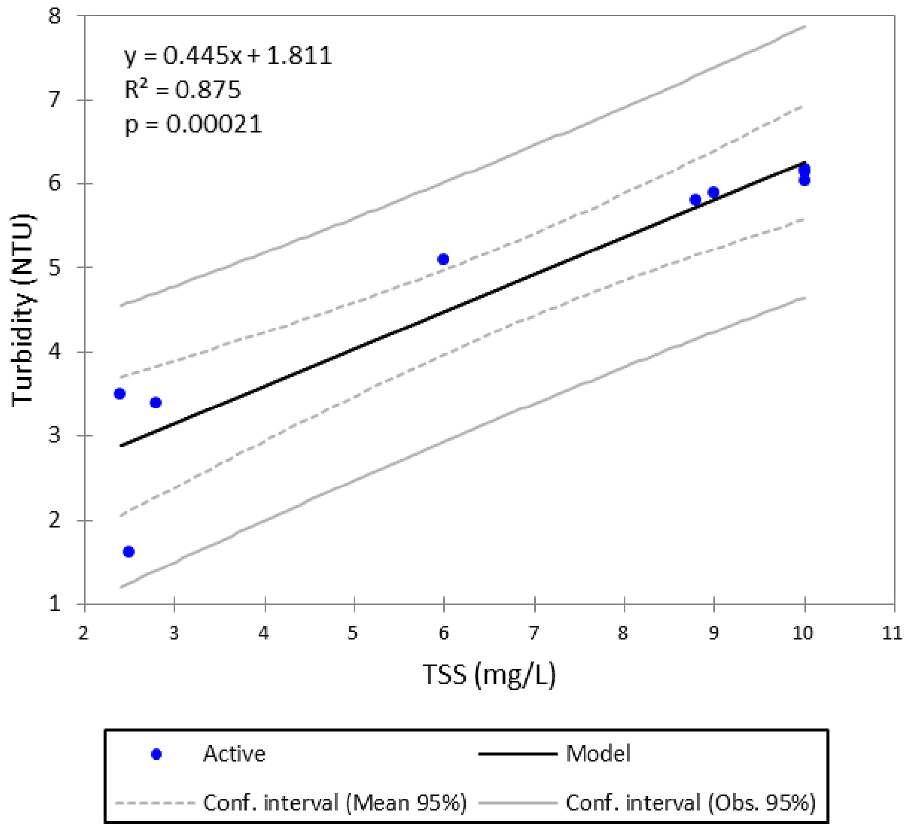

Figure 3-12. Linear regression between laboratory measured TSS and turbidity, based on water samples collected during February and March 2012.

3.4 SUMMARY

Water quality monitoring was conducted to document changes (if any) in water quality during operation of Reach 1, and to help determine the spatial extent over which any changes to water quality may have occurred. Water quality data were collected from upstream of Lake Manitoba and throughout Lake St. Martin, the Reach 1 Emergency Outlet Channel System, and Sturgeon Bay during operation of Reach 1. Water quality data collections consisted of several components, each with discrete objectives. Water quality monitoring consisted of the following programs:

- Regional Water Quality Monitoring Program (RWQMP);
- Operational EMP Monitoring; and,
- In situ and TSS Monitoring in Sturgeon Bay.

3.4.1 Regional Water Quality Monitoring Program

During the conduct of the RWQMP, water quality information was collected from all major waterbodies and waterways that were affected by flooding and encompassed the major inputs to the north basin of Lake Manitoba (i.e., Waterhen River and at the Lake Manitoba Narrows) downstream to and including Sturgeon Bay on Lake Winnipeg. The objectives of the program were to:

- monitor water quality conditions during Reach 1 operation;
- supplement data sets at sites within the study area where Manitoba Conservation and Water Stewardship, Water Quality Management Branch (MCWS) conducts water quality monitoring; and,
- evaluate spatial differences in water quality within the study area.

RWQMP results indicate that water quality within the study area can be generally described as moderately nutrient-rich, low to moderately turbid, slightly alkaline, hard to very hard, and well-oxygenated.

Lake St. Martin was consistently isothermal and *in situ* parameters, including DO, turbidity, pH, and specific conductance were consistent across depth. Molar ratios of N:P indicated that the lake was phosphorus limited in 2012. All routine water quality variables for which there are MWQSOGs and CCME guidelines, including phosphorus, DO, pH, ammonia, nitrate and nitrite were within PAL objectives and guidelines.

Buffalo Creek and the Dauphin River were also phosphorus limited and all routine water quality variables for which there are MWQSOGs and CCME PAL guidelines, including phosphorus, DO, pH, ammonia, nitrate and nitrite were within PAL objectives and guidelines.

Sturgeon Bay was consistently isothermal and DO, turbidity, pH and specific conductance were fairly consistent across depth. Based on N:P molar ratios, the bay was phosphorus limited during all seasons. The water quality of Sturgeon Bay was influenced by the Dauphin River such that sites closest to the river mouth exhibited water quality similar to upstream sites, including: higher alkalinity; higher conductivity and TDS; higher total nitrogen; lower carbon concentrations and, higher chlorophyll *a*. This trend was particularly evident during the open-water season. The MWQSOGs narrative guideline for phosphorus in lakes was exceeded at the mouth of the Dauphin River during May and four sites in Sturgeon Bay during July. DO concentrations near the bottom were below the MWQSOGs for the protection of cold water aquatic life at the mouth of the river in July.

Concentrations of the major ions (i.e., calcium, chloride, magnesium, potassium, sodium, and sulphate) tended to be higher at sites closer to the Dauphin River outflow than at the other sites sampled in Sturgeon Bay, reflecting the higher concentration of these substances at upstream waterbodies in the region relative to Lake Winnipeg. Aluminum, cadmium, chloride, fluoride, iron, selenium, and silver all exceeded PAL guidelines or objectives on at least one occasion within the study area. All other metals and major ions were within MWQSOGs and CCME guidelines for PAL.

Of the 63 pesticides analysed for, only glyphosate and 2,4-D were detected in the study area; both were below the federal and provincial guidelines for PAL.

3.4.2 Operational EMP Monitoring

Operational EMP monitoring was conducted from January to Reach 1 closure in November 2012. The objective was to monitor potential changes to water quality in Buffalo Creek and the lower Dauphin River during operation of Reach 1, and was a continuation of Construction EMP monitoring conducted during fall 2011.

Construction EMP monitoring indicated that TSS concentrations had returned to near baseline conditions following an initial increase measured in November 2011 (AECOM 2012). During the spring freshet in 2012, TSS concentrations increased at all sites, but particularly in Reach 1 and Buffalo Creek where values were above the estimated long-term CCME guideline. TSS concentrations at these locations had returned to near baseline conditions by the April sampling period. Dissolved oxygen concentrations were below the CCME lowest allowable limit for cold water ecosystems in Lake St. Martin, Buffalo Creek, and the Dauphin River downstream of the confluence with Buffalo Creek in March 2012. All other DO measurements taken from March to June were within applicable CCME guidelines for PAL. Nutrient concentrations in Lake St. Martin and in the Dauphin River upstream of Buffalo Creek were typically higher or similar to concentrations measured within Reach 1 and Buffalo Creek, and in the Dauphin River downstream of Buffalo Creek.

3.4.3 *In situ* and TSS Monitoring

In situ and TSS monitoring were conducted in Sturgeon Bay during February and March 2012. Objectives were to:

- supplement data collected during fall 2011;
- collect baseline water quality information in the vicinity of the proposed Reach 3 outlet;
- help delineate the spatial extent over which suspended sediment inputs may be distributed in Sturgeon Bay; and,

- develop a reliable turbidity/TSS relationship to assist in the future analysis of turbidity data.

Results indicated that the water in Sturgeon Bay was clear in winter, 2012. In general, TSS concentrations were below the analytical detection limit (2 mg/L and 5 mg/L). However, higher concentrations (up to 8.8 mg/L) were measured within the mixing zone of the Dauphin River. A small number of laboratory samples were used to establish a TSS/turbidity relationship for Sturgeon Bay. Additional samples will subsequently be used to strengthen the relationship.

4.0 EROSION, SEDIMENTATION, AND HABITAT

It was anticipated that a large amount of organic and mineral sediments could be introduced to Sturgeon Bay due to operation of Reach 1 and Reach 3. Deposition of sediments eroded from Reach 1 and Reach 3 could potentially alter existing substrate conditions and, therefore, fish habitat in Sturgeon Bay.

To address this potential effect, several studies were conducted or initiated during fall 2011. These included the collection of water quality and bed load samples to document sediment transport into Sturgeon Bay, installation of sediment traps to document sedimentation rates in Sturgeon Bay, and the collection of substrate information to support the understanding of sedimentation as well as support fish habitat descriptions. Results of these studies are presented in North/South Consultants Inc. (2013) or, in the case of the sedimentation rate study, here.

Numerous studies were proposed (see Appendix 1-1) to collect additional information during operation of Reach 1, prior to and during operation of Reach 3, and following closure of both reaches during 2012. These included the following:

- Sedimentation Rates in Sturgeon Bay (Study ESH-1);
- Collection of Supplemental Substrate Information in Relation to the Reach 3 Outlet and Northwest Side of Sturgeon Bay (Study ESH-2);
- Collection of Supplemental Habitat Information in Relation to the Reach 3 Outlet and Northwest Side of Sturgeon Bay (Study ESH-3);
- Post-Project Dauphin River Habitat Assessment (Study ESH-4);
- Post-Project Substrate Assessment (Study ESH-5);
- Post-Project Sturgeon Bay Habitat Assessment (Study ESH-6); and,
- Post-Project Habitat Assessment of the Buffalo Creek Watershed (Study ESH-7).

As previously discussed, operation of Reach 1 continued into November 2012 and, consequently, all programs related to post-project assessments were deferred. Supplemental substrate and habitat studies related to operation of Reach 3 were completed prior to the decision not to use it.

The following sections provide methods and results for sedimentation, substrate, and habitat studies conducted until August 2012.

4.1 SEDIMENTATION RATES IN STURGEON BAY

Sedimentation rate studies were initiated in October 2011, when 30 sediment traps were deployed throughout Sturgeon Bay and left in place through the winter (Figure 4-1; also North/South Consultants Inc. 2013). Studies proposed for 2012 included the continued use of the traps installed in 2011, as well as the installation and retrieval/re-installation of additional traps in February and March 2012, respectively, and retrieval of all traps in June 2012.

The objectives of setting the additional traps were to:

- expand the area and density of coverage provided by sediment traps deployed in fall 2011;
- collect sedimentation data in Sturgeon Bay during the winter months;
- collect sedimentation data near Willow Point and the proposed Reach 3 Outlet prior to operation of Reach 3;
- collect sedimentation data during operation of Reach 3; and,
- collect sediment traps immediately following cessation of diversion flows to determine the extent of sediment deposition in Sturgeon Bay that occurred during operation of the diversion channels.

Since Reach 3 was not operated and Reach 1 remained operational throughout the study period, some of the above stated objectives could not be addressed.

4.1.1 Methods

Additional sediment traps were deployed throughout Sturgeon Bay during 2012, but particular emphasis was placed on the southwest portion of the bay in the vicinity of the Dauphin River and Reach 3 outlets. Taps deployed in October 2011 (original traps) and those deployed in February 2012 (additional traps) were retrieved and re-deployed on different occasions throughout the study period. The Gantt chart in Figure 4-2 illustrates the schedule whereby the original and additional traps were retrieved and re-deployed.

4.1.1.1 Field Methods

Sediment traps consisted of three 0.5 m long plastic pipes with a 5.0 cm outer diameter (inner diameter of 4.68 cm), clamped together with cable ties. The bottom of each pipe was sealed. Foam was attached along the length of the trap to maintain the pipes upright in the water column. To anchor the trap, the bottom of the pipes was connected by a short rope to a cinder block. Effort was made to ensure that when the cinder block was lying flat, the length of rope attaching the block to the trap was such that bottom of the trap was suspended 30 cm above the lake bottom. Further buoyancy was provided by attaching an additional float from the top of the trap. The additional float also served to help in trap retrieval.

The original traps set in October 2011 were intended to remain in place through the following winter. Consequently, the top float was attached to the trap such that the float was suspended in the water column approximately 2 m below the surface of the water. This was to prevent the trap from being moved around by ice during spring break up. Traps set and retrieved through the ice during winter were constructed in the same manner, except that a line attached to the top float was tied off to a pole on the surface of the ice (Figure 4-3). Traps set in winter that were to be retrieved following ice break up were constructed in the same fashion as those deployed during October 2011 (i.e., with the top float suspended 2 m beneath the water surface). Finally, the top float on traps deployed during open water and retrieved during open water was allowed to float on the water surface to facilitate trap retrieval.

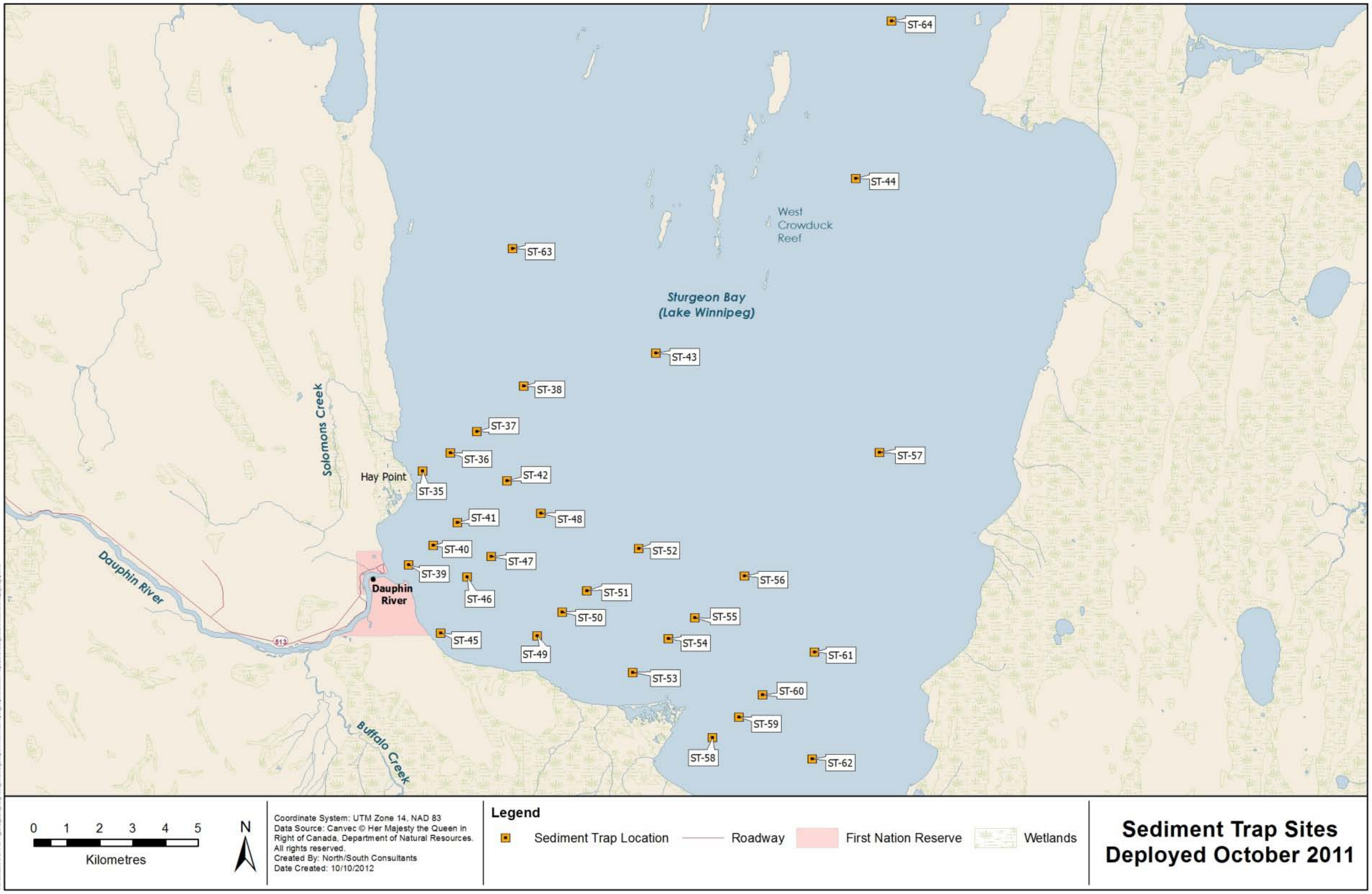

Figure 4-1. Location of sediment traps deployed in Sturgeon Bay during October 2011.

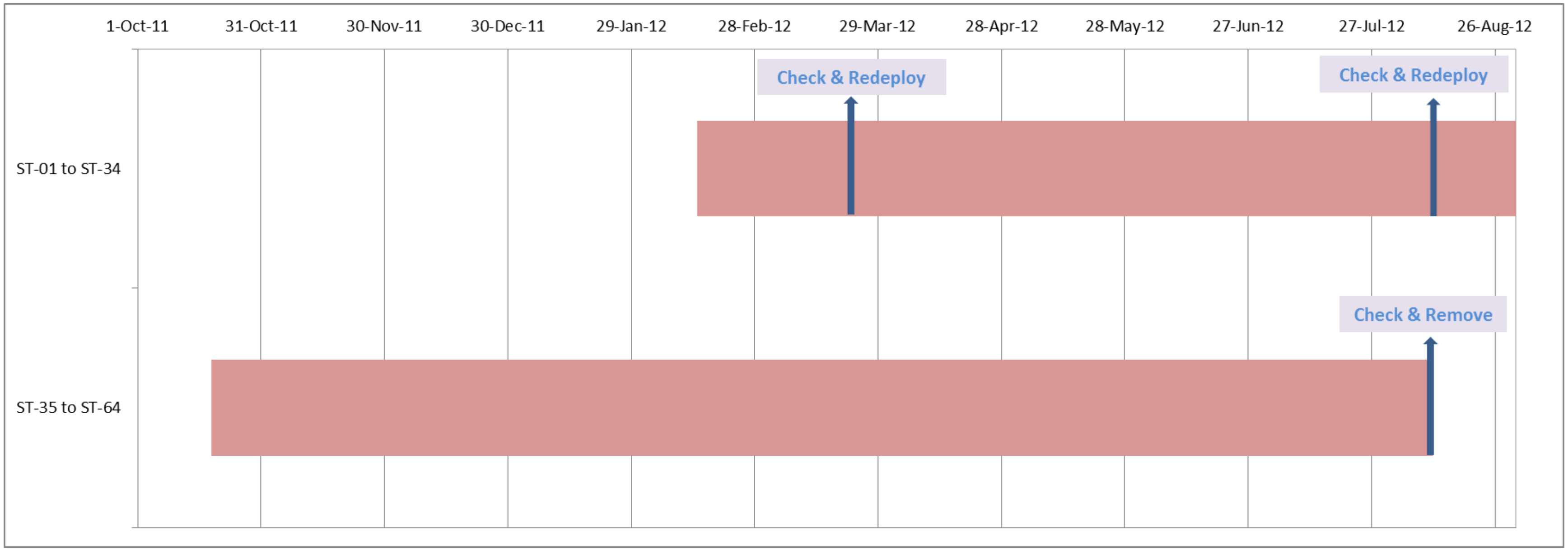

Figure 4-2. Deployment and sampling schedule for two sets of sediment traps installed in Sturgeon Bay, 2011-2012. Note: Not all traps were re-deployed at each interval due to damage or loss of individual traps. See Figures 4-5 and 4-6 for details of individual traps.

Figure 4-3. Sediment trap construction, February, 2012. Note the positions of the cinder block anchor, the sediment trap and the top float.

At the time of deployment, the following information was recorded at each trap location:

- deployment date and time;
- location (UTM coordinates; recorded with a hand held GPS receiver);
- water depth (m); and,
- ice thickness (m; only for traps deployed in winter time).

In situ measurements of water quality conditions were taken at each trap site to support water quality monitoring programs (see Section 3.3). All measurements were made using a Horiba® W22-XD water quality meter and were recorded from the water surface to a depth of approximately 1 m from the sediments in 1.5 m increments. Measurements collected during winter were recorded at 1.5 m below the ice surface at 1.5 m increments to a depth of approximately 1 m above the lake bottom. *In situ* measurements included water temperature, dissolved oxygen, conductivity, turbidity and pH. As well, water samples for laboratory analysis of TSS and turbidity were collected during trap deployment in February and again during trap retrieval and re-deployment during March. Results are presented in Section 3.3.

As with trap deployment, trap retrieval was accomplished using several methods. Traps deployed and retrieved during winter were lifted to the water surface using the attachment line connecting the trap to a pole frozen in the into the top ice surface. Traps deployed in opened water and retrieved during the same open water period were lifted to the water surface using the surface float. Finally, traps left in place during periods of ice cover (i.e., traps with a submerged top float) but retrieved in open water were first located with side scan sonar and then retrieved using two methods. The first method attempted was to use a grappling hook to snag the top float of the trap. This was attempted in late July, but was largely unsuccessful; only a single trap was retrieved. Traps could be located but not efficiently retrieved. The second method was to use a professional diving team to retrieve the traps once located; this method proved to be the best approach and most traps were successfully retrieved.

For all trap retrieval methods, the sample collection technique was the same. The trap was slowly lifted to the water surface to avoid disturbing sediments within the trap. The contents of the three plastic pipes comprising the trap were poured into a 4 L plastic container. The trap pipes were rinsed with water, which was also poured into the sample container. This process was repeated until the trap pipes were clean of sediment. Samples were labelled, the collection date and time were noted, and samples were kept refrigerated until delivery to the laboratory.

4.1.1.2 Laboratory and Data Analyses

Sediment sample laboratory analyses were conducted by ALS Laboratories in Winnipeg. Analyses included the following:

- analysis of particle size;
- moisture content;
- dry weight; and,
- organic content.

Dry weight and organic carbon content were used to calculate the inorganic dry weight for each sample using the following equation:

Inorganic Dry Weight (g) = Total Dry Weight (g) x (100 – Organic Carbon Content (%)/100)

Sedimentation rate for each trap was calculated using the following equation:

Total Dry Weight (mg) / 51.6 cm^2 (the sediment trap surface area) / Number of Days Trap was Deployed

Values that were less than the analytical detection limits were treated as half the detection limit for use in equations and calculation of means (e.g., < 1.0 g = 0.5 g). Laboratory and sedimentation rate data were tabulated and means calculated. Total dry weight and sedimentation rates were graphed for comparison along and between transects in Sturgeon Bay to examine spatial variability related to distance from shore, water depth, and proximity to the Dauphin River.

4.1.2 Results

The timing of sediment trap deployment and retrieval during the study period is illustrated in Figure 4-2. In addition to the 30 traps deployed in October 2011, 34 sediment traps were deployed in February, and retrieved in March 2012 (Figure 4-4). Thirty-one traps were re-deployed in March. All sediment traps were retrieved in August 2012 (Figure 4-5), nine of which were re-deployed (Figure 4-6).

4.1.2.1 February-March 2012

Sediment traps deployed in February were set in water depths ranging from 2.7-8.0 m (Table 4-1). All traps were retrieved during March and samples collected. Thirty-one traps were re-deployed in March, to be sampled again during summer 2012; three traps were damaged and so not re-deployed.

At the time the traps were deployed, water quality samples for TSS and turbidity analyses were collected from all sites (n = 34). *In situ* measurements of turbidity were also collected but data were considered suspect and were not discussed in this report (see Section 3.3). A smaller number of water samples were collected when traps were retrieved and re-deployed in March (n = 9; Section 3.3). Again, *in situ* measurements of turbidity were collected but were considered suspect and, while presented in an appendix, were not are not considered further (see Section 3.3).

Suspended sediments were generally low in Sturgeon bay during February. TSS and turbidity ranged from < 2.0 mg/L to 2.8 mg/L and 1.6 NTU to 4.35 NTU, respectively (Section 3.3). TSS and turbidity were higher at ST-13, the site located nearest the mouth of the Dauphin River, than at other sites sampled; in the water sample collected at this location TSS was 8.8 mg/L and turbidity was 5.80 NTU. TSS and turbidity were also low during March, ranging from < 5.0 mg/L to 10 mg/L and from 1.71 NTU to 6.18 NTU, respectively. Although fewer samples were collected during March and over a smaller area, sites in closer proximity to the Dauphin River tended to have higher TSS and turbidity values than sites farther removed (Table 3-10).

Of the 34 sediment traps deployed in February 2012, all but one trap were recovered in March 2012 and samples retrieved (Table 4-1; Figure 4-4). The trap at Site ST-21 was not found. Traps were deployed for 36-40 days. With two exceptions (traps at sites ST-4 and ST-10), traps were re-deployed after samples were removed.

Laboratory analytical results for sediment samples collected during March are provided in Table 4-2. In general, very little sediment was collected over the period of February-March and most sediment parameters, including total dry weight and inorganic dry weight, were below the laboratory detection rate for almost all samples (Table 4-2). Only at ST-5, among the sites farthest removed from the Dauphin River (Figure 4-4) was total dry weight above the laboratory detection limit (Table 4-2).

Sedimentation rate was low over the February-March period, ranging between 0.24-0.27 mg/cm^2/day at all locations except ST 5, where sedimentation rate was calculated as 3.72 mg/cm^2/day (Table 4-2). Reasons for the large amount of sediment collected at this location are not clear.

The amount of sediment collected in the traps was too small to complete particle size analysis for any of the samples, but enough material was collected to determine the organic component of the sediments (Table 4-2). The percentage of organic material averaged 3.22 %, and ranged from below the laboratory detection limit to a maximum of 5.13 % (Table 4-2).

4.1.2.2 March-August 2012

Nineteen of the 31 traps deployed in March 2012 were retrieved and sampled during August 2012 (Table 4-3; Figure 4-5). A single trap, ST-14, was retrieved during July. The remaining traps could not be located during summer. Sampling duration for traps set during this time period ranged from 119-143 days (Table 4-3). Nine sediment traps were reset following the August sampling, for retrieval in late fall 2012 (Table 4-4; Figure 4-6).

Water quality sampling for the RWQMP was conducted during July 2012, prior to sediment trap retrieval in August. During July, TSS and turbidity readings were higher than observed throughout Sturgeon Bay during February and March, 2012. TSS ranged from 4.7-11.4 mg/L and turbidity ranged from 3.5-10.4 NTU (Table 3.6). While the highest TSS value was recorded at a site closest to the Dauphin River, the second largest TSS value was recorded farthest from the Dauphin River.

Laboratory analytical results for sediment samples collected traps deployed in March and retrieved in August are provided in Table 4-5. Considerably more sediment was collected during March-August compared to that collected during the February-March period. All sediment parameters for all samples collected by these traps were above analytical detection limits.

Sample total dry weights ranged from 13-131 g and, on average, organic carbon (4.6%) accounted for a greater proportion of the sample dry weights than inorganic carbon (2.8%; Table 4-5). Silt comprised the largest proportion of particle sizes in all samples.

Sedimentation rate varied considerably between locations, ranging from 2.12 to 18.32 mg/cm^2/day (Table 4-5). Mean sedimentation rate was 10.7 mg/cm^2/day (Table 4-5).

4.1.2.3 October 2011 - August 2012

Twenty-three of the 30 sediment traps deployed in October 2011 were retrieved and sampled during summer August 2012 (Table 4-3; Figure 4-5). The remaining traps could not be located. Sampling duration for traps set during this time period ranged from 295-297 days (Table 4-3).

As discussed above, TSS and turbidity readings during July were higher than observed throughout Sturgeon Bay during February and March, 2012. TSS ranged from 4.7-11.4 mg/L and turbidity ranged from 3.5-10.4 NTU (Table 3.6). While the highest TSS value was recorded at a site closest to the Dauphin River, the second largest TSS value was recorded farthest from the Dauphin River.

Laboratory analytical results for sediment samples collected traps deployed in October 2011 and retrieved in August are provided in Table 4-5. As would be expected because of the long sampling duration, more sediment was collected during the October-August period than other sampling periods.

Sample total dry weights ranged from 37-354 g and, on average, organic carbon (4.9%) accounted for a greater proportion of the sample dry weights than inorganic carbon (2.9%; Table 4-5).

Silt comprised the greatest proportion of particle sizes in all but one sample (ST-40), where sand was dominant (Table 4-5). ST-40 was nearest to the Dauphin River (Figure 4-5), suggesting that suspended sand particles carried by Dauphin River flow are deposited in Sturgeon Bay within close proximity to the Dauphin River while finer particles (i.e., silts and clays) are carried farther.

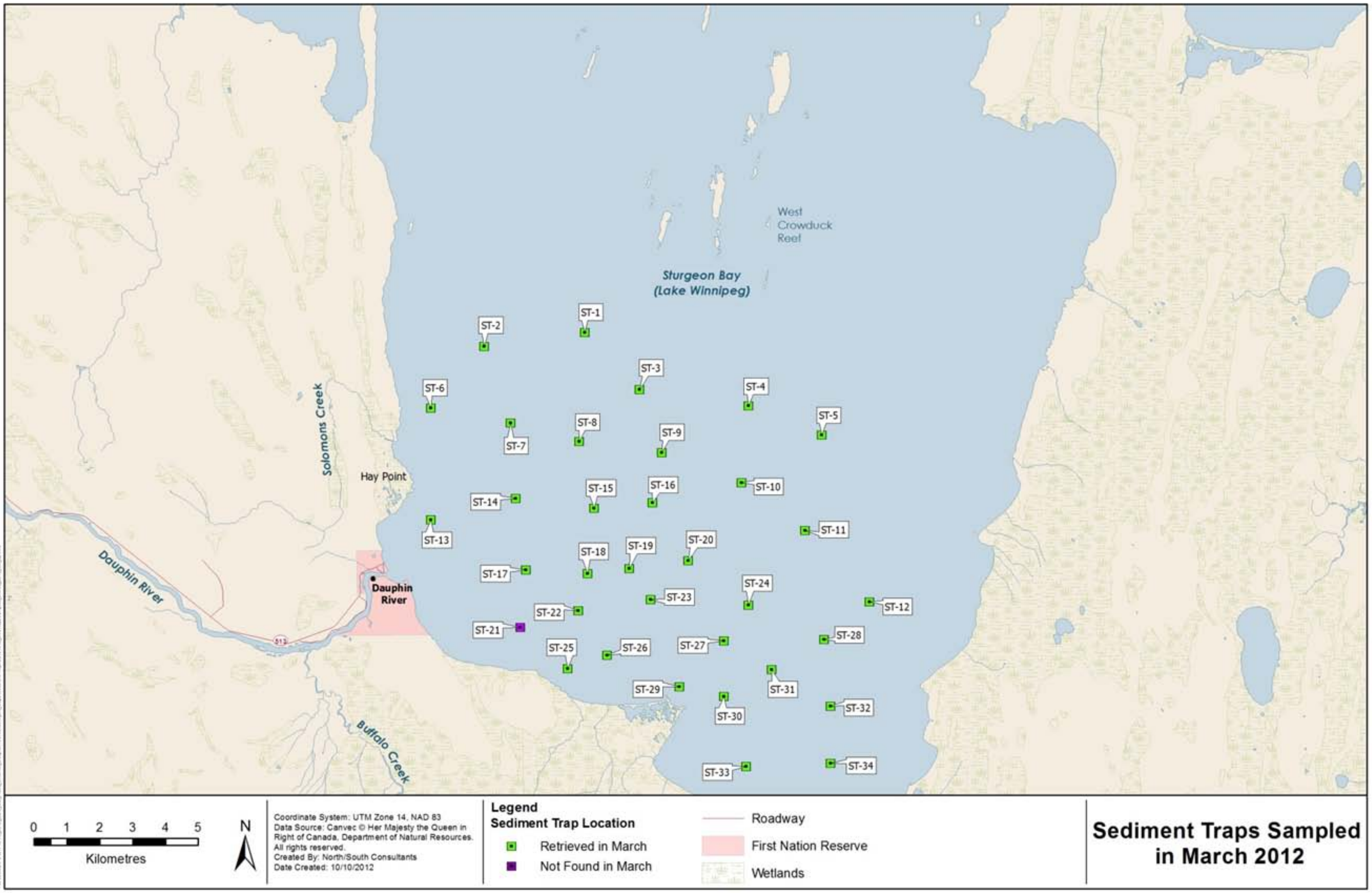

Figure 4-4. Location of sediment traps deployed in Sturgeon Bay during February and retrieved during March 2012.

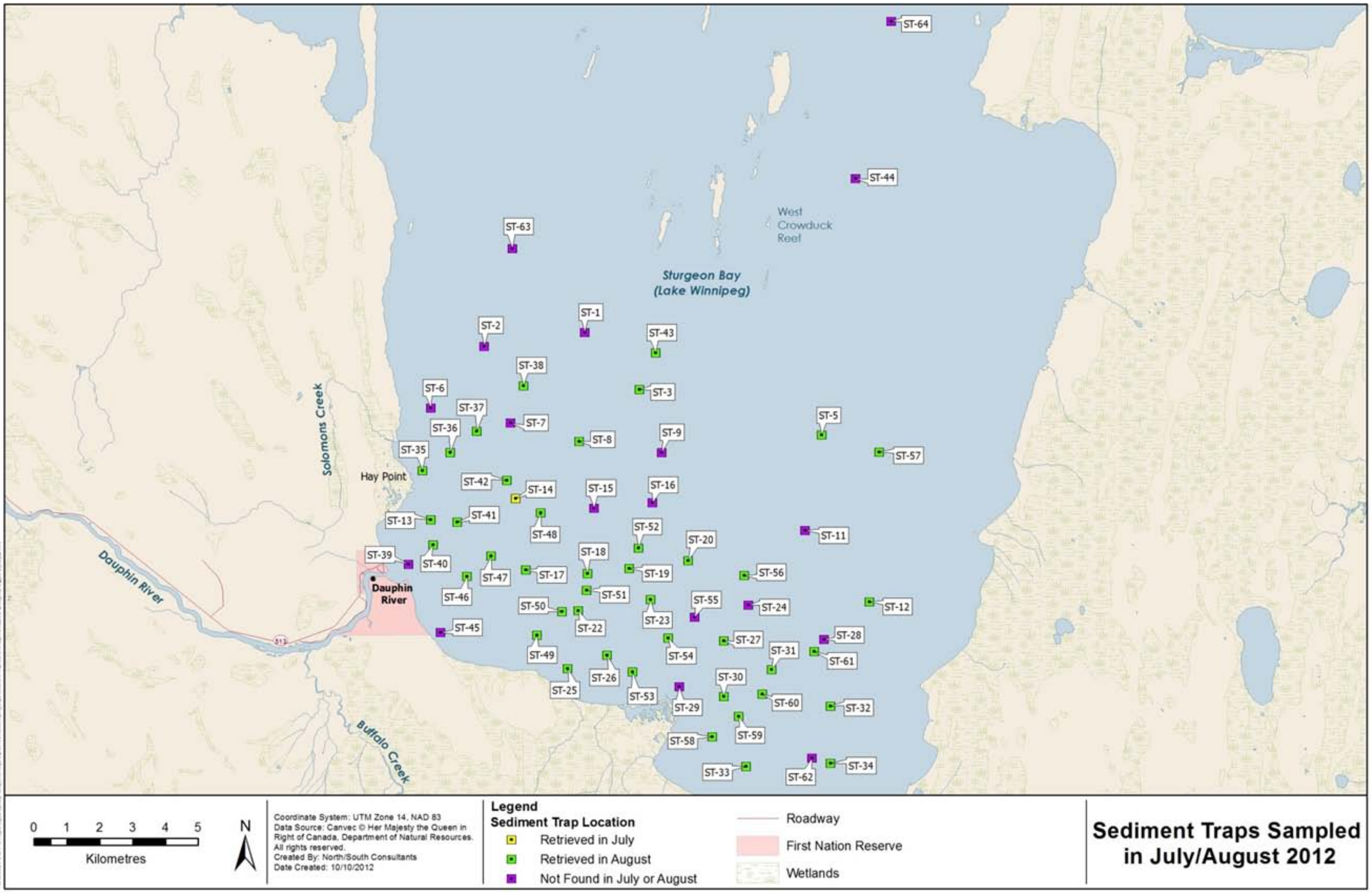

Figure 4-5. Location of sediment traps deployed in October 2011 and March 2012 in Sturgeon Bay and sampled during summer 2012.

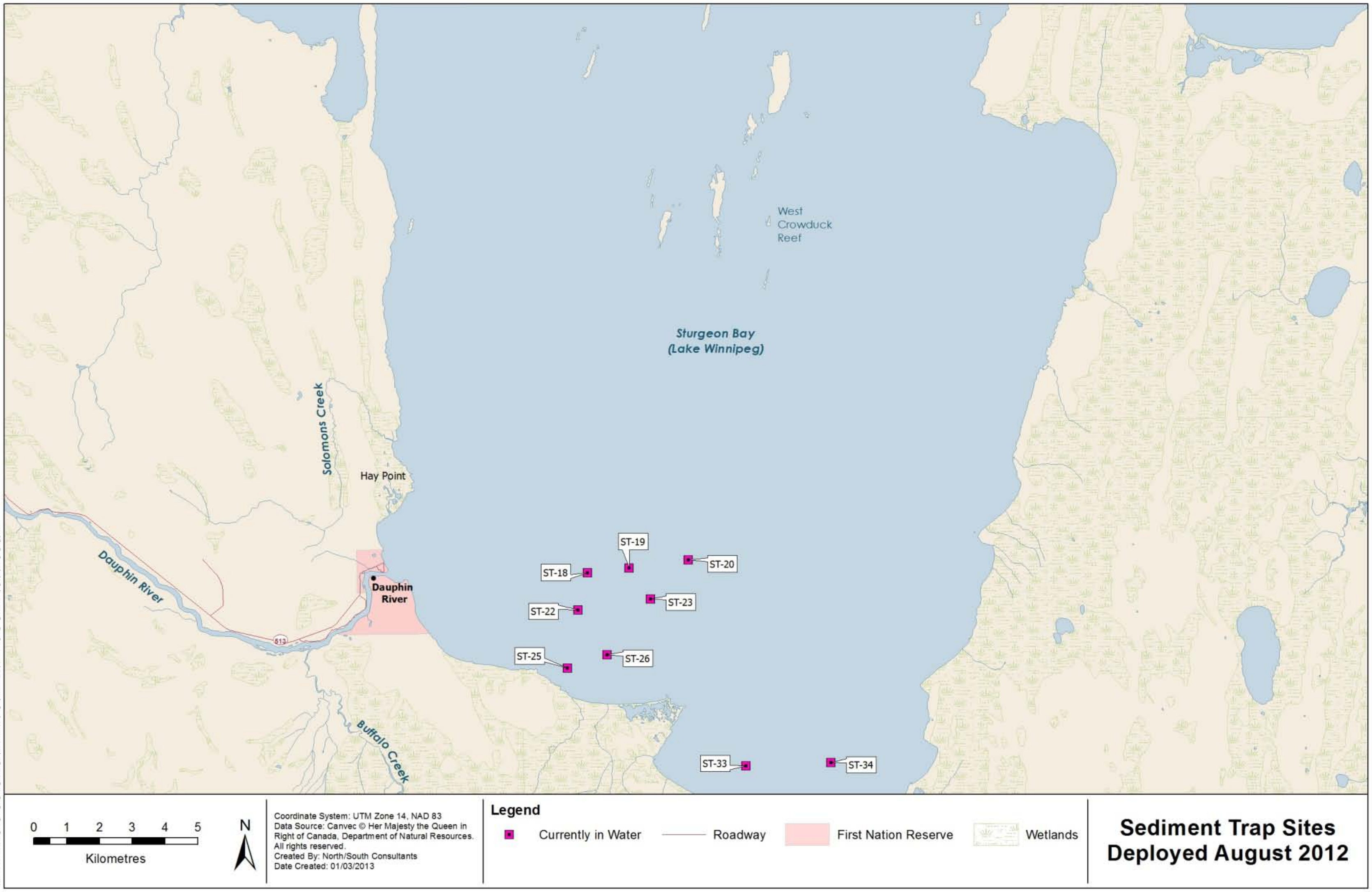

Figure 4-6. Location of sediment traps deployed in Sturgeon Bay during August 2012.

Table 4-1. Location of sediment traps deployed in Sturgeon Bay during February 2012.

Site ID [1]	Water Depth (m)	Ice Thickness (m)	Location [2]		Date Deployed	Date Sampled	Set Duration (days)
			Easting	Northing			
ST-1	8.0	0.72	570664	5764473	12-Feb-12	23-Mar-12	40
ST-2	6.8	0.71	567599	5764050	12-Feb-12	23-Mar-12	40
ST-3	8.0	0.73	572323	5762729	12-Feb-12	23-Mar-12	40
ST-4	7.0	0.73	575642	5762238	14-Feb-12	23-Mar-12	38
ST-5	6.5	0.78	577877	5761357	14-Feb-12	23-Mar-12	38
ST-6	6.0	0.66	565974	5762170	12-Feb-12	23-Mar-12	40
ST-7	6.8	0.72	568412	5761713	12-Feb-12	23-Mar-12	40
ST-8	7.3	0.78	570495	5761154	12-Feb-12	23-Mar-12	40
ST-9	7.7	0.75	573000	5760815	12-Feb-12	23-Mar-12	40
ST-10	7.5	0.75	575438	5759901	14-Feb-12	23-Mar-12	38
ST-11	7.0	0.69	577369	5758444	13-Feb-12	23-Mar-12	39
ST-12	6.5	0.72	579333	5756276	13-Feb-12	23-Mar-12	39
ST-13	4.6	0.78	565974	5758766	12-Feb-12	21-Mar-12	38
ST-14	6.3	0.72	568564	5759426	12-Feb-12	21-Mar-12	38
ST-15	7.0	0.68	570952	5759122	12-Feb-12	21-Mar-12	38
ST-16	7.4	0.78	572730	5759291	14-Feb-12	21-Mar-12	36
ST-17	5.8	0.80	568869	5757242	14-Feb-12	21-Mar-12	36
ST-18	6.1	0.68	570749	5757140	14-Feb-12	21-Mar-12	36
ST-19	6.5	0.68	572018	5757293	14-Feb-12	21-Mar-12	36
ST-20	7.0	0.78	573813	5757530	14-Feb-12	23-Mar-12	38
ST-21	4.0	0.69	568700	5755497	13-Feb-12	Not Found	-
ST-22	5.5	0.80	570461	5756005	14-Feb-12	21-Mar-12	36
ST-23	6.5	0.90	572662	5756344	14-Feb-12	23-Mar-12	38
ST-24	6.8	0.73	575642	5756175	14-Feb-12	23-Mar-12	38
ST-25	2.7	0.68	570139	5754244	13-Feb-12	21-Mar-12	37
ST-26	3.9	0.78	571341	5754651	13-Feb-12	23-Mar-12	39
ST-27	6.5	0.73	574897	5755091	14-Feb-12	23-Mar-12	38
ST-28	6.8	0.80	577945	5755125	13-Feb-12	23-Mar-12	39
ST-29	4.0	0.70	573542	5753685	13-Feb-12	23-Mar-12	39
ST-30	5.9	0.65	574897	5753397	13-Feb-12	23-Mar-12	39
ST-31	6.5	0.85	576353	5754210	13-Feb-12	23-Mar-12	39
ST-32	6.3	0.90	578148	5753092	13-Feb-12	23-Mar-12	39
ST-33	5.0	0.80	575574	5751263	13-Feb-12	23-Mar-12	39
ST-34	5.3	0.78	578148	5751365	13-Feb-12	23-Mar-12	39

1 - see Figure 4-4.

2 - UTM coordinates; Datum NAD 83, Zone 14U.

Table 4-2. Laboratory results from sediment traps deployed in February 2012 and sampled during March 2012 in Sturgeon Bay.

Site ID [1]	% Moisture	Total Dry Weight (g)	Total Wet Weight (g)	$CaCO_3$ Equivalent (%)	Inorganic Carbon (%)	Total Carbon by Combustion (%)	Total Organic Carbon (%)	Inorganic Dry Weight [2] (g)	Sedimentation Rate ($mg/cm^2/day$)
Analytical Detection Limit	*0.1*	*1*	*1*	*0.8*	*0.1*	*0.1*	*0.1*	-	-
ST-1	99.9	<1	399	33.7	4.0	5.6	1.6	<1	0.24
ST-2	100.0	<1	434	26.2	3.1	6.8	3.7	<1	0.24
ST-3	99.9	<1	408	20.6	2.5	5.5	3.0	<1	0.24
ST-4	99.9	<1	386	23.6	2.8	5.2	2.3	<1	0.25
ST-5	98.5	7.3	471	50.8	6.1	6.5	0.4	7.3	3.72
ST-6	100.0	<1	427	30.5	3.7	8.8	5.1	<1	0.24
ST-7	100.0	<1	425	26.5	3.2	5.2	2.1	<1	0.24
ST-8	99.9	<1	386	40.9	4.9	6.3	1.3	<1	0.24
ST-9	99.9	<1	314	26.7	3.2	7.4	4.2	<1	0.24
ST-10	100.0	<1	283	23.7	2.8	5.4	2.6	<1	0.25
ST-11	99.9	<1	240	28.6	3.4	5.9	2.5	<1	0.25
ST-12	99.9	<1	266	23.3	2.8	5.9	3.1	<1	0.25
ST-13	99.8	<1	270	26.3	3.2	5.9	2.7	<1	0.25
ST-14	99.9	<1	419	30.4	3.6	7.4	3.7	<1	0.25
ST-15	99.9	<1	292	28.5	3.4	7.7	4.3	<1	0.25
ST-16	99.9	<1	282	27.1	3.3	6.7	3.4	<1	0.27
ST-17	99.7	<1	295	46.1	5.5	8.3	2.8	<1	0.27
ST-18	99.9	<1	348	34.7	4.2	7.3	3.1	<1	0.27
ST-19	99.9	<1	342	33.1	4.0	7.1	3.2	<1	0.27
ST-20	99.9	<1	448	24.9	3.0	7.3	4.4	<1	0.25
ST-22	99.9	<1	392	36.3	4.4	7.4	3.0	<1	0.27
ST-23	99.9	<1	406	34.0	4.1	7.1	3.0	<1	0.25
ST-24	99.9	<1	410	27.9	3.4	7.3	4.0	<1	0.25
ST-25	99.9	<1	352	27.4	3.3	8.1	4.8	<1	0.26
ST-26	99.9	<1	350	29.8	3.6	7.5	3.9	<1	0.25
ST-27	99.9	<1	429	26.1	3.1	6.8	3.7	<1	0.25
ST-28	99.9	<1	401	24.8	3.0	6.5	3.5	<1	0.25

Table 4-2. (continued).

Site ID [1]	% Moisture	Total Dry Weight (g)	Total Sample Weight (g)	$CaCO_3$ Equivalent (%)	Inorganic Carbon (%)	Total Carbon by Combustion (%)	Total Organic Carbon (%)	Inorganic Dry Weight [2] (g)	Sedimentation Rate ($mg/cm^2/day$)
Analytical Detection Limit	*0.1*	*1*	*1*	*0.8*	*0.1*	*0.1*	*0.1*	-	-
ST-29	100.0	<1	407	54.5	6.5	6.6	<0.10	<1	0.25
ST-30	99.9	<1	401	23.0	2.8	6.0	3.2	<1	0.25
ST-31	99.9	<1	409	26.5	3.2	7.6	4.4	<1	0.25
ST-32	99.9	<1	383	20.8	2.5	5.4	2.9	<1	0.25
ST-33	99.9	<1	426	20.8	2.5	6.5	4.0	<1	0.25
ST-34	99.9	<1	379	28.8	3.5	6.5	3.0	<1	0.25
n	33	33	33	33	33	33	33	33	33
Mean	99.9	<1	372	29.9	3.6	6.7	3.2	<1	0.36 [3]
SD [3]	0.3	1.2	60	8.1	1.0	0.9	1.0	1.2	0.6
Min	98.5	<1	240	20.6	2.5	5.2	<0.1	<1	0.24
Max	100.0	7.3	471	54.5	6.5	8.8	5.1	7.3	3.72

1 - see Figure 4-4.

2 - Inorganic Dry Weight =Total Dry Weight *((100-Total Organic Carbon)/100).

3 - SD = standard deviation.

Table 4-3. Location of sediment traps deployed in October 2011 and March 2012 in Sturgeon Bay and sampled during summer 2012.

Site ID	Water Depth (m)	Ice Thickness	Location [2]		Date Deployed	Date Retrieved [3]	Set Duration (days)
			Easting	Northing			
Traps Deployed in March 2012							
ST-1	8.0	0.72	570664	5764473	23-Mar-12	Not Found	-
ST-2	6.8	0.71	567599	5764050	23-Mar-12	Not Found	-
ST-3	8.0	0.73	572323	5762729	23-Mar-12	11-Aug-12	141
ST-5	6.5	0.78	577877	5761357	23-Mar-12	11-Aug-12	141
ST-6	6.0	0.66	565974	5762170	23-Mar-12	Not Found	-
ST-7	6.8	0.72	568412	5761713	23-Mar-12	Not Found	-
ST-8	7.3	0.78	570495	5761154	23-Mar-12	10-Aug-12	140
ST-9	7.7	0.75	573000	5760815	23-Mar-12	Not Found	-
ST-11	7.0	0.69	577369	5758444	23-Mar-12	Not Found	-
ST-12	6.5	0.72	579333	5756276	23-Mar-12	11-Aug-12	141
ST-13	4.6	0.78	565974	5758766	21-Mar-12	11-Aug-12	143
ST-14	6.3	0.72	568564	5759426	21-Mar-12	18-Jul-12	119
ST-15	7.0	0.68	570952	5759122	21-Mar-12	Not Found	-
ST-16	7.4	0.78	572730	5759291	21-Mar-12	Not Found	-
ST-17	5.8	0.80	568869	5757242	21-Mar-12	11-Aug-12	143
ST-18	6.1	0.68	570749	5757140	21-Mar-12	9-Aug-12	141
ST-19	6.5	0.68	572018	5757293	21-Mar-12	9-Aug-12	141
ST-20	7.0	0.78	573813	5757530	23-Mar-12	9-Aug-12	139
ST-22	5.5	0.80	570461	5756005	21-Mar-12	9-Aug-12	141
ST-23	6.5	0.90	572662	5756344	23-Mar-12	9-Aug-12	139
ST-24	6.8	0.73	575642	5756175	23-Mar-12	Not Found	-
ST-25	2.7	0.68	570139	5754244	21-Mar-12	9-Aug-12	141
ST-26	3.9	0.78	571341	5754651	23-Mar-12	9-Aug-12	139
ST-27	6.5	0.73	574897	5755091	23-Mar-12	11-Aug-12	141
ST-28	6.8	0.80	577945	5755125	23-Mar-12	Not Found	-
ST-29	4.0	0.70	573542	5753685	23-Mar-12	Not Found	-
ST-30	5.9	0.65	574897	5753397	23-Mar-12	10-Aug-12	140
ST-31	6.5	0.85	576353	5754210	23-Mar-12	11-Aug-12	141
ST-32	6.3	0.90	578148	5753092	23-Mar-12	11-Aug-12	141
ST-33	5.0	0.80	575574	5751263	23-Mar-12	10-Aug-12	140
ST-34	5.3	0.78	578148	5751365	23-Mar-12	10-Aug-12	140

Table 4-3. (continued).

Current Site ID [1]	Original Site ID [2]	Total Depth (m)	Ice Thickness	Location [3]		Date Deployed	Date Retrieved [4]	Set Duration (days)
				Easting	Northing			
Traps Deployed in October 2011								
ST-35	ST-1A	5.1	N/A	565727	5760267	19-Oct-11	10-Aug-12	296
ST-36	ST-1B	6.8	N/A	566579	5760823	19-Oct-11	10-Aug-12	296
ST-37	ST-1C	7.1	N/A	567376	5761466	19-Oct-11	10-Aug-12	296
ST-38	ST-1D	7.5	N/A	568803	5762853	19-Oct-11	10-Aug-12	296
ST-39	ST-2A	3.7	N/A	565304	5757412	19-Oct-11	Not Found	-
ST-40	ST-2B	4.8	N/A	566044	5758006	19-Oct-11	10-Aug-12	296
ST-41	ST-2C	5.9	N/A	566787	5758704	19-Oct-11	11-Aug-12	297
ST-42	ST-2D	6.6	N/A	568292	5759972	19-Oct-11	10-Aug-12	296
ST-43	ST-2E	7.7	N/A	572819	5763850	19-Oct-11	11-Aug-12	297
ST-44	ST-2F	5.5	N/A	578902	5769157	19-Oct-11	Not Found	-
ST-45	ST-3A	3.5	N/A	566279	5755348	19-Oct-11	Not Found	-
ST-46	ST-3B	5.5	N/A	567083	5757050	19-Oct-11	9-Aug-12	295
ST-47	ST-3C	6.2	N/A	567815	5757665	19-Oct-11	11-Aug-12	297
ST-48	ST-3D	6.7	N/A	569325	5758977	19-Oct-11	10-Aug-12	296
ST-49	ST-4A	3.7	N/A	569206	5755261	19-Oct-11	9-Aug-12	295
ST-50	ST-4B	5.7	N/A	569976	5755980	19-Oct-11	11-Aug-12	297
ST-51	ST-4C	6.5	N/A	570721	5756620	19-Oct-11	9-Aug-12	295
ST-52	ST-4D	7.2	N/A	572297	5757915	19-Oct-11	9-Aug-12	295
ST-53	ST-5A	4.1	N/A	572121	5754140	19-Oct-11	9-Aug-12	295
ST-54	ST-5B	5.9	N/A	573201	5755177	19-Oct-11	9-Aug-12	295
ST-55	ST-5C	6.8	N/A	574013	5755805	19-Oct-11	Not Found	-
ST-56	ST-5D	7.2	N/A	575524	5757079	19-Oct-11	10-Aug-12	296
ST-57	ST-5E	6.4	N/A	579618	5760828	19-Oct-11	11-Aug-12	297
ST-58	ST-6A	5.5	N/A	574542	5752168	19-Oct-11	10-Aug-12	296
ST-59	ST-6B	6.4	N/A	575351	5752785	19-Oct-11	10-Aug-12	296
ST-60	ST-6C	6.8	N/A	576072	5753464	19-Oct-11	10-Aug-12	296
ST-61	ST-6D	7.2	N/A	577651	5754758	19-Oct-11	11-Aug-12	297
ST-62	ST-7A	5.4	N/A	577577	5751518	19-Oct-11	Not Found	-
ST-63	ST-8A	7.8	N/A	568463	5767026	19-Oct-11	Not Found	-
ST-64	ST-9A	7.2	N/A	579988	5773937	19-Oct-11	Not Found	-

1 - see Figure 4-5.

2 - site names originally reported in North/South Consultants Inc. (2013); Site names were re-assigned to standardize naming protocols between sampling sessions.

3 - UTM coordinates; Datum NAD 83, Zone 14U.

4 - ‘Not Found’ means traps could not be located and, consequently, no samples were retrieved from those locations.

Table 4-4. Location of sediment traps deployed in August 2012 for sampling in fall 2012.

Site ID [1]	Water Depth (m)	Location [2]		Date Deployed
		Easting	Northing	
ST-18	6.1	570747	5757156	9-Aug-12
ST-19	6.5	572029	5757302	9-Aug-12
ST-20	7.0	573820	5757520	9-Aug-12
ST-22	5.5	570598	5755891	9-Aug-12
ST-23	6.5	572672	5756344	9-Aug-12
ST-25	2.7	570164	5754233	9-Aug-12
ST-26	3.9	571328	5754647	9-Aug-12
ST-33	5.0	575539	5751277	9-Aug-12
ST-34	5.3	578139	5751375	9-Aug-12

1 - see Figure 4-6

2 - UTM coordinates; Datum NAD 83, Zone 14U.

Table 4-5. Laboratory results from sediment traps deployed in October 2011 and March 2012 in Sturgeon Bay and sampled during summer 2012.

Site ID [1]	Bulk Density (g/cm^3)	% Moisture	Porosity (%)	Total Dry Weight (g)	Wet Weight (g)	$CaCO_3$ Equivalent (%)	Inorganic Carbon (%)	Total Carbon by Combustion (%)	Total Organic Carbon (%)	Inorganic Dry Weight [2] (g)	Sedimentation Rate (mg/cm^2/day)	Particle Size Composition [3] Sand (%)	Silt (%)	Clay (%)	Texture
ADL	*0.05*	*0.1*	*1*	*1*	*1*	*0.8*	*0.1*	*0.1*	*0.1*	*-*		*0.1*	*0.1*	*0.1*	
Traps Deployed in March 2012															
ST-3	0.77	98.7	71	42.1	3220	7.9	1.0	4.9	4.0	40.4	5.79	0.6	87.7	11.6	Silt
ST-5	0.82	98.4	69	49.7	3170	9.0	1.1	5.0	3.9	47.7	6.83	3.4	78.7	18.0	Silt loam
ST-8	0.7	98.4	74	52	3340	12.7	1.5	5.6	4.1	49.9	7.20	0.6	90.8	8.5	Silt
ST-12	0.85	97.8	68	71.4	3200	11.5	1.4	6.0	4.6	68.1	9.81	0.7	82.8	16.5	Silt loam
ST-13	0.8	97	70	97.4	3200	28.7	3.4	8.8	5.3	92.2	13.20	6.1	87.8	6.1	Silt
ST-14	0.45	99.5	83	13	2580	19.4	2.3	6.7	4.4	12.4	2.12	0.6	83.1	16.3	Silt loam
ST-17	0.8	97.1	70	98.7	3420	35.1	4.2	9.4	5.2	93.6	13.38	3.9	86.0	10.2	Silt
ST-18	0.79	96.4	70	81.4	2280	28.5	3.4	8.3	4.9	77.4	11.19	0.4	92.3	7.3	Silt
ST-19	0.76	98.2	71	57.8	3180	21.9	2.6	7.6	5.0	54.9	7.94	1.2	80.4	18.4	Silt loam
ST-20	0.75	98.2	72	59.5	3360	15.1	1.8	6.6	4.8	56.7	8.30	0.7	85.7	13.7	Silt loam
ST-22	0.8	97.1	70	103.8	3600	34.4	4.1	8.8	4.6	99.0	14.27	3.5	90.2	6.4	Silt
ST-23	0.79	98.1	70	60.1	3220	24.4	2.9	7.8	4.9	57.2	8.38	0.6	85.1	14.4	Silt loam
ST-25	0.82	96.4	69	128.3	3520	32.1	3.9	8.0	4.2	122.9	17.63	16.6	76.0	7.4	Silt loam
ST-26	0.82	96.1	69	131.4	3340	34.1	4.1	8.1	4.0	126.1	18.32	14.7	79.0	6.3	Silt loam / silt
ST-27	0.73	98.3	72	60.5	3470	20.6	2.5	7.4	4.9	57.5	8.32	0.5	72.7	26.9	Silt loam
ST-30	0.76	97.7	71	75.6	3220	27.1	3.3	7.8	4.5	72.2	10.47	0.5	94.4	5.1	Silt
ST-31	0.79	98.1	70	66.9	3510	22.1	2.7	7.4	4.8	63.7	9.20	0.6	68.5	30.9	Silty clay loam
ST-32	0.79	97.4	70	85.2	3230	22.2	2.7	7.6	5.0	81.0	11.71	8.5	82.9	8.6	Silt
ST-33	0.89	96.5	67	112.3	3180	27.8	3.3	7.6	4.3	107.5	15.55	7.9	82.7	9.4	Silt
ST-34	0.84	96.9	68	102	3310	27.5	3.3	7.3	4.0	98.0	14.12	6.1	88.5	5.4	Silt

Table 4-5. (continued).

Site ID [1]	Bulk Density (g/cm^3)	% Moisture	Porosity (%)	Total Dry Weight (g)	Wet Weight (g)	$CaCO_3$ Equivalent (%)	Inorganic Carbon (%)	Total Carbon by Combustion (%)	Total Organic Carbon (%)	Inorganic Dry Weight [2] (g)	Sedimentation Rate (mg/cm^2/day)	Particle Size Composition [3] Sand (%)	Silt (%)	Clay (%)	Texture
ADL	*0.05*	*0.1*	*1*	*1*	*1*	*0.8*	*0.1*	*0.1*	*0.1*	-		*0.1*	*0.1*	*0.1*	
Summary Statistics for Traps Deployed in March 2012															
n	20	20	20	20	20	20	20	20	20	20	20	20	20	20	-
Mean	0.78	97.6	71	77.5	3228	23.1	2.8	7.3	4.6	73.9	10.69	3.9	83.8	12.4	-
SD [4]	0.09	0.9	3	30.1	306	8.4	1.0	1.2	0.4	28.8	4.11	4.8	6.6	7.1	-
Min	0.45	96.1	67	13.0	2280	7.9	1.0	4.9	3.9	12.4	2.12	0.4	68.5	5.1	-
Max	0.89	99.5	83	131.4	3600	35.1	4.2	9.4	5.3	126.1	18.32	16.6	94.4	30.9	-
Traps Deployed in October 2011															
ST-35	0.79	96.5	70	129.9	3710	25.8	3.1	8.2	5.1	123.2	8.50	1.2	88.8	10.0	Silt
ST-36	0.72	97.8	73	79.2	3570	16.6	2.0	7.5	5.5	74.8	5.19	0.3	90.8	8.9	Silt
ST-37	0.74	98.0	72	71.9	3620	14.5	1.7	6.4	4.7	68.5	4.71	0.2	86.4	13.4	Silt loam
ST-38	0.72	97.8	73	69.8	3250	11.8	1.4	5.8	4.4	66.7	4.57	0.4	88.1	11.5	Silt
ST-40	0.95	90.4	64	354.0	3700	25.5	3.1	5.8	2.8	344.3	23.18	67.2	26.7	6.1	Sandy loam
ST-41	0.81	95.6	70	146.6	3330	36.1	4.3	6.1	1.8	144.0	9.57	3.5	87.9	8.6	Silt
ST-42	0.87	97.3	67	86.1	3200	17.7	2.1	6.8	4.6	82.1	5.64	0.4	86.5	13.1	Silt loam
ST-43	0.55	98.0	79	67.0	3410	13.5	1.6	11.5	9.9	60.4	4.37	3.3	83.0	13.7	Silt loam
ST-46	0.80	93.3	70	233.0	3500	37.5	4.5	10.1	5.6	220.0	15.31	17.0	74.6	8.4	Silt loam
ST-47	0.84	96.1	68	144.6	3700	36.2	4.3	10.1	5.8	136.2	9.44	1.2	87.2	11.6	Silt
ST-48	0.79	97.6	70	75.9	3200	21.1	2.5	7.6	5.1	72.0	4.97	0.2	90.1	9.7	Silt
ST-49	0.80	93.4	70	178.1	2690	37.6	4.5	9.1	4.6	169.9	11.70	12.9	75.3	11.8	Silt loam
ST-50	0.84	96.0	68	134.4	3360	37.7	4.5	9.4	4.9	127.9	8.77	5.0	88.4	6.7	Silt

Table 4-5. (continued).

Site ID[1]	Bulk Density (g/cm^3)	% Moisture	Porosity (%)	Total Dry Weight (g)	Wet Weight (g)	$CaCO_3$ Equivalent (%)	Inorganic Carbon (%)	Total Carbon by Combustion (%)	Total Organic Carbon (%)	Inorganic Dry Weight[2] (g)	Sedimentation Rate (mg/cm^2/day)	Particle Size Composition[3] Sand (%)	Silt (%)	Clay (%)	Texture
ADL	*0.05*	*0.1*	*1*	*1*	*1*	*0.8*	*0.1*	*0.1*	*0.1*	*-*		*0.1*	*0.1*	*0.1*	
ST-51	0.82	96.2	69	108.1	2840	31.7	3.8	9.1	5.3	102.4	7.10	1.5	88.2	10.3	Silt
ST-52	0.79	97.2	70	88.7	3150	18.2	2.2	6.8	4.6	84.6	5.83	0.7	81.4	18.0	Silt loam
ST-53	0.81	95.1	70	158.1	3250	32.8	3.9	8.3	4.4	151.1	10.39	11.1	80.9	8.0	Silt
ST-54	0.79	96.9	70	99.5	3200	29.4	3.5	8.3	4.8	94.7	6.54	0.6	92.5	6.9	Silt
ST-56	0.78	97.9	71	67.6	3150	14.1	1.7	6.1	4.4	64.6	4.43	0.7	85.7	13.7	Silt loam
ST-57	0.82	97.8	69	73.4	3370	10.0	1.2	5.9	4.7	70.0	4.79	6.5	82.5	11.0	Silt
ST-58	0.82	96.6	69	97.5	2870	25.5	3.1	7.6	4.5	93.1	6.38	2.6	86.3	11.1	Silt
ST-59	0.83	97.1	69	94.8	3280	25.4	3.1	7.7	4.7	90.4	6.21	1.4	89.6	8.9	Silt
ST-60	0.78	97.0	71	96.0	3160	24.1	2.9	7.9	5.0	91.2	6.29	0.8	92.2	6.9	Silt
ST-61	0.82	97.2	69	88.2	3150	16.4	2.0	6.4	4.5	84.2	5.76	0.7	80.8	18.5	Silt loam

Summary Statistics for Traps Deployed in October 2011

n	23	23	23	23	23	23	23	23	23	23	23	23	23	23	-
Mean	0.79	96.4	70	119.2	3286	24.3	2.9	7.8	4.9	113.8	7.81	6.1	83.2	10.7	-
SD[4]	0.07	1.9	3	65.9	271	9.2	1.1	1.6	1.4	64.0	4.32	14.1	13.2	3.3	-
Min	0.55	90.4	64	67.0	2690	10.0	1.2	5.8	1.8	60.4	4.37	0.2	26.7	6.1	-
Max	0.95	98.0	79	354.0	3710	37.7	4.5	11.5	9.9	344.3	23.18	67.2	92.5	18.5	-

1 - see Figure 4-5.

2 - Inorganic Dry Weight =Total Dry Weight *((100-Total Organic Carbon)/100).

3 - As a proportion of the inorganic fraction. Size fractions: sand = 2.0mm to 0.05mm; silt = 0.05 mm to 2 µm; clay <2 µm.

4 - SD = standard deviation.

4.1.2.4 Spatial and Temporal Variation

Spatial variation in sedimentation rates was examined by looking at the distribution of total dry weight and calculated sedimentation rate along transects extending from nearshore to offshore. Transects occurred from north of the Dauphin River south and east towards the southeast corner of Sturgeon Bay. Information from samples collected during October 2011-August 2012 and March-August 2012 were used in this analysis. Data from all sampling periods were used when considering temporal variation in sedimentation rates.

Total dry weight of samples from traps set in October 2011 was highest along transects nearest to the outflow from the Dauphin River (Transects 2 and 4; Figure 4-7) and lowest along transects north of the Dauphin River and east of Willow Point (Transects 1 and 12; Figure 4-7). For most transects, sample dry weight decreased with increasing distance from shore. Only Transect 12 showed no difference between sites. In addition, there was relatively little difference in sample dry weights between the most offshore sites along all transects. Similar trends were observed for sedimentation rates calculated along each transect (Figure 4-8). The highest sedimentation rates were observed at nearshore sites along transects positioned near the outflow from the Dauphin River.

Total dry weight of samples from traps deployed in March 2012 (Figure 4-9) was lower than from traps deployed in October 2011 (Figures 4-7). The difference was greatest at sites nearest to the Dauphin River outflow (e.g., Transect 3) where total dry weight was more than three times lower in nearshore traps deployed in March 2012 than those deployed in October 2011. In contrast, sedimentation rates were relatively similar between March 2012 and October 2011 samples for traps that were deployed in close proximity to each other (Figures 4-8 and 4-10). Collectively, this indicates relatively low sedimentation rates between October and March; lower sedimentation rates in winter are expected due to the presence of ice cover which would eliminate wind-induced re-suspension in the lake. The sedimentation rates observed in February-March 2012 support this observation.

Sediment trap data collected in 2011/2012 indicate spatial variability in sedimentation rates in Sturgeon Bay. Available data suggest:

- sedimentation rates in Sturgeon Bay are minimal during periods of ice cover when wind and wave-induced sediment re-suspension does not occur;
- sedimentation rates sedimentation rates were higher in the immediate vicinity of the Dauphin River, relative to areas north and southeast of the river; and
- sites located in nearshore areas generally have higher sedimentation rates than offshore sites during open water periods.

The latter spatial pattern may reflect actual higher rates of sedimentation in these areas, due, for example, to suspended sediment loads introduced from the Dauphin River, but may also reflect effects of shoreline erosion and/or sediment re-suspension. Effects of wind-induced sediment re-suspension would be greatest in shallow areas; sedimentation rate was significantly negatively correlated to water depth (Figure 4-11).

Sediment traps cannot readily distinguish between “new” sediments introduced from tributaries or shoreline erosion and sediments introduced to the traps from existing sediments being re-suspended in the water column by wind. Instead, sediment traps measure both “sources” of sediments collectively and, where sediment re-suspension is substantive, may grossly overestimate the actual sedimentation rate of newly introduced suspended solids.

McCullough et al. (2001) reported that antecedent winds are the most critical factor controlling concentrations of total suspended solids (TSS) in Lake Winnipeg. Nearshore and/or shallow areas, as well as areas adjacent to highly erodible shorelines, tend to have higher concentrations of TSS than deeper, pelagic sites in Lake Winnipeg (Environment Canada and Manitoba Water Stewardship 2011). Therefore, shallow areas which are more susceptible to wind effects may experience higher rates of sediment re-suspension. This pathway may contribute to the observed higher sedimentation rates at shallow sites, relative to deeper sites, in Sturgeon Bay.

The collection of additional sediment data in upcoming years will provide additional information that will help understand the effects that operation of Reach 1 may have had on aquatic environments in Sturgeon Bay.

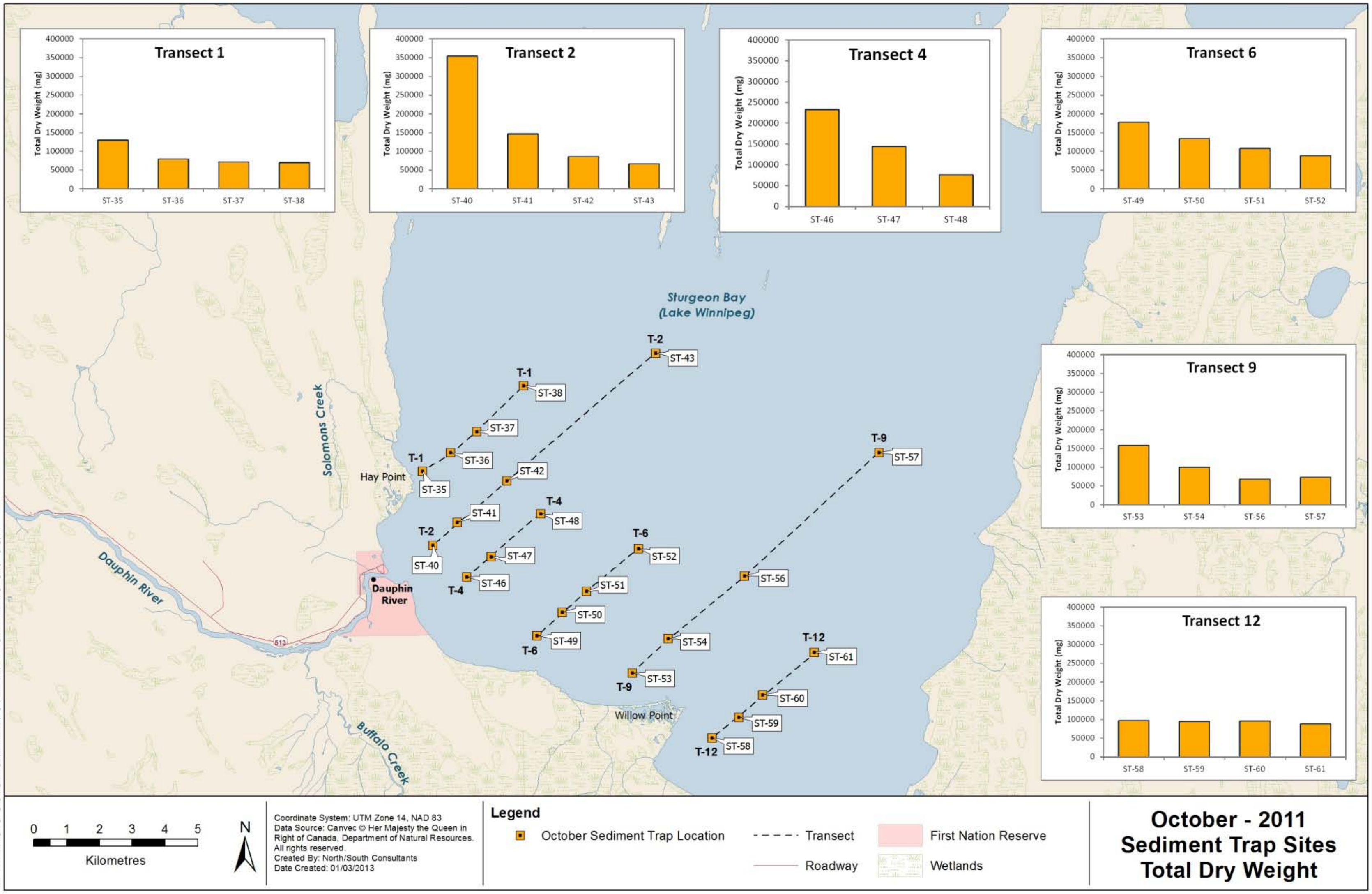

Figure 4-7. Total dry weight of samples, by transect, collected during summer 2012 from traps deployed in October 2011.

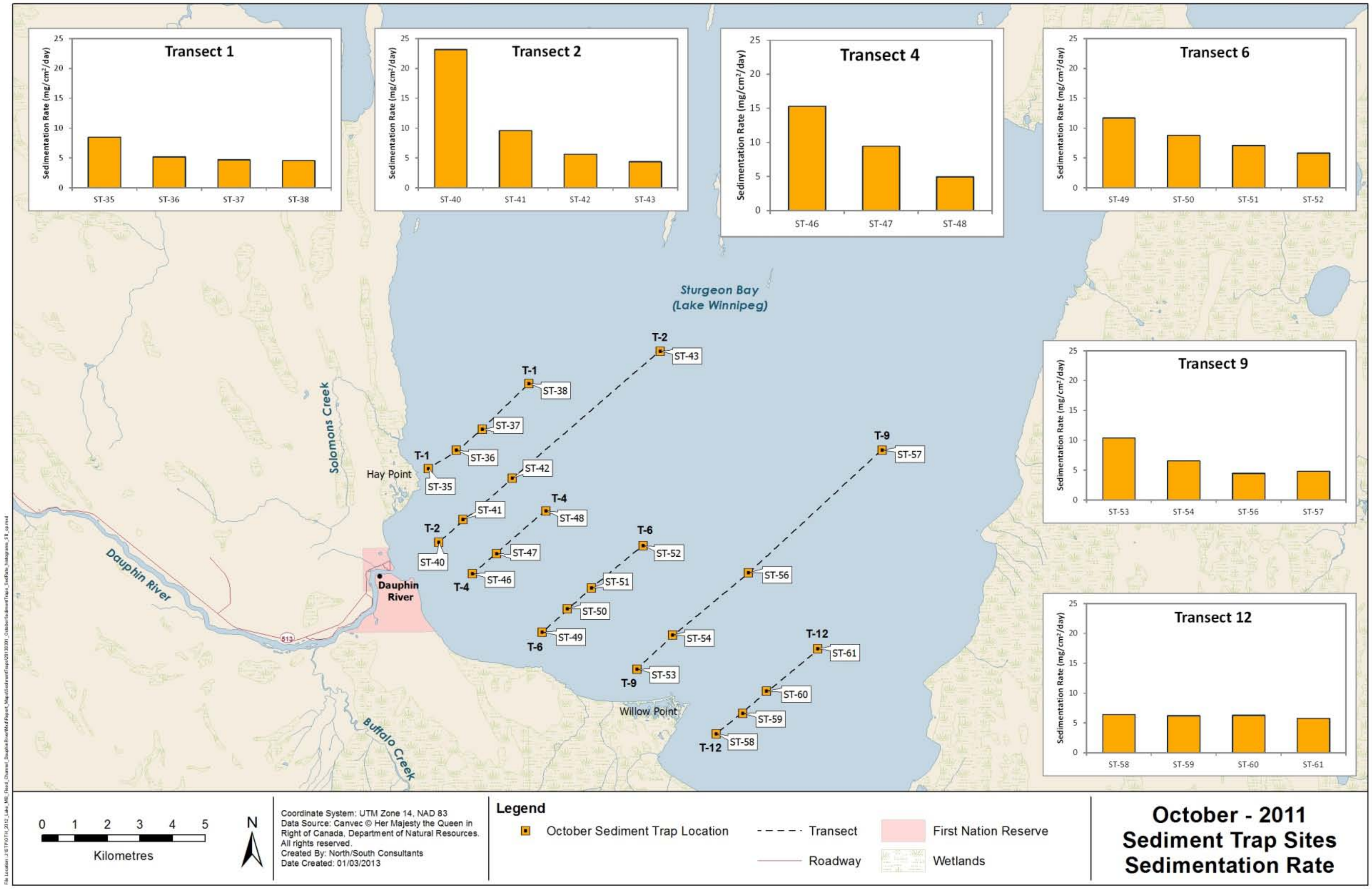

Figure 4-8. Sedimentation rate for samples, by transect, collected during summer 2012 from traps deployed in October 2011.

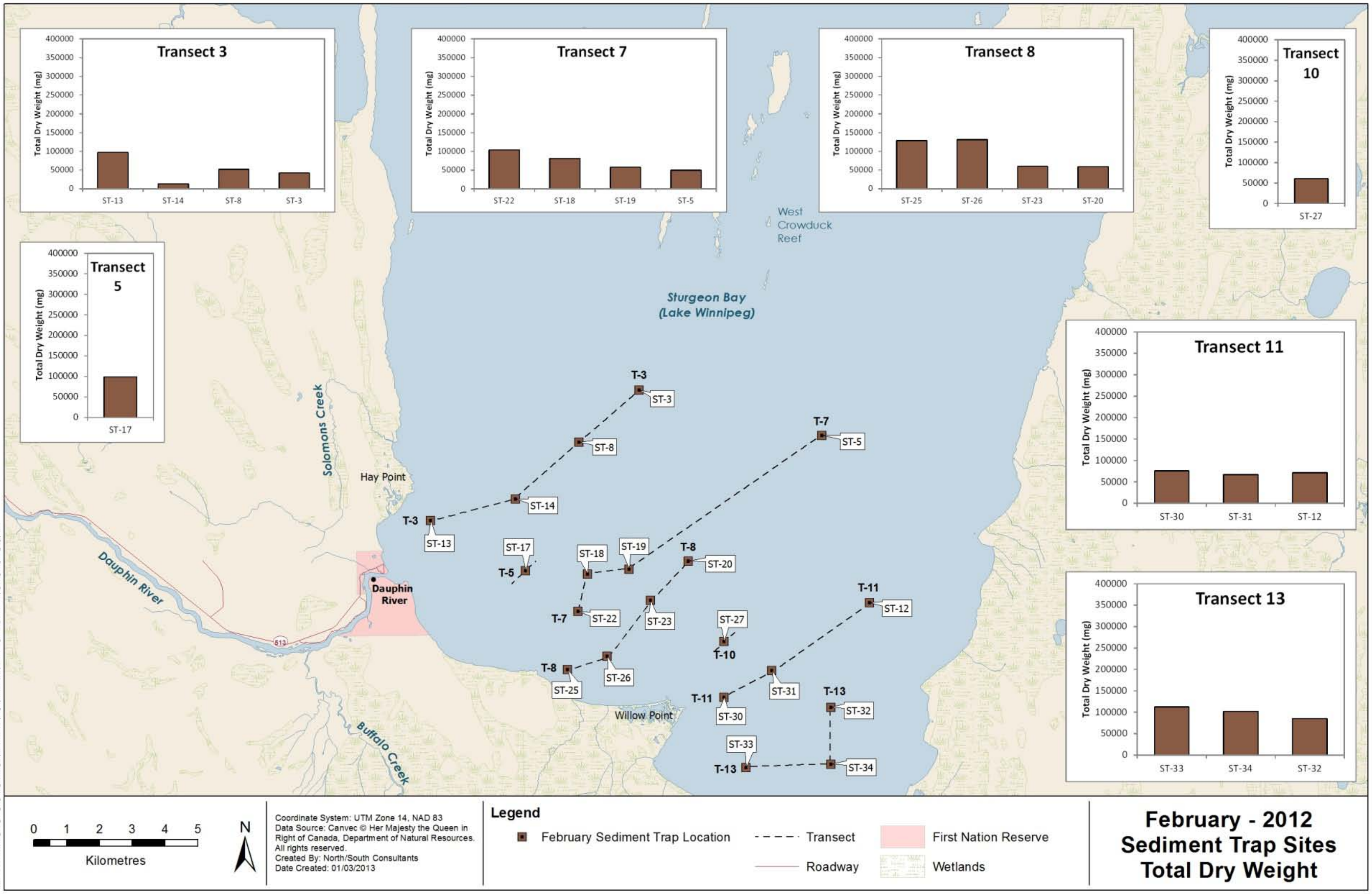

Figure 4-9. Total dry weight of samples, by transect, collected during summer 2012 from traps deployed in March 2012.

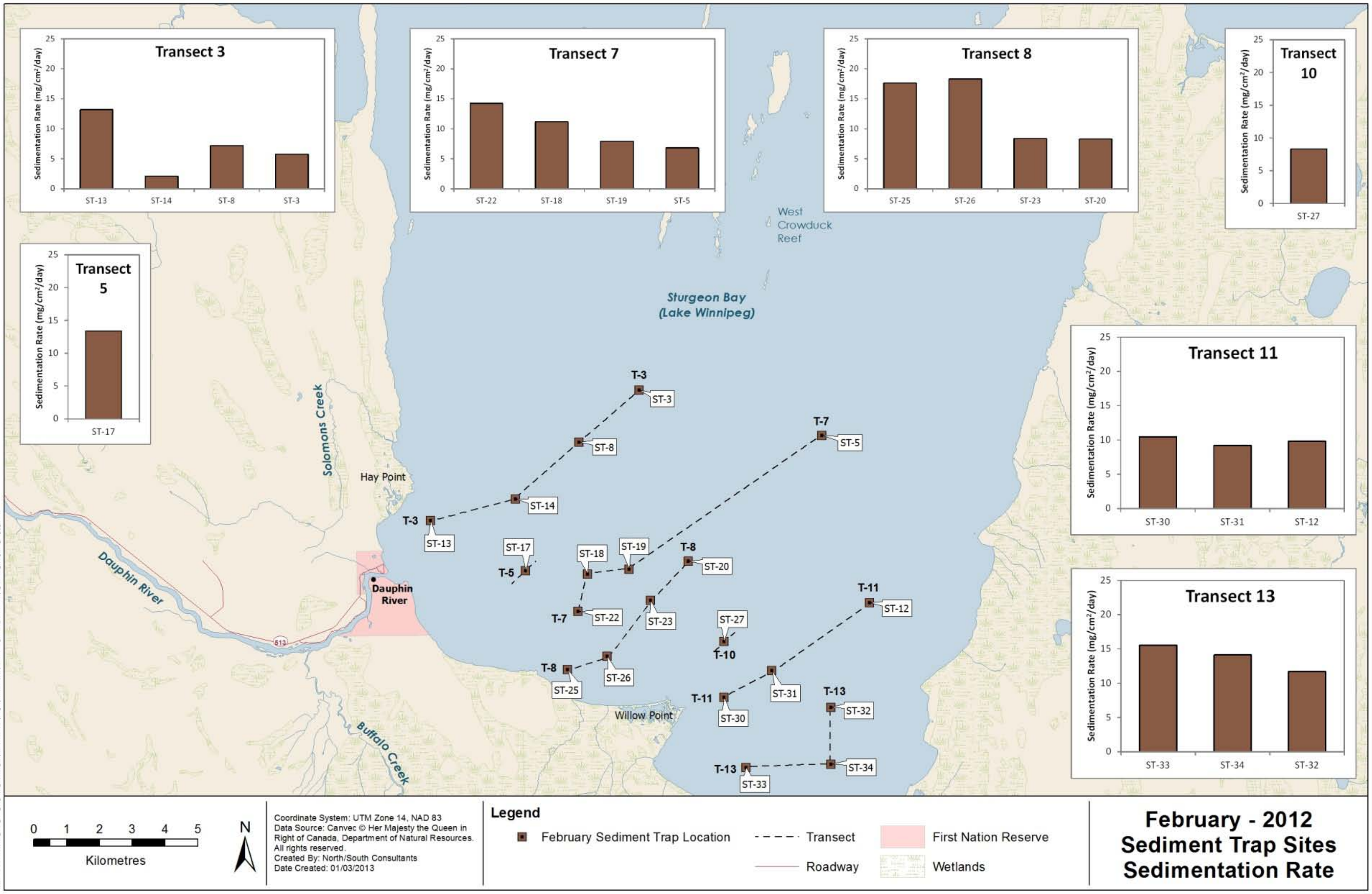

Figure 4-10. Sedimentation rate for samples, by transect, collected during summer 2012 from traps deployed in March 2012.

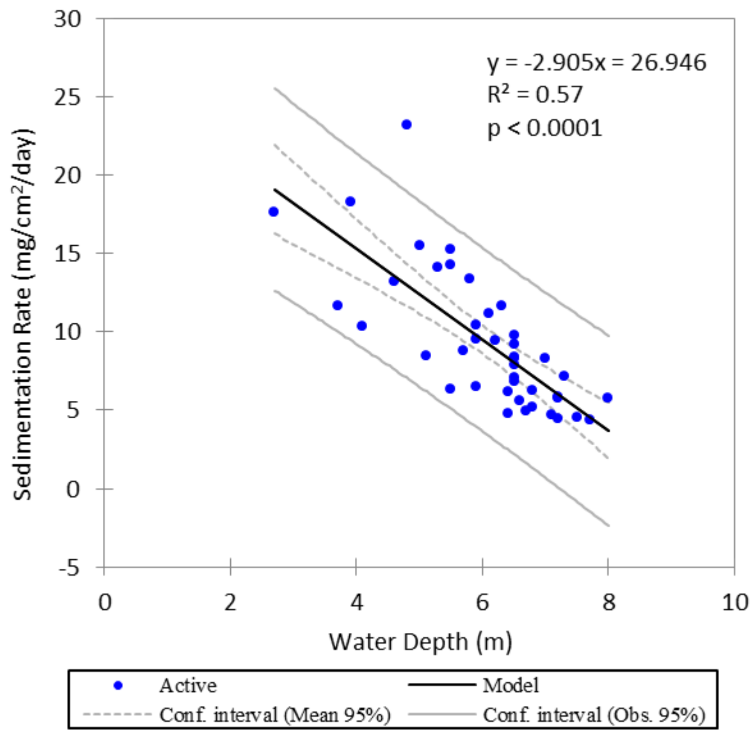

Figure 4-11. Linear regression between water depth (measured in February 2012) and calculated sedimentation rates, based on sediment trap data collected during summer 2012. Site ST-14 was excluded because it was retrieved approximately 3 weeks earlier than the other traps.

4.2 SUPPLEMENTAL SUBSTRATE AND HABITAT INFORMATION

Prior to operation of Reach 1, pre-project substrate and habitat information was collected in Sturgeon Bay. Water depth and substrate composition was documented between the Dauphin River and Willow Point. Results are presented in North/South Consultants Inc. (2013).

This study was intended to supplement existing baseline information for Sturgeon Bay by collecting additional water depth and substrate data from the vicinity of the proposed Reach 3 outlet near Willow Point, and between Willow Point and the Dauphin River prior to operation of Reach 3. Additional habitat information was to be collected from offshore areas of Sturgeon Bay north of Dauphin River if time permitted prior to the onset of operation of Reach 3.

4.2.1 Methods

The study was conducted during March 2012, prior to the proposed start date for operation of Reach 3. Data collections were comprised of water depth information, *in situ* substrate classifications and the collection of substrate samples for laboratory analysis of particle size. Sampling effort focussed on nearshore areas where spawning may occur, particularly in the vicinity of the proposed Reach 3 outlet near Willow Point and between Willow Point and the Dauphin River.

In situ substrate classifications were conducted at all sites by lowering an Aqua View 740C underwater camera through a hole in the ice and identifying the proportions of silt/clay, sand, gravel, small and large cobble, and boulders within the camera's field of view. A metered metal rod was lowered to the substrate surface prior to lowering the camera in order to provide scale for the size classifications. Water and ice depths were recorded at each site.

Substrate size classification was based on Wentworth (1922), and included the following size categories:

- Boulder > 256 mm
- Cobble 64-256 mm
- Gravel (aggregate) 2-64 mm
- Sand (aggregate) 62.5 µm – 2 mm
- Silt 3.9-62.5 µm
- Clay < 3.9 µm

Ekman grabs from a subset of survey locations, those with primarily small substrate sizes, were submitted to ALS Laboratories in Winnipeg for analysis of particle size. ALS Laboratories substrate size classification for sand, silt, and clay differs slightly than the Wentworth (1922) categories. ALS Laboratories for these particle size groupings are as follows:

- Sand (aggregate) 0.05-2 mm
- Silt 2 µm – 0.05 mm
- Clay < 2 µm

4.2.2 Results

Thirty-three sites along nine transects were surveyed from 25-27 March (Table 4-6, Figure 4-12). Water depths and *in situ* substrate classifications were collected at all 33 sites (Table 4-6). Substrate samples were collected from ten of the 33 sites and were submitted to ALS Laboratories for detailed particle size analysis. Results are presented in Table 4-6. Imagery from underwater photography and videography (all sites except T4-5 and T14-3) and sediment grabs (all sites from which grabs were possible) are presented in Appendix 4-1. Figure 4-13 illustrates an example of a sediment grab from a site (Site T3-1) that contains more than 80% silt content. Figure 4-14 shows substrate from a site (Site T10-1) with less silt (66.2%) and more clay content (28.4%).

Water depths ranged from 1.0-6.5 m, generally increasing further from shore. Ice thicknesses ranged from 0.38-0.78 m with the greatest depth of ice typically found at more offshore sites along each transect.

Along most transects, the proportion of smaller substrates (silt/clay, sand, and gravel) increased with increasing distance from shore while boulders and cobbles were more abundant in nearshore areas (Table 4-6). The softest substrates (silt/clay dominant) were found almost exclusively offshore at depths greater than 5.0 m where forces that transport and re-suspend sediment (e.g., wind, currents) are reduced by water depth.

Seven of 10 samples submitted for laboratory analyses were from the most offshore sites along their respective transects. Substrate at these locations was silt dominated with a silt loam texture (Table 4-6). In addition, the proportion of silt generally increased with depth (Tables 4-5 and 4-6). Of the three remaining samples, T4-3 and T16-5 were nearest to shore, shallowest and were clay dominant while T14-4 was in deeper water and primarily composed of sand.

Table 4-6. Locations where substrate classifications were conducted in Sturgeon Bay during March 2012.

Site ID [1]	Sample Date	Location [2]		Total Water Depth (m)	Ice Depth (m)	Substrate Grab Taken
		Easting	Northing			
T1-3	25-Mar-12	574903	5751123	3.9	0.61	N
T1-4	25-Mar-12	574563	5750764	-	0.53	N
T1-5	25-Mar-12	574200	5750443	1.3	0.45	N
T3-1	26-Mar-12	571998	5757177	6.3	0.75	Y
T3-2	26-Mar-12	570669	5755663	4.8	0.68	N
T3-3	26-Mar-12	570049	5754915	4.1	0.70	N
T3-4	26-Mar-12	569629	5754575	2.5	0.68	N
T4-1	26-Mar-12	569188	5757871	6.0	0.67	Y
T4-2	26-Mar-12	568103	5756120	4.8	0.76	N
T4-3	26-Mar-12	567221	5755538	3.6	0.66	Y
T4-4	26-Mar-12	566266	5755384	3.4	0.57	N
T4-5	26-Mar-12	565978	5755363	-	-	N
T10-1	27-Mar-12	571726	5757274	6.5	0.77	Y
T10-2	27-Mar-12	571866	5755283	4.4	0.73	N
T10-3	27-Mar-12	571774	5754272	4.0	0.68	N
T10-4	27-Mar-12	571702	5753757	3.3	0.67	N
T10-5	27-Mar-12	571644	5753236	1.4	0.59	N
T11-2	25-Mar-12	574904	5752171	5.0	0.74	Y
T11-3	25-Mar-12	574127	5751602	2.9	0.61	N
T11-4	25-Mar-12	573763	5751320	1.7	0.44	N
T11-5	25-Mar-12	573287	5750989	1.0	0.38	N
T13-2	27-Mar-12	573069	5755175	5.0	0.68	Y
T13-3	27-Mar-12	572865	5754566	4.3	0.72	N
T13-4	27-Mar-12	572679	5754058	4.0	0.73	N
T14-3	25-Mar-12	574846	5753363	5.3	0.74	Y
T14-4	25-Mar-12	574389	5752991	4.9	0.78	Y
T14-5	25-Mar-12	573814	5752737	1.9	0.69	N
T15-4	27-Mar-12	570766	5754532	4.0	0.65	N
T15-5	27-Mar-12	570478	5753787	2.3	0.56	N
T16-2	27-Mar-12	569885	5756886	5.5	0.69	Y
T16-3	27-Mar-12	569005	5755819	4.0	0.73	N
T16-4	26-Mar-12	568311	5755142	3.5	0.65	N
T16-5	26-Mar-12	567583	5754617	2.4	0.53	Y

1 - see Figure 4-12.

2 - UTM coordinates; Datum NAD 83, Zone 14U.

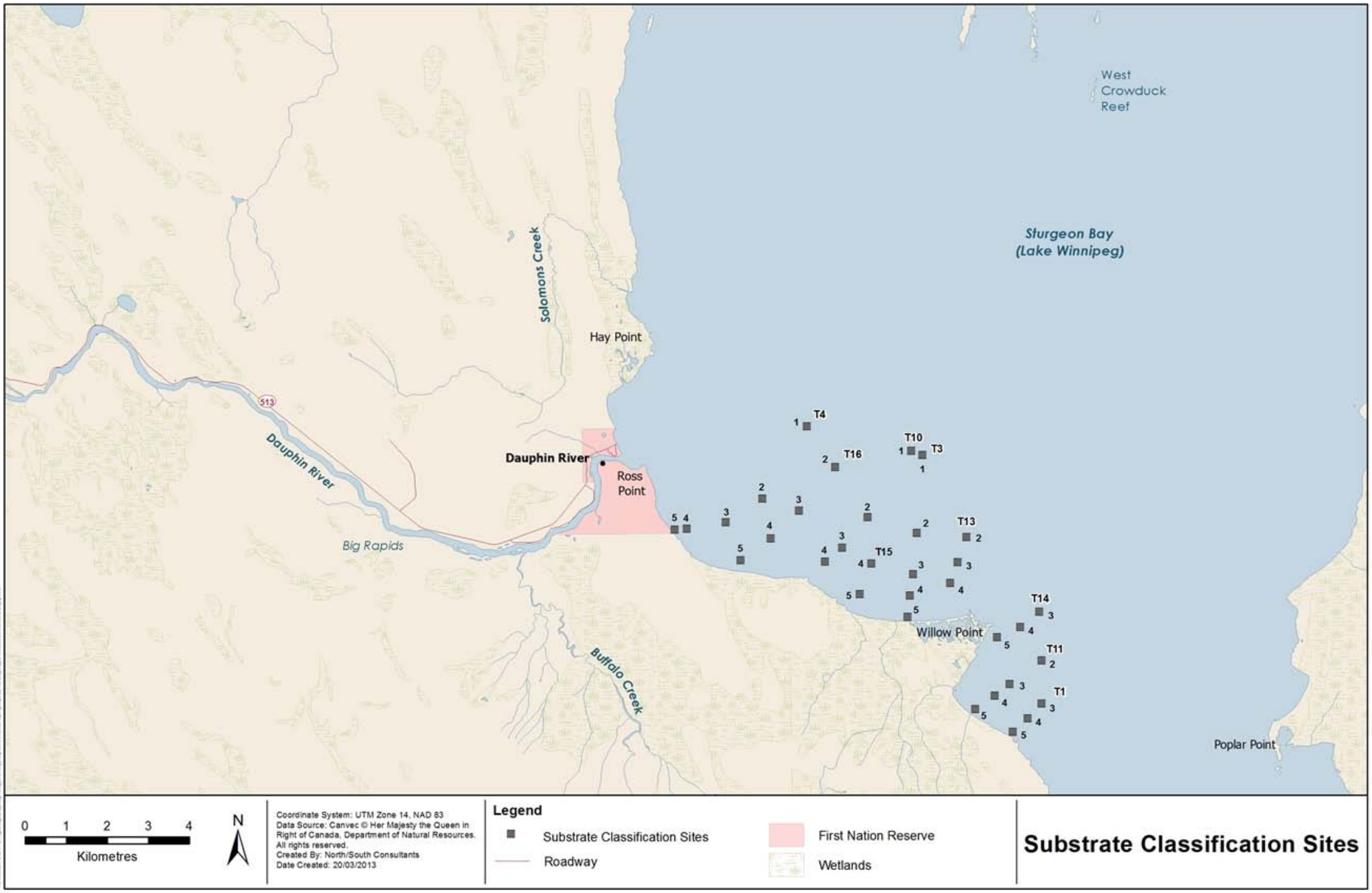

Figure 4-12. Locations where substrate classifications were conducted in Sturgeon Bay during March 2012.

Table 4-7. *In situ s*ubstrate classification and laboratory particle size analysis at sites in Sturgeon Bay during March 2012.

Site ID	Compaction	*In Situ* Substrate Classification (% total) [1]						Laboratory Particle Size Analysis (%)			
		Silt/Clay	Sand	Gravel	Small Cobble	Large Cobble	Boulder	Sand (2.0 mm - 0.05 mm)	Silt (0.05 mm - 2 um)	Clay (< 2 um)	Texture [2]
T1-3	hard	-	80	10	5	4	1	-	-	-	-
T1-4	hard	-	10	20	60	-	10	-	-	-	-
T1-5B	hard	-	5	15	30	40	10	-	-	-	-
T3-1	soft	100	-	-	-	-	-	4.81	81.1	14.1	Silt Loam
T3-2	hard	-	-	10	25	50	15	-	-	-	-
T3-3	hard	-	5	15	20	30	30	-	-	-	-
T3-4	hard	5	10	15	25	30	15	-	-	-	-
T4-1	soft	100	-	-	-	-	-	4.1	82.3	13.6	Silt Loam
T4-2	medium/hard	40	40	20	-	-	-	-	-	-	-
T4-3	hard	50	30	20	-	-	-	24.4	25	50.6	Clay
T4-4	hard	5	10	10	35	30	10	-	-	-	-
T4-5	hard	-	15	20	30	20	15	-	-	-	-
T10-1	soft	100	-	-	-	-	-	5.43	66.2	28.4	Silty Clay Loam
T10-2	hard	20	5	20	35	15	5	-	-	-	-
T10-3	hard	-	15	40	25	15	5	-	-	-	-
T10-4	hard	-	5	20	40	20	15	-	-	-	-
T10-5	hard	-	15	30	45	10	-	-	-	-	-
T11-2	soft	100	-	-	-	-	-	23.9	64.8	11.3	Silt Loam
T11-3	hard	-	30	-	50	20	-	-	-	-	-
T11-4	hard	-	5	15	20	60	-	-	-	-	-
T11-5	hard	-	70	15	5	5	5	-	-	-	-
T13-2	soft	100	-	-	-	-	-	11.4	69.3	19.3	Silt Loam
T13-3	hard	-	-	5	20	40	35	-	-	-	-
T13-4	hard	-	10	15	30	25	15	-	-	-	-
T14-3	soft	100	-	-	-	-	-	16.1	64.1	19.8	Silt Loam
T14-4	soft	99	-	-	-	1	-	82.6	13.6	3.72	Loamy Sand
T14-5	hard	-	-	60	30	10	-	-	-	-	-
T15-4	hard	20	5	15	40	20	-	-	-	-	-
T15-5	hard	-	-	10	60	25	5	-	-	-	-

Table 4-7. (continued).

Site ID	Compaction	*In Situ* Substrate Classification (% total) [1]						Laboratory Particle Size Analysis (%)			
		Silt/Clay	Sand	Gravel	Small Cobble	Large Cobble	Boulder	Sand (2.0 mm - 0.05 mm)	Silt (0.05 mm - 2 um)	Clay (< 2 um)	Texture [2]
T16-2	soft	100	-	-	-	-	-	5.12	70.7	24.1	Silt Loam
T16-3	hard	-	-	5	20	55	20	-	-	-	-
T16-4	hard	20	10	30	15	25	-	-	-	-	-
T16-5	hard	60	15	25	-	-	-	19.5	27.8	52.7	Clay

1 - note that size definitions for sand, silt, and clay differ slightly between *in situ* and laboratory analyses; see method section

2 - Loam is a substrate type composed of sand, silt, and clay in relatively even concentration. As the proportions of these components vary, different types or textures can result such as sandy loam, silty loam, clay loam, etc.

Figure 4-13. Substrate sample from Site T3-1, March 2012.

Figure 4-14. Substrate sample from Site T10-1, March 2012.

4.3 SUMMARY

4.3.1 Sedimentation Rates in Sturgeon Bay

Sedimentation rates were monitored in Sturgeon Bay from October 2011 through August 2012. Sedimentation data were collected from a series of sediment traps deployed throughout Sturgeon Bay. Numerous traps were deployed, retrieved and re-deployed between October 2011 and August 2012 to provide insight into sedimentation during winter and summer periods while Reach 1 was in operation. The data will be compared with similar information to be collected following operation of Reach 1.

Sampling periods reported here include the following:

- deployment of 30 sediment traps in October 2011, 23 of which were retrieved in August 2012;
- deployment of 34 sediment traps in February 2012, all which were retrieved in March 2012; and,
- deployment of 31 sediment traps in March 2012, 19 of which were retrieved August 2012.

Sediment trap data indicate spatial and temporal variability in sedimentation rates in Sturgeon Bay. Available data suggest:

- sedimentation rates in Sturgeon Bay are minimal during periods of ice cover when wind and wave-induced sediment re-suspension does not occur;
- sedimentation rates were higher in the immediate vicinity of the Dauphin River, relative to areas north and southeast of the river; and
- sites located in nearshore areas generally have higher sedimentation rates than offshore sites during open water periods.

The latter spatial pattern may reflect actual higher rates of sedimentation in these areas, due, for example, to suspended sediment loads introduced from the Dauphin River, but may also reflect effects of shoreline erosion and/or sediment re-suspension. Effects of wind-induced sediment re-suspension would be greatest in shallow areas and results here suggest that sedimentation rate was significantly decreased with increasing water depth.

The collection of additional sediment data in upcoming years will provide additional information that will help understand the effects that operation of Reach 1 may have had on aquatic environments in Sturgeon Bay.

4.3.2 Supplemental Substrate and Habitat Information

Supplemental substrate and fish habitat information were collected to supplement existing baseline information for Sturgeon Bay by collecting additional water depth and substrate data from the vicinity of the proposed Reach 3 outlet near Willow Point and between Willow Point and the Dauphin River. The intent was to collect additional information describing those habitat features prior to operation of Reach 3.

Water depth was measured, an underwater digital camera was used to provide *in situ* assessments of substrate characteristics at sample locations, and substrate samples were collected from areas where sands, silts, and clays where the predominant substrate. Substrate samples were then analyzed for particle size composition in a laboratory.

Data were collected from 33 sites from 25-27 March 2012. Water depths ranged from 1.0-6.5 m, generally increasing further from shore. In general, the proportion of smaller substrates (silt/clay, sand, and gravel) increased with increasing distance from shore while boulders and cobbles were more abundant in nearshore areas. The softest substrates (silt/clay dominant) were found almost exclusively offshore at depths greater than 5.0 m where forces that transport and re-suspend sediment (e.g., wind, currents) are reduced by water depth

5.0 SPRING FISHERIES INVESTIGATIONS

Spring fisheries investigations were identified in the work plan (North/South Consultants Inc. 2012a; see Appendix 1-1) as study ***FS-2 - Spring Fisheries Surveys in the Dauphin River and Sturgeon Bay.*** The objectives of the spring fisheries investigations as stated were to:

- provide information on fish use of habitat within the Dauphin River between its confluence with Buffalo Creek and Sturgeon Bay in early spring (emphasis on spring spawning fish and identification of spawning grounds, particularly Walleye and Northern Pike);
- provide information on fish utilization of nearshore habitats in Sturgeon Bay during early spring (emphasis on spring spawning fish and identification of spawning grounds, particularly Walleye and Northern Pike);
- determine whether fish move upstream from Sturgeon Bay into Reach 3 during spring;
- provide information on fish utilization of habitats within the lower extent of Buffalo Creek during spring and following the closure of Reach 1;
- determine if Lake Whitefish eggs spawned in the Dauphin River and lower-most reaches of Buffalo Creek during fall 2011 successfully hatched in spring 2012;
- determine if Lake Whitefish successfully spawned in nearshore areas of Sturgeon Bay during fall 2011 (emphasis on nearshore habitats in Sturgeon Bay near Willow Point and the proposed Reach 3 outlet); and,
- monitor debris accumulation in gill nets set in Sturgeon Bay in the vicinity of the Dauphin River and Willow Point.

Subsequent to delivery of the workplan to DFO and following discussion with MIT, the proposed study was expanded to include fisheries investigations in Lake St. Martin and limited investigations at Grand Rapids. The intent of the Lake St. Martin work was to determine whether Lake Whitefish successfully spawned in Lake St. Martin during fall 2011 (i.e., did their eggs successfully incubate through the winter of 2011/2012 and hatch during spring 2012), document the movement of larval fish out of Lake St. Martin and into Reach 1 and the Dauphin River, and to attempt to locate concentrations of spring spawning fish (emphasis on Walleye). Lake Winnipeg at Grand Rapids was added as a reference location against which information regarding the abundance and density of larval Lake Whitefish collected in Sturgeon Bay and Lake St. Martin might be compared.

Although Reach 3 was constructed, an exceptionally mild winter allowed sufficient drainage from Lake Manitoba and Lake St. Martin to reduce water levels to a point where risk of ice jamming and flooding at Dauphin River became negligible. Consequently, Reach 3 was not operated and field investigations related to fish movements into Reach 3 were not conducted.

5.1 METHODS

The nature of the study objectives and the timing of the biological activities to be documented dictated that field investigations be conducted at specific and different times during the course of the spring. For example, larval Lake Whitefish hatch shortly after ice off, adult Walleye move to spawning areas and begin to spawn concurrently or shortly thereafter, and larval Walleye hatch about 2-3 weeks after spawning occurs. Consequently, numerous short-duration field campaigns (sampling periods) were conducted during spring. This provided snapshots of biological activity over a broader time period and allowed field investigations to target specific biological occurrences, as well as document general spring fish activity and habitat use as spring progressed.

Field activities focused on four general study areas. These included:

- Lake St. Martin, including entrance to the Dauphin River and the entrance to Reach 1;
- the lower reach of the Dauphin River, extending from approximately 2 km upstream of the Buffalo Creek confluence downstream to Sturgeon Bay, and including the lowermost reach of Buffalo Creek;
- nearshore areas of Sturgeon Bay with particular emphasis on areas in the immediate vicinity of the Dauphin River and Willow Point; and,
- Lake Winnipeg at Grand Rapids.

Within each general study area, field activities focused on specific areas where local knowledge, fisheries work conducted in fall 2011 (North/South Consultants Inc. 2011c), and habitat assessments have indicated that spawning by Walleye and Lake Whitefish (both species of commercial and domestic importance) may occur.

In general, field activities focused on documenting the occurrence and timing of fish spawning activity, the occurrence, distribution and abundance of larval fish, and the occurrence, distribution and abundance of adult fish and their status with respect to spawning activity. A suite of fisheries sampling methods were used within each study area to collect information or document conditions to address specific questions.

At Lake St. Martin, field activities included the following:

- deployment of a temperature logger during the open water season to document water temperatures during spawning periods;
- installation of egg mats in areas where experimental gill net sets revealed concentrations of adult Walleye in spawning condition;
- installation of drift traps at the entrance to Reach 1 to document the movement of larvae and smaller fish out of Lake St. Martin and into Reach 1;
- installation of larval drift traps at the entrance to the Dauphin River to document the movement of larvae and smaller fish out of Lake St. Martin and into the Dauphin River;

- conduct of neuston tows to determine the presence and abundance of larval Lake Whitefish and other species in Lake St. Martin (i.e., help determine the success of the fall 2011 Lake Whitefish spawn);
- conduct of experimental gillnetting in Lake St. Martin to determine the status of spawning fish (pre-spawn, ready to spawn, post-spawn) and to attempt to locate spawning aggregations of Walleye and other species; and,
- documentation of debris accumulation in experimental gill nets.

At Dauphin River and Buffalo Creek, field activities included the following:

- deployment of three temperature loggers (one in Buffalo Creek and two in the Dauphin River) during the open water season to document water temperatures during spawning periods;
- installation of egg mats in the lower Dauphin River in the vicinity of the Buffalo Creek confluence to collect fish eggs and document fish spawning activity in that area;
- installation of larval drift traps in the lower-most reach of Buffalo Creek to document the presence of larvae and smaller fish drifting out of the creek;
- installation of drift traps in the lower Dauphin River in the vicinity of the Buffalo Creek confluence to document the presence of larval and smaller fish drifting down the Dauphin River and to determine whether Lake Whitefish eggs spawned there in fall 2011 (North/South Consultants Inc. 2011c) and eggs spawned during spring by other species successfully incubated (i.e., help determine the success of the fall 2011 Lake Whitefish spawn and spring 2012 spawn by other species); and,
- conduct of boat electrofishing in the lower reaches of the Dauphin River to document fish use during spring and to locate spawning aggregations of fish, particularly Walleye.

At Sturgeon Bay, field activities included the following:

- deployment of a temperature logger during the open water season to document water temperatures during spawning periods;
- installation of egg mats in Sturgeon Bay to capture fish eggs to identify spawning locations for spring spawning fish;
- conduct of neuston tows to determine the presence and abundance of larval Lake Whitefish and other species in nearshore areas of Sturgeon Bay;
- conduct of experimental gillnetting in Sturgeon Bay to determine status of spring spawning fish (pre-spawn, ready to spawn, post-spawn) and to attempt to locate spawning aggregations of Walleye and possibly locate spawning areas for Walleye and other species; and,
- documentation of debris accumulation in experimental gill nets.

At Grand Rapids, located on Lake Winnipeg approximately 165 km north of the Dauphin River, field investigations focused on conducting neuston tows to capture larval Lake Whitefish to provide information to compare against similar information collected in Sturgeon Bay.

The following sections provide detailed methods for each type of sampling equipment used during 2012 aquatic investigations.

5.1.1 Water Temperature

Onset HOBO Water Temperature Pro v2 loggers were installed in mid-April at five locations throughout the study area (Table 5-1; Figure 5-1), including the following:

- Buffalo Creek upstream of the Dauphin River;
- Lake St. Martin approximately 1.5 km west of Reach 1;
- the Dauphin River upstream of Buffalo Creek;
- the Dauphin River downstream of Buffalo Creek; and,
- Sturgeon Bay north of the Dauphin River mouth.

Temperature loggers were operated continuously until early November and were programmed to record water temperature at four hour intervals. Water temperature data were downloaded periodically from the loggers using software provided by the manufacturer (Onset HOBOware Pro ver. 2.3.1). Water temperature was plotted to illustrate daily changes throughout the period of installation.

Table 5- 1. Site information for temperature loggers deployed in Lake St. Martin, Buffalo Creek, the Dauphin River, and Sturgeon Bay, 2012.

Site ID	Site Description	Date Installed	Date Removed	Days in Water [1]	UTM (14U)		Depth (m)
					Easting	Northing	
DR-1	Buffalo Creek (U/S of DR)	16-Apr	08-Nov	191	562152	5754634	0.5
DR-2	Lake St. Martin (~1.5 km from Reach 1)	14-Apr	29-May	45	562376	5754951	-
DR-3	Dauphin River (U/S of Buffalo Cr.)	16-Apr	08-Nov	198	562827	5755165	0.5
DR-4	Dauphin River (D/S of Buffalo Cr.)	16-Apr	08-Nov	206	562631	5754836	1.0
DR-5	Sturgeon Bay N	18-Apr	07-Nov	203	562780	5754913	3.0

1 - Days in water do not include the following: DR-1 was on dry land from 3-17 October before being re-deployed; DR-2 was lost at some point after the last data download on 29 May; and DR-3 was pulled on 16 October and re-deployed on 23 October.

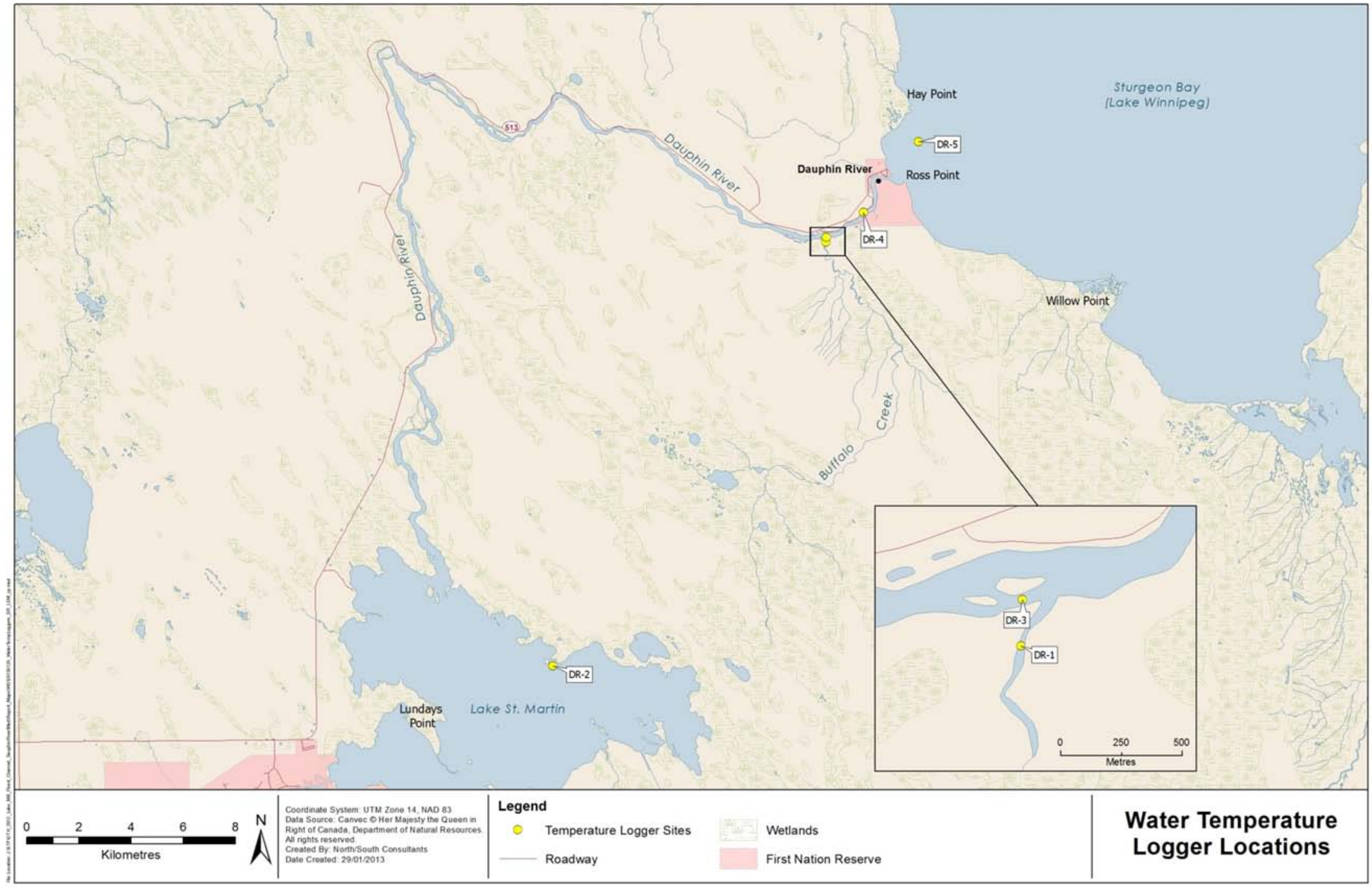

Figure 5-1. Location of water temperature loggers installed in Lake St. Martin, Buffalo Creek, the Dauphin River and Sturgeon Bay during 2012.

5.1.2 Spawning Activity and Larval Fish

5.1.2.1 Egg Mats

Egg mats have frequently been used to collect fish eggs in order to determine spawning habitat preferences and delineate spawning locations (La Haye et al. 2003; Manny et al. 2007; MacDougall and MacDonell 2009; Thompson 2009). Egg mats are set in or immediately downstream of areas where spawning is thought to occur and as eggs settle onto the substrate or are stirred up from the river bottom they readily adhere to the filter material of the egg mat (Figure 5-2). Egg mats used in this study were comparable to those used in fall monitoring activities in the lower Dauphin River (North/South Consultants Inc. 2011c) and Walleye spawning investigations at other locations (Manny et al. 2007; Thompson 2009).

Egg mats consisted of 39 x 19 x 9 cm cinder blocks wrapped with air filter material (i.e., latex-coated horse hair or fiberglass; Figure 5-3). The filter material was held in place against the cinder block with sideline. Eggs mats were deployed by attaching a float and line to the cinder block and lowering the egg mat to the river or lake bottom. Date, time, and UTM coordinates were recorded for every egg mat that was set.

Timing and location of egg mat deployment was based upon the presence of spawning adult fish in areas of interest. Single egg mats were deployed throughout areas of interest and were lifted, checked for the presence of fish eggs, and reset at least once during the sampling period. At each sampling station, the filter material was removed and placed into an individually labelled bag. A clean filter was re-attached to the cinder block and the egg mat re-deployed in approximately the same location. Date, time and UTM coordinates were recorded during each re-deployment. After being transported to shore, the filter material was examined for the presence of fish eggs. Any eggs recovered were preserved in 10% formalin for subsequent enumeration and species identification. Egg mat catches were tabulated by site.

Figure 5-2. Lake Whitefish eggs collected on an egg mat set in the lower Dauphin River during fall, 2011.

Figure 5-3. An egg mat ready for deployment.

5.1.2.2 Drift Traps

Drift traps are frequently used in riverine environments to capture invertebrates, fish eggs and fish larvae drifting downstream. Two types of drift traps were used during this study. The first, referred to hereafter as "large" traps, had a mouth opening of 43 x 85 cm and included a 300 cm long screen bag constructed of 950 µm Nitex®, which tapered to a 9 cm diameter removable ABS pipe cod-end. The second type of drift trap was of similar design but was much smaller. These, hereafter referred to as "small drift traps", were designed after Burton and Flannagan (1976), had a mouth opening of 15 x 15 cm, and a 1 m long cod end constructed of 500 µm Nitex®.

All large drift traps used in this study were deployed as floating traps set at the water surface. Floating traps consisted of the Nitex® screen bag assembly inserted into a buoyant ABS frame. The frames were constructed of two 1.8 m long x 15 cm diameter L-shaped pontoons constructed of plastic ABS pipe. The pontoons were held together with a lightweight aluminum frame using two cross bars at each end (Figure 5-4). The opening of the drift trap was set perpendicular to the pontoons, with the cod-end floating freely at the rear of the trap. To deploy the floating drift traps, a large anchor (approximately 25 kg) was set first. The trap was attached to the anchor by a 10 m line and oriented so that the trap mouth faced upstream. The cod end was allowed to float freely to the rear of the trap.

Figure 5-4. A large floating drift trap deployed near the inlet to Reach 1 during spring 2012.

Small drift traps used in this study were either deployed as floating drift traps set at the water surface or were attached to two metal T-bars pounded into the water body substrate. When deployed as floating traps, a wooden pontoon approximately 20 cm wide, 2.5 cm thick, and 120 cm long was used to buoy the small traps. The trap was attached to the bottom of the pontoon using metal brackets such that the trap mouth was approximately 10 cm below the surface of the water when deployed. Traps were oriented with the trap mouth facing upstream and were held in position by a 10 m line attached to a large anchor. Traps attached to metal T-bars were positioned so that the trap mouth was oriented directly into the current and positioned approximately 10 cm below the surface of the water (Figure 5-5). As water levels receded, traps were moved to areas of higher water velocity.

During this study, drift traps were set for two 24-hour periods during each sampling period. Traps were emptied after 24 hours. Set and lift dates and times were recorded, along with the UTM coordinates for each trap location. Contents from each trap were preserved in 10% formalin for subsequent sorting in the laboratory. Water velocity was measured at the mouth of each drift trap using a Swoffer flow meter during each sampling period to allow for the estimation of the volume of water passing through the drift traps during each sampling session.

Figure 5-5. Deploying a small drift trap affixed to metal T-bars pounded into the substrate of Buffalo Creek during spring 2012.

Fish eggs and fish were removed from each sample in the North/South Consultants Inc. laboratory, enumerated by species and sample site, and tabulated. Drift samples from all regions were subjected to quality assurance/quality control (QA/QC) measures whereby a second taxonomist identified and enumerated a random subsample representing approximately 10% of the total samples. Particular emphasis was placed on QA/QC for coregonine (Lake Whitefish and Cisco) identification due to their importance to people, the project, and because they can be difficult to differentiate between depending on size and condition of the samples. If there was less than 5% difference in counts and identifications between the two taxonomists for all samples, then the original numbers were used for consistency of reporting. If the difference was greater, samples in question were re-examined by the first taxonomist. All debris and invertebrates captured in the drift traps were preserved and archived against future need.

5.1.2.3 Neuston Tows

Sampling for larval fish can provide information about spawning success and, if sampling is done early before the larvae have been widely distributed by currents, can indicate approximate spawning areas. Immediately after hatching in the spring, larval fish are unable to actively transport themselves. They are transported by wind and wave-generated currents and ascend to the water surface, where they are susceptible to capture.

In this study, surface sampling for larval fish was conducted using a neuston sampler. Neuston samplers consist of an aluminum box comprised of a mouth opening 45 x 45 cm in dimension, and include wings and a depressor to control box elevation within the water column. A 500 µm mesh Nitex® screen bag tapered into a removable 500 µm Nitex® cod-end is attached to the aluminum box. A General Oceanics flow meter is mounted in the mouth opening of the aluminum box to estimate the volume of water filtered and provide a means of standardizing the catch-per-unit-effort (CPUE) of the catch. This allows for comparison between neuston tows and between sampling areas. Complete dimensions and assembly instructions are provided in Mason and Phillips (1986).

Neuston samplers are towed behind and to the starboard side of a boat, sampling water undisturbed by the boat's propeller and wake. The objective is to have the sampler sitting in the water column such that, when being towed, approximately 30 cm of the mouth is submerged and the top of the box is oriented parallel to the surface of the water (Figure 5-6). Preferred boat speed is 4-6 knots (7-11 km/hr; Mason and Phillips 1986). Upon completion of each run, the neuston sampler was brought into the boat and contents were transferred from the cod end into labelled sampling jars and preserved with 10% formalin for subsequent identification in the laboratory.

When conducting neuston tows, the following information was recorded:

- date and time of day;
- GPS data - starting and end waypoint, as well a track log of the tow;
- general weather conditions, including estimation of wind speed and direction;
- sea state (wave height and general direction) and general orientation of the tow to wave direction;
- revolution count on flow meter at start and end of tow;
- time at the beginning and end of each run;
- qualitative description of catch (amount of debris, description of debris, presence/absence of fish if possible); and,
- any other conditions that may affect the tow or distribution of larval fish.

All fish were identified to species, enumerated, and tabulated by species for each neuston tow. Catch-per-unit-effort (CPUE) was calculated for each tow as the number of fish captured per 100 m^3 of water filtered by the neuston. Track logs of the tows were plotted to show the area sampled.

Figure 5-6. A neuston sampler being towed to sample larval fish in Lake St. Martin during spring 2012.

5.1.3 Adult Fish

5.1.3.1 Experimental Gill Nets

Experimental gill nets were set with the intention of identifying fish concentrations in areas where local knowledge has indicated that spawning by commercially important species such as Walleye or Lake Whitefish occurs. In general, net sets were of short set duration (less than 2 hours) to minimize fish mortality.

Experimental gill nets used were 137.2 m long and consisted of 22.9 m long by 1.8 m deep panels of 1.5, 2.0, and 3.0 inch stretched twisted nylon mesh and 3.75, 4.25, and 5.0 inch stretched twisted monofilament mesh. Net location, set date and time, and retrieval date and time were recorded along with other information including water depth, water temperature, and weather conditions.

All fish captured were enumerated by species and sampling location. Each fish (mortalities and live released fish) was measured for fork length (± 1 mm) and round weight (± 25 g). All spring spawning species were examined to determine spawning status (i.e., determine sex and state of sexual maturity maturity) by gently applying pressure on the abdomen to try and extrude gametes (i.e., eggs or sperm). The gonads of fish that died while in the gill nets were examined internally to determine spawning status. The following sexual maturity codes were used:

Females (F)
2 - maturing to spawn (pre-spawn)
3 - ripe (immediate pre-spawn)
4 - spend (post-spawn)

Males (M)
7 - maturing to spawn (pre-spawn)
8 - ripe (immediate pre-spawn)
9 - spend (post-spawn)

All live fish were released following sampling. All live Walleye and Lake Whitefish were marked with individually numbered plastic Floy® FD-94 T-bar anchor tags prior to release. Floy® tags were inserted between the basal pterygiophores of the dorsal fin using a Dennison® Mark II tagging gun.

The gillnetting catch was tabulated by species and capture location. CPUE was calculated for the overall catch and for each species and site, and was calculated as the number of fish caught per 100 m gillnet gang per hour for short duration sets and per 24 hours for two overnight sets in Sturgeon Bay. Total CPUE was calculated by averaging all net set CPUE values.

Mean fork length (mm), weight (g) and condition factor (K) was calculated for each species. Condition factor was calculated for fish where fork length and round weight were measured, using the following formula (after Fulton 1911, in Ricker 1975):

$$K = \text{round weight (g)} \times 10^5/(\text{fork length})^3$$

Length-frequency distributions were plotted for each species where $n \geq 15$ fish. Length intervals of 25 mm were used for most species (e.g., 225-249 mm). A 50 mm interval was used for Northern Pike. Gill net catches were tabulated by species and net set to allow for the examination of changes in catch composition between sampling periods during spring 2012.

5.1.3.2 Boat-based Electrofishing

Boat based-electrofishing is conducted by arcing high voltage, high amperage electricity through the water from an anode array extending from the bow of an aluminum boat. The boat acts as a cathode, and lines of electrical current are established between the anode and the boat as the electrofisher is operated. The electric field causes muscle contractions in fish that lie within the electric field, forcing them to swim towards the anode. Prolonged exposure stuns the fish. Field technicians stationed at the front of the boat use large dip nets to collect stunned or partially stunned fish (Figure 5-7).

Figure 5-7. A boat-based electrofisher in operation during a night-time sampling session.

Numerous electrofishing runs were conducted during each sampling period. Effort was made to sample in various habitat types. The following information was collected for each electrofishing run:

- Date and time of day;
- GPS data - starting and end waypoint, as well a track log of the path followed by the electrofishing boat;
- Fishing effort (number of seconds the electrofisher operated);
- Electrofisher settings (volts, amperage, pulse width and frequency); and,
- A species-specific count of fish observed but not captured.

Captured fish were allowed to recuperate in a tub of water prior to measuring. Biological data collection was similar to that described for gillnetting. All captured fish were enumerated by species and sampling location. Each fish was measured for fork length (± 1 mm) and round weight (± 25 g). All spring spawning species were examined to determine spawning status (i.e., determine sex and state of sexual maturity) by gently applying pressure on the abdomen to try and extrude gametes (i.e., eggs or sperm). Codes used for sex and state of maturity are described in Section 5.1.3.1. All fish were live released following sampling. All Walleye and Lake Whitefish were marked with individually numbered plastic Floy® FD-94 T-bar anchor tags prior to release. Floy® tags were inserted between the basal pterygiophores of the dorsal fin using a Dennison® Mark II tagging gun.

Fish catches were tabulated by species and electrofishing run. Total counts presented here include fish observed as well as captured. Often, large schools of fish are encountered during spawning periods and, when stunned by the electrofisher, so many are present that it is not possible to collect them all. Inclusion of observed fish in the catch provides a more accurate depiction of the fish present when electrofishing was conducted. The CPUE for electrofishing runs was calculated as the number of fish captured per 60 seconds of electrofishing. Total CPUE was calculated by averaging CPUE values for all electrofishing runs.

Mean fork length (mm), weight (g) and condition factor (K) was calculated for each species. Condition factor was calculated for fish where fork length and round weight were measured, using the following formula (after Fulton 1911, in Ricker 1975):

$$K = \text{round weight (g)} \times 10^5/(\text{fork length})^3$$

Length-frequency distributions were plotted for each species where $n \geq 15$ fish. Length intervals of 25 mm were used for most species (e.g., 225-249 mm). A 50 mm interval was used for Northern Pike. Electrofishing catches were tabulated by species and run to allow for the examination of changes in catch composition between sampling periods during spring 2012.

5.1.4 Debris Monitoring

The possibility that increases in flow through the bog/wetland complex surrounding Big Buffalo Lake and down Buffalo Creek could result in erosion and transport of large amounts of debris (organic and mineral materials, scoured peat bog, and terrestrial vegetation such as trees, etc.) that would ultimately be introduced into Sturgeon Bay was recognized prior to operation of Reach 1. Commercial fishers working Sturgeon Bay expressed concern that increased debris could negatively affect the commercial fishery by causing the destruction of fishing nets, increased effort to keep nets clean and fishing efficiently and possibly by reducing fish stocks in Sturgeon Bay due to damage/alteration of spawning areas through increased sedimentation. The occurrence of debris in experimental gill nets set in Sturgeon Bay was recorded during fall 2011 to help address this concern.

Monitoring programs to document debris in gillnet gangs have previously been conducted in Manitoba. From 1993 to 1997, Manitoba Hydro, the Province of Manitoba, and the Norway House Fisherman's Cooperative conducted a monitoring program to document the effects that debris may have had on the commercial fishery in Playgreen Lake (Graveline and Horne 1998). The methods used in that study were followed for this program.

The quantity and type of debris were evaluated for gill nets set in Lake St. Martin and Sturgeon Bay. The amount of debris in each gang was categorized based on the percentage of the gang area (surface area of mesh) fouled by debris. Categories for debris quantity were as follows:

- None (no debris in gang; nets were clean);
- Low (< 5% of gang area covered by debris);
- Medium (5-15% of gang area covered by debris);
- High (16-25% of gang area covered by debris); and,
- Very High (> 25% of gang area covered by debris).

The type of debris was then categorized as a percentage of the total amount of debris in the gang. By this method, the sum of the relative percentage of all debris types present always equalled 100%, regardless of the debris level. For example, if a gang contained only one stick, sticks would constitute 100% of the debris in the gang. Categories for debris composition were as follows:

- Terrestrial vegetation (trees, shrubs, grass, etc.);
- Terrestrial moss (muskeg);
- Sticks (driftwood or logs);
- Aquatic vegetation (weeds);
- Algae;
- Silt/mud; and,
- Other (rocks, shells, etc.).

The amount and type of debris that occurred in each gang was tabulated.

5.2 RESULTS

Warm weather conditions during winter 2011 and spring 2012 resulted in an earlier than normal ice break up on lakes and rivers in the study area. The first field campaign was initiated in mid-April, and sampling sessions continued into mid-June. There were a total of eight sampling periods including two summer neuston sampling periods that were exclusive to Sturgeon Bay. The additional Sturgeon Bay sampling was opportunistically continued into early July as part of a pilot debris monitoring program (North/South Consultants Inc. 2012b).

Table 5-2 provides a summary of the number of sampling sessions and sampling activities within each general study area that were conducted as part of fisheries investigations for the project. Table 5-2 lists the fish species (common and scientific names) captured in each general study area during all spring fisheries studies.

The following sections provide a brief overview of sampling effort and results from the spring monitoring program.

Table 5-2. Summary of tasks completed as part of fisheries investigations conducted during spring 2012.

Location and Sample Period	Egg Mats	Larval Drift	Neuston Tows	Boat-based Electrofishing	Experimental Gillnetting
Lake St. Martin					
14-17 April	-	✓	✓	-	✓
24-26 April	-	✓	✓	-	✓
07-09 May	-	✓	✓	-	✓
16-18 May	-	✓	✓	-	✓
28-30 May	-	✓	✓	-	✓
Dauphin River and Buffalo Creek					
16-19 April	✓	✓	-	✓	-
27-30 April	✓	✓	-	✓	-
08-11 May	✓	✓	-	✓	-
17-21 May	✓	✓	-	✓	-
30 May - 03 June	✓	✓	-	✓	-
13-15 June [1]		✓	-	-	-
Sturgeon Bay					
16-19 April	-	-	✓	-	✓
27-30 April	✓	-	✓	-	✓
08-11 May	✓	-	✓	-	✓
17-21 May	✓	-	✓	-	✓
30 May - 03 June	✓	-	✓	-	✓
13-15 June	✓	-	✓	-	-
26-27 June [2]	-	-	✓	-	-
03-05 July [2]	-	-	✓	-	-
Grand Rapids					
31 May - 01 June	-	-	✓	-	-

1 - Drift traps set Buffalo Creek only.

2 - Neuston tows conducted opportunistically during the conduct of a pilot debris monitoring program (North/South Consultants Inc. 2012b).

Table 5-3. List of fish species captured during fisheries investigations in Lake St. Martin, the Dauphin River/Buffalo Creek area, and Sturgeon Bay during spring 2012.

Common Name	Scientific Name	Lake St. Martin	Dauphin R. / Buffalo Cr.	Sturgeon Bay
Brook Stickleback	*Culaea inconstans*	-	✓	-
Burbot	*Lota lota*	-	-	-
Central Mudminnow	*Umbra limi*	-	✓	
Cisco	*Coregonus artedi*	✓	✓	✓
Common Carp	*Cyprinus carpio*	-	✓	-
Emerald Shiner	*Notropis atherinoides*	✓	✓	✓
Fathead Minnow	*Pimephales promelas*	✓	✓	-
Finescale Dace	*Phoxinus neogaeus*	-	✓	-
Freshwater Drum	*Aplodinotus grunniens*	✓	✓	✓
Iowa Darter	*Etheostoma exile*	-	✓	-
Johnny Darter	*Etheostoma nigrum*	-	✓	-
Lake Whitefish	*Coregonus clupeaformis*	✓	✓	✓
Longnose Sucker	*Catostomus catostomus*	✓	✓	✓
Ninespine Stickleback	*Pungitius pungitius*	✓	✓	✓
Northern Pike	*Esox lucius*	✓	✓	✓
Northern Redbelly Dace	*Phoxinus eos*	-	✓	-
Quillback	*Carpiodes cyprinus*	-	✓	-
Rainbow Smelt	*Osmerus mordax*	-	✓	✓
River Shiner	*Notropis blennius*	✓	✓	-
Sauger	*Sander canadensis*	-	✓	✓
Shorthead Redhorse	*Moxostoma macrolepidotum*	✓		✓
Spottail Shiner	*Notropis hudsonius*	-	✓	✓
Trout-perch	*Percopsis omiscomaycus*	-	✓	✓
Walleye	*Sander vitreus*	✓	✓	✓
White Bass	*Morone chrysops*	-	✓	✓
White Sucker	*Catostomus commersonii*	✓	✓	✓
Yellow Perch	*Perca flavescens*	✓	✓	✓

5.2.1 Lake St. Martin

Sampling at Lake St. Martin was conducted between 14 April and 30 May, and included five sampling periods (Table 5-2). Fish sampling was confined to the north basin of the lake, and focused on three areas within that basin. These included the following:

- The vicinity of the outlet to the Dauphin River;
- The vicinity of the outlet to Reach 1; and,
- The vicinity of the narrows between the north and south basins of the lake, where local knowledge has indicated that spawning by Lake Whitefish occurs.

Sampling activity in each of these areas included the collection of larval fish using drift traps and a neuston sampler, and the collection of adult fish using experimental gill nets. The following sections present results from the various sampling activities conducted at Lake St. Martin.

5.2.1.1 Water Temperature

At the onset of sampling, the lake was ice free and water temperature was less than 5°C (Figure 5-8). Water temperature increased to approximately 15°C by mid- May, but then decreased to 10°C by the end of the fish sampling program. The Lake St. Martin temperature logger was lost sometime after the last download on 29 May, so no additional temperature data were available for 2012.

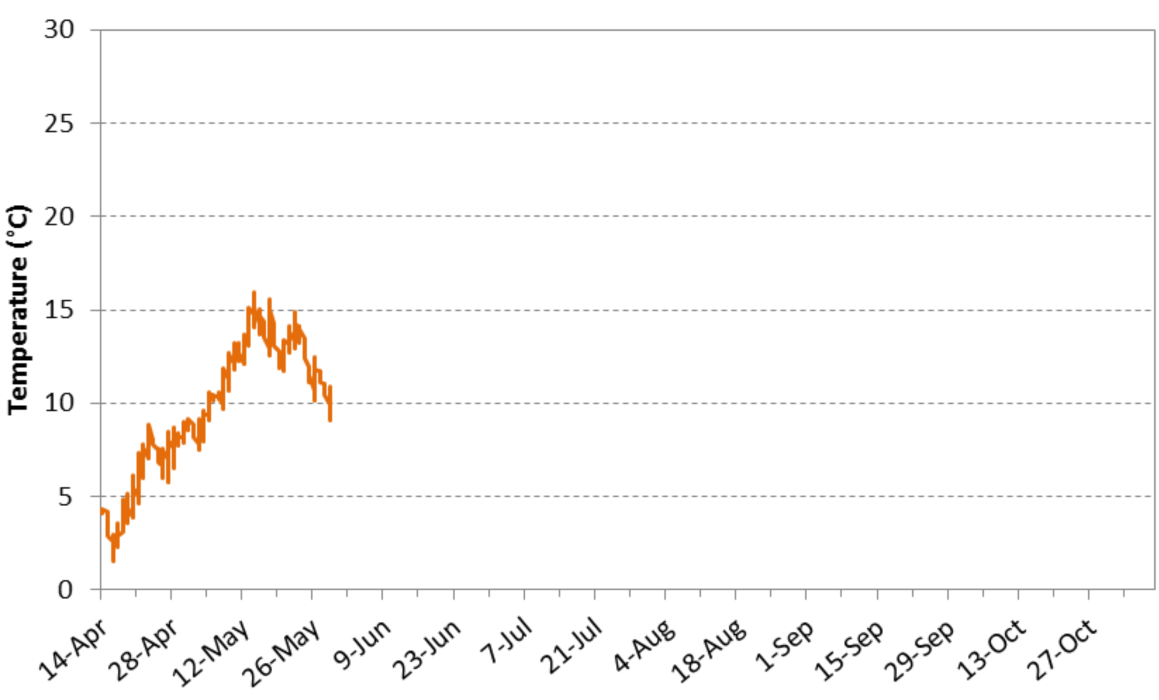

Figure 5-8. Water temperature in Lake St. Martin during 2012.

5.2.1.2 Spawning Activity and Larval Fish

Egg Mats

Very few adult Walleye were captured in Lake St. Martin during spring (see Section 5.2.1.3) and, consequently, mats to collect Walleye eggs were not set.

Drift Trap Sampling

Seven drift traps were set in Lake St. Martin during the spring monitoring program. Of these, four were set at the entrance to Reach 1 and three were set in the Dauphin River (Table 5-4; Figure 5-9). Two additional traps were set within Reach 1 on 29 May, approximately 300 m downstream of the inlet, but were partially destroyed by high water velocity. These were removed and not reset.

A total of 14,312 fish eggs or larval fish were collected (Table 5-5). Small numbers of eggs (n = 70) were collected at both sampling locations and were comprised largely of sucker eggs. Shorthead Redhorse, Longnose Sucker, and White Sucker all occur in Lake St. Martin, but White Sucker were much more abundant than the other sucker species captured during spring 2012 adult fish surveys (see Section 5.1.4 – Lake St. Martin Gillnetting), and were particularly numerous concurrently with the capture of eggs in drift traps. Furthermore, large schools of White Sucker were observed near the entrance to Reach 1 and in the immediate vicinity of the drift traps set at that location. Thus, it is likely that eggs collected in the drift traps were White Sucker eggs. A small number of minnow (Family Cyprinidae, unidentified to species) eggs and other unidentified eggs were collected in traps set at the inlet to Reach 1.

Table 5-4. Location and type of drift traps set in the Lake St. Martin area during spring 2012.

Site	Site Description	Trap Type	Location [1]	
			Easting	Northing
DT-1	at inlet to Reach 1	Floating – small	553291	5739258
DT-2	at inlet to Reach 1	Floating – large	553332	5739268
DT-3	at inlet to Reach 1	Floating – small	553355	5739269
DT-4	at inlet to Dauphin River	Floating – small	546934	5743110
DT-5	at inlet to Dauphin River	Floating – large	546891	5743061
DT-6	at inlet to Dauphin River	Floating – small	546805	5743030
DT-7	at inlet of Reach 1	Floating – small	553330	5739208
DT-8	Reach 1 ~300 m DS of inlet	Staked - small	553401	5739659
DT-9	Reach 1 ~350 m DS of inlet	Staked – small	553403	5739625

1 - UTM coordinates; NAD 83 Zone 14U; site-specific locations illustrated in Figure 5-9.

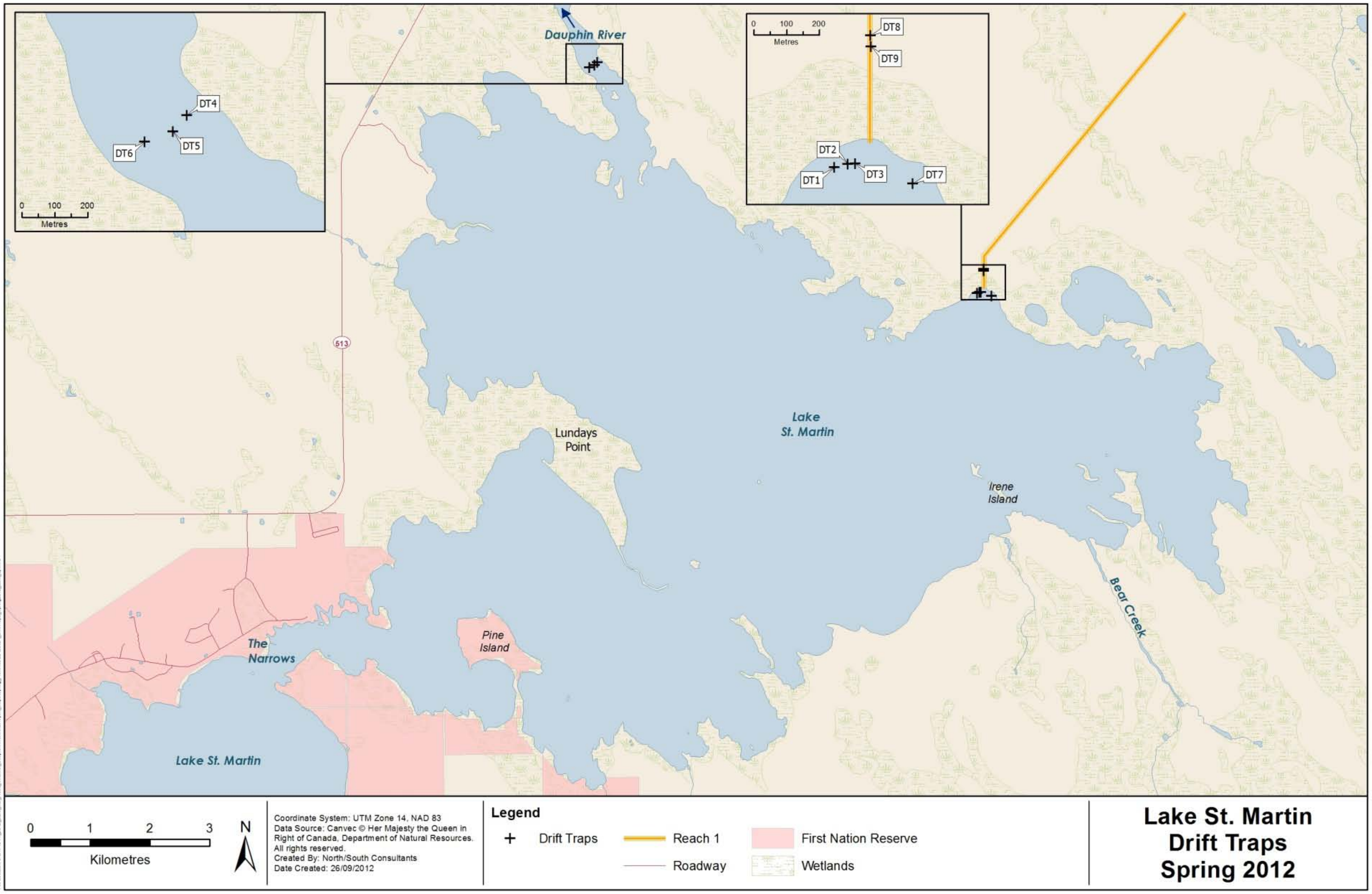

Figure 5-9. Location of drift traps set in the Lake St. Martin area during spring 2012. Note that DT-8 and DT-9 were set within Reach 1.

Table 5-5. Site-specific catch of fish eggs and larval fish from drift traps set in the Lake St. Martin area during spring 2012.

Lift Date	Site [1]	Fish Eggs		Larval Fish [2]							Total
		Count	Species	Lake Whitefish	Cisco	Sucker	Percid	Yellow Perch	Minnows	Stickleback	
15-Apr-12	DT-1	-	-	1	-	-	-	-	-	-	1
	DT-2	-	-	36	-	-	-	-	-	-	36
	DT-3	-	-	9	1	-	-	-	-	-	10
	DT-4	-	-	3	-	-	-	-	-	-	3
	DT-5	-	-	5	-	-	-	-	-	-	5
	DT-6	-	-	-	-	-	-	-	-	-	0
16-Apr-12	DT-1	-	-	-	-	-	-	-	-	-	0
	DT-2	-	-	5	-	-	-	-	-	-	5
	DT-3	-	-	1	-	-	-	-	-	-	1
	DT-4	-	-	2	-	-	-	-	-	-	2
	DT-5	-	-	-	-	-	-	-	-	-	0
	DT-6	-	-	-	-	-	-	-	-	-	0
17-Apr-12	DT-1	-	-	1	-	-	-	-	-	-	1
	DT-2	-	-	9	15	-	-	-	-	-	24
	DT-3	-	-	-	1	-	-	-	-	-	1
	DT-4	-	-	-	1	-	-	-	-	-	1
	DT-5	-	-	-	-	-	-	-	-	-	0
	DT-6	-	-	-	-	-	-	-	-	-	0
25-Apr-12	DT-1	-	-	-	-	-	-	-	-	-	0
	DT-2	-	-	3	1	-	-	-	-	-	4
	DT-3	-	-	-	-	-	-	-	-	-	0
	DT-4	-	-	-	2	-	-	-	-	-	2
	DT-5	-	-	3	2	-	-	-	-	-	5
	DT-6	-	-	-	1	-	-	-	-	-	1
	DT-7	-	-	-	-	-	-	-	-	-	0
26-Apr-12	DT-1	-	-	-	-	-	-	-	-	-	0
	DT-2	-	-	6	4	-	-	-	-	-	10
	DT-3	-	-	-	-	-	-	-	-	-	0
	DT-4	-	-	-	-	-	-	-	-	-	0
	DT-5	-	-	2	-	-	-	-	-	-	2
	DT-6	-	-	-	-	-	-	-	-	-	0
	DT-7	-	-	-	-	-	-	-	-	-	0
8-May-12	DT-1	-	-	-	-	-	-	-	-	-	0
	DT-2	11	sucker	2	-	-	-	-	-	-	13
	DT-3	-	-	-	-	-	-	-	-	-	0
	DT-4	-	-	-	-	-	-	-	-	-	0
	DT-5	43	sucker	2	3	-	-	-	-	-	48
	DT-6	-	-	-	-	-	-	-	-	-	0
	DT-7	-	-	-	-	-	-	-	-	-	0
9-May-12	DT-1	2	sucker	-	-	-	-	-	-	-	2
	DT-2	-	-	19	8	-	-	-	-	-	27
	DT-3	-	-	1		-	-	-	-	-	1
	DT-4	-	-	-	-	-	-	-	-	-	0
	DT-5	-	-	2	1	-	-	-	-	-	3
	DT-6	-	-	-	-	-	-	-	-	-	0
	DT-7	2	sucker	-	-	-	-	-	-	-	2

Table 5-5. (continued).

Lift Date	Site [1]	Fish Eggs		Larval Fish [2]							Total
		Count	Species	Lake Whitefish	Cisco	Sucker	Percid	Yellow Perch	Minnows	Stickleback	
17-May-12	DT-1	-	-	-	-	1	-	-	-	-	1
	DT-2	-	-	17	-	-	-	-	-	-	17
	DT-3	-	-	-	-	-	-	-	-	-	0
	DT-4	-	-	-	-	-	-	-	-	-	0
	DT-5	-	-	6	-	-	-	-	-	-	6
	DT-6	-	-	-	-	-	-	-	-	-	0
	DT-7	1	sucker	-	-	-	-	-	-	-	1
18-May-12	DT-1	-	-	-	-	-	-	-	-	-	0
	DT-2	-	-	17	-	11	12	-	-	-	40
	DT-3	-	-	-	-	-	-	-	1	-	1
	DT-4	-	-	-	-	-	-	-	-	-	0
	DT-5	-	-	28	-	3	-	-	-	-	31
	DT-6	-	-	-	-	-	-	-	-	-	0
	DT-7	4	cyprinid	-	-	-	-	-	2	-	6
29-May-12	DT-1	1	Unidentified	-	-	-	-	20	-	-	21
	DT-2	-	-	304	-	-	-	6224	-	-	6528
	DT-3	-	-	-	-	-	-	14	-	-	14
	DT-4	-	-	-	-	-	6	-	-	-	6
	DT-5	-	-	52	-	3	10	247	-	4	316
	DT-6	-	-	-	-	-	2	-	-	-	2
	DT-7	-	-	-	-	-	-	66	-	-	66
	DT-8[3]	-	-	-	-	2	-	12	-	-	14
	DT-9[3]	6	Unidentified	-	-	-	-	-	-	-	6
30-May-12	DT-1	-	-	-	-	-	-	47	-	-	47
	DT-2	-	-	176	-	-	-	6512	-	-	6688
	DT-3	-	-	-	-	-	-	68	-	-	68
	DT-4	-	-	-	-	-	12	-	-	-	12
	DT-5	-	-	33	10	2	3	-	-	-	48
	DT-6	-	-	-	-	-	-	-	1	-	1
	DT-7	-	-	-	-	-	-	162	-	-	162
Total		70		745	50	22	45	13372	4	4	14312

1 - Traps DT-1 to DT-3 and DT-7 set at the inlet to Reach 1; traps DT-4 to DT-6 set at the inlet to the Dauphin River; DT-8 and DT-9 set in Reach 1; locations illustrated in Figure 5-9.

2 - Several sucker, minnow (Family Cyprinidae), stickleback and percid (e.g., Walleye, Sauger, Yellow Perch) species were captured in Lake St. Martin during spring 2012; these groups were not always identified to species because of difficulty discerning between species when in larval stage.

3 - DT-8 and DT-9 were set within Reach 1; both traps were partially destroyed due to high water velocity and only partial samples were obtained.

The 14,242 larval fish captured in drift traps included 745 Lake Whitefish, 50 Cisco, 13,372 Yellow Perch, and a small number of larval suckers, minnows, stickleback, and percids (Table 5-5). Again, it is thought that larval suckers were White Sucker because of the large number of adult White Suckers observed and captured during the course of the spring program relative to other sucker species. Similarly, due to the large numbers of Yellow Perch that were identified in the larval drift catch and the proportion of adults relative to other percids, it is thought that unidentified percid larvae were also likely Yellow Perch.

Larval Lake Whitefish and Cisco were captured at the onset of the spring sampling program, and, although present in samples collected from both locations, were much more abundant at the inlet to Reach 1 than in the Dauphin River (Table 5-5). Larval Lake Whitefish were consistently captured across all study periods with a peak catch of 304 fish on 29 May at the inlet to Reach 1 at a water temperature of approximately 10°C. Larval Cisco were captured primarily from mid-April to early May.

Larval stickleback were captured only once, in the Dauphin River on 29 May. Larval Yellow Perch, percids, suckers and minnows first appeared in the drift trap catch during mid-May when water temperature peaked at approximately 15°C and were captured at both locations. Approximately 98% of the larval Yellow Perch (n = 13,125) were captured at the inlet to Reach 1 with 12,736 of those larvae captured in DT-2 on 29 and 30 May. The large number of eggs in a single trap over a short period of time suggests that some Yellow Perch spawning may have occurred in the immediate vicinity of DT-2 in mid to late May 2012 at water temperatures of 10-15°C.

In addition to eggs and larval fish, 343 juvenile and adult fish were captured in drift traps (Table 5-6). The catch was composed of ten species of fish, including five minnow species, Brook and Ninespine Stickleback, and three percid (Family Percidae) species including Johnny Darter, Iowa Darter, and Yellow Perch (Table 5-6). Fathead Minnows were the most abundant juvenile and adult fish captured in drift traps, followed by Emerald Shiner, River Shiner, and Ninespine Stickleback. Fathead Minnows and Ninespine Sticklebacks were captured across all sampling periods. However, River Shiners were most abundant in April while Emerald Shiners were one of the most frequently captured fish in mid to late May. Two drift traps (DT-2 at the inlet to Reach 1 and DT-5 in the Dauphin River) captured the majority of juvenile and adult fish (Table 5-6).

Table 5-6. Site-specific catch of juvenile and adult fish from drift traps set in the Lake St. Martin area during spring 2012.

Lift Date	Site	Blacknose Shiner	Emerald Shiner	Fathead Minnow	River Shiner	Spottail Shiner	Brook Stickleback	Ninespine Stickleback	Johnny Darter	Iowa Darter	Yellow Perch	Total
15-Apr-12	DT-1	1		3	-	-	-	-	-	-	-	4
	DT-2	-	2	11	4	-	1	6	1	4	2	31
	DT-3	-	-	-	-	-	-	-	-	-	-	0
	DT-4	-	-	-	-	-	-	-	-	-	-	0
	DT-5	-	-	1	12	-	-	3	-	-	-	16
	DT-6	-	-	1	-	-	-	-	-	-	-	1
16-Apr-12	DT-1	-	-	1	-	-	-	-	-	-	-	1
	DT-2	-	3	1	18	3	-	1	-	-	1	27
	DT-3	-	-	-	-	-	-	-	-	-	-	0
	DT-4	-	-	-	-	-	-	-	-	-	-	0
	DT-5	-	1	2	1	-	-	-	-	-	-	4
	DT-6	-	-	-	-	-	-	1	-	-	-	1
17-Apr-12	DT-1	-	-	-	-	-	-	-	-	-	-	0
	DT-2	-	1	1	13		2	14	-	-	-	31
	DT-3	-	-	-	-	-	-	-	-	-	-	0
	DT-4	-	-	-	-	-	-	-	-	-	-	0
	DT-5	-	-	20	-	-	2	2	-	-	1	25
	DT-6	-	-	-	-	-	-	-	-	-	-	0
25-Apr-12	DT-1	-	-	-	-	-	-	-	-	-	-	0
	DT-2	-	-	-	4	-	-	-	-	1	-	5
	DT-3	-	-	-	-	-	-	-	-	-	-	0
	DT-4	-	-	-	-	-	-	-	-	-	-	0
	DT-5	-	-	7	4	-	1	1	-	-	-	13
	DT-6	-	-	-	-	-	-	-	-	-	-	0
	DT-7	-	-	-	-	-	-	-	-	-	-	0
26-Apr-12	DT-1	-	-	-	-	-	-	-	-	-	-	0
	DT-2	-	-	3	-	-	-	-	-	-	-	3
	DT-3	-	-	-	-	-	-	-	-	-	-	0
	DT-4	-	-	-	-	-	-	-	-	-	-	0
	DT-5	-	-	4	1	-	-	1	-	-	-	6
	DT-6	-	-	-	-	-	-	-	-	-	-	0
	DT-7	-	-	-	-	-	-	-	-	-	-	0

Table 5-6. (continued)

Lift Date	Site	Blacknose Shiner	Emerald Shiner	Fathead Minnow	River Shiner	Spottail Shiner	Brook Stickleback	Ninespine Stickleback	Johnny Darter	Iowa Darter	Yellow Perch	Total
8-May-12	DT-1	-	-	-	-	-	-	-	-	-	-	0
	DT-2	-	-	2	-	1	-	-	-	1	1	5
	DT-3	-	-	-	-	-	-	-	-	-	-	0
	DT-4	-	-	-	-	-	-	-	-	-	-	0
	DT-5	-	-	7	-	-	2	-	-	-	1	10
	DT-6	-	-	-	-	-	-	-	-	-	-	0
	DT-7	-	-	-	-	-	-	-	-	-	-	0
9-May-12	DT-1	-	-	-	-	-	-	-	-	-	-	0
	DT-2	-	-	10	-	5	1	4	-	2	1	23
	DT-3	-	-	-	-	-	-	-	-	-	-	0
	DT-4	-	-	-	-	-	-	-	-	-	-	0
	DT-5	-	-	9	-	-	6	3	-	-	-	18
	DT-6	-	-	-	-	-	-	-	-	-	-	0
	DT-7	-	-	-	-	-	-	-	-	-	-	0
17-May-12	DT-1	-	-	-	-	-	-	-	-	-	-	0
	DT-2	-	1	6	-	-	2	3	2	-	-	14
	DT-3	-	-	-	-	-	-	-	-	-	-	0
	DT-4	-	-	-	-	-	-	-	-	-	-	0
	DT-5	-	4	3	-	-	1	4	-	-	1	13
	DT-6	-	-	-	-	-	-	-	-	-	-	0
	DT-7	-	-	-	-	-	-	-	-	-	-	0
18-May-12	DT-1	-	-	-	-	-	-	-	-	-	-	0
	DT-2	-	5	-	3	-	-	1	-	-	-	9
	DT-3	-	-	-	-	-	-	-	-	-	-	0
	DT-4	-	-	-	-	-	-	-	-	-	-	0
	DT-5	-	1	-	-	-	2	3	-	-	-	6
	DT-6	-	-	-	-	-	-	-	-	-	-	0
	DT-7	-	-	-	-	-	-	-	-	-	-	0

Table 5-6. (continued).

Lift Date	Site	Blacknose Shiner	Emerald Shiner	Fathead Minnow	River Shiner	Spottail Shiner	Brook Stickleback	Ninespine Stickleback	Johnny Darter	Iowa Darter	Yellow Perch	Total
29-May-12	DT-1	-	-	-	-	-	-	-	-	-	-	0
	DT-2	-	16	16	-	-	-	-	-	-	-	32
	DT-3	-	-	-	-	-	-	-	-	-	-	0
	DT-4	-	-	-	-	-	-	-	-	-	-	0
	DT-5	-	1	3	-	-	-	1	-	2	-	7
	DT-6	-	-	1	-	-	-	-	-	-	-	1
	DT-7	-	-	-	-	-	-	-	-	-	-	0
	DT-8	-	-	-	-	-	-	-	-	-	-	0
	DT-9	-	-	-	-	-	-	-	-	-	-	0
30-May-12	DT-1	-	-	-	-	-	-	-	-	-	-	0
	DT-2	-	32	-	-	-	-	-	-	-	-	32
	DT-3	-	-	-	-	-	-	-	-	-	-	0
	DT-4	-	-	-	-	-	-	-	-	-	-	0
	DT-5	-	-	2	-	-	1	1	-	-	1	5
	DT-6	-	-	-	-	-	-	-	-	-	-	0
	DT-7	-	-	-	-	-	-	-	-	-	-	0
Total		1	67	114	60	9	21	49	3	10	9	343

1 - Traps DT-1 to DT-3 and DT-7 set at the inlet to Reach 1; traps DT-4 to DT-6 set at the inlet to the Dauphin River; DT-8 and DT-9 set in Reach 1; locations illustrated in Figure 5-9.

Neuston Sampling

A total of 40 neuston tows were conducted in Lake St. Martin during spring 2012 (Table 5-7; Figure 5-10). Tow duration ranged from 15-32 minutes, although most tows were between 25 and 30 minutes (Table 5-7). During the conduct of most tows, 150-200 m^3 of water was filtered.

A total of 604 larval and juvenile or adult fish and one sucker egg were captured in the tows (Table 5-8). The catch was composed largely of larval fish (n = 594); only ten juvenile or adult fish were captured. Larvae from at least six species of fish were captured. Larval Lake Whitefish were the most abundant (n = 259), followed by larval Yellow Perch (n = 170), larval minnows (n = 55), larval Cisco (n = 54), larval darters (n = 49) and larval suckers (n = 7). Lake Whitefish and Yellow Perch also had the highest CPUE in neuston tows (Table 5-9). Several species of each of minnows, darters and suckers occur within Lake St. Martin (Table 5-2). Larvae of different species within these groups are very difficult to differentiate between and are therefore pooled by group (taxonomic grouping at the Family level). However, it should be noted that a large numbers of adult White Sucker were observed and captured during the course of the spring program relative to other sucker species, and it is thought that larval suckers captured in the neuston tows were White Suckers.

A single larval Lake Whitefish was captured on 17 April, but both Lake Whitefish and Cisco larvae were present in neuston tows occurring on and after 24 April (Table 5-8) at water temperatures of approximately 6-8°C (Figure 5-8). Both species were captured in all areas where neuston tows were conducted. Larval Lake Whitefish were present in the catch until the end of May when sampling was terminated, but no larval Cisco were captured after 16 May. Larval minnows and suckers were first captured in mid-May as water temperature approached 15°C (Figure 5-8), and larval darters and Yellow Perch were first captured during the last sampling period at the end of May. The earliest sampling period had the lowest average CPUE (0.16 fish/100 m^3) while the final sampling period had the highest (32.40 fish/100 m^3), due largely to increased numbers of Lake Whitefish and the appearance of Yellow Perch larvae (Table 5-9).

Table 5-7. The location, time, and duration of neuston tows conducted in Lake St. Martin during spring 2012.

Neuston Tow	Date	Start Location [1]		End Location [1]		Start Time	End Time	Duration (minutes)	Flow Meter Count		Tow Distance [2] (m)	Volume [3] (m^3)
		Easting	Northing	Easting	Northing				Start	End		
NT-01	16-Apr-12	553045	5738786	553623	5738922	10:33	10:56	23.0	746552	772860	706	95
NT-02	16-Apr-12	553615	5738927	553466	5739076	11:07	11:37	30.0	772870	858077	1704	230
NT-03	16-Apr-12	553342	5739297	553258	5738647	12:56	13:23	27.0	858068	928528	1409	190
NT-04	16-Apr-12	546538	5744246	546787	5743054	16:52	17:20	28.0	928567	20657	1841	248
NT-05	16-Apr-12	546905	5743116	547073	5742741	17:27	17:57	30.0	20818	115620	1896	255
NT-06	16-Apr-12	546907	5742922	546664	5744813	18:04	18:27	23.0	115328	180544	1304	176
NT-07	17-Apr-12	542777	5733470	542112	5733638	11:30	11:57	27.0	533508	615702	1643	221
NT-08	17-Apr-12	541949	5733664	542044	5733687	12:27	13:00	33.0	615708	639077	467	63
NT-09	17-Apr-12	542503	5733463	543792	5734104	13:08	13:38	30.0	639070	738830	1995	269
NT-10	24-Apr-12	553414	5738621	554357	5737482	17:06	17:34	28.0	739008	748953	198	26
NT-11	24-Apr-12	554241	5737502	552228	5737979	17:45	18:15	30.0	748949	839199	1805	243
NT-12	26-Apr-12	545060	5734099	545578	5733865	15:15	15:46	31.0	839259	928632	1787	241
NT-13	26-Apr-12	545527	5733846	546963	5734678	15:50	16:22	32.0	928638	16209	1751	236
NT-14	26-Apr-12	546923	5734591	545833	5733325	16:29	16:54	25.0	16208	82389	1323	178
NT-15	26-Apr-12	546900	5740406	546626	5741235	17:27	17:57	30.0	82388	146383	1279	172
NT-16	26-Apr-12	546593	5741255	547909	5740243	18:00	18:30	30.0	146378	220108	1474	199
NT-17	7-May-12	547179	5734068	547088	5733097	12:58	13:29	31.0	220298	313568	1865	251
NT-18	7-May-12	548082	5734142	547855	5731857	14:17	14:48	31.0	313578	384098	1410	190
NT-19	7-May-12	547077	5733157	547077	5733157	15:27	15:58	31.0	384090	458749	1493	201
NT-20	8-May-12	555605	5736871	554889	5735465	11:40	12:10	30.0	458751	542596	1676	226
NT-21	8-May-12	555145	5735470	554712	5735825	12:28	12:58	30.0	542608	629418	1736	234
NT-22	8-May-12	552994	5738179	552641	5737920	15:35	16:07	32.0	629453	720387	1818	245
NT-23	8-May-12	553104	5738215	551582	5737425	17:13	17:43	30.0	720398	795118	1494	201
NT-24	9-May-12	545586	5740852	547288	5742301	11:20	11:50	30.0	795118	862584	1349	182
NT-25	9-May-12	547181	5742469	547558	5741108	11:55	12:25	30.0	862578	950888	1766	238

Table 5-7. (continued).

Neuston Tow	Date	Start Location [1]		End Location [1]		Start Time	End Time	Duration (minutes)	Flow Meter Count		Tow Distance [2] (m)	Volume [3] (m^3)
		Easting	Northing	Easting	Northing				Start	End		
NT-26	16-May-12	547409	5734357	545584	5734040	11:34	12:04	30.0	950887	31209	1606	216
NT-27	16-May-12	544823	5734339	543535	5733492	12:21	12:51	30.0	31208	107649	1528	206
NT-28	16-May-12	541472	5733051	543948	5733479	13:28	13:57	29.0	107600	186748	1582	213
NT-29	16-May-12	555158	5735050	554293	5736272	15:34	15:54	20.0	186737	244009	1145	154
NT-30	16-May-12	546847	5743151	546478	5745166	16:35	16:55	20.0	243998	301145	1142	154
NT-31	16-May-12	546339	5745377	546035	5747292	17:01	17:21	20.0	305158	356021	1017	137
NT-32	17-May-12	553314	5739274	553962	5738041	12:53	13:19	26.0	356019	424288	1365	184
NT-33	17-May-12	553881	5738087	553243	5739131	13:24	13:50	26.0	424288	495551	1425	192
NT-34	29-May-12	547752	5734250	546406	5734095	9:24	9:44	20.0	495538	553129	1151	155
NT-35	29-May-12	546474	5733904	545392	5734346	9:51	10:11	20.0	553129	610049	1138	153
NT-36	29-May-12	545396	3734450	546785	5733800	10:18	10:38	20.0	610038	663600	1071	144
NT-37	29-May-12	552000	5738101	553126	5738958	11:58	12:18	20.0	663589	719739	1123	151
NT-38	29-May-12	553169	5738874	554379	5737957	12:25	12:45	20.0	719728	781118	1227	165
NT-39	29-May-12	544710	5741769	545819	5740852	15:41	16:01	20.0	781092	840128	1180	159
NT-40	29-May-12	545777	5740814	546642	5740626	16:08	16:23	15.0	840128	874749	692	93

1 - UTM coordinates; NAD 83 Zone 14U; neuston tow locations illustrated in Figure 5-10.

2 - Tow distance (m) calculated as the number of flow meter revolutions x 0.02687.

3 - Volume filtered calculated as the tow distance (m) x 0.135 m^2.

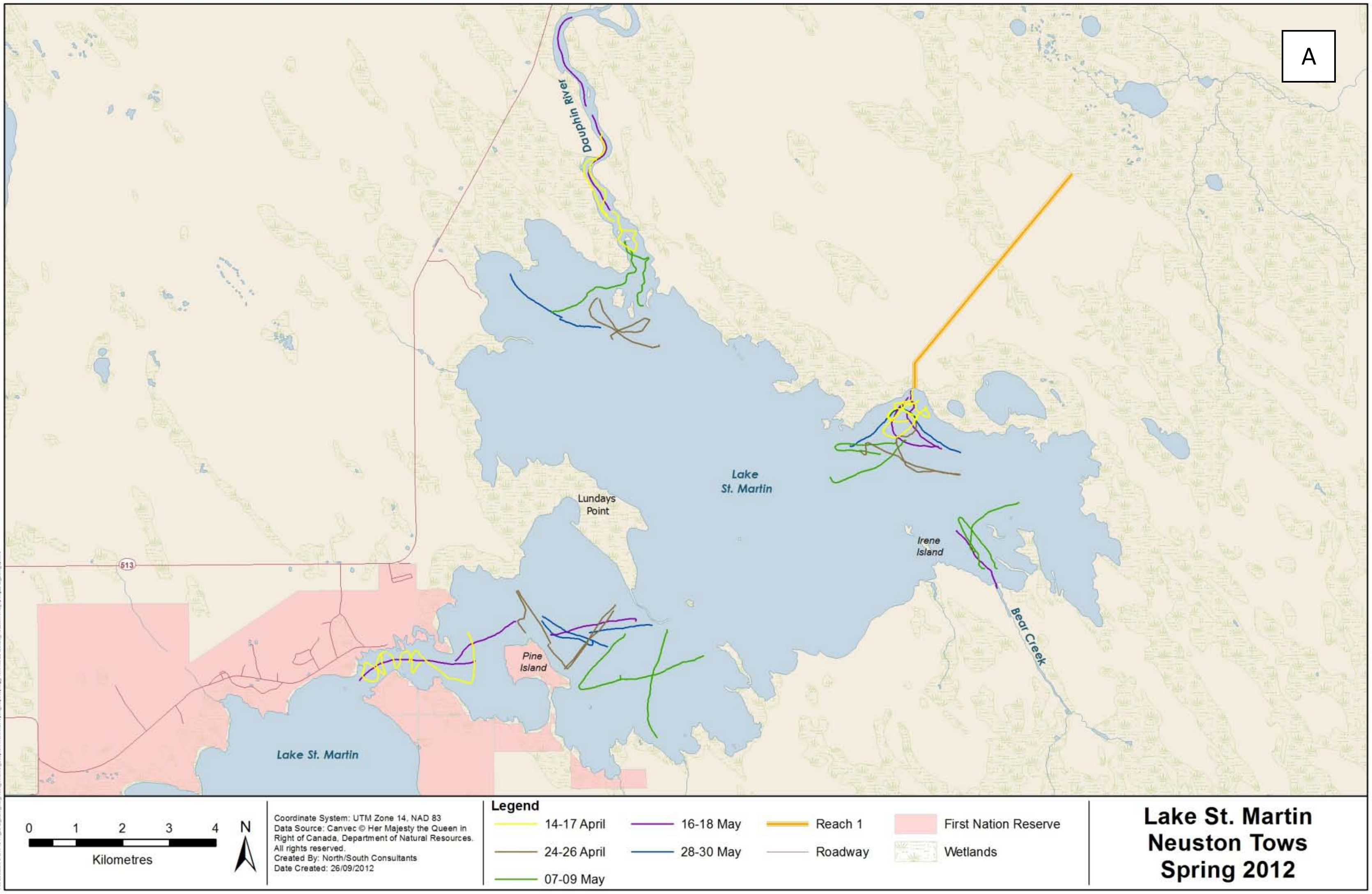

Figure 5-10. Overview of locations (A) and detailed sampling period-specific locations (B, C, D, E, F) where neuston tows were conducted in Lake St. Martin during spring 2012.

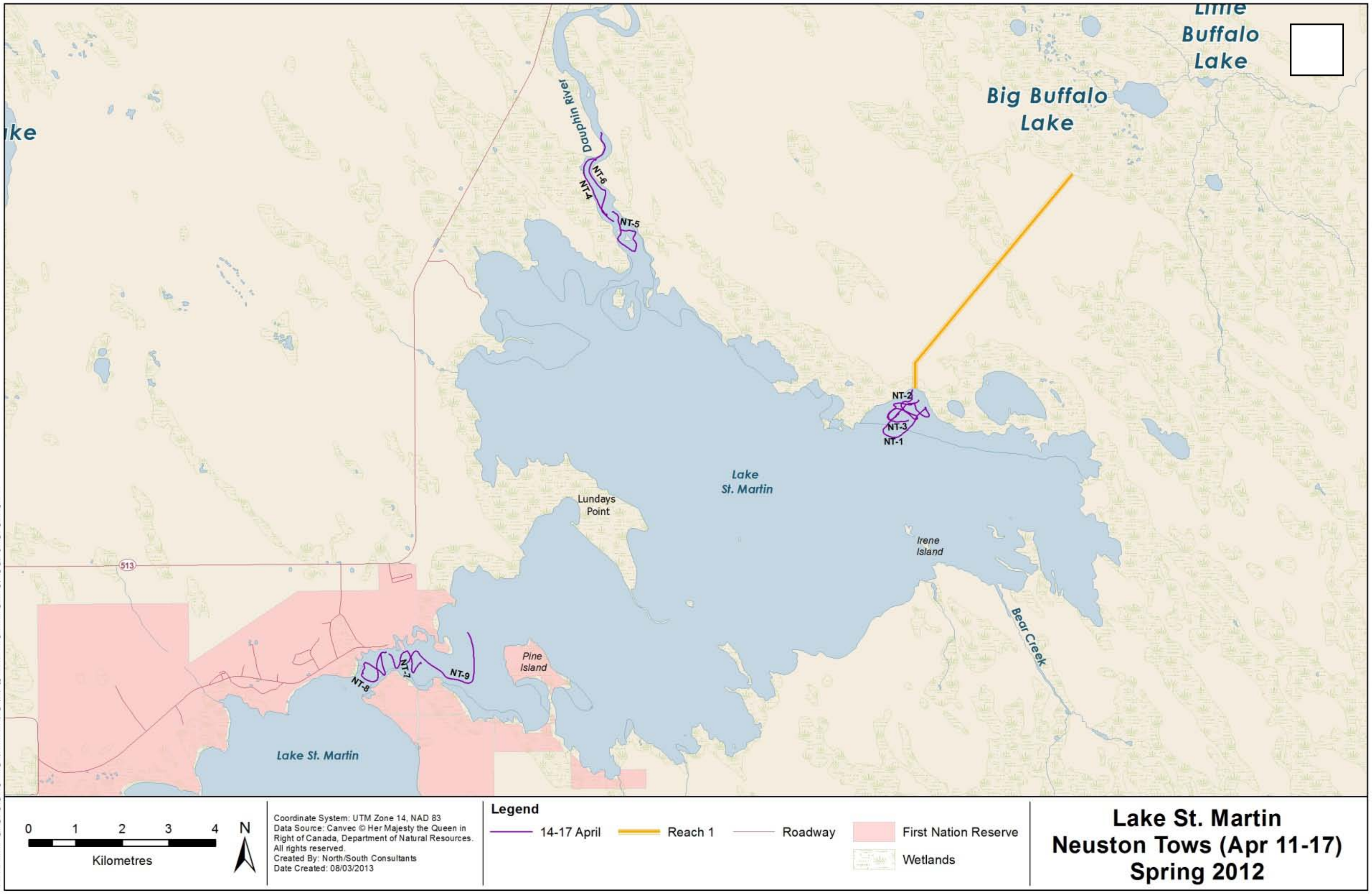

Figure 5-10. (continued).

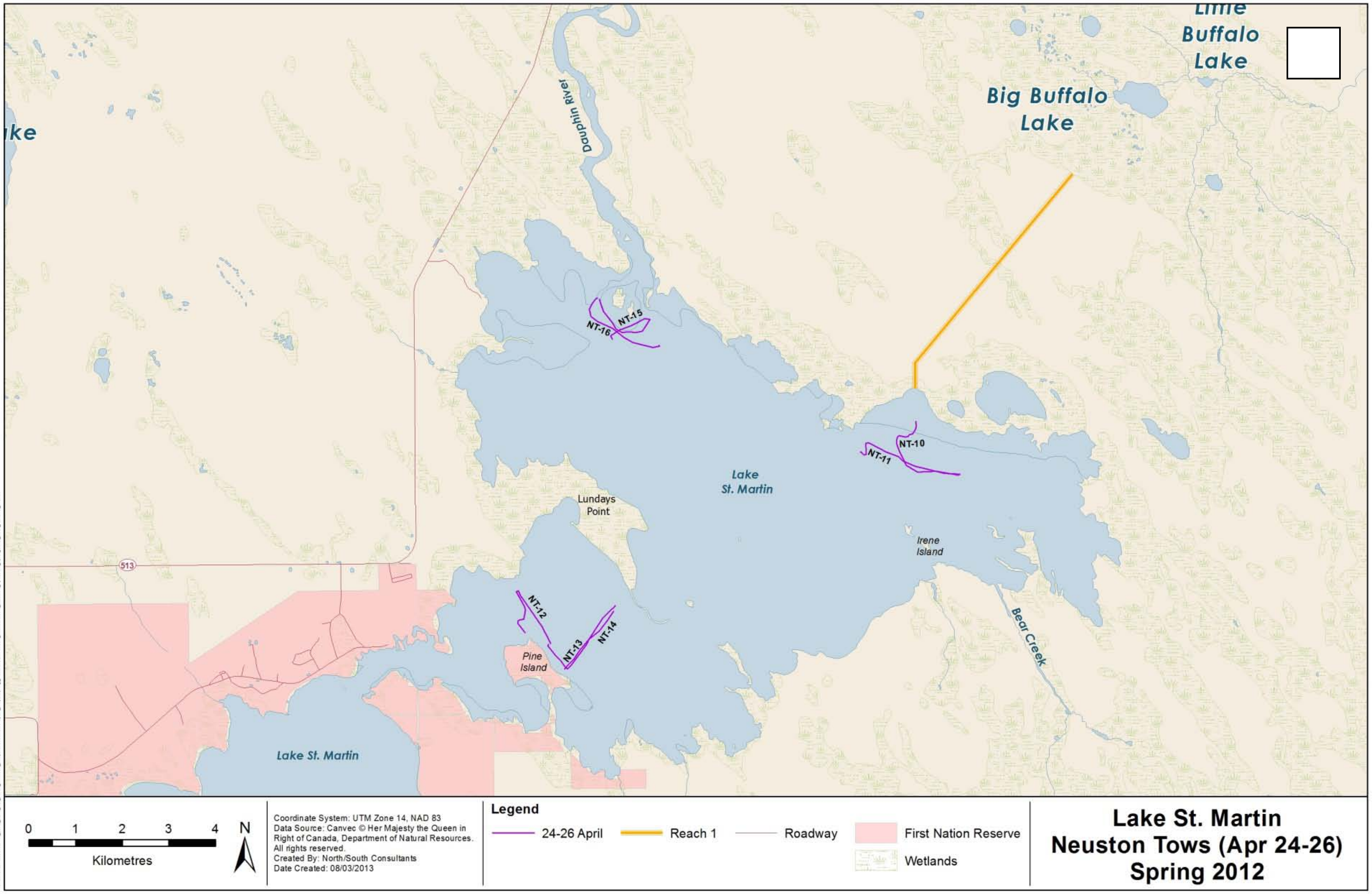

Figure 5-10. (continued).

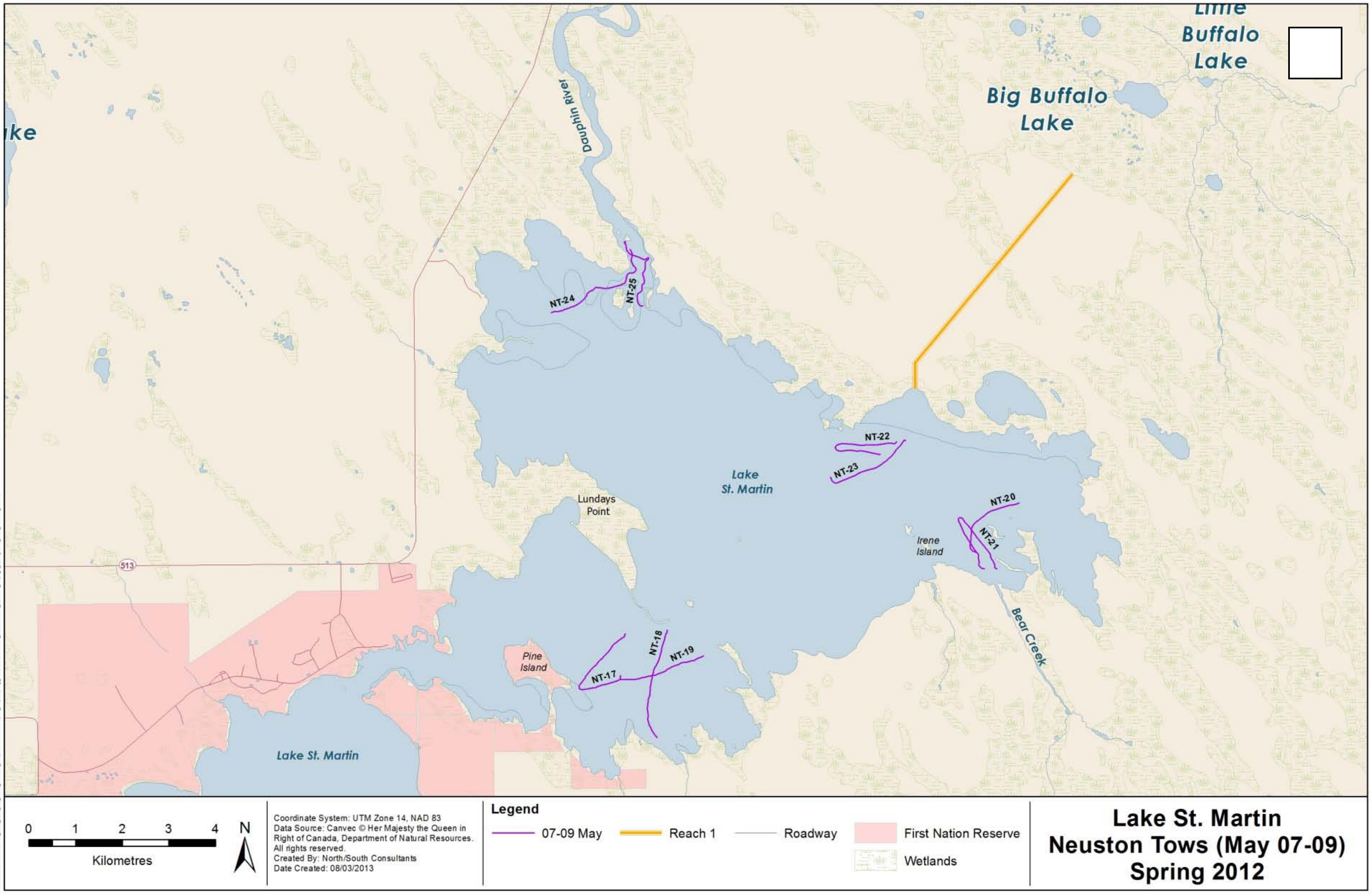

Figure 5-10. (continued).

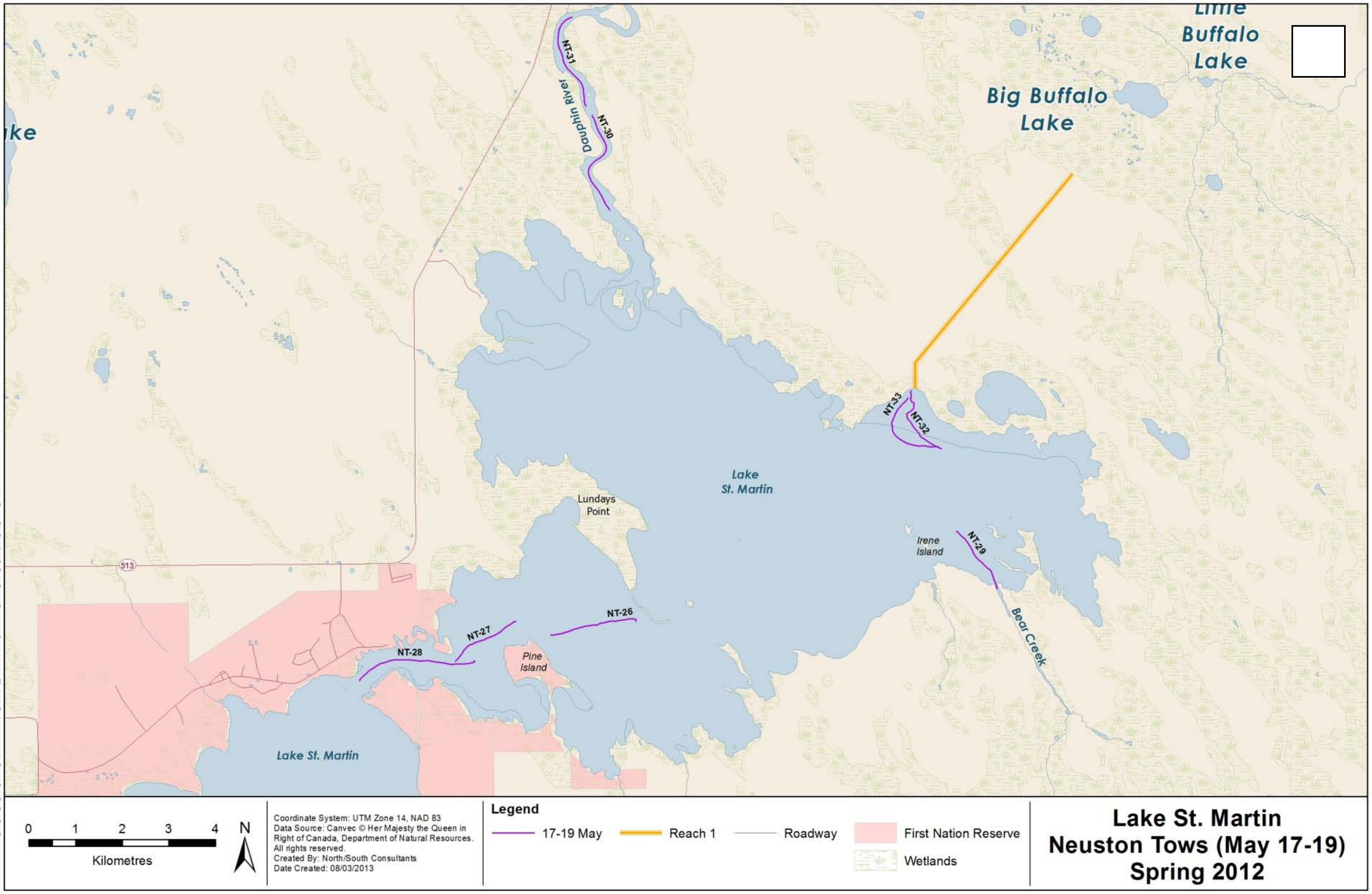

Figure 5-10. (continued).

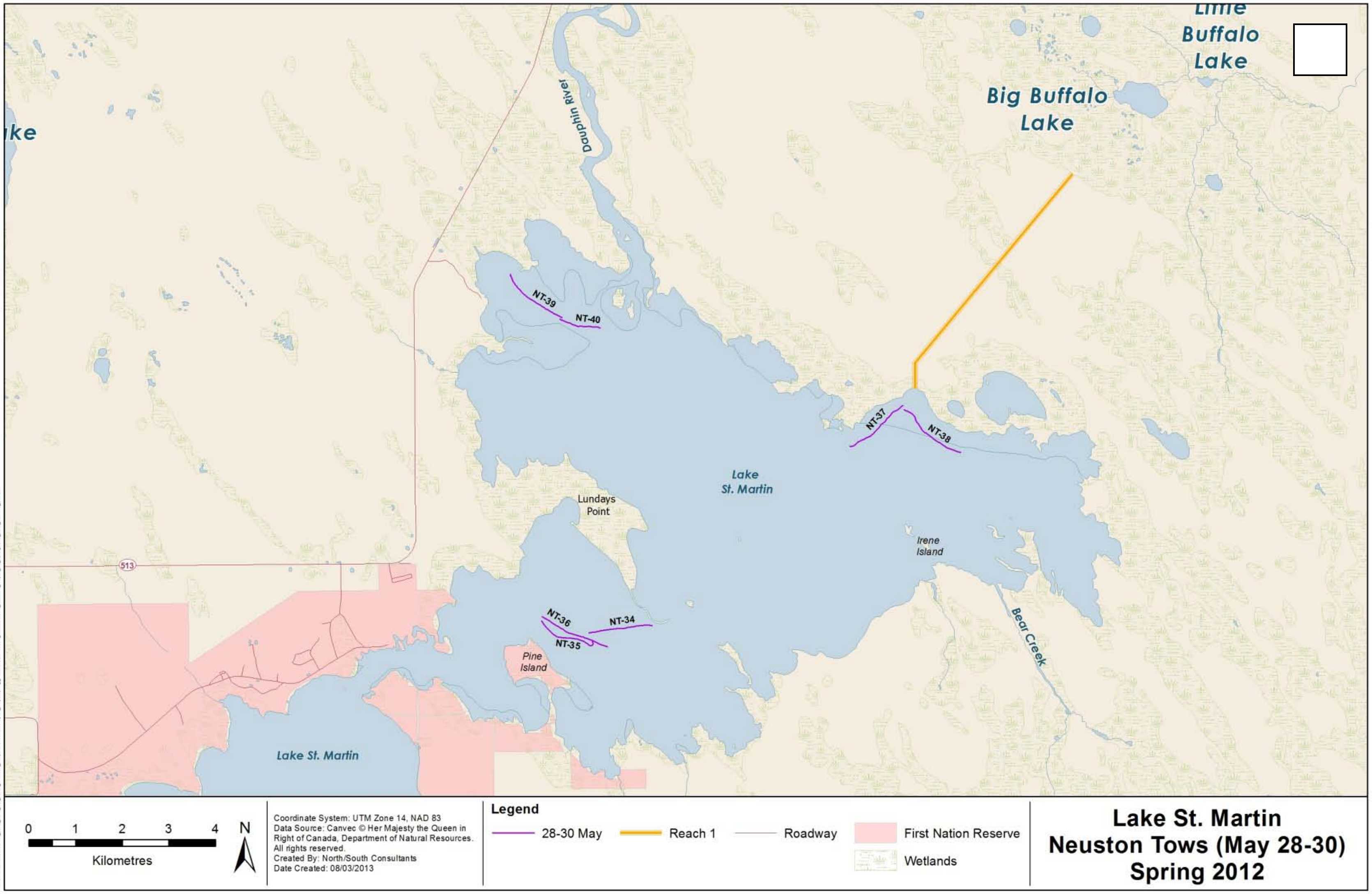

Figure 5-10. (continued).

Table 5-8. Tow-specific catch of larval and adult fish from neuston tows conducted in Lake St. Martin during spring 2012.

Neuston Tow [1]	Date	Larval Fish						Adult Fish				Total
		Lake Whitefish	Cisco	Sucker [2]	Yellow Perch	Darter [3]	Minnows [4]	Emerald Shiner	Fathead Minnow	River Shiner	Ninespine Stickleback	
NT-01	16-Apr-12	-	-	-	-	-	-	-	-	-	-	0
NT-02	16-Apr-12	-	-	-	-	-	-	-	-	-	-	0
NT-03	16-Apr-12	-	-	-	-	-	-	-	-	1	-	1
NT-04	16-Apr-12	-	-	-	-	-	-	-	-	-	-	0
NT-05	16-Apr-12	-	-	-	-	-	-	-	-	-	-	0
NT-06	16-Apr-12	-	-	-	-	-	-	-	1	-	-	1
NT-07	17-Apr-12	-	-	-	-	-	-	-	-	-	-	0
NT-08	17-Apr-12	-	-	-	-	-	-	-	-	-	-	0
NT-09	17-Apr-12	1	-	-	-	-	-	-	-	-	-	1
NT-10	24-Apr-12	2	2	-	-	-	-	-	2	-		6
NT-11	24-Apr-12	3	1	-	-	-	-	-	-	-	-	4
NT-12	26-Apr-12	9	3	-	-	-	-	-	-	-	-	12
NT-13	26-Apr-12	12	6	-	-	-	-	-	-	-	-	18
NT-14	26-Apr-12	10	13	-	-	-	-	-	-	-	1	24
NT-15	26-Apr-12	-	3	-	-	-	-	-	-	-	-	3
NT-16	26-Apr-12	3	7	-	-	-	-	-	1	-	-	11
NT-17	7-May-12	13	2	-	-	-	-	-	-	-	-	15
NT-18	7-May-12	17	4	-	-	-	-	-	-	-	-	21
NT-19	7-May-12	11		-	-	-	-	-	-	-	-	11
NT-20	8-May-12	24	5	-	-	-	-	-	-	-	-	29
NT-21	8-May-12	13	2	-	-	-	-	-	-	1	-	16
NT-22	8-May-12	1		-	-	-	-	-	-	-	-	1
NT-23	8-May-12	7	1	-	-	-	-	-	-	-	-	8
NT-24	9-May-12	1		-	-	-	-	-	-	-	-	1
NT-25	9-May-12	3	3	-	-	-	-	-	-	-	-	6

Table 5-8. (continued).

Neuston Tow [1]	Date	Larval Fish						Adult Fish				Total
		Lake Whitefish	Cisco	Sucker [2]	Yellow Perch	Darter [3]	Minnows [4]	Emerald Shiner	Fathead Minnow	River Shiner	Ninespine Stickleback	
NT-26	16-May-12	3	-	-	-	-	-	-	-	-	-	3
NT-27	16-May-12	3	-	-	-	-	-	-	-	-	-	3
NT-28	16-May-12		1	-	-	-		-	-	-	-	1
NT-29	16-May-12	6		-	-	-	49	1	-	-	-	56
NT-30	16-May-12	-	1	-	-	-		-	-	-	-	1
NT-31	16-May-12	-	-	-	-	-	2	-	-	-	-	2
NT-32	17-May-12	2	-	6	-	-		-	-	-	-	8
NT-33	17-May-12	1	-	-	-	-	4	-	-	-	-	5
NT-34	29-May-12	21	-	-	11	-	-	-	-	-	-	32
NT-35	29-May-12	19	-	1	29	-	-	1	-	-	-	50
NT-36	29-May-12	48	-	-	61	-	-	-	-	-	-	109
NT-37	29-May-12	5	-	-	52	-	-	-	-	-	-	57
NT-38	29-May-12	17	-	-	-	49	-	-	-	-	-	66
NT-39	29-May-12	2	-	-	4	-	-	-	-	-	-	6
NT-40	29-May-12	2	-	-	13	-	-	1	-	-	-	16
						-	-					
All Tows		259	54	7	170	49	55	3	4	2	1	604

1 - Neuston tow locations illustrated in Figure 5-10.

2 - Several sucker species were captured in Lake St. Martin during spring 2012; White Sucker were the most abundant sucker species captured and it is thought that sucker eggs and larvae captured were White Suckers.

3 - At least two darter species occur in Lake St. Martin (Table 6); not identified to species because of difficulty discerning between species when in larval stage.

4 - Minnows = Family Cyprinidae; not identified to species because of difficulty discerning between species when in larval stage.

Table 5-9. Tow-specific catch-per-unit-effort (# fish/100 m^3) from neuston tows conducted in Lake St. Martin during spring 2012.

Neuston Tow	Date	Larval Fish						Juvenile/Adult Fish				Total
		Lake Whitefish	Cisco	Sucker	Yellow Perch	Darters	Minnows	Emerald Shiner	Fathead Minnow	River Shiner	Ninespine Stickleback	
NT-01	16-Apr-12	-	-	-	-	-	-	-	-	-	-	0.00
NT-02	16-Apr-12	-	-	-	-	-	-	-	-	-	-	0.00
NT-03	16-Apr-12	-	-	-	-	-	-	-	-	0.53	-	0.53
NT-04	16-Apr-12	-	-	-	-	-	-	-	-	-	-	0.00
NT-05	16-Apr-12	-	-	-	-	-	-	-	-	-	-	0.00
NT-06	16-Apr-12	-	-	-	-	-	-	-	0.57	-	-	0.57
NT-07	17-Apr-12	-	-	-	-	-	-	-	-	-	-	0.00
NT-08	17-Apr-12	-	-	-	-	-	-	-	-	-	-	0.00
NT-09	17-Apr-12	0.37	-	-	-	-	-	-	-	-	-	0.37
NT-10	24-Apr-12	7.45	7.45	-	-	-	-	-	7.45	-	-	22.35
NT-11	24-Apr-12	1.23	0.41	-	-	-	-	-	-	-	-	1.64
NT-12	26-Apr-12	3.73	1.24	-	-	-	-	-	-	-	-	4.97
NT-13	26-Apr-12	5.08	2.54	-	-	-	-	-	-	-	-	7.61
NT-14	26-Apr-12	5.60	7.28	-	-	-	-	-	-	-	0.56	13.43
NT-15	26-Apr-12	-	1.74	-	-	-	-	-	-	-	-	1.74
NT-16	26-Apr-12	1.51	3.52	-	-	-	-	-	0.50	-	-	5.53
NT-17	7-May-12	5.16	0.79	-	-	-	-	-	-	-	-	5.96
NT-18	7-May-12	8.93	2.10	-	-	-	-	-	-	-	-	11.03
NT-19	7-May-12	5.46	-	-	-	-	-	-	-	-	-	5.46
NT-20	8-May-12	10.60	2.21	-	-	-	-	-	-	-	-	12.81
NT-21	8-May-12	5.55	0.85	-	-	-	-	-	-	0.43	-	6.83
NT-22	8-May-12	0.41	-	-	-	-	-	-	-	-	-	0.41
NT-23	8-May-12	3.47	0.50	-	-	-	-	-	-	-	-	3.97
NT-24	9-May-12	0.55	-	-	-	-	-	-	-	-	-	0.55
NT-25	9-May-12	1.26	1.26	-	-	-	-	-	-	-	-	2.52

Table 5-9. (continued).

Neuston Tow	Date	Larval Fish						Juvenile/Adult Fish				Total
		Lake Whitefish	Cisco	Sucker	Yellow Perch	Darters	Minnows	Emerald Shiner	Fathead Minnow	River Shiner	Ninespine Stickleback	
NT-26	16-May-12	1.38	-	-	-	-	-	-	-	-	-	1.38
NT-27	16-May-12	1.45	-	-	-	-	-	-	-	-	-	1.45
NT-28	16-May-12	-	0.47	-	-	-	-	-	-	-	-	0.47
NT-29	16-May-12	3.88	-	-	-	-	31.69	0.65	-	-	-	36.21
NT-30	16-May-12	-	0.65	-	-	-	-	-	-	-	-	0.65
NT-31	16-May-12	-	-	-	-	-	1.46	-	-	-	-	1.46
NT-32	17-May-12	1.09	-	3.26	-	-	-	-	-	-	-	4.34
NT-33	17-May-12	0.52	-	-	-	-	2.08	-	-	-	-	2.60
NT-34	29-May-12	13.51	-	-	7.07	-	-	-	-	-	-	20.58
NT-35	29-May-12	12.36	-	0.65	18.87	-	-	-	-	-	-	32.53
NT-36	29-May-12	33.19	-	-	42.18	-	-	-	-	-	-	75.37
NT-37	29-May-12	3.30	-	-	34.30	-	-	-	-	-	-	37.60
NT-38	29-May-12	10.26	-	-	-	29.56	-	-	-	-	-	39.82
NT-39	29-May-12	1.25	-	-	2.51	-	-	-	-	-	-	3.76
NT-40	29-May-12	2.14	-	-	13.91	-	-	-	-	-	-	17.12
All Tows		3.45	0.72	0.09	2.26	0.65	0.73	0.04	0.05	0.03	0.01	8.05

5.2.1.3 Adult Fish

Gillnetting

A total of 33 experimental gill nets were set in Lake St. Martin during spring (Table 5-10; Figure 5-11). Nets were set for less than three hours to minimize fish mortality.

The gillnet catch included 497 fish, representing eight species (Table 5-11). The most abundant species captured were White Sucker (n = 246; 49.5%) and Northern Pike (n = 147; 29.6%), followed by Yellow Perch (n = 58; 11.7%), Lake Whitefish (n = 21; 4.2%) and Longnose Sucker (n = 16; 3.2%). Small numbers of Shorthead Redhorse (n = 4; 0.8%), Walleye (n = 4; 0.8%), and Freshwater Drum (n = 1; 0.2%) were also captured (Table 5-11).

Fish catches were low at the onset of the spring monitoring program in mid-April (Sampling Period 1) when water temperature was approximately 5°C (Figure 5-8). The CPUE during Sampling Period 1 was 0.35 fish/100 m gang/hour, with Northern Pike the most frequently captured species (Table 5-12). Catches increased towards the end of April (CPUE = 5.35) as water temperature increased to about 8°C and larger numbers of Northern Pike were captured. Peak catch rates of 19.22 fish/100 m gang/hour were reached during the third sampling period (early May) when water temperature was 10°C and White Sucker and Yellow Perch numbers increased significantly. Catches in mid and late May were lower than early May due largely to a decrease in White Sucker CPUE that likely corresponded to movements out of the study area following completion of spawning.

Most species of fish occurred throughout the study area, although some species such as Lake Whitefish tended to be more concentrated in certain areas such as the Dauphin River or Reach 1 inlet. In particular, approximately half of the White Suckers (n = 126) were captured in two nets (GN-17 and GN-18) set near the mouth of Bear Creek to the south of the Reach 1 inlet (Table 5-12; Figure 5-11). Most of the suckers in the two nets were adult fish in an advanced pre-spawn condition (Table 5-13). It is thought that suckers concentrating in that area were staging, prior to making spawning movements into the creek. Local people have indicated that suckers are known to spawn in that creek.

Besides White Sucker, adult Northern Pike, Longnose Sucker, Yellow Perch and a small number of Walleye were captured that were in an advanced pre-spawn state and would have spawned shortly after capture (Table 5-13). Most fish in pre-spawn condition were captured in early to mid-May.

The following sections describe the overall metrics for each species where the number of fish captured was greater than ten. Condition factors were calculated for each species based on length and weight measurements (Table 5-14).

Table 5-10. Location, water depth, water temperature, and set duration for experimental gill nets set in Lake St. Martin during spring, 2012.

Site	Location [1]		Water Depth (m)	Water Temperature (°C)	Set Date	Set Time	Pull Date	Pull Time	Duration (hrs)
	Easting	Northing							
GN-1	553455	5739070	-	2.2	16-Apr-12	10:06	16-Apr-12	11:52	1.8
GN-2	553326	5739042	-	2.2	16-Apr-12	10:06	16-Apr-12	12:03	2.0
GN-3	553268	5739212	-	2.2	16-Apr-12	12:24	16-Apr-12	13:29	1.1
GN-4	547674	5742015	-	2.2	16-Apr-12	14:17	16-Apr-12	16:19	2.0
GN-5	547512	5741990	-	2.2	16-Apr-12	14:21	16-Apr-12	16:09	1.8
GN-6	546554	5744163	-	2.2	16-Apr-12	16:41	16-Apr-12	18:40	2.0
GN-7	542052	5733343	-	2.2	17-Apr-12	10:14	17-Apr-12	12:11	2.0
GN-8	542102	5733465	-	2.2	17-Apr-12	10:20	17-Apr-12	12:06	1.8
GN-9	542468	5733711	-	2.2	17-Apr-12	12:20	17-Apr-12	13:48	1.5
GN-10	546691	5741512	1.5-3.0	6.0	25-Apr-12	9:16	25-Apr-12	11:36	2.3
GN-11	546635	5740952	3.5-3.0	6.0	25-Apr-12	9:28	25-Apr-12	12:16	2.8
GN-12	552966	5738578	3.0-3.0	5.0	26-Apr-12	9:16	26-Apr-12	11:47	2.5
GN-13	553393	5738519	3.0-3.0	5.0	26-Apr-12	9:25	26-Apr-12	12:06	2.7
GN-14	547205	5734254	3.0-2.0	11.0	7-May-12	12:45	7-May-12	13:54	1.2
GN-15	547106	5733142	3.0-3.0	11.0	7-May-12	13:42	7-May-12	15:07	1.4
GN-16	547960	5734304	3.0-1.5	11.0	7-May-12	14:15	7-May-12	16:13	2.0
GN-17	555028	5735391	1.9-1.9	10.0	8-May-12	12:21	8-May-12	13:13	0.9
GN-18	554953	5735972	2.3-1.9	10.0	8-May-12	13:06	8-May-12	14:13	1.1
GN-19	553861	5738095	2.4-2.6	10.0	8-May-12	15:20	8-May-12	16:20	1.0
GN-20	553190	5730214	2.5-2.4	10.0	8-May-12	15:34	8-May-12	16:52	1.3
GN-21	546895	5740589	2.0-2.4	11.0	9-May-12	8:22	9-May-12	10:34	2.2
GN-22	547521	5740475	2.7-2.2	11.0	9-May-12	8:30	9-May-12	10:00	1.5
GN-23	544903	5734198	2.7-2.4	14.0	16-May-12	12:15	16-May-12	13:00	0.8
GN-24	541534	5732902	2.7-2.4	14.0	16-May-12	13:23	16-May-12	14:05	0.7
GN-25	554913	5735673	2.3-1.4	14.0	16-May-12	15:25	16-May-12	16:02	0.6
GN-26	547183	5742847	1.3-2.5	14.0	18-May-12	8:51	18-May-12	9:40	0.8
GN-27	553332	5739198	1.5-1.7	14.0	18-May-12	10:24	18-May-12	11:08	0.7

Table 5-10. (continued).

Site	Location [1]		Water Depth (m)	Water Temperature (°C)	Set Date	Set Time	Pull Date	Pull Time	Duration (hrs)
	Easting	Northing							
GN-28	553224	5738152	2.3-2.4	10.0	28-May-12	14:00	28-May-12	15:40	1.7
GN-29	554546	5737956	2.3-2.3	10.0	28-May-12	14:15	28-May-12	16:00	1.8
GN-30	547804	5735538	2.3-2.4	10.0	29-May-12	9:00	29-May-12	11:20	2.3
GN-31	547832	5733662	1.9-2.1	10.0	29-May-12	9:15	29-May-12	11:00	1.8
GN-32	548052	5739811	2.5-2.6	10.0	29-May-12	14:35	29-May-12	16:50	2.3
GN-33	547234	5740240	2.3-2.4	10.0	29-May-12	14:50	29-May-12	16:30	1.7

1 - UTM coordinates; NAD 83 Zone 14U; site-specific locations illustrated in Figure 5-11.

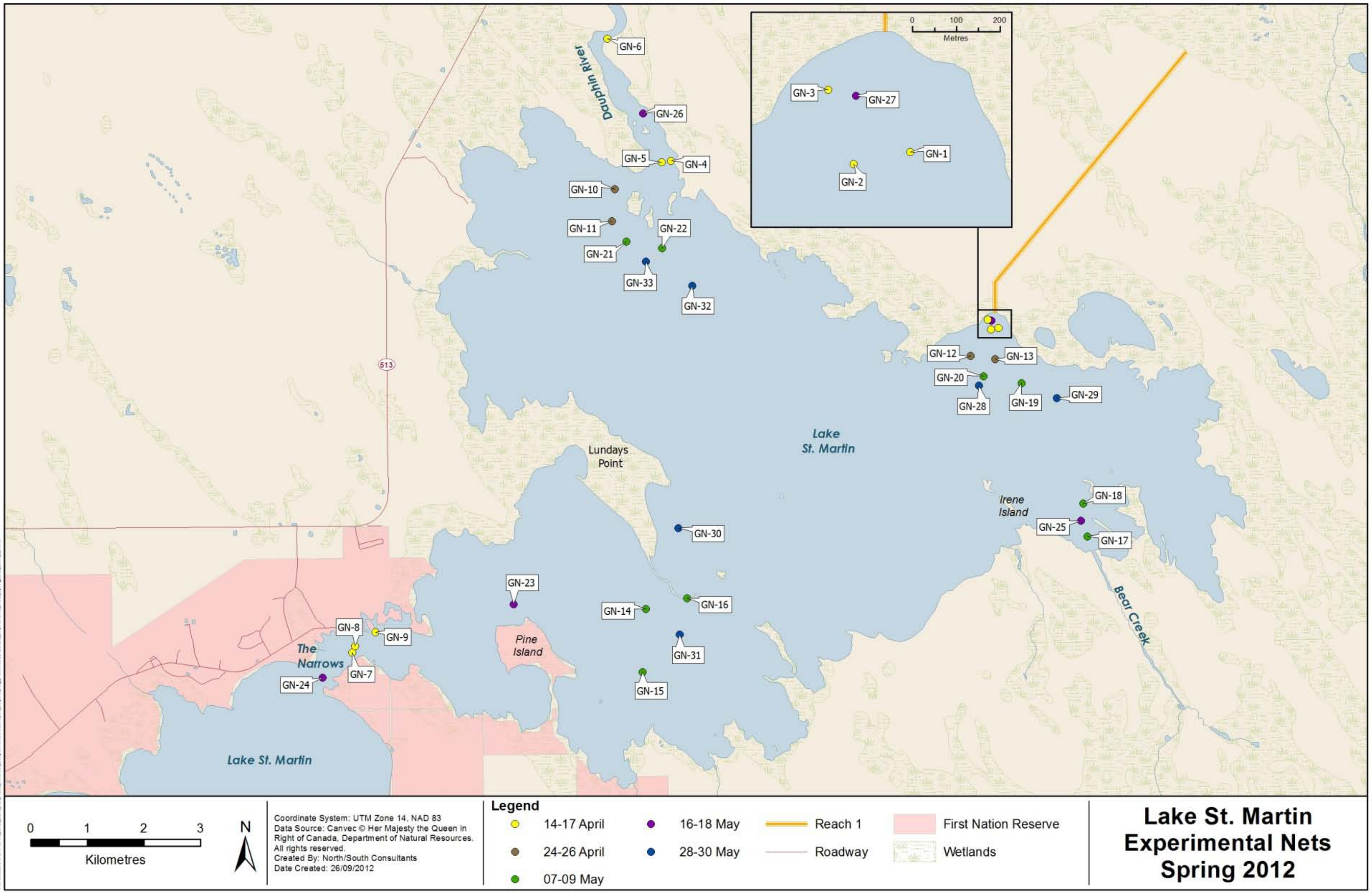

Figure 5-11. Location of experimental gill nets set in Lake St. Martin during spring 2012.

Table 5-11. Site-specific catch and relative abundance (%) of each fish species captured in experimental gill nets set in Lake St. Martin during spring 2012.

Sampling Period	Site	Species								Total
		Freshwater Drum	Lake Whitefish	Longnose Sucker	Northern Pike	Shorthead Redhorse	Walleye	White Sucker	Yellow Perch	
1	GN-1	-	-	1	1	-	-	-	-	**2**
	GN-2	-	-	-	2	-	-	-	-	**2**
	GN-3	-	-	-	-	-	-	-	-	**0**
	GN-4	-	-	-	2	-	-	-	-	**2**
	GN-5	-	-	-	-	-	-	1	-	**1**
	GN-6	-	-	-	-	-	-	-	-	**0**
	GN-7	-	-	-	-	-	-	-	-	**0**
	GN-8	-	-	-	-	-	-	-	-	**0**
	GN-9	-	-	-	1	-	-	-	-	**1**
	Total	**-**	**-**	**1**	**6**	**-**	**-**	**1**	**-**	**8**
	RA (%)	**-**	**-**	**12.5**	**75.0**	**-**	**-**	**12.5**	**-**	**100**
2	GN-10	-	2	-	16	-	-	-	-	**18**
	GN-11	-	4	2	23	-	-	3	1	**33**
	GN-12	-	1	-	3	-	-	1	2	**7**
	GN-13	-	-	2	14	-	1	1	1	**19**
	Total	**-**	**7**	**4**	**56**	**-**	**1**	**5**	**4**	**77**
	RA (%)	**-**	**9.1**	**5.2**	**72.7**	**-**	**1.3**	**6.5**	**5.2**	**100**
3	GN-14	-	-	-	-	-	-	-	-	**0**
	GN-15	-	-	-	2	-	-	3	3	**8**
	GN-16	-	-	4	2	-	-	14	11	**31**
	GN-17	-	-	1	3	-	-	79	2	**85**
	GN-18	-	-	2	6	-	-	46	17	**71**
	GN-19	-	-	2	5	1	2	13	3	**26**
	GN-20	-	-	2	2	-	-	2	1	**7**
	GN-21	-	-	-	11	-	-	13	4	**28**
	GN-22	-	1	-	6	-	-	6	3	**16**
	Total	**-**	**1**	**11**	**37**	**1**	**2**	**176**	**44**	**272**
	RA (%)	**-**	**0.4**	**4.0**	**13.6**	**0.4**	**0.7**	**64.7**	**16.2**	**100**
4	GN-23	-	-	-	1	2	-	6	-	**9**
	GN-24	-	-	-	3	-	-	6	-	**9**
	GN-25	-	-	-	-	-	-	9	3	**12**
	GN-26	-	-	-	2	1	-	4	1	**8**
	GN-27	-	-	-	3	-	-	4	-	**7**
	Total	**-**	**-**	**-**	**9**	**3**	**-**	**29**	**4**	**45**
	RA (%)	**-**	**-**	**-**	**20.0**	**6.7**	**-**	**64.4**	**8.9**	**100**
5	GN-28	-	3	-	3	-	-	6	-	**12**
	GN-29	-	1	-	2	-	-	3	-	**6**
	GN-30	-	2	-	5	-	-	14	3	**24**
	GN-31	1	-	-	4	-	1	5	1	**12**
	GN-32	-	4	-	7	-	-	5	1	**17**
	GN-33	-	3	-	18	-	-	2	1	**24**
	Total	**1**	**13**	**-**	**39**	**-**	**1**	**35**	**6**	**95**
	RA (%)	**1.1**	**13.7**	**-**	**41.1**	**-**	**1.1**	**36.8**	**6.3**	**100**
Overall	***Total***	***1***	***21***	***16***	***147***	***4***	***4***	***246***	***58***	***497***
	RA (%)	***0.2***	***4.2***	***3.2***	***29.6***	***0.8***	***0.8***	***49.5***	***11.7***	***100.0***

Table 5-12. Catch-per-unit-effort (CPUE; #fish/100 m gang/hour) for each fish species captured in experimental gill nets set in Lake St. Martin during spring 2012.

Sampling Period	Site	Duration (hrs)	CPUE								
			Freshwater Drum	Lake Whitefish	Longnose Sucker	Northern Pike	Shorthead Redhorse	Walleye	White Sucker	Yellow Perch	Total
1	GN-1	1.77	0.00	0.00	0.41	0.41	0.00	0.00	0.00	0.00	0.82
	GN-2	1.95	0.00	0.00	0.00	0.75	0.00	0.00	0.00	0.00	0.75
	GN-3	1.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GN-4	2.03	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.00	0.72
	GN-5	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.41
	GN-6	1.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GN-7	1.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GN-8	1.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GN-9	1.47	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.50
		Mean	**0.00**	**0.00**	**0.05**	**0.26**	**0.00**	**0.00**	**0.05**	**0.00**	**0.35**
		SD[1]	**0.00**	**0.00**	**0.14**	**0.33**	**0.00**	**0.00**	**0.14**	**0.00**	**0.36**
2	GN-10	2.33	0.00	0.63	0.00	5.01	0.00	0.00	0.00	0.00	5.63
	GN-11	2.80	0.00	1.04	0.52	5.99	0.00	0.00	0.78	0.26	8.59
	GN-12	2.52	0.00	0.29	0.00	0.87	0.00	0.00	0.29	0.58	2.03
	GN-13	2.68	0.00	0.00	0.54	3.81	0.00	0.27	0.27	0.27	5.17
		Mean	**0.00**	**0.49**	**0.27**	**3.92**	**0.00**	**0.07**	**0.34**	**0.28**	**5.35**
		SD	**0.00**	**0.45**	**0.31**	**2.22**	**0.00**	**0.14**	**0.33**	**0.24**	**2.69**
3	GN-14	1.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GN-15	1.42	0.00	0.00	0.00	1.03	0.00	0.00	1.54	1.54	4.11
	GN-16	1.97	0.00	0.00	1.48	0.74	0.00	0.00	5.18	4.07	11.47
	GN-17	0.87	0.00	0.00	0.84	2.51	0.00	0.00	66.20	1.68	71.23
	GN-18	1.12	0.00	0.00	1.30	3.91	0.00	0.00	29.94	11.07	46.22
	GN-19	1.00	0.00	0.00	1.46	3.65	0.73	1.46	9.48	2.19	18.96
	GN-20	1.30	0.00	0.00	1.12	1.12	0.00	0.00	1.12	0.56	3.93
	GN-21	2.20	0.00	0.00	0.00	3.65	0.00	0.00	4.31	1.33	9.28
	GN-22	1.50	0.00	0.49	0.00	2.92	0.00	0.00	2.92	1.46	7.78
		Mean	**0.00**	**0.05**	**0.69**	**2.17**	**0.08**	**0.16**	**13.41**	**2.65**	**19.22**
		SD	**0.00**	**0.16**	**0.68**	**1.47**	**0.24**	**0.49**	**21.82**	**3.35**	**23.86**
4	GN-23	0.75	0.00	0.00	0.00	0.97	1.94	0.00	5.83	0.00	8.75
	GN-24	0.70	0.00	0.00	0.00	3.12	0.00	0.00	6.25	0.00	9.37
	GN-25	0.62	0.00	0.00	0.00	0.00	0.00	0.00	10.58	3.53	14.11
	GN-26	0.82	0.00	0.00	0.00	1.78	0.89	0.00	3.56	0.89	7.11
	GN-27	0.73	0.00	0.00	0.00	3.00	0.00	0.00	3.99	0.00	6.99
		Mean	**0.00**	**0.00**	**0.00**	**1.77**	**0.57**	**0.00**	**6.04**	**0.88**	**9.27**
		SD	**0.00**	**0.00**	**0.00**	**1.33**	**0.86**	**0.00**	**2.79**	**1.53**	**2.90**
5	GN-28	1.67	0.00	1.31	0.00	1.31	0.00	0.00	2.62	0.00	5.24
	GN-29	1.75	0.00	0.42	0.00	0.83	0.00	0.00	1.25	0.00	2.50
	GN-30	2.33	0.00	0.63	0.00	1.56	0.00	0.00	4.38	0.94	7.51
	GN-31	1.75	0.42	0.00	0.00	1.67	0.00	0.42	2.08	0.42	5.00
	GN-32	2.25	0.00	1.30	0.00	2.27	0.00	0.00	1.62	0.32	5.51
	GN-33	1.67	0.00	1.31	0.00	7.86	0.00	0.00	0.87	0.44	10.48
		Mean	**0.07**	**0.83**	**0.00**	**2.58**	**0.00**	**0.07**	**2.14**	**0.35**	**6.04**
		SD	**0.17**	**0.56**	**0.00**	**2.63**	**0.00**	**0.17**	**1.26**	**0.35**	**2.70**
Overall		**Mean**	**0.01**	**0.22**	**0.23**	**1.88**	**0.11**	**0.07**	**5.01**	**0.96**	**8.49**
		SD	***0.07***	***0.43***	***0.47***	***1.92***	***0.38***	***0.26***	***12.31***	***2.08***	***14.10***

1 - SD = standard deviation.

Table 5-13. Sex and maturity status of fish species captured in experimental gill nets set in Lake St. Martin during spring 2012.

Sex & Maturity	Species					
	Longnose Sucker	Northern Pike	Walleye	White Sucker	Yellow Perch	Total
Female						
Ripe	-	-	1	2	-	3
Spent	-	2	-	44	6	52
Resting	-	1	-	4	1	6
Total	-	3	1	50	7	61
Male						
Preparing to Spawn	-	-	1	-	-	1
Ripe	6	8	1	116	25	156
Spent	-	-	1	1	-	2
Immature	-	1	-	-	-	1
Total	6	9	3	117	25	160
Unknown						
Immature	-	1	-	-	-	1
Total	6	13	4	167	32	222

Table 5-14. Fork length (mm), weight (g) and condition factor for fish species captured in experimental gill nets set in Lake St. Martin during spring 2012.

Species	Fork Length (mm)				Weight (g)				K			
	n [1]	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Lake Whitefish	21	413	20	387 - 459	8	1153	288	875 - 1550	8	1.49	0.13	1.27 - 1.67
Longnose Sucker	16	460	50	379 - 559	16	1523	612	900 - 3250	16	1.50	0.16	1.31 - 1.86
Northern Pike	144	445	138	204 - 790	98	959	641	50 - 3900	98	0.73	0.11	0.48 - 1.09
White Sucker	244	409	53	168 - 534	207	1243	361	100 - 2300	207	1.71	0.20	0.91 - 2.24
Yellow Perch	57	154	40	99 - 313	4	100	134	25 - 300	4	1.17	0.38	0.89 - 1.71

1 - number of fish measured; may not equal total number captured.

2 - SD = standard deviation.

Lake Whitefish

Lake Whitefish (n = 21) were captured during three out of the five sampling periods (Table 5-11). Mean CPUE for all sampling periods was 0.22 fish/100 m gang /hour (Table 5-12) with a peak of 0.83 in late May. Mean fork length, weight and condition factor were 413 mm, 1,153 g and 1.49, respectively (Table 5-14). The modal fork length interval for Lake Whitefish was 400-424 mm and the overall length-frequency distribution range was narrow (Figure 5-12).

Longnose Sucker

Longnose Sucker (n = 16) were captured during the three earliest sampling periods (Table 5-11). Mean CPUE for all sampling periods was 0.23 fish/100 m gang /hour with a peak of 0.69 in early May (Table 5-12). Mean fork length, weight and condition factor were 460 mm, 1,523 g and 1.50, respectively (Table 5-14). Half of the captured Longnose Sucker were 425-474 mm (Figure 5-13).

Northern Pike

Northern Pike (n = 144) were captured during all five sampling periods, and were the second most abundant fish species captured (Table 5-11). Mean CPUE for all sampling periods was 1.88 fish/100 m gang/hour with a peak of 3.92 in late April (Table 5-12). Mean fork length, weight and condition factor were 445 mm, 959 g and 0.73, respectively (Table 5-14). Captured Northern Pike had a broad length-frequency distribution with a modal fork length interval of 500-549 mm (Figure 5-14).

White Sucker

White Sucker (n = 244) were captured during all five sampling periods, and were the most abundant fish caught in Lake St. Martin gill nets (Table 5-11). Mean CPUE for all sampling periods was 5.01 fish/100 m gang/hour with a peak of 13.41 in early May (Table 5-12). Mean fork length, weight and condition factor were 409 mm, 1,243 g and 1.71, respectively (Table 5-14). The modal fork length interval for White Sucker was 425-449 mm, with more than 48% of the catch measuring 400-449 mm (Figure 5-15).

Yellow Perch

Yellow Perch (n = 57) was the third most abundant species, and was caught during four of the five sampling periods (Table 5-11). Mean CPUE for all sampling periods was 0.96 fish/100 m gang/hour with a peak of 2.65 in early May (Table 5-12). Mean fork length, weight and condition factor were 154 mm, 100 g and 1.17, respectively (Table 5-14). The modal fork length interval of 125-149 mm accounted for more than 68% of the total Yellow Perch catch (Figure 5-16).

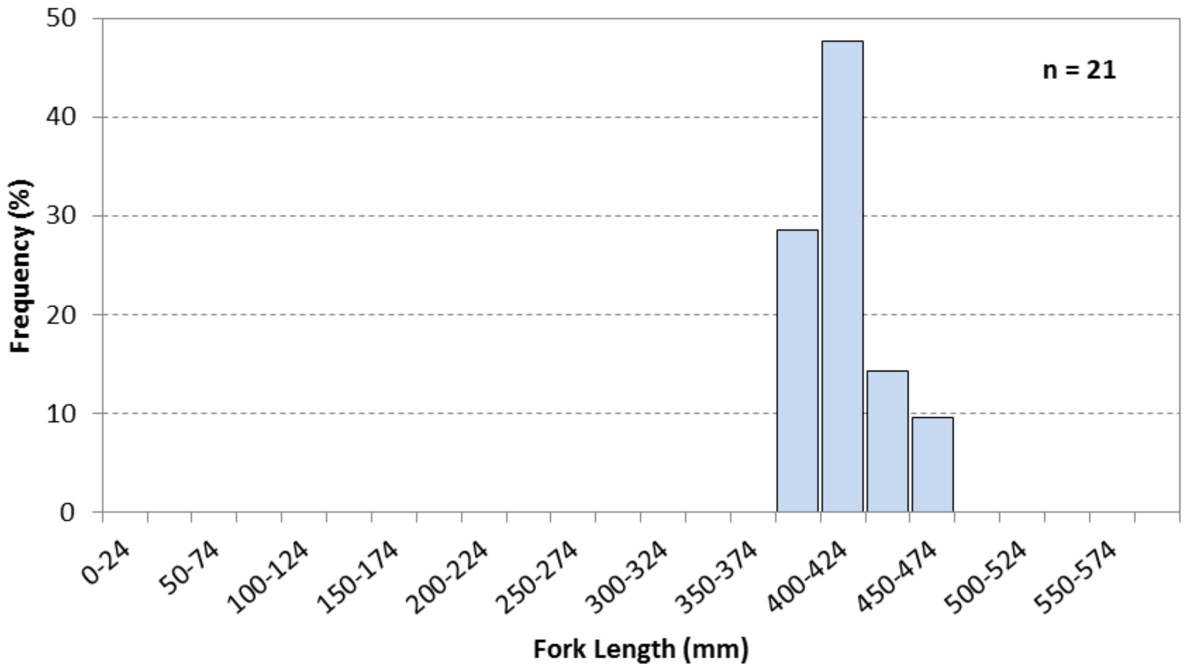

Figure 5-12. Length-frequency distribution for Lake Whitefish captured in standard experimental gill nets set in Lake St. Martin during spring 2012.

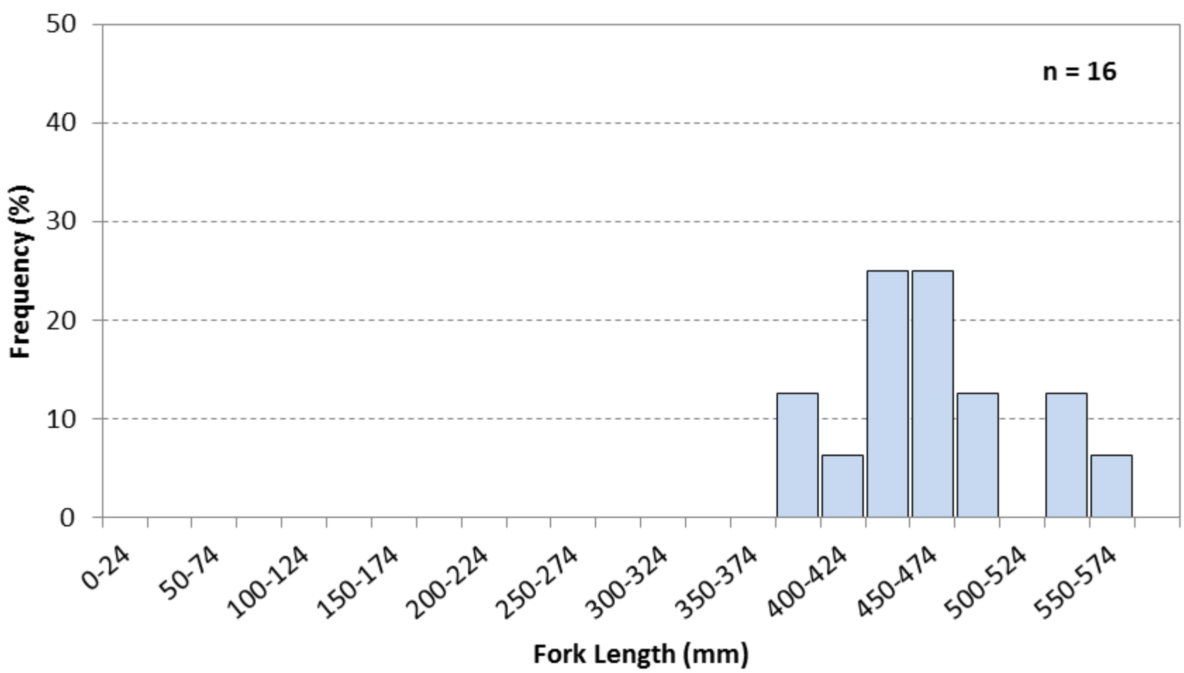

Figure 5-13. Length-frequency distribution for Longnose Sucker captured in standard experimental gill nets set in Lake St. Martin during spring 2012.

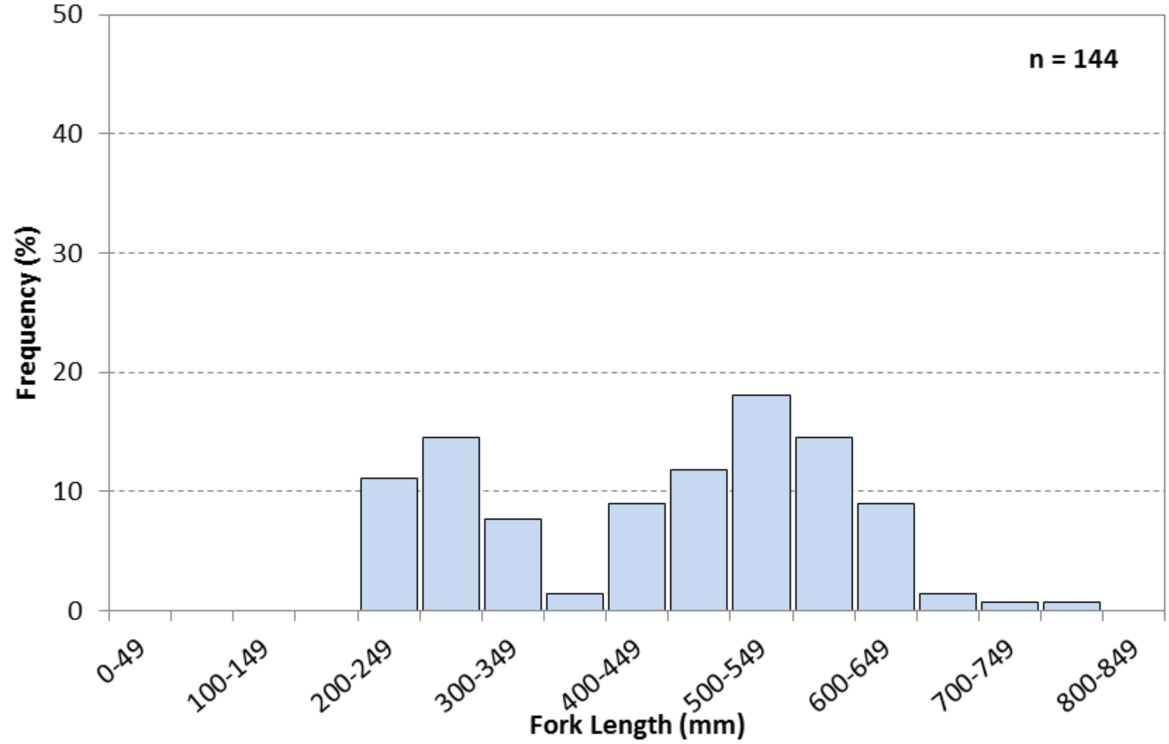

Figure 5-14. Length-frequency distribution for Northern Pike captured in standard experimental gill nets set in Lake St. Martin during spring 2012.

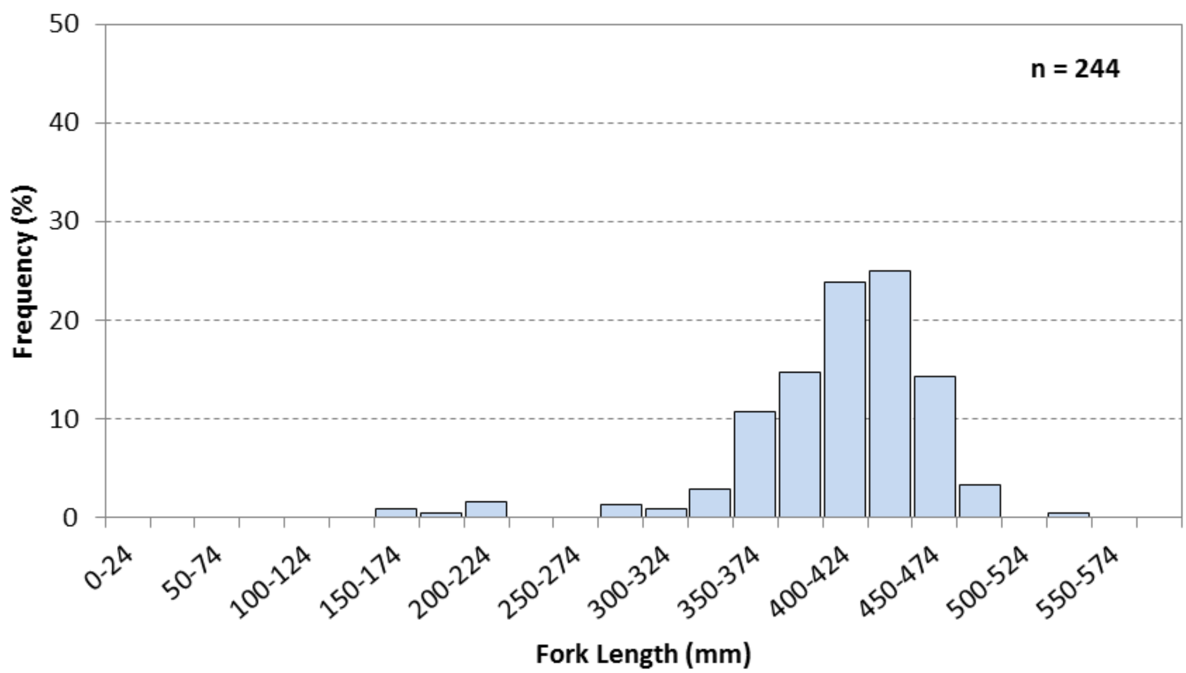

Figure 5-15. Length-frequency distribution for White Sucker captured in standard experimental gill nets set in Lake St. Martin during spring 2012.

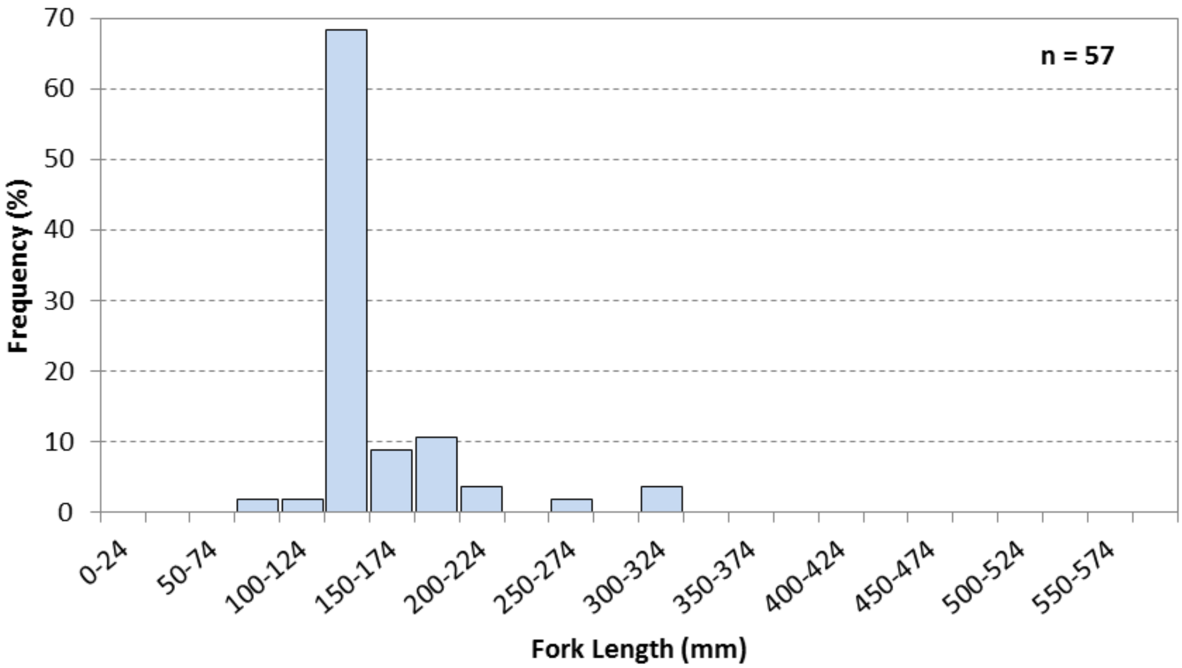

Figure 5-16. Length-frequency distribution for Yellow Perch captured in standard experimental gill nets set in Lake St. Martin during spring 2012.

5.2.1.4 Debris Monitoring

Debris levels were obtained from 18 of 33 experimental gill nets set in Lake St Martin from 14 April to 30 May, 2012 (Table 5-10; Figure 5-11). Of these 18 nets, 15 contained low levels of debris, while the other three nets contained no debris (Table 5-15). Terrestrial vegetation (grass) represented 79.7% of the debris observed, while aquatic vegetation (weeds) represented 16.3%, algae 2.7%, other (rocks) 1.0% and terrestrial moss 0.3% (Table 5-15; Figure 5-17).

Table 5-15. Net-specific debris level and composition in experimental gill nets set in Lake St. Martin during spring 2012.

Site	Set Duration (hrs)	Debris Level [1]	Debris Type (% of total debris per net)							Comments
			Terrestrial Vegetation	Terrestrial Moss	Sticks	Aquatic Vegetation	Algae	Silt/Mud	Other	
GN-1	1.8	Low	80%	-	-	-	20%	-	-	-
GN-2	2.0	Low	80%	-	-	-	20%	-	-	-
GN-3 [2]	1.1	-	-	-	-	-	-	-	-	-
GN-4 [2]	2.0	-	-	-	-	-	-	-	-	-
GN-5 [2]	1.8	-	-	-	-	-	-	-	-	-
GN-6 [2]	2.0	-	-	-	-	-	-	-	-	-
GN-7	2.0	None	-	-	-	-	-	-	-	-
GN-8	1.8	None	-	-	-	-	-	-	-	-
GN-9 [2]	1.5	-	-	-	-	-	-	-	-	-
GN-10 [2]	2.3	-	-	-	-	-	-	-	-	-
GN-11 [2]	2.8	-	-	-	-	-	-	-	-	-
GN-12 [2]	2.5	-	-	-	-	-	-	-	-	-
GN-13 [2]	2.7	-	-	-	-	-	-	-	-	-
GN-14	1.2	Low	50%	-	-	50%	-	-	-	-
GN-15	1.4	Low	100%	-	-	-	-	-	-	-
GN-16	2.0	Low	95%	-	-	-	-	-	5%	-
GN-17	0.9	Low	100%	-	-	-	-	-	-	-
GN-18	1.1	Low	100%	-	-	-	-	-	-	-
GN-19	1.0	Low	100%	-	-	-	-	-	-	-
GN-20	1.3	Low	100%	-	-	-	-	-	-	-
GN-21	2.2	Low	50%		-	50%	-	-	-	-
GN-22	1.5	Low	95%	5%	-	-	-	-	-	-
GN-23	0.8	None	-	-	-	-	-	-	-	-
GN-24	0.7	Low	50%	-	-	50%	-	-	-	-
GN-25	0.6	Low	100%	-	-	-	-	-	-	-
GN-26	0.8	Low	-	-	-	95%			5%	-
GN-27	0.7	Low	95%	-	-	-	-	-	5%	-
GN-28 [2]	1.7	-	-	-	-	-	-	-	-	-
GN-29 [2]	1.8	-	-	-	-	-	-	-	-	-
GN-30 [2]	2.3	-	-	-	-	-	-	-	-	-
GN-31 [2]	1.8	-	-	-	-	-	-	-	-	-
GN-32 [2]	2.3	-	-	-	-	-	-	-	-	-
GN-33 [2]	1.7	-	-	-	-	-	-	-	-	-

1 - Debris level categories defined in Section 5.1.4.

2 - Debris levels not recorded.

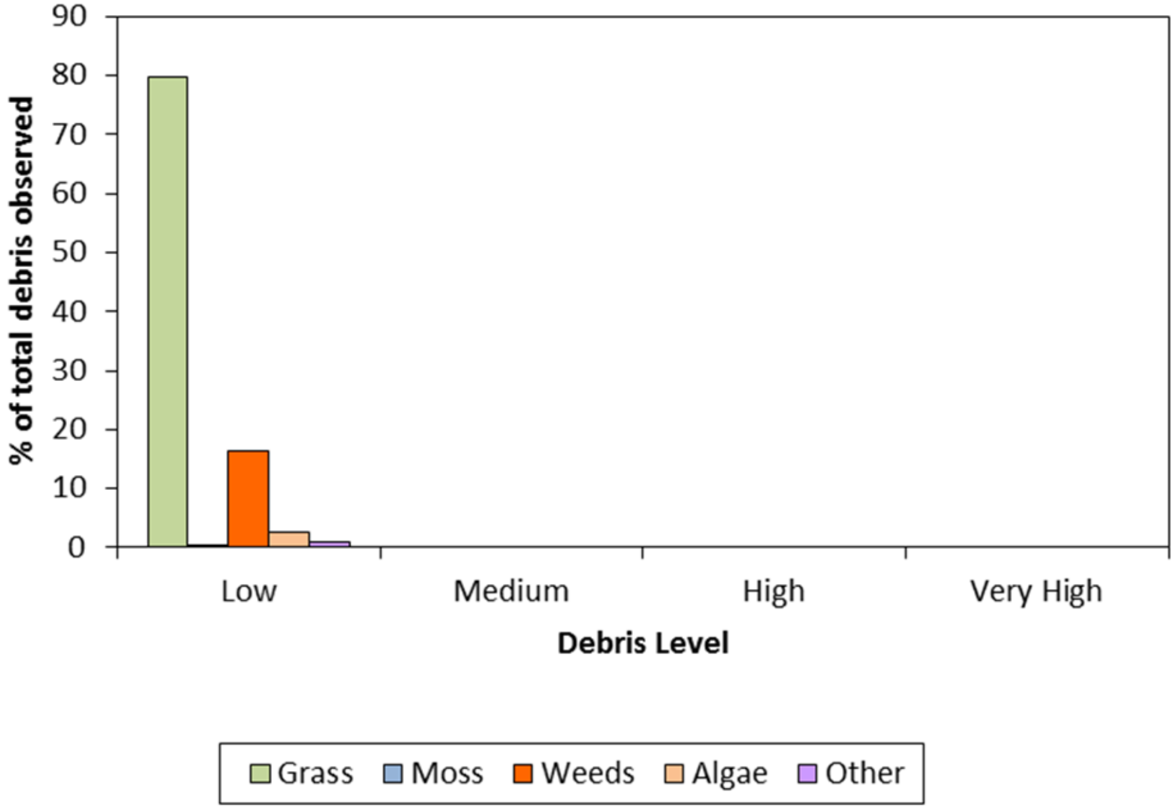

Figure 5-17. Relative composition of debris observed in 15 experimental gill nets set in Lake St. Martin during spring 2012. Note that 3 of 18 nets for which debris information was recorded had no debris in them.

5.2.2 Dauphin River and Buffalo Creek

Sampling at Dauphin River was conducted between 16 April and 15 June, and included six sampling periods (Table 5-2). Only larval drift sampling was conducted during the last period (Table 5-2).

Fish sampling was confined to the lower-most reach of the Dauphin River, extending from approximately 2 km upstream of the Buffalo Creek confluence downstream to Sturgeon Bay. Sampling activity included the collection of fish eggs using egg mats, collection of larval fish in the lower Dauphin River and Buffalo Creek using drift traps, and the collection of adult fish using a boat-based electrofisher. The following sections present results from the various sampling activities conducted in the Dauphin River.

5.2.2.1 Water Temperature

Two water temperature loggers were installed in the lower Dauphin River during April: one upstream of the confluence of Buffalo Creek; and one downstream of the Buffalo Creek confluence (Table 5-1; Figure 5-1). A third logger was installed in the lower most reach of Buffalo Creek (Table 5-1; Figure 5-1).

The three temperature loggers deployed in the area recorded similar temperature patterns throughout the period of record, although daily temperature fluctuations in Buffalo Creek were greater (higher peaks and lower valleys) than in the Dauphin River due to shallower depths in the creek (Figure 5-18). Water from Buffalo Creek appeared to have little effect on water temperature in the Dauphin River downstream of Buffalo Creek confluence; water temperatures recorded upstream of the Buffalo Creek confluence (DR-3) varied little from those recorded downstream of the confluence (DR-4).

At the onset of sampling, the Dauphin River was clear of ice and water temperature was approximately 2-3°C. Water temperature steadily increased to about 15°C by mid-May, but then decreased to 10°C by 26 May. Temperature then increased sharply to approximately 20-21°C by 7 June, remaining in the 15-20°C range until the end of fish sampling on 15 June. Water temperature continued to increase to a peak of more than 27°C in mid-July after which it gradually decreased to about 0°C by the time the loggers were removed. Declining water level resulted in the loggers at DR-1 and DR-3 being out of the water from 03-17 October and 16-23 October, respectively, and, consequently no water temperature data was collected at those locations during those dates.

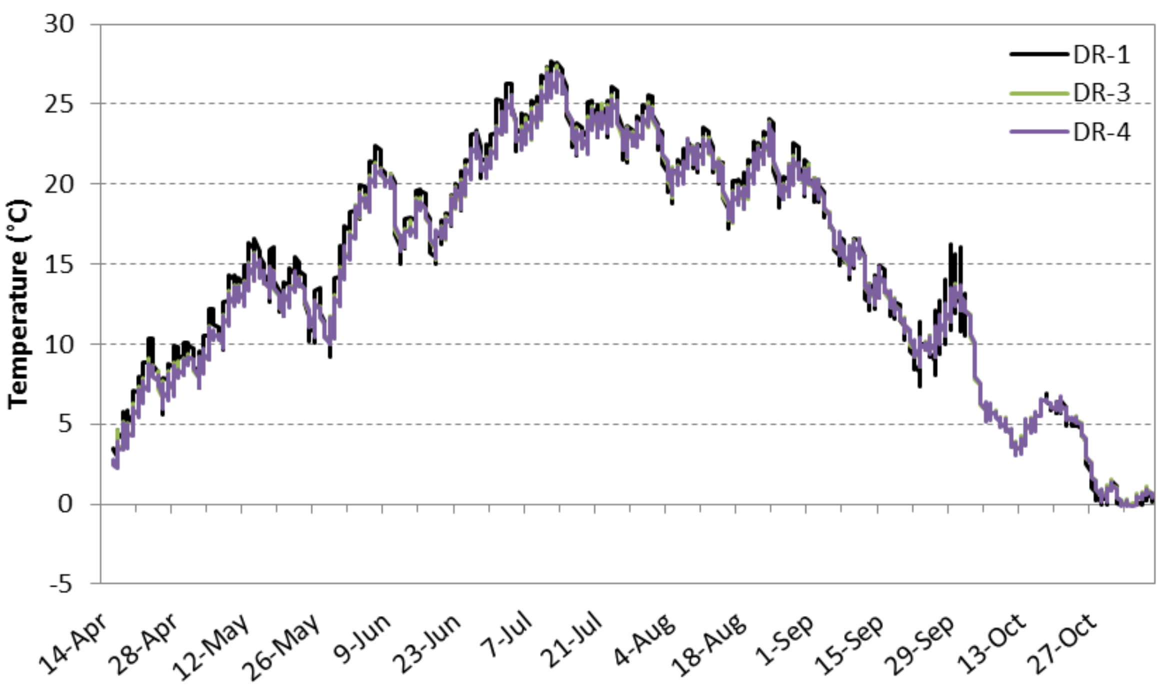

Figure 5-18. Water temperature in the Dauphin River (DR-3 and DR-4) and Buffalo Creek (DR-1) during 2012.

5.2.2.2 Spawning Activity and Larval Fish

Fish spawning activity and egg hatch were monitored in the immediate vicinity of the confluence of Buffalo Creek and the Dauphin River. Monitoring during fall 2011 indicated that that area was used by Lake Whitefish for spawning (North/South Consultants Inc. 2011c; North/South Consultants Inc. 2013). One of the objectives of the 2012 spring fisheries investigations was to determine whether Lake Whitefish eggs spawned in the area during fall 2011 successfully incubated and hatched. Further, local knowledge has suggested that the area is important to spring spawning fish as well. Egg mats and larval drift traps were deployed in the area to monitor spawning activity during spring 2012.

Egg Mats

Eight egg mats were deployed in the immediate vicinity of the confluence of Buffalo Creek and the lower Dauphin River (Table 5-16; Figure 5-19). An additional two egg mats were set approximately 500 and 1,400 m farther downstream, respectively. All of the egg mats were successfully checked on 13 May, except for EM-4, which was the mat set downstream of the confluence. EM-4 had been washed away and was not recovered.

Fish eggs, all of which were identified to be sucker eggs, were collected from each of the remaining nine egg mats (Table 5-16). The egg mats were reset and left in place to determine whether species of fish other than suckers might spawn in the area. No fish eggs were collected when the egg mats were lifted and removed on 03 June.

Table 5-16. Location, lift dates, and catches from egg mats set in Dauphin River during spring 2012.

Egg Mat	Waterbody	Set Date	Location [1]		Pull Date [2]	Egg Count	Species [3]	Pull Date [4]	Egg Count	Species
			Easting	Northing						
EM-1	Dauphin River	19-Apr-12	562185	5754824	11-May-12	2	Sucker	03-Jun-12	0	-
EM-2	Dauphin River	19-Apr-12	562249	5754816	11-May-12	69	Sucker	03-Jun-12	0	-
EM-3	Dauphin River	19-Apr-12	562386	5754848	11-May-12	24	Sucker	03-Jun-12	0	-
EM-4	Dauphin River	19-Apr-12	562855	5755196	11-May-12			Lost		
EM-5	Dauphin River	19-Apr-12	563533	5755586	11-May-12	45	Sucker	03-Jun-12	0	-
EM-6	Dauphin River	19-Apr-12	562137	5754802	11-May-12	22	Sucker	03-Jun-12	0	-
EM-7	Dauphin River	19-Apr-12	562420	5754874	11-May-12	17	Sucker	03-Jun-12	0	-
EM-8	Dauphin River	19-Apr-12	562311	5754908	11-May-12	13	Sucker	03-Jun-12	0	-
EM-9	Dauphin River	19-Apr-12	562014	5754788	11-May-12	4	Sucker	03-Jun-12	0	-
EM-10	Dauphin River	19-Apr-12	562150	5754940	11-May-12	85	Sucker	03-Jun-12	0	-

1 - UTM coordinates; NAD 83 Zone 14U; site-specific locations illustrated in Figure 5-19.

2 - Egg mat lifted and reset.

3 - Several sucker species were captured in the Dauphin River during spring 2012; White Sucker were by far the most abundant fish captured in the vicinity of the eggs mats and it is thought that the eggs captured were White Sucker eggs.

4 - Egg mat lifted and removed.

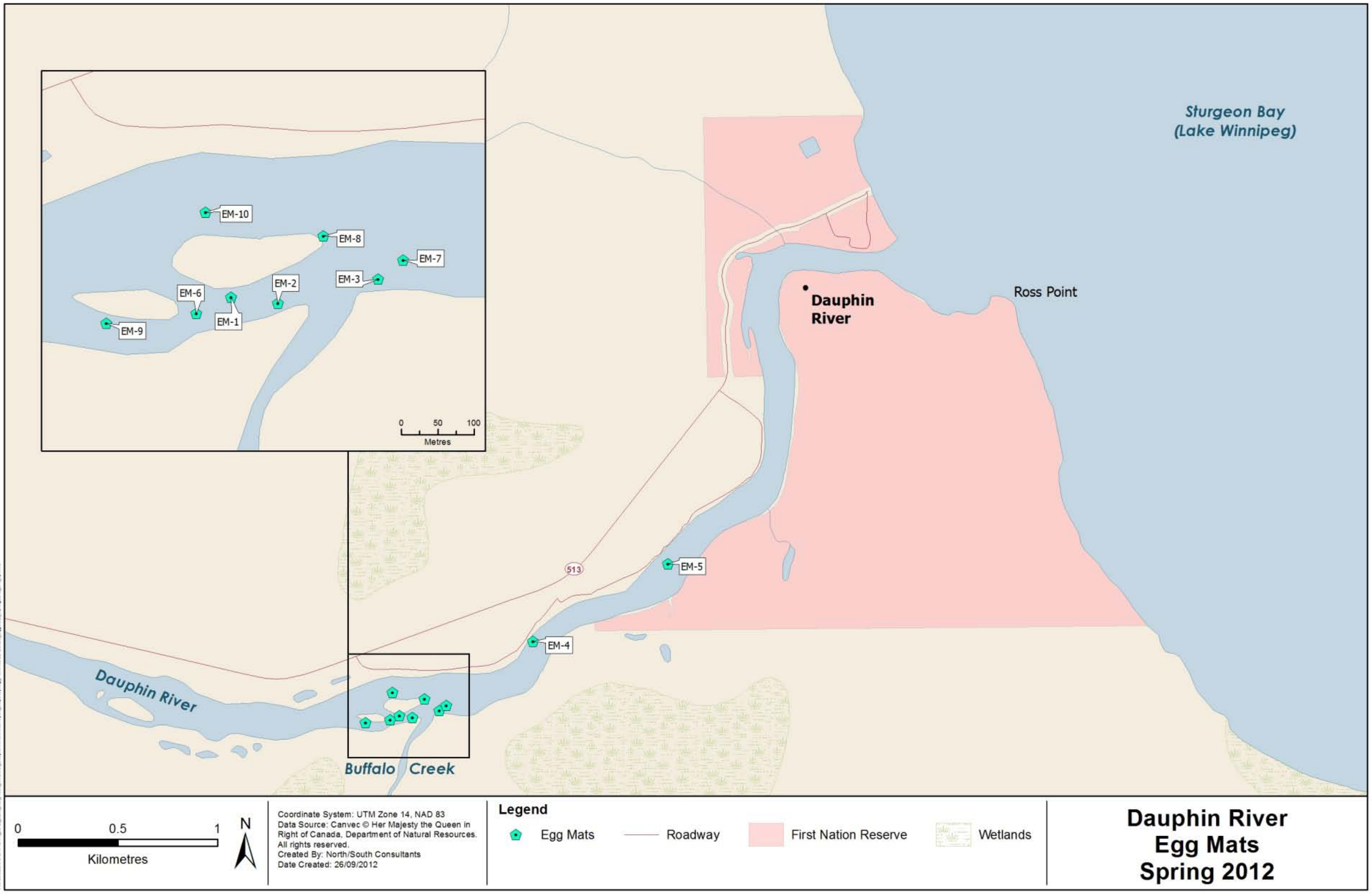

Figure 5-19. Location of egg mats set in the Dauphin River during spring 2012.

Drift Trap Sampling

Four drift traps were set in the Dauphin River in the immediate vicinity of its confluence with Buffalo Creek (Table 5-17; Figure 5-20), an area where Lake Whitefish were known to spawn during fall 2011 (North/South Consultants Inc. 2011c; North/South Consultants Inc. 2013). An additional two drift traps were set in Buffalo Creek, approximately 200 and 250 m upstream of the Dauphin River, respectively.

A total of 107,320 fish eggs or larval fish were collected across all sampling periods (Table 5-18). The vast majority of the 12,922 fish eggs were identified as sucker eggs, and were collected from all drift traps in the Dauphin River and Buffalo Creek. Small numbers of minnow and unidentified eggs were collected largely during the late May/early June sampling period at water temperatures of 10-15°C. Sucker eggs first were documented in low numbers in the drift at the beginning of spring sampling and were most abundant during the late April and mid-May periods (Table 5-18), indicating that spawning by suckers had begun by mid-April and peaked around the end of April and the first half of May.

Shorthead Redhorse, Longnose Sucker, and White Sucker were all captured in the Dauphin River during spring, but White Sucker were much more abundant than the other sucker species (see Section 5.2.2.3), particularly during the peak period of egg capture. It is thought that eggs collected in the drift traps were from White Suckers.

A total of 94,398 larval fish were identified from drift traps set in the Dauphin River and Buffalo Creek. Larval Lake Whitefish, Cisco, suckers, unidentified percids (likely darters or Yellow Perch; Family Percidae), Yellow Perch, Northern Pike, sculpins (Family Cottidae), Rainbow Smelt, and minnows (Family Cyprinidae) were captured in drift traps set in the Dauphin River (Table 5-18). Larval Lake Whitefish, Cisco, suckers, unidentified percids (likely darters or Yellow Perch; Family Percidae), Yellow Perch, Northern Pike, stickleback (Family Gasterosteidae), sculpins (Family Cottidae), White Bass, and minnows (Family Cyprinidae) were captured in drift traps set in Buffalo Creek. Suckers comprised 95% of the larval fish catch (Table 5-18). Lake Whitefish, sculpins, and cyprinids were the next most abundant larval species.

Larval Lake Whitefish were captured in all but DT-4 at the onset of the spring monitoring program (Table 5-18). By the end of April, Cisco larvae appeared in the drift catches. Lake Whitefish were most abundant in the catches at the end of April when water temperature was about 10°C, but a second of whitefish larvae were captured at the end of May/early June when water temperature was approximately 15°C (Table 5-18; Figure 5-18). Larval whitefish were captured periodically throughout the remainder of the sampling program.

Cisco were captured almost exclusively at the end of April. Larval suckers first appeared in the drift catches on 09 May in small numbers. The number of larvae captured in mid-May was considerably higher and, by the end of May, thousands were captured per drift trap (Table 5-18). Water temperature at that time was 10-15°C (Figure 5-18). Stickleback, sculpins, White Bass, and cyprinid larvae were captured almost exclusively from the end of May until mid-June (Table 5-18). Water temperature ranged from 15-20°C during this period (Figure 5-18).

In addition to larval fish, 582 juvenile or adult fish representing 14 different species were identified from drift trap catches (Table 5-19). Fathead Minnows were most abundant (n = 442), while much smaller numbers (n < 30) of all other species were documented. Fathead Minnows were captured in large numbers in late April and again from mid to late May (Table 5-19).

Table 5-17. Location and type of drift traps set in the Dauphin River and Buffalo Creek during spring 2012.

Site	Site Description	Trap Type	Location [1]	
			Easting	Northing
DT-1	Dauphin River - DS of Buffalo Creek confluence, S-bank	Floating - large	562524	5754851
DT-2	Dauphin River - US of Buffalo Creek confluence, S-bank	Floating - large	562214	5754818
DT-3	Dauphin River - US of Buffalo Creek between S-bank & small island	Floating - small	562061	5754775
DT-4	Dauphin River - US of Buffalo Creek confluence; N-Bank of N. Island	Floating - small	562258	5754930
DT-5	Buffalo Creek - 200 m US of Dauphin River ; W-bank	Staked - small	512152	5754634
DT-6	Buffalo Creek -250 m US of Dauphin River ; W-bank	Staked - small	562178	5754601

1 - UTM coordinates; NAD 83 Zone 14U; site-specific locations illustrated on Figure 5-20.

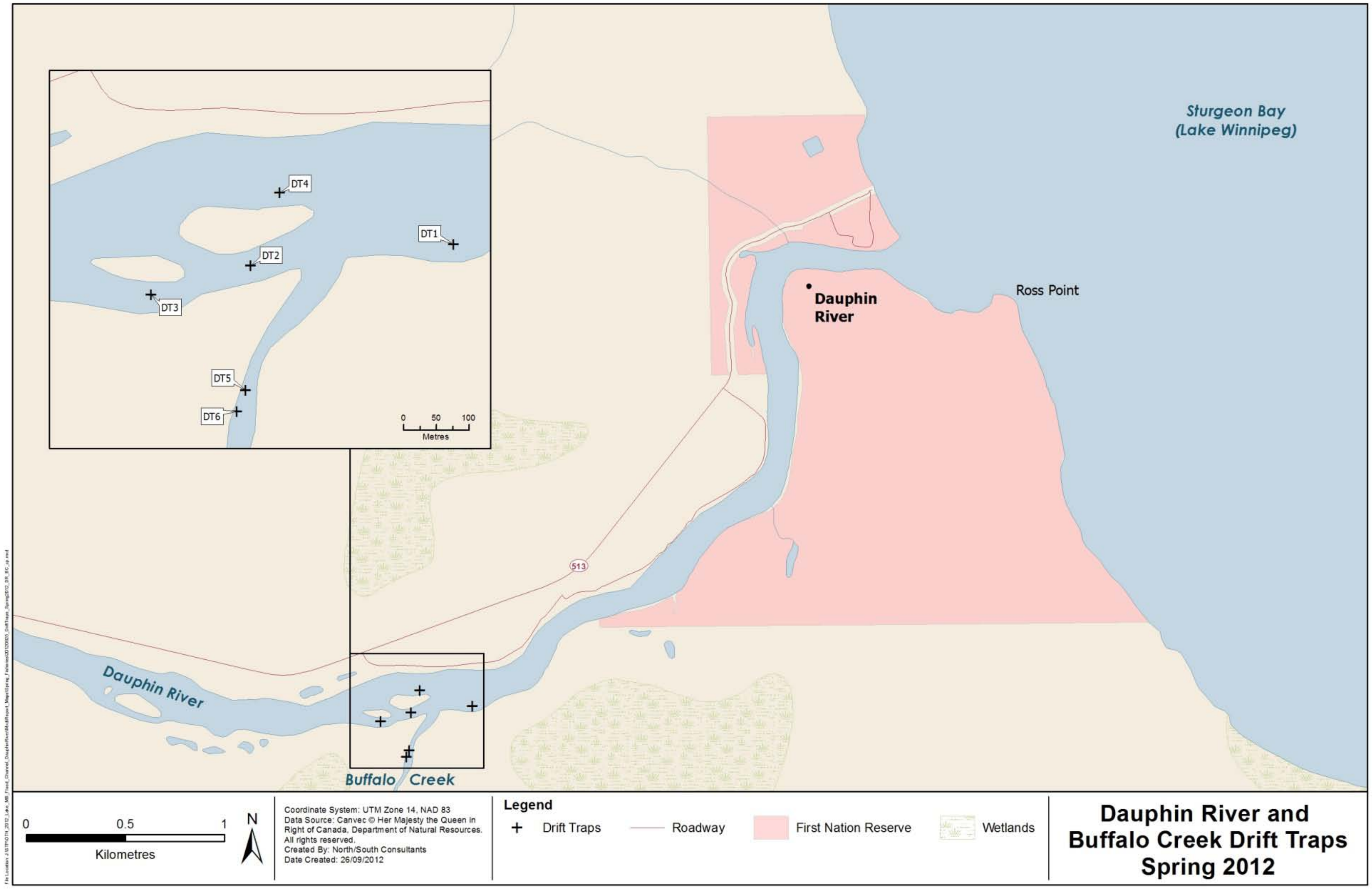

Figure 5-20. Location of drift traps set in the Dauphin River and Buffalo Creek during spring 2012.

Table 5-18. Site-specific catch of fish eggs and larval fish from drift traps set in the lower Dauphin River and Buffalo Creek during spring 2012.

Lift Date	Site [1]	Fish Eggs		Larval Fish											Total
		n	Species [2]	Lake Whitefish	Cisco	Suckers [2]	Percids [3]	Yellow Perch	Northern Pike	Stickleback [3]	Sculpin [3]	Rainbow Smelt	White Bass	Minnows [3]	
17-Apr-12	DT-1	12	sucker	4	-	-	-	-	-	-	-	-	-	-	16
	DT-2	12	sucker	13	-	-	-	-	-	-	-	-	-	-	25
	DT-3	3	sucker	7	-	-	-	-	-	-	-	-	-	-	10
	DT-4	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT-5	-	-	2	-	-	-	-	-	-	-	-	-	-	2
	DT-6	-	-	2	-	-	-	-	-	-	-	-	-	-	2
18-Apr-12	DT-1	20	sucker	2	-	-	-	-	-	-	-	-	-	-	22
	DT-2	62	sucker	25	-	-	-	-	-	-	-	-	-	-	87
	DT-3	18	sucker	11	-	-	-	-	-	-	-	-	-	-	29
	DT-4	1	sucker	-	-	-	-	-	-	-	-	-	-	-	1
	DT-5	-	-	3	-	-	-	-	-	-	-	-	-	-	3
	DT-6	-	-	3	-	-	-	-	-	-	-	-	-	-	3
29-Apr-12	DT-1	796	sucker	-	-	-	-	-	-	-	-	-	-	-	796
	DT-2	8	sucker	1	-	-	-	-	-	-	-	-	-	-	9
	DT-3	187	sucker	48	6	-	-	-	-	-	-	-	-	-	241
	DT-4	5	sucker	-	-	-	-	-	-	-	-	-	-	-	5
	DT-5	9	sucker	11	10	-	-	-	-	-	-	-	-	-	30
	DT-6	3	sucker	1	3	-	-	-	-	-	-	-	-	-	7
30-Apr-12	DT-1	676	sucker	10	6	-	-	-	-	-	-	-	-	-	692
	DT-2	468	sucker	322	18	-	-	-	-	-	-	-	-	-	808
	DT-3	207	sucker	66	8	-	-	-	-	-	-	-	-	-	281
	DT-4	32	sucker	-	-	-	-	-	-	-	-	-	-	-	32
	DT-5	10	sucker	6	7	-	-	-	-	-	-	-	-	-	23
	DT-6	8	sucker	18	16	-	-	-	-	-	-	-	-	-	42

Table 5-18. (continued).

Lift Date	Site [1]	Fish Eggs		Larval Fish											Total
		n	Species [2]	Lake Whitefish	Cisco	Suckers [2]	Percids [3]	Yellow Perch	Northern Pike	Stickleback [3]	Sculpin [3]	Rainbow Smelt	White Bass	Minnows [3]	
9-May-12	DT-1	1820	sucker	-	-	-	-	-	-	-	-	-	-	-	1820
	DT-2	1696	sucker	-	-	-	-	-	-	-	-	-	-	-	1696
	DT-3	98	sucker	3	-	2	-	-	-	-	-	-	-	-	103
	DT-4	548	sucker	-	-	-	-	-	-	-	-	-	-	-	548
	DT-5	26	sucker	4	-	2	-	-	-	-	-	-	-	-	32
	DT-6	25	sucker	5	-	-	-	-	-	-	-	-	-	-	30
10-May-12	DT-1	4000	sucker	12	-	14	-	-	-	-	-	-	-	-	4026
	DT-2	772	sucker	5	-	4	-	-	-	-	-	-	-	-	781
	DT-3	78	sucker	3	-	1	-	-	-	-	-	-	-	-	82
	DT-4	1000	sucker	-	-	3	-	-	-	-	-	-	-	-	1003
	DT-5	23	sucker	8	2	1	-	-	-	-	-	-	-	-	34
	DT-6	20	sucker	3	-	-	-	-	-	-	-	-	-	-	23
18-May-12	DT-1	34	sucker	-	-	308	-	-	-	-	-	-	-	-	342
	DT-2	-	-	-	-	48	13	-	-	-	-	4	-	-	65
	DT-3	-	-	-	-	9	-	1	-	-	-	-	-	-	10
	DT-4	-	-	-	-	1	-	-	-	-	-	-	-	-	1
	DT-5	-	-	1		276	-	-	-	-	-	-	-	-	277
	DT-6	1	sucker	-	-	115	-	-	-	-	-	-	-	-	116
19-May-12	DT-1	49	sucker	-	-	439	-	-	1	-	-	-	-	-	489
	DT-2	-	-	34	-	519	-	-	-	-	-	-	-	-	553
	DT-3	-	-	-	-	17	-	-	-	-	-	-	-	1	18
	DT-4	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT-5	-	-	-	-	466	-	-	-	-	-	-	-	-	466
	DT-6	2	sucker	-	-	295	-	-	-	-	-	-	-	-	297

Table 5-18. (continued).

Lift Date	Site [1]	Fish Eggs		Larval Fish											Total
		n	Species [2]	Lake Whitefish	Cisco	Suckers [2]	Percids [3]	Yellow Perch	Northern Pike	Stickleback [3]	Sculpin [3]	Rainbow Smelt	White Bass	Minnows [3]	
31-May-12	DT-1	96	minnow	448	-	12512	-	-	-	-	192	-	-	-	13248
	DT-2	-	-	192	-	25728	-	-	-	-	256	-	-	-	26176
	DT-3	-	-	-	-	560	-	-	-	-	14	-	-	-	574
	DT-4	-	-	2	-	674	-	18	-	-	6	-	-	-	700
	DT-5	-	-	40	-	7928	-	-	-	80	8	-	-	-	8056
	DT-6	-	-	16	-	2336	20	-	4	120	8	-	-	-	2504
1-Jun-12	DT-1	96	minnow	256	-	15904	128	-	-	-	128	-	-	64	16576
	DT-2	-	-	32	-	14208	-	-	-	-	224	-	-	-	14464
	DT-3	1	Unidentified	-	-	129	-	-	-	-	3	-	-	-	133
	DT-4	-	-	-	-	1042	-	-	-	-	16	-	-	-	1058
	DT-5	-	-	16	-	3716	76	-	-	-	4	-	-	-	3812
	DT-6	-	-	8	-	1500	-	-	-	148	16	-	-	4	1676
15-Jun-12	DT-5	-	-	16	-	1024	-	36	-	-	-	-	-	600	1676
	DT-6	-	-	-	-	242	-	25	-	-	1	-	421	-	689
Total		12922		1659	76	90023	237	80	5	348	876	4	421	669	107320

1 - Traps DT-1 to DT-4 set in the Dauphin River; DT-5 and DT-6 set in Buffalo Creek; see Figure 5-20.

2 - Several sucker species were captured in the Dauphin River during spring 2012; White Sucker were the most abundant sucker species captured and it is thought that sucker eggs and larvae captured were White Suckers.

3 - Percids = Family Percidae; Stickleback = Family Gasterosteidae; Sculpin = Family Cottidae; minnows = Family Cyprinidae.

Table 5-19. Site-specific catch of juvenile and adult fish from drift traps set in the Dauphin River and Buffalo Creek during spring 2012.

Lift Date	Site [1]	Northern Pike	Emerald Shiner	Fathead Minnow	Finescale Dace	Northern Redbelly Dace	River Shiner	Spottail Shiner	White Sucker	Central Mudminnow	Brook Stickleback	Ninespine Stckleback	Johnny Darter	Iowa Darter	Yellow Perch	Total
17-Apr-12	DT1	-	-	-	-	2	-	4	-	3	-	-	-	-	-	9
	DT2	-	1	1	-	-	4	-	-	-	1		-	-	-	7
	DT3	-	-	1	-	-	1	-	-	-	1	2	-	-	-	5
	DT4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT5	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
	DT6	-	-	-	-	-	-	1	-		-	-	-	-	-	1
18-Apr-12	DT1	-	-	-	-	-	-	3	-	2	-	-	-	-	-	5
	DT2	-	-	-	-	-	2	2	-		-	1	1	-	-	6
	DT3	-	-	-	-	-	1	1	-		-	2	-	-	-	4
	DT4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
29-Apr-12	DT1	-	-	6	1	-	-	-	-	-	1	2	-	1	-	11
	DT2	-	3	27	-	-	-	-	-	-	-	2	-	-	-	32
	DT3	-	-	4	-	-	-	-	-	-	-	-	-	-	-	4
	DT4	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
	DT5	-	-	6	1	-	-	-		1	-	1		1		10
	DT6	-	-	8	-	-	-	-	-	-	-	-	-	1	-	9
30-Apr-12	DT1	-	3	5	-	-	-	1	-	-	-	-	-	-	-	9
	DT2	-	2	96	-	-	-	-	-	-	-	2	-	-	2	102
	DT3	-	-	7	-	-	-	-	-	-	-	2	1	-	-	10
	DT4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT5	-	-	4	-	1		2	-	-	1	-	-	-	-	8
	DT6	-	-	1	-	-	-	-	-	-	1	-	-	-	-	2
09-May-12	DT1	-	-	-	-	-	-	8	-	-	-	-	-	-	-	8
	DT2	-	12	4	-	-	-	-	-	-	4	-	-	-	-	20
	DT3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT5	-	-	5	-	-	-	-	-	-	-	-	-	-	-	5
	DT6	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
10-May-12	DT1	-	-	4	2	-	-	1	1	1	1	2	-	-	-	12
	DT2	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3
	DT3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT5	-	-	-	2	2	-	-	-	-	-	-	-	-	-	4
	DT6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0

Table 5-19. (continued).

Lift Date	Site [1]	Northern Pike	Emerald Shiner	Fathead Minnow	Finescale Dace	Northern Redbelly	River Shiner	Spottail Shiner	White Sucker	Central Mudminnow	Brook Stickleback	Ninespine Stckleback	Johnny Darter	Iowa Darter	Yellow Perch	Total
18-May-12	DT1	-	-	6	-	-	-	-	-	1	-	3	-	-	-	10
	DT2	-	-	36	-	-	-	-	-	-	-	1	2	-	-	39
	DT3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT5	-	-	11	-	-	-	-	-	-	-	-	-	-	-	11
	DT6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
19-May-12	DT1	-	-	2	-	-	-	-	-	-	-	2	-	-	-	4
	DT2	1	1	90	-	-	-	3	-	-	-	4	1	1	1	102
	DT3	-	-	5	-	-	-	-	-	-	-	-	-	-	-	5
	DT4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT5	-	-	4	-	3	-	-	-	-	-	-	-	1	-	8
	DT6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
31-May-12	DT1	-	-	32	-	-	-	-	-	-	-	-	-	-	-	32
	DT2	-	-	64	-	-	-	-	-	-	-	-	-	-	-	64
	DT3	-	-	4	-	-	2	-	-	-	-	-	-	-	-	6
	DT4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
01-Jun-12	DT1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	DT6	-	-	-	-	4	-	-	-	-	-	-	-	-	-	4
15-Jun-12	DT5	-	-	8	-	-	-	-	-	-	-	-	-	-	-	8
	DT6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Total		1	22	442	6	13	10	26	1	8	11	29	5	5	3	582

1 - Traps DT-1-DT-4 set in the Dauphin River; DT-5 and DT-6 set in Buffalo Creek; see Figure 5-20.

5.2.2.3 Adult Fish

Boat Electrofishing

Forty three boat electrofishing runs were conducted during spring in the lower reach of the Dauphin River, extending from approximately 2 km upstream of the Buffalo Creek confluence downstream to Sturgeon Bay (Table 5-20; Figure 5-21).

A total of 2,190 fish comprising 12 species were captured or observed (Table 5-21). White Sucker was the most abundant species, accounting for 57.9% of the total catch (n = 1267). Carp (n = 416; 19.0%), Freshwater Drum (n = 182; 8.3%), and Shorthead Redhorse (n = 164; 7.5%) were the next most abundant. Small numbers of the remaining species were captured (Table 5-21). Twelve Lake Whitefish and two Walleye were marked with Floy tags during electrofishing studies (Appendix 5-1).

Some shifts in fish catch composition (as used here, the term “fish catch composition” includes captured and observed fish) were observed between sampling periods. In early spring when water temperature was below 10°C (Figure 5-18), the fish catch was dominated by White Sucker (sampling period-specific mean CPUE = 1.57 fish/60s) and smaller numbers of Northern Pike (CPUE = 0.62 fish/60s) (Table 5-22), both of which spawn in early spring. By the end of April, the number of White Sucker captured or observed had peaked (CPUE = 9.77 fish/60s), the number of Northern Pike had declined (CPUE = 0.29 fish/60s), and the catch rate of Carp had increased from 0.13 to 5.07 fish/60 s. In early May, as water temperature increased above 10°C, the number of White Sucker remained high (CPUE = 6.60), Carp numbers decreased (CPUE = 0.72), and more Shorthead Redhorse were observed (Table 5-22). By mid- to late May when water temperature approached 15°C (Figure 5-18), the number of White Sucker in the electrofishing catch had decreased considerably (CPUE = 0.20 fish/60s), Shorthead Redhorse and Carp CPUE remained higher at 0.49 fish/60s and 1.41 fish/60s, respectively, and the incidence of Freshwater Drum increased (CPUE = 1.09 fish/60s). Total fish numbers dropped considerably by the end of May when the catch was comprised largely of Shorthead Redhorse and Freshwater Drum (Table 5-22). The observed shifts in catch composition are attributed to differences in the timing of spawning or feeding movements by the various fish species as water temperature increased.

Table 5-20. The location and fishing effort of boat electrofishing runs conducted in the Dauphin River during spring 2012.

Electrofishing Run	Date	Start Location [1]		End Location [1]		Fishing Effort (secs)	Electrofisher Settings		
		Easting	Northing	Easting	Northing		Hz	Pulse (m/s)	Voltage
EF-1	17-Apr-12	561947	5754832	562253	5754799	447	60	2	500
EF-2	17-Apr-12	561913	5754789	562376	5754951	329	60	3	500
EF-3	17-Apr-12	562341	5755014	562827	5755165	296	60	3	500
EF-4	17-Apr-12	562519	5754880	562631	5754836	182	60	3	500
EF-5	17-Apr-12	562610	5754836	562780	5754913	148	60	3	500
EF-6	17-Apr-12	564044	5756131	563939	5757032	841	60	3	500
EF-7	17-Apr-12	564088	5757044	564657	5757043	359	60	3	500
EF-8	17-Apr-12	564734	5757121	564706	5757283	450	60	3	500
EF-9	27-Apr-12	561972	5754967	562199	5755023	218	60	3	500
EF-10	27-Apr-12	561954	5754848	562253	5754797	350	60	3	500
EF-11	27-Apr-12	559768	5755329	560012	5755307	151	60	3	500
EF-12	27-Apr-12	559981	5755325	560179	5755241	140	60	3	500
EF-13	27-Apr-12	560409	5755083	560776	5754786	445	60	3	500
EF-14	27-Apr-12	563385	5755340	563571	5755433	265	60	3	500
EF-15	27-Apr-12	563998	5756049	563923	5756942	560	60	3	500
EF-16	28-Apr-12	564030	5756085	564016	5756242	65	60	3	500
EF-17	28-Apr-12	564042	5756132	563963	5757086	714	60	3	500
EF-18	28-Apr-12	564056	5756921	564679	5757041	400	60	3	500
EF-19	28-Apr-12	561890	5754814	562259	5754793	222	60	3	500
EF-20	28-Apr-12	562457	5754858	562600	5754816	105	60	3	500
EF-21	28-Apr-12	562601	5754817	562915	5755063	243	60	3	500
EF-22	8-May-12	562859	5755226	563418	5755531	241	60	3	500
EF-23	8-May-12	563369	5755505	564016	5756151	779	60	3	500
EF-24	8-May-12	564014	5756150	564611	5757142	1718	60	3	500
EF-25	8-May-12	564097	5756544	564666	5757045	772	60	3	500
EF-26	8-May-12	561798	5754877	562850	5755217	1201	60	3	500
EF-27	8-May-12	560543	5755094	562044	5755013	1480	60	3	500
EF-28	8-May-12	562033	5754934	562726	5755074	937	60	3	500
EF-29	8-May-12	562111	5754981	562847	5755212	693	60	3	500
EF-30	20-May-12	563213	5755398	563627	5755776	968	60	3	500
EF-31	20-May-12	563647	5755774	563986	5756406	989	60	3	500
EF-32	20-May-12	564055	5756422	563959	5756799	99	60	3	500
EF-33	21-May-12	560361	5755153	560812	5755046	757	60	3	500
EF-34	21-May-12	560822	5755028	561881	5754947	1297	60	3	500
EF-35	21-May-12	560511	5755063	562272	5754800	2042	60	3	500
EF-36	21-May-12	562340	5754930	562845	5755212	932	60	3	500
EF-37	31-May-12	559720	5755313	561055	5754990	589	60	3	500
EF-38	31-May-12	560563	5754965	560759	5754820	293	60	3	500
EF-39	31-May-12	560924	5754869	561849	5754792	546	60	3	500
EF-40	31-May-12	561826	5754788	562865	5755226	670	60	3	500
EF-41	31-May-12	562484	5754849	562986	5755282	407	60	3	500
EF-42	31-May-12	563243	5755316	564019	5755831	556	60	3	500
EF-43	31-May-12	564019	5755919	564177	5757072	551	60	3	500

1 - UTM coordinates; NAD 83 Zone 14U; site-specific locations illustrated on Figure 5-21.

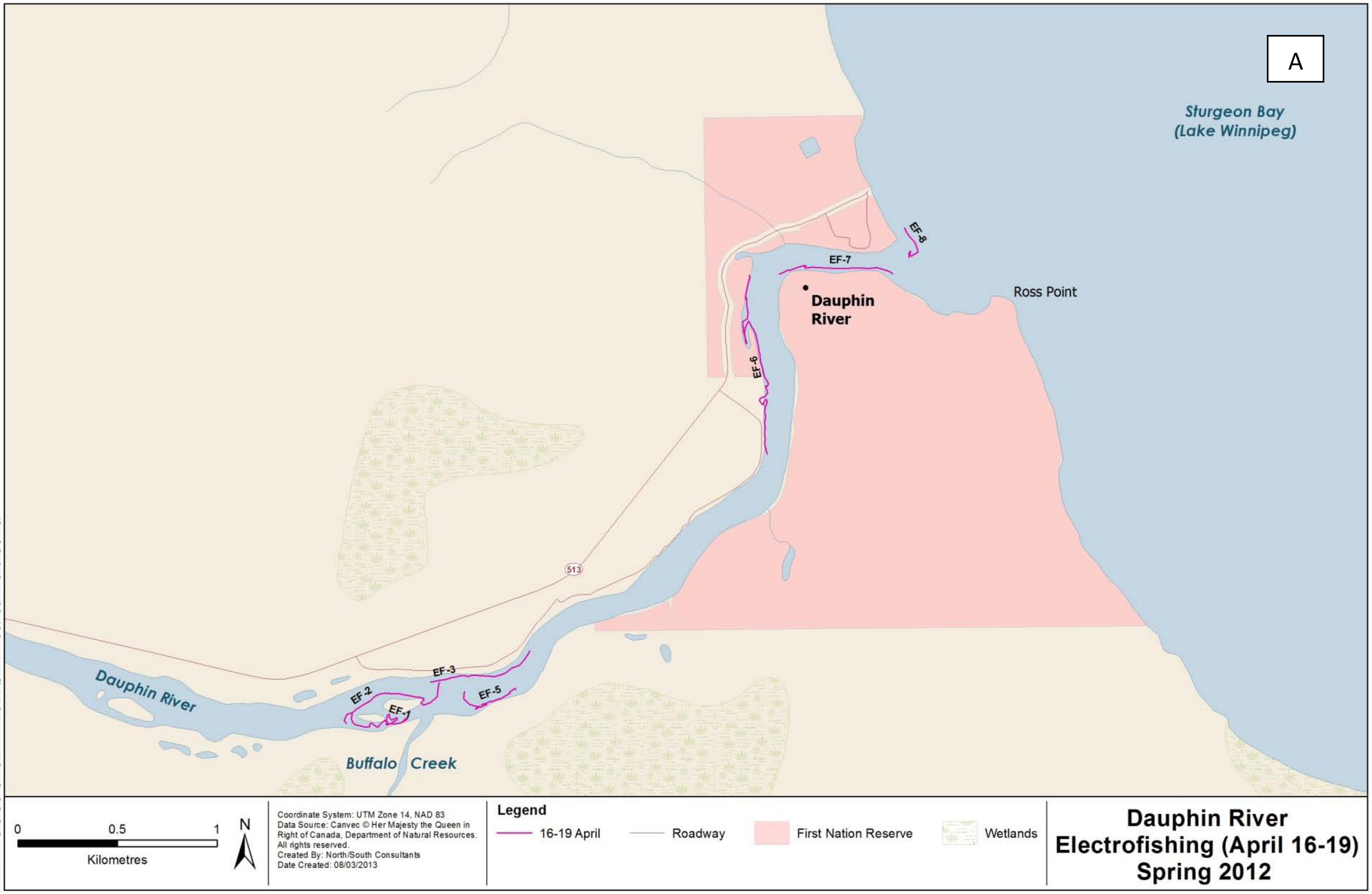

Figure 5-21. Detailed sampling period-specific locations (A, B, C, D, E) where boat electrofishing runs where conducted in the Dauphin River during spring 2012.

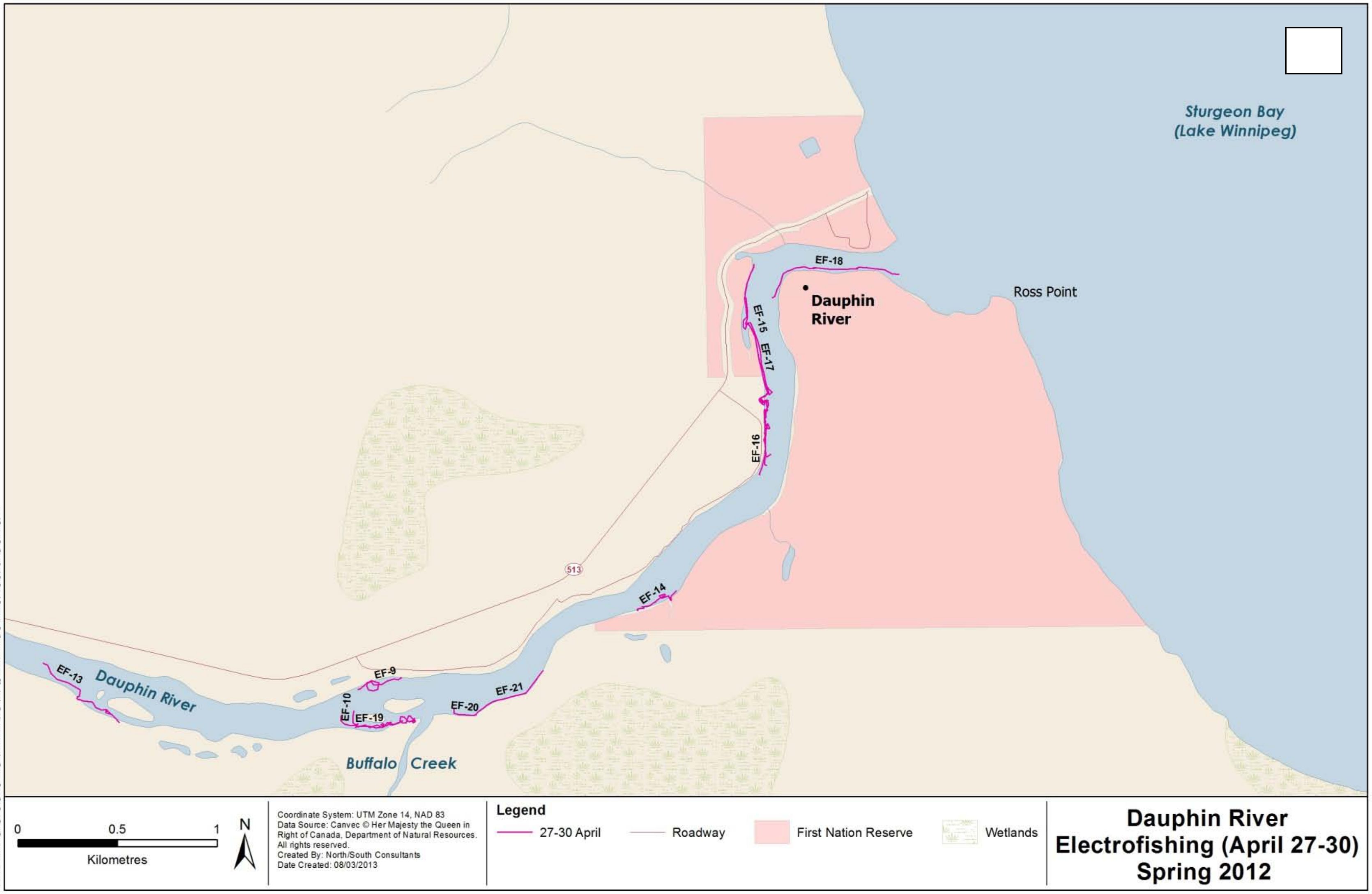

Figure 5-21. (continued).

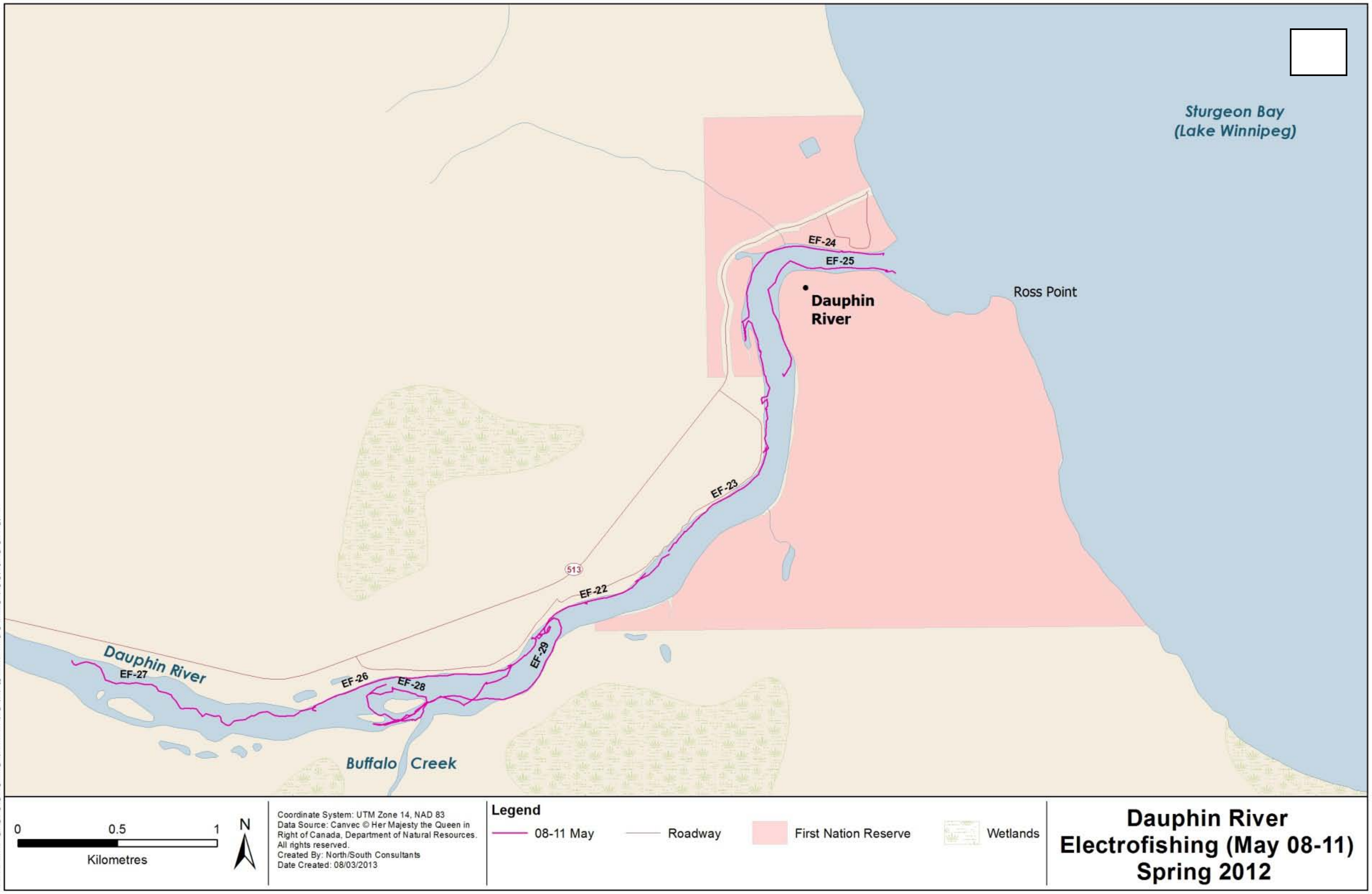

Figure 5-21. (continued).

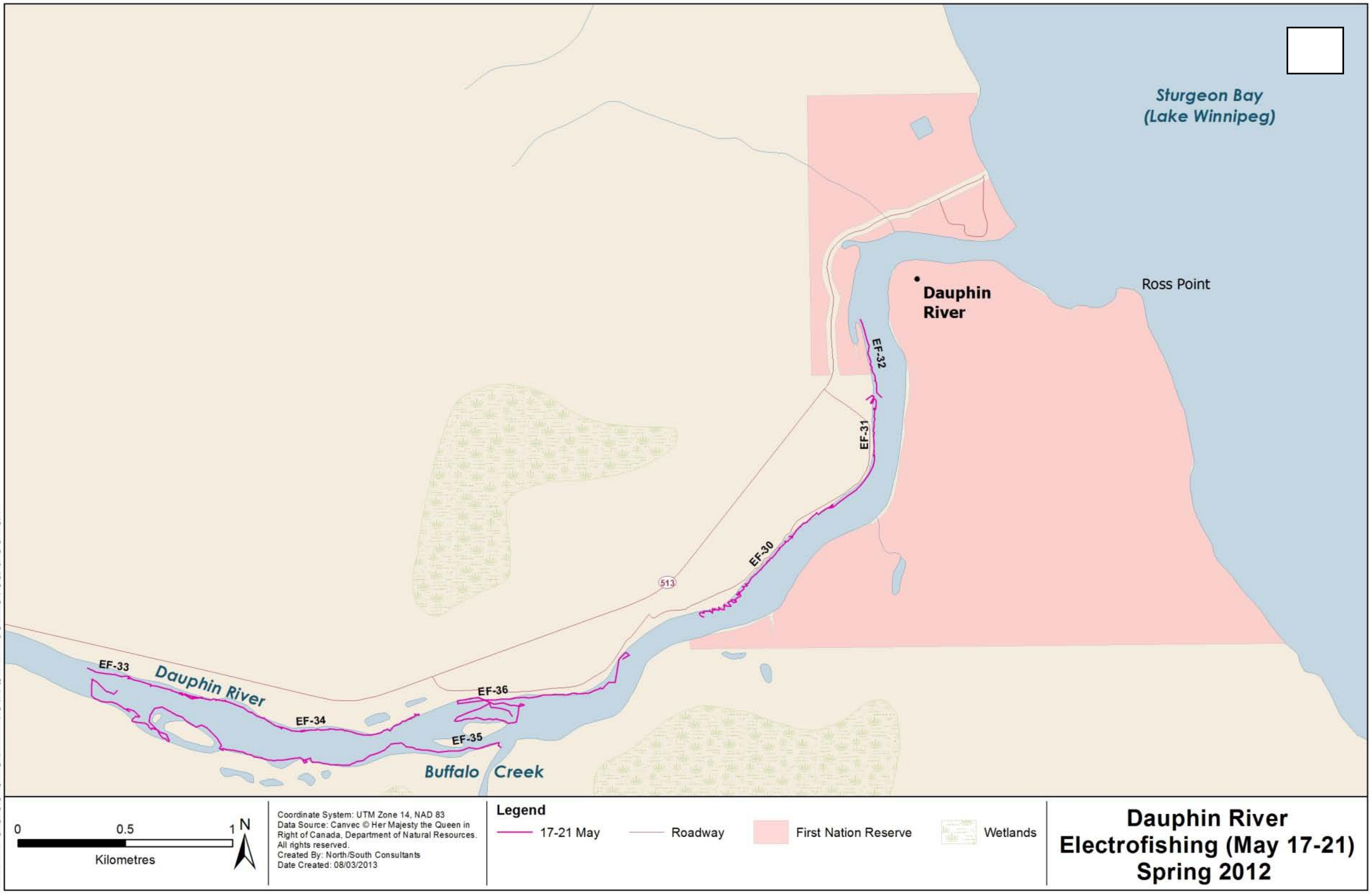

Figure 5-21. (continued).

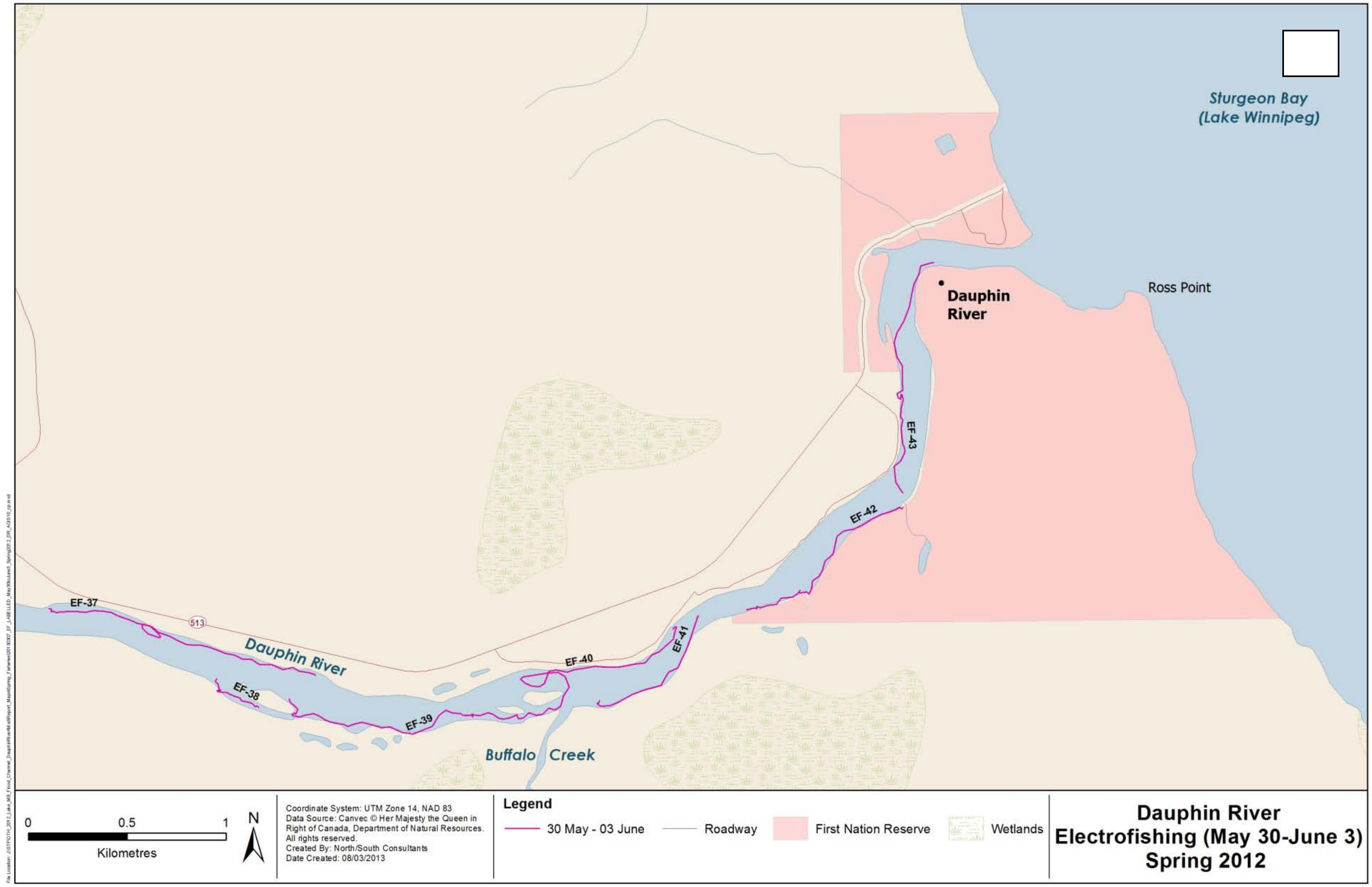

Figure 5-21. (continued).

Table 5-21. Run-specific number and sampling period-specific mean relative abundance (%) of fish captured during electrofishing runs conducted in the Dauphin River during spring 2012.

Sampling Period	Electrofishing Run	Number of Fish												Total
		Common Carp	Cisco	Freshwater Drum	Lake Whitefish	Longnose Sucker	Northern Pike	Quillback	Shorthead Redhorse	Spottail Shiner	Walleye	White Sucker	Yellow Perch	
1	EF-1	-	-	-	-	-	-	-	-	-	-	33	-	**33**
	EF-2	-	-	-	-	-	-	-	-	-	-	-	-	**-**
	EF-3	-	-	-	1	-	2	-	-	-	-	2	-	**5**
	EF-4	2	-	-	-	-	8	-	-	-	-	2	-	**12**
	EF-5	1	-	-	-	-	-	-	-	-	-	16	-	**17**
	EF-6	-	-	-	-	1	17	-	-	-	-	6	-	**24**
	EF-7	-	-	-	-	-	4	-	-	-	-	1	-	**5**
	EF-8	-	-	-	-	-	-	-	-	-	-	-	-	**-**
	Total	**3**	**-**	**-**	**1**	**1**	**31**	**-**	**-**	**-**	**-**	**60**	**-**	**96**
	RA (%)	**3.1**	**-**	**-**	**1.0**	**1.0**	**32.3**	**-**	**-**	**-**	**-**	**62.5**	**-**	**100**
2	EF-9	-	-	-	-	1	-	-	-	-	-	63	-	**64**
	EF-10	-	-	-	-	2	-	-	-	-	-	58	-	**60**
	EF-11	-	-	-	-	4	-	-	-	-	-	69	-	**73**
	EF-12	-	-	-	-	1	-	-	-	-	-	57	-	**58**
	EF-13	-	-	-	-	1	1	-	-	-	-	54	-	**56**
	EF-14	1	-	-	-	-	4	-	-	-	-	18	-	**23**
	EF-15	25	-	-	-	-	1	-	1	-	-	6	14	**47**
	EF-16	2	-	-	3	1	-	-	-	-	-	13	-	**19**
	EF-17	2	-	-	-	1	4	-	2	2	-	11	1	**23**
	EF-18	7	-	-	-	-	2	-	-	-	-	-	-	**9**
	EF-19	-	-	-	-	-	-	-	-	-	-	76	-	**76**
	EF-20	105	-	-	-	-	3	-	-	-	-	-	-	**108**
	EF-21	-	-	-	-	-	1	-	-	-	-	10	-	**11**
	Total	**142**	**-**	**-**	**3**	**11**	**16**	**-**	**3**	**2**	**-**	**435**	**15**	**627**
	RA (%)	**22.6**	**-**	**-**	**0.5**	**1.8**	**2.6**	**-**	**0.5**	**0.3**	**-**	**69.4**	**2.4**	**100**

Table 5-21. (continued).

Sampling Period	Electrofishing Run	Number of Fish												Total
		Common Carp	Cisco	Freshwater Drum	Lake Whitefish	Longnose Sucker	Northern Pike	Quillback	Shorthead Redhorse	Spottail Shiner	Walleye	White Sucker	Yellow Perch	
3	EF-22	1	1	-	-	2	1	-	-	-	-	45	-	**50**
	EF-23	-	-	2	2	3	-	-	-	-	-	57	3	**67**
	EF-24	3	-	-	-	-	-	-	-	-	-	6	-	**9**
	EF-25	-	-	-	-	-	-	-	-	-	-	1	1	**2**
	EF-26	32	2	1	1	1	2	-	-	-	1	86	-	**126**
	EF-27	30	-	1	-	2	2	-	6	-	-	173	-	**214**
	EF-28	20	-	-	-	-	-	-	4	-	1	169	-	**194**
	EF-29	15	-	-	-	1	-	-	10	-	-	171	-	**197**
	Total	**101**	**3**	**4**	**3**	**9**	**5**	**-**	**20**	**-**	**2**	**708**	**4**	**859**
	RA (%)	**11.8**	**0.3**	**0.5**	**0.3**	**1.0**	**0.6**	**-**	**2.3**	**-**	**0.2**	**82.4**	**0.5**	**100**
4	EF-30	11	-	8	-	-	-	-	1	-	-	4	-	**24**
	EF-31	13	-	16	-	-	-	-	-	3	-	1	-	**33**
	EF-32	-	-	-	-	-	-	-	-	2	-	-	-	**2**
	EF-33	25	-	20	-	-	-	-	14	-	-	1	-	**60**
	EF-34	35	-	25	1	-	-	-	19	-	-	7	-	**87**
	EF-35	-	-	7	-	-	-	-	27	-	-	17	-	**51**
	EF-36	75	-	50	4	-	-	1	9	-	-	3	-	**142**
	Total	**159**	**-**	**126**	**5**	**-**	**-**	**1**	**70**	**5**	**-**	**33**	**-**	**399**
	RA (%)	**39.8**	**-**	**31.6**	**1.3**	**-**	**-**	**0.3**	**17.5**	**1.3**	**-**	**8.3**	**-**	**100**
5	EF-37	2	-	-	28	-	-	-	9	-	-	2	-	**41**
	EF-38	-	-	3	-	-	-	-	6	-	-	14	-	**23**
	EF-39	1	-	5	-	-	1	-	36	-	-	8	-	**51**
	EF-40	-	-	6	11	-	-	-	14	-	-	6	-	**37**
	EF-41	6	-	8	-	-	-	-	4	-	-	-	-	**18**
	EF-42	2	-	30	-	-	-	-	2	4	-	1	-	**39**
	EF-43	-	-	-	-	-	-	-	-	-	-	-	-	**0**
	Total	**11**	**-**	**52**	**39**	**-**	**1**	**-**	**71**	**4**	**-**	**31**	**-**	**209**
	RA (%)	**5.3**	**-**	**24.9**	**18.7**	**-**	**0.5**	**-**	**34.0**	**1.9**	**-**	**14.8**	**-**	**100**
Overall	***Total***	***416***	**3**	**182**	**51**	**21**	**53**	**1**	**164**	**11**	**2**	**1267**	**19**	**2190**
	RA (%)	***19.0***	***0.1***	***8.3***	***2.3***	***1.0***	***2.4***	***0.0***	***7.5***	***0.5***	***0.1***	***57.9***	***0.9***	***100***

1 - Electrofishing run locations are illustrated in Figure 5-20.

Table 5-22. Run-specific catch-per-unit-effort (CPUE; # fish/60 seconds) and sampling period-specific mean CPUE for each species captured during electrofishing runs conducted in the Dauphin River during spring 2012.

Sampling Period	Electrofishing Run	Effort (seconds)	CPUE												
			Common Carp	Cisco	Freshwater Drum	Lake Whitefish	Longnose Sucker	Northern Pike	Quillback	Shorthead Redhorse	Spottail Shiner	Walleye	White Sucker	Yellow Perch	Total
	EF-1	447	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.43	0.00	4.43
	EF-2	329	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	EF-3	296	0.00	0.00	0.00	0.20	0.00	0.41	0.00	0.00	0.00	0.00	0.41	0.00	1.01
	EF-4	182	0.66	0.00	0.00	0.00	0.00	2.64	0.00	0.00	0.00	0.00	0.66	0.00	3.96
1	EF-5	148	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.49	0.00	6.89
	EF-6	841	0.00	0.00	0.00	0.00	0.07	1.21	0.00	0.00	0.00	0.00	0.43	0.00	1.71
	EF-7	359	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.00	0.17	0.00	0.84
	EF-8	450	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mean	**0.13**	**0.00**	**0.00**	**0.03**	**0.01**	**0.62**	**0.00**	**0.00**	**0.00**	**0.00**	**1.57**	**0.00**	**2.35**
		SD [1]	**0.26**	**0.00**	**0.00**	**0.07**	**0.03**	**0.93**	**0.00**	**0.00**	**0.00**	**0.00**	**2.47**	**0.00**	**2.48**
	EF-9	218	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	17.34	0.00	17.61
	EF-10	350	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	9.94	0.00	10.29
	EF-11	151	0.00	0.00	0.00	0.00	1.59	0.00	0.00	0.00	0.00	0.00	27.42	0.00	29.01
	EF-12	140	0.00	0.00	0.00	0.00	0.43	0.00	0.00	0.00	0.00	0.00	24.43	0.00	24.86
	EF-13	445	0.00	0.00	0.00	0.00	0.13	0.13	0.00	0.00	0.00	0.00	7.28	0.00	7.55
	EF-14	265	0.23	0.00	0.00	0.00	0.00	0.91	0.00	0.00	0.00	0.00	4.08	0.00	5.21
	EF-15	560	2.68	0.00	0.00	0.00	0.00	0.11	0.00	0.11	0.00	0.00	0.64	1.50	5.04
2	EF-16	65	1.85	0.00	0.00	2.77	0.92	0.00	0.00	0.00	0.00	0.00	12.00	0.00	17.54
	EF-17	714	0.17	0.00	0.00	0.00	0.08	0.34	0.00	0.17	0.17	0.00	0.92	0.08	1.93
	EF-18	400	1.05	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	1.35
	EF-19	222	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.54	0.00	20.54
	EF-20	105	60.00	0.00	0.00	0.00	0.00	1.71	0.00	0.00	0.00	0.00	0.00	0.00	61.71
	EF-21	243	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	2.47	0.00	2.72
		Mean	**5.07**	**0.00**	**0.00**	**0.21**	**0.29**	**0.29**	**0.00**	**0.02**	**0.01**	**0.00**	**9.77**	**0.12**	**15.80**
		SD	**16.53**	**0.00**	**0.00**	**0.77**	**0.47**	**0.50**	**0.00**	**0.05**	**0.05**	**0.00**	**9.79**	**0.41**	**16.56**

Table 5-22. (continued).

Sampling Period	Electrofishing Run	Effort (seconds)	CPUE												
			Common Carp	Cisco	Freshwater Drum	Lake Whitefish	Longnose Sucker	Northern Pike	Quillback	Shorthead Redhorse	Spottail Shiner	Walleye	White Sucker	Yellow Perch	Total
3	EF-22	241	0.25	0.25	0.00	0.00	0.50	0.25	0.00	0.00	0.00	0.00	11.20	0.00	12.45
	EF-23	779	0.00	0.00	0.15	0.15	0.23	0.00	0.00	0.00	0.00	0.00	4.39	0.23	5.16
	EF-24	1718	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.31
	EF-25	772	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.16
	EF-26	1201	1.60	0.10	0.05	0.05	0.05	0.10	0.00	0.00	0.00	0.05	4.30	0.00	6.29
	EF-27	1480	1.22	0.00	0.04	0.00	0.08	0.08	0.00	0.24	0.00	0.00	7.01	0.00	8.68
	EF-28	937	1.28	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.06	10.82	0.00	12.42
	EF-29	693	1.30	0.00	0.00	0.00	0.09	0.00	0.00	0.87	0.00	0.00	14.81	0.00	17.06
		Mean	**0.72**	**0.04**	**0.03**	**0.03**	**0.12**	**0.05**	**0.00**	**0.17**	**0.00**	**0.01**	**6.60**	**0.04**	**7.82**
		SD	**0.69**	**0.09**	**0.05**	**0.05**	**0.17**	**0.09**	**0.00**	**0.30**	**0.00**	**0.03**	**5.35**	**0.08**	**6.01**
4	EF-30	968	0.68	0.00	0.50	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.25	0.00	1.49
	EF-31	989	0.79	0.00	0.97	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.06	0.00	2.00
	EF-32	99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.21	0.00	0.00	0.00	1.21
	EF-33	757	1.98	0.00	1.59	0.00	0.00	0.00	0.00	1.11	0.00	0.00	0.08	0.00	4.76
	EF-34	1297	1.62	0.00	1.16	0.05	0.00	0.00	0.00	0.88	0.00	0.00	0.32	0.00	4.02
	EF-35	2042	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.79	0.00	0.00	0.50	0.00	1.50
	EF-36	932	4.83	0.00	3.22	0.26	0.00	0.00	0.06	0.58	0.00	0.00	0.19	0.00	9.14
		Mean	**1.41**	**0.00**	**1.09**	**0.04**	**0.00**	**0.00**	**0.01**	**0.49**	**0.20**	**0.00**	**0.20**	**0.00**	**3.45**
		SD	**1.68**	**0.00**	**1.09**	**0.10**	**0.00**	**0.00**	**0.02**	**0.47**	**0.45**	**0.00**	**0.17**	**0.00**	**2.86**
5	EF-37	589	0.20	0.00	0.00	2.85	0.00	0.00	0.00	0.92	0.00	0.00	0.20	0.00	4.18
	EF-38	293	0.00	0.00	0.61	0.00	0.00	0.00	0.00	1.23	0.00	0.00	2.87	0.00	4.71
	EF-39	546	0.11	0.00	0.55	0.00	0.00	0.11	0.00	3.96	0.00	0.00	0.88	0.00	5.60
	EF-40	670	0.00	0.00	0.54	0.99	0.00	0.00	0.00	1.25	0.00	0.00	0.54	0.00	3.31
	EF-41	407	0.88	0.00	1.18	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.00	2.65
	EF-42	556	0.22	0.00	3.24	0.00	0.00	0.00	0.00	0.22	0.43	0.00	0.11	0.00	4.21
	EF-43	551	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mean	**0.20**	**0.00**	**0.87**	**0.55**	**0.00**	**0.02**	**0.00**	**1.17**	**0.06**	**0.00**	**0.66**	**0.00**	**3.52**
		SD	**0.32**	**0.00**	**1.12**	**1.08**	**0.00**	**0.04**	**0.00**	**1.32**	**0.16**	**0.00**	**1.03**	**0.00**	**1.82**
Overall		**Mean**	***1.96***	***0.01***	***0.33***	***0.17***	***0.11***	***0.21***	***0.00***	***0.31***	***0.05***	***0.00***	***4.62***	***0.04***	***7.80***
		SD	***9.11***	***0.04***	***0.75***	***0.61***	***0.29***	***0.52***	***0.01***	***0.69***	***0.20***	***0.01***	***7.06***	***0.23***	***10.90***

1 - SD = standard deviation.

Based upon the extrusion of gametes, seven species of fish captured during the electrofishing program showed evidence of spawning during spring 2012 (Table 5-23). These included Carp, Longnose Sucker, Northern Pike, Shorthead Redhorse, White Sucker, Walleye, and Yellow Perch. Although a large number of Carp were observed, sex and maturity was determined from only a small number (n = 3) of fish examined. These were all males that were in an early pre-spawn stage during late April and early May.

Sex and state of maturity was determined for a small number of Longnose Sucker (n = 9) and a large number of White Sucker (n = 245). Most male and female fish of both species were in an early pre-spawn condition until the end of April and an advanced state of pre-spawn condition by the first week of May. White Suckers in a post-spawn state were observed by the end of May. Male and female Shorthead Redhorse examined were in an early pre-spawn condition during the first week of May, most fish were in an advanced pre-spawn condition by late May, and a small number of male fish were determined to be in a post-spawn condition by the end of May.

Northern Pike in an early pre-spawn state were captured in small numbers up to the end of April, but very few pike were captured in the Dauphin River during May or June. A single male Walleye and a single male Yellow Perch were determined to be in an advanced pre-spawn condition on 8 May.

Table 5-23. Sex and maturity status of fish species captured during electrofishing runs conducted in the Dauphin River during spring 2012.

Sex & Maturity	Species								
	Common Carp	Cisco	Longnose Sucker	Northern Pike	Shorthead Redhorse	Walleye	White Sucker	Yellow Perch	Total
Female									
Preparing to Spawn	-	-	5	6	4	-	108	-	**123**
Ripe	-	-	1	-	-	-	52	-	**53**
Total	***-***	***-***	***6***	***6***	***4***	***-***	***160***	***-***	**176**
Male									
Preparing to Spawn	3	-	4	7	7	-	51	-	**72**
Ripe	-	-	5	1	36	1	192	1	**236**
Spent	-	-	-	-	6	-	2	-	**8**
Total	***3***	***-***	***9***	***8***	***49***	***1***	***245***	***1***	**316**
Unknown									
Immature	-	1	-	-	-	-	-	-	**1**
Total	***-***	***1***	***-***	***-***	***-***	***-***	***-***	***-***	**1**

The following sections describe the overall metrics of each species where the number of fish captured was greater than 10. Condition factors were calculated for each species based on length and weight measurements (Table 5-24).

Table 5-24. Fork length (mm), weight (g) and condition factor for fish species captured during electrofishing runs conducted in the Dauphin River, spring 2012.

Species	Fork Length (mm)				Weight (g)				K			
	n[1]	Mean	SD[2]	Range	n	Mean	SD	Range	n	Mean	SD	Range
Freshwater Drum	29	524	53	440 - 625	29	2465	842	1400 - 4600	29	1.66	0.16	1.38 - 2.00
Longnose Sucker	21	460	29	424 - 530	21	1556	319	1150 - 2250	21	1.59	0.16	1.35 - 1.87
Northern Pike	22	551	149	250 - 880	22	1685	1425	150 - 5500	22	0.83	0.08	0.69 - 1.01
Shorthead Redhorse	89	389	29	320 - 520	89	1009	259	550 - 2500	89	1.68	0.14	1.37 - 2.11
White Sucker	483	452	44	184 - 550	483	1516	439	100 - 3000	483	1.60	0.17	1.14 - 2.15

1 - n = number of fish measured; may not equal total number captured.

2 - SD = standard deviation.

Freshwater Drum

Freshwater Drum (n = 29) were captured during the last three electrofishing sampling periods from mid- to late May and were the most abundant fish captured during the 20-21 May sampling period (Table 5-21). Mean CPUE for all sampling periods was 0.33 fish/minute (Table 5-22). Mean fork length, weight, and condition factor were 524 mm, 2,465 g and 1.66, respectively (Table 5-24). The modal fork length interval for Freshwater Drum was 450-474 mm (Figure 5-22).

Longnose Sucker

Longnose Sucker (n = 21) were captured during the first three sampling periods conducted in Dauphin River and were most abundant in the catch from the end of April (Table 5-21). Mean CPUE for all sampling periods was 0.11 fish/minute (Table 5-22). Mean fork length, weight and condition factor were 460 mm, 1,556 g, 1.59, respectively (Table 5-24). Captured Longnose Sucker had a narrow length-frequency distribution where more than 76% of the fish were between 425 and 474 mm (Figure 5-23).

Northern Pike

Northern Pike (n = 22) abundance decreased from initial spring sampling through to the last sampling period (Table 5-21). Mean CPUE for Northern Pike for all sampling periods was 0.21 fish/minute (Table 5-22). Mean fork length, weight and condition factor were 551 mm, 1,685 g and 0.83, respectively (Table 5-24). The length-frequency distribution for captured Northern Pike was broad with a modal interval of 450-499 mm (18% of the catch) and an additional seven size categories each representing 9-14% of the catch (Figure 5-24).

Shorthead Redhorse

Shorthead Redhorse (n = 89) were not captured during the first sampling period in mid-April, but catches steadily increased through the remainder of April and May (Table 5-21). Mean CPUE for all sampling periods was 0.31 fish/minute (Table 5-22). Mean fork length, weight and condition factor were 389 mm, 1,009 g and 1.68, respectively (Table 5-24). The modal fork length interval, representing more than 41% of the Shorthead Redhorse catch, was 375-399 mm (Figure 5-25).

White Sucker

White Sucker (n = 483) were the most abundant species captured over the five sampling periods (Table 5-21). Mean CPUE was 57.9 fish/minute (Table 5-22). Mean fork length, weight and condition factor were 452 mm, 1,516 g and 1.60, respectively (Table 5-24). The modal fork length interval of White Sucker was 450-474 mm and almost 90% of the catch was 400-524 mm in length (Figure 5-26).

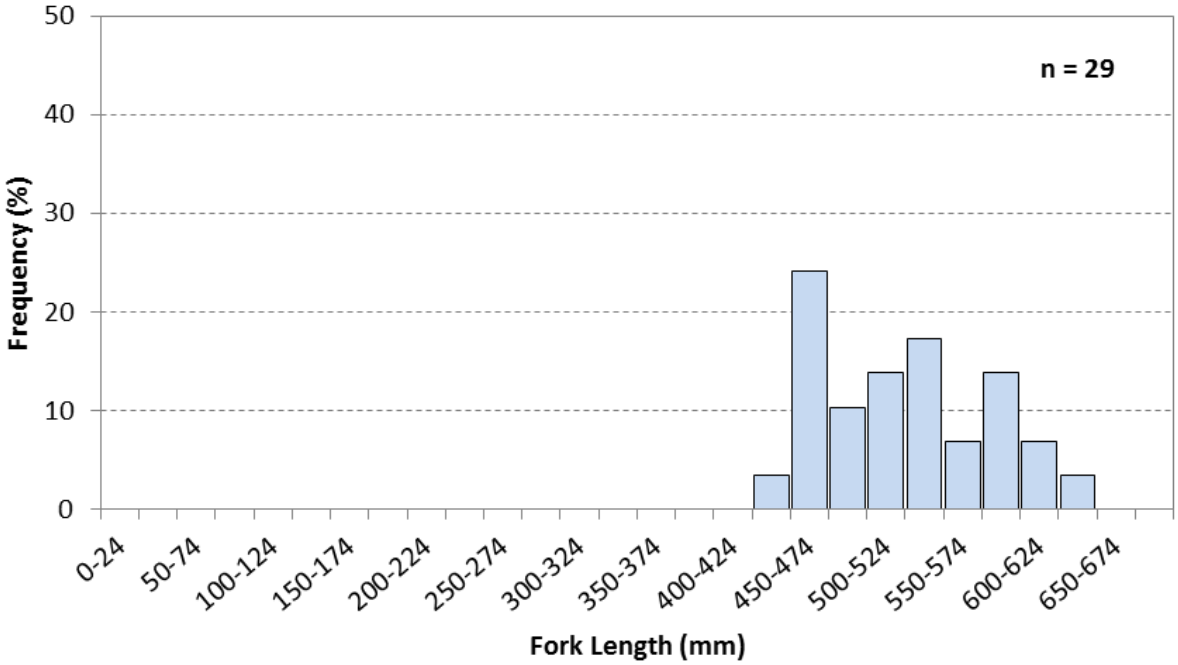

Figure 5-22. Length-frequency distribution for Freshwater Drum captured during electrofishing runs conducted in the Dauphin River during spring 2012.

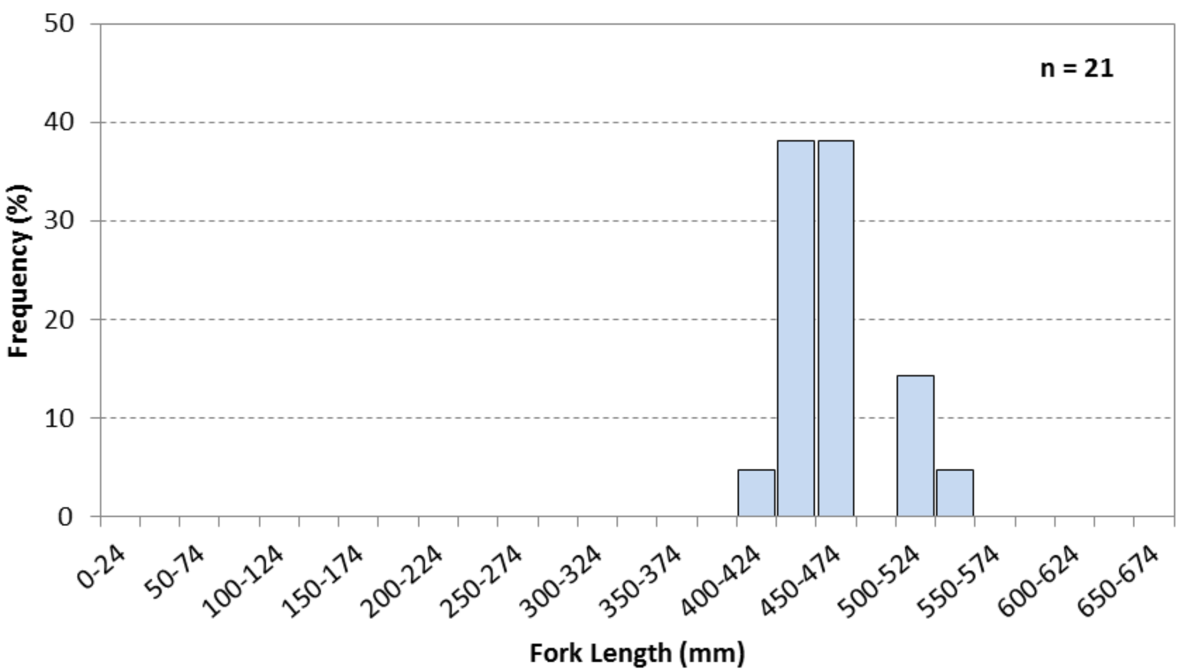

Figure 5-23. Length-frequency distribution for Longnose Sucker captured during electrofishing runs conducted in the Dauphin River during spring 2012.

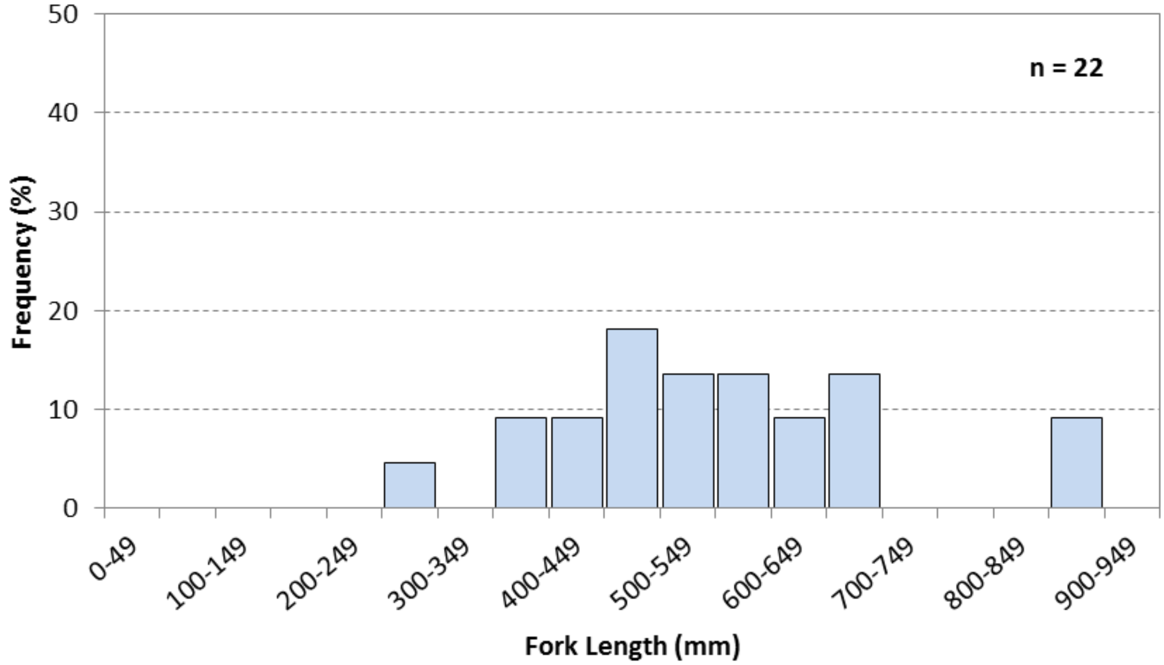

Figure 5-24. Length-frequency distribution for Northern Pike captured during electrofishing runs conducted in the Dauphin River during spring 2012.

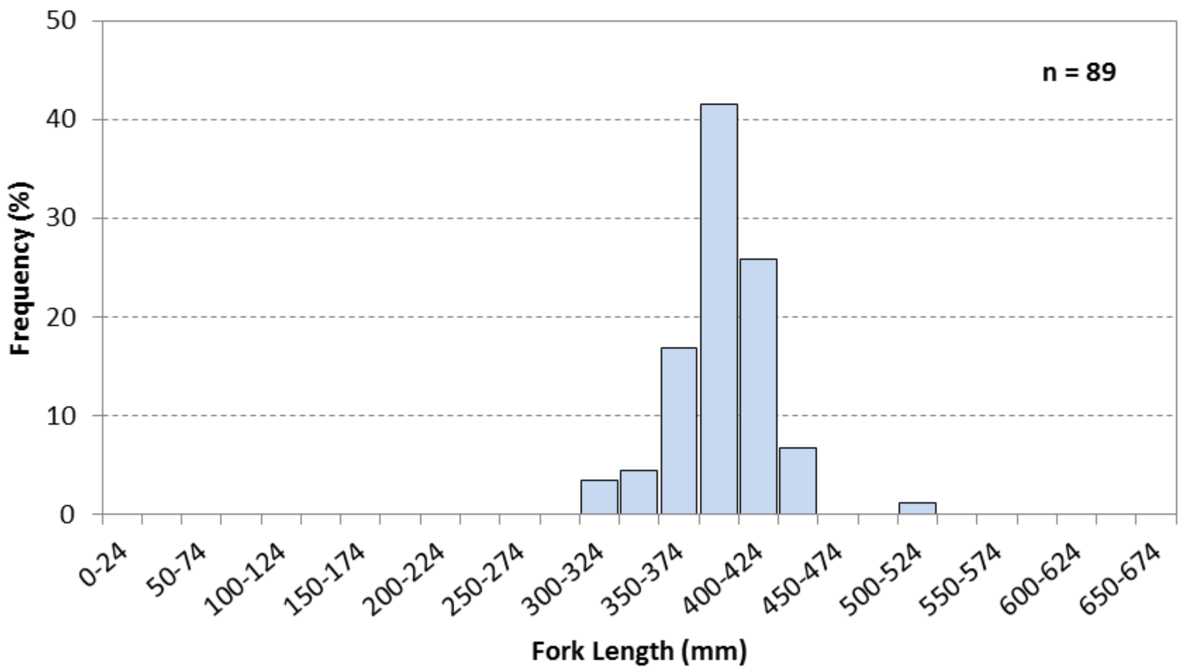

Figure 5-25. Length-frequency distribution for Shorthead Redhorse captured during electrofishing runs conducted in the Dauphin River during spring 2012.

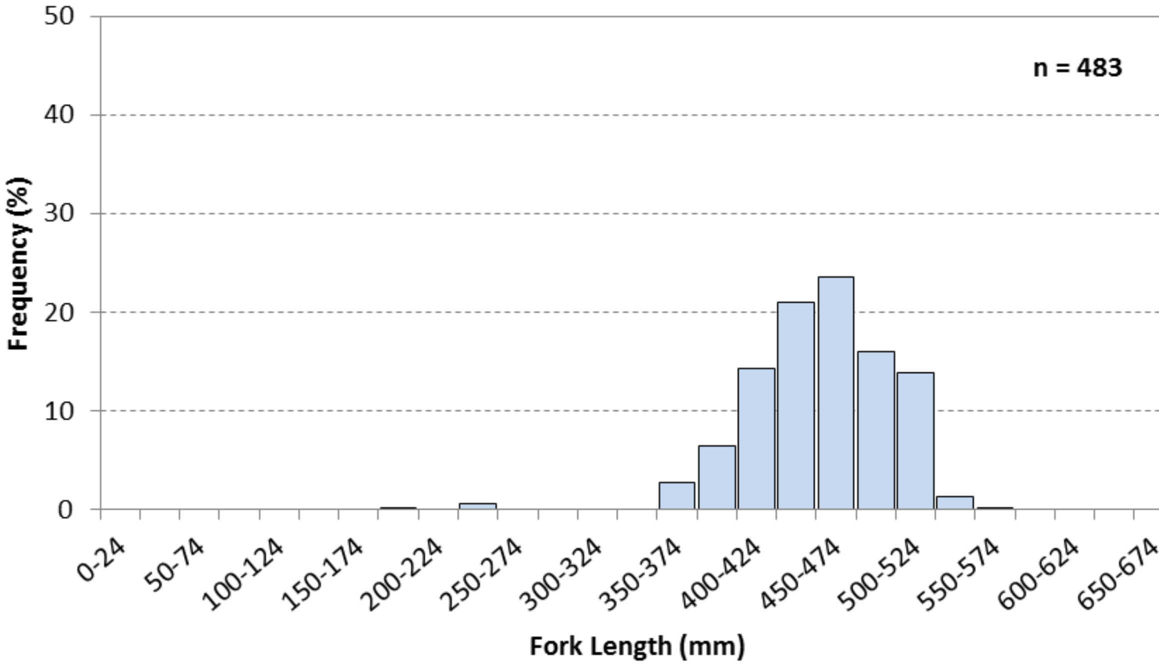

Figure 5-26. Length-frequency distribution for White Sucker captured during electrofishing runs conducted in the Dauphin River during spring 2012.

5.2.3 Sturgeon Bay

Sampling in Sturgeon Bay began on 16 April and continued until 15 June, and included six sampling periods (Table 5-2). Additional, opportunistic sampling was completed from mid-June until 05 July in Sturgeon Bay during the conduct of a pilot debris monitoring program (North/South Consultants Inc. 2012b).

Sampling activity was focused on nearshore areas along the southern portion of Sturgeon Bay in areas where local knowledge indicated that spawning by a variety of fish species occurs, and where potential effects of operation of Reach 1 could be greatest. Particular emphasis was placed upon nearshore areas to the west and east of Willow Point. Sampling included the collection of fish eggs using egg mats, larval fish using a neuston sampler, and the collection of adult fish using experimental gill nets. The following sections present results from the various sampling activities conducted in Sturgeon Bay.

5.2.3.1 Water Temperature

At the onset of spring sampling, most of Sturgeon Bay remained ice covered. Extended areas of open water occurred near the mouth of the Dauphin River and narrow (~250 m) wide leads occurred along the shore to the south and east of the Dauphin River. Most of the ice cover had either melted or drifted away by the time the second sampling period began. Water temperature was less than 2°C at the onset of sampling and rose steadily to about 13°C by mid-May (Figure 5-27). A brief decrease to approximately 10°C towards the end of May was followed by a steady increase to a peak water temperature of about 24°C by mid-July. Temperature at the end of fish sampling in mid-June was approximately 17°C. When the logger was removed at the end of October, water temperature had decreased to 1-2°C.

Figure 5-27. Water temperature in Sturgeon Bay during 2012.

5.2.3.2 Spawning Activity and Larval Fish

Egg mats

Fifteen egg mats were deployed in Sturgeon Bay at the end of April (Table 5-25). Mats were deployed in clusters in three general locations along the Sturgeon Bay shore to the south and east of the mouth of the Dauphin River, including immediately to the east and south of the Dauphin River, at a point located halfway (Halfway Point) between the Dauphin River and Willow Point, and at Willow Point (Figure 5-28).

All of the egg mats, except for EM-11, EM-12, and EM-13, were successfully checked and re-deployed at the end of May (Table 5-25; Figure 5-28). The egg mats at EM-11, EM-12, and EM-13 were initially deployed near the mouth of the Dauphin River. All three mats were successfully relocated and retrieved, but had been dragged by water currents and, consequently, the filter fabric on the traps had largely been destroyed. These traps were removed and not re-deployed.

Fish eggs were recovered from EM-14 and EM-17 (both set at Willow Point; Figure 5-28) and at EM-21, EM-22, and EM-23 (all set at Halfway Point). Most eggs were identified as being Yellow Perch eggs, but individual eggs from two sites (EM-17 and EM-22) could not be identified to fish species (Table 5-25).

Egg mats were checked and removed on 14 June. Three fish eggs identified as White Bass eggs were retrieved from EM-15 set at Willow Point (Table 5-25; Figure 5-28); all remaining mats contained no fish eggs.

Table 5-25. Location, lift dates, and catches from egg mats set in Sturgeon Bay during spring 2012.

Egg Mat	Waterbody	Set Date	Location [1]		Pull Date [2]	Egg Count	Species	Pull Date [3]	Egg Count	Species
			Easting	Northing						
EM-11	Sturgeon Bay	29-Apr-12	565866	5756567	30-May-12			Destroyed		
EM-12	Sturgeon Bay	29-Apr-12	565842	5756381	30-May-12			Destroyed		
EM-13	Sturgeon Bay	29-Apr-12	565824	5756198	30-May-12			Destroyed		
EM-14	Sturgeon Bay	29-Apr-12	573803	5752913	30-May-12	21	Yellow Perch	14-Jun-12	0	-
EM-15	Sturgeon Bay	29-Apr-12	573796	5752782	30-May-12	0	-	14-Jun-12	3	White Bass
EM-16	Sturgeon Bay	30-Apr-12	573843	5753135	30-May-12	0	-	14-Jun-12	0	-
EM-17	Sturgeon Bay	30-Apr-12	573673	5753277	30-May-12	1	Unidentified	14-Jun-12	0	-
EM-18	Sturgeon Bay	30-Apr-12	572436	5753840	30-May-12	0	-	14-Jun-12	0	-
EM-19	Sturgeon Bay	30-Apr-12	573263	5753495	30-May-12	0	-	14-Jun-12	0	-
EM-20	Sturgeon Bay	30-Apr-12	573351	5753372	30-May-12	1	Yellow Perch	14-Jun-12	0	-
EM-21	Sturgeon Bay	30-Apr-12	569302	5754351	02-Jun-12	2	Yellow Perch	14-Jun-12	0	-
EM-22	Sturgeon Bay	30-Apr-12	569202	5754370	02-Jun-12	1	Unidentified	14-Jun-12	0	-
EM-23	Sturgeon Bay	30-Apr-12	569174	5754457	02-Jun-12	0	-	14-Jun-12	0	-
EM-24	Sturgeon Bay	30-Apr-12	569288	5754454	02-Jun-12	0	-	14-Jun-12	0	-
EM-25	Sturgeon Bay	30-Apr-12	569030	5754420	02-Jun-12	0	-	14-Jun-12	0	-

1 - UTM coordinates; NAD 83 Zone 14U; site-specific locations illustrated on Figure 5-28.

2 - Egg mat lifted and reset.

3 - Egg mat lifted and removed.

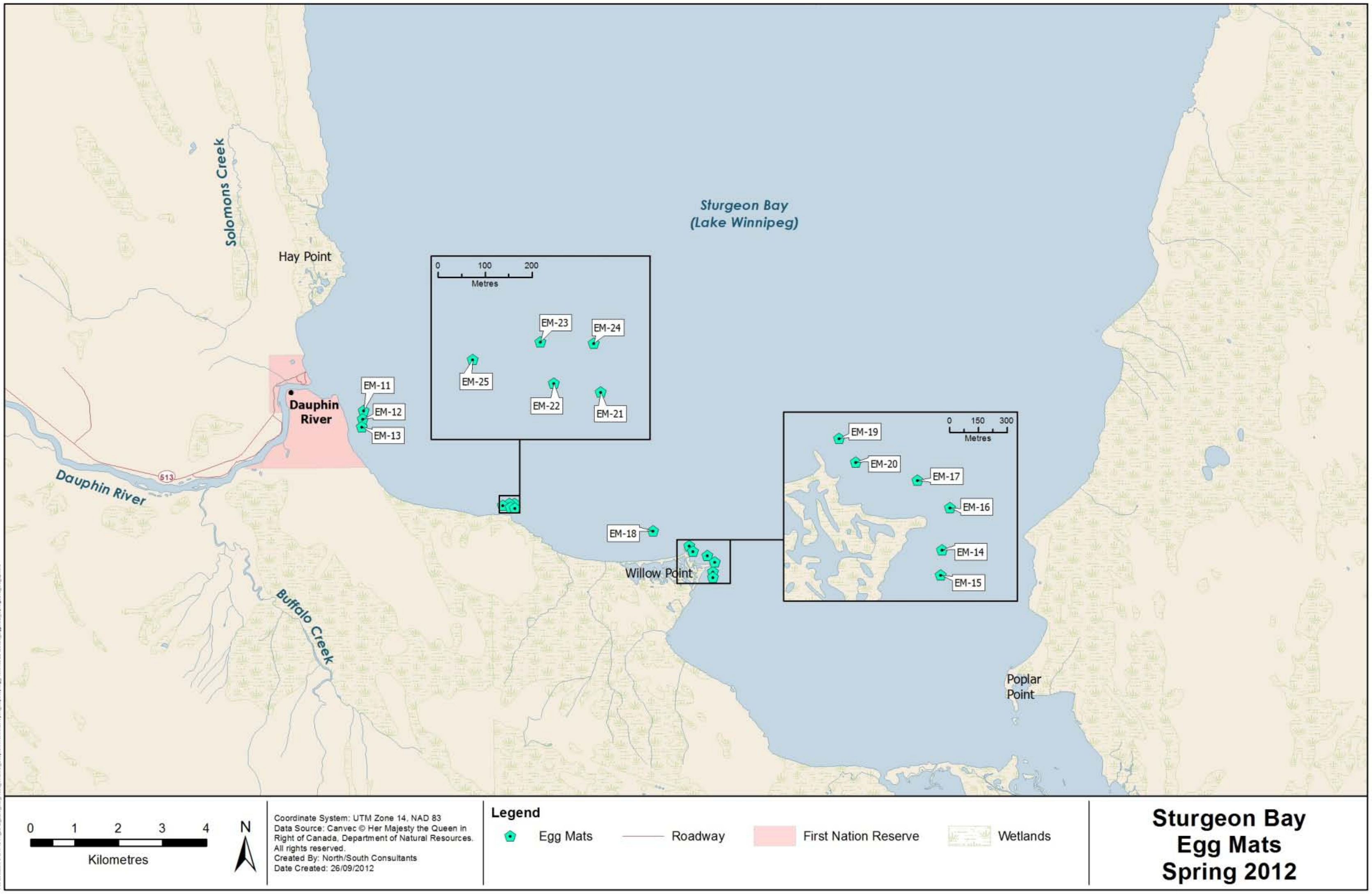

Figure 5-28. Location of egg mats set in Sturgeon Bay during spring 2012.

Neuston Tows

Fifty eight neuston tows were conducted along the Sturgeon Bay shoreline from 16 April to 05 July (Table 5-26; Figure 5-29). Tow duration ranged from 7-43 minutes, but effort was made to standardize duration to about 20 minutes, and most tows were 15-25 minutes long (Table 5-26). The volume of water filtered varied with tow duration.

A total of 494 larval fish were captured in the tows (Table 5-27). Larvae from at least seven species of fish were captured. Larval Yellow Perch were most abundant (n = 173), followed by Lake Whitefish (n = 90) Cisco (n = 87) and suckers (n = 71). Larval Lake Whitefish were captured at the onset of the spring monitoring program, peaking in late April at water temperatures of 5-8°C with an average CPUE of 4.07 fish/100 m^3 (Table 5-28). Overall larval Lake Whitefish CPUE was 0.76 fish/100 m^3 (Table 5-28). Individual larvae were captured near the mouth of the Dauphin River on 18 and 19 April (Table 5-28). Larval Cisco were captured only during the late April sampling period at an average CPUE of 6.00 fish/100 m^3 (Table 5-28). Larval Lake Whitefish and Cisco were most abundant in neuston tows conducted to the east and west of Willow Point at the end of April (Table 5-28; Figure 5-29). Larval Lake Whitefish continued to be captured until early June, but generally in lower numbers than observed at the end of April. Larval Lake Whitefish were not captured after 02 June.

Larval suckers were first captured on 20 May at an approximate water temperature of 12-13°C, peaked in early to mid-June when water temperature exceeded 15°C and were captured in small numbers until the end of sampling (Table 5-28). Overall CPUE for sucker larvae was 0.60 fish/100 m^3 (Table 5-28). Larval Yellow Perch were first captured at the end of May, peaking from the end of May to mid-June with an average CPUE of 3.18 fish/100 m^3, and were almost absent from the catch by the end of June (Tables 5-27 and 5-28).

A total of 3,331 juvenile and adult fish were captured in the tows (Table 5-29). Juvenile or adult Emerald Shiner were by far the most frequently captured fish, comprising more than 99% of the catch with an overall average CPUE of 27.90 fish/100 m^3 (Tables 5-29 and 5-30). Two Spottail Shiner, a single Rainbow Smelt, and nine Ninespine Stickleback were the only other juvenile or adult fish captured.

Table 5-26. The location, time and duration of neuston tows conducted in Sturgeon Bay during spring 2012.

Neuston Tow	Date	Start Location [1]		End Location [1]		Start Time	End Time	Duration (minutes)	Flow Meter Count		Tow Distance [2] (m)	Volume [3] (m^3)
		Easting	Northing	Easting	Northing				Start	End		
NT-1	18-Apr-12	565715	5756322	565666	5755835	5:31:00 PM	5:38:00 PM	7.0	0	20322	543	73
NT-2	18-Apr-12	565516	5756481	564750	5757002	5:51:00 PM	6:05:00 PM	14.0	20322	65269	1200	162
NT-3	18-Apr-12	566068	5759108	565142	5757384	6:23:00 PM	6:44:00 PM	21.0	41169	113792	1939	261
NT-4	19-Apr-12	566826	5757028	565673	5757365	1:16:00 PM	1:59:00 PM	43.0	114398	261298	3922	529
NT-5	28-Apr-12	568857	5754488	569753	5754015	6:19:00 PM	6:36:00 PM	17.0	261317	310442	1312	177
NT-6	28-Apr-12	572783	5753733	571914	5753481	6:48:00 PM	7:04:00 PM	16.0	312299	365638	1424	192
NT-7	28-Apr-12	571764	5753472	570806	5753300	7:11:00 PM	7:25:00 PM	14.0	365624	412355	1248	168
NT-8	28-Apr-12	570719	5753298	569807	5753943	7:29:00 PM	7:43:00 PM	14.0	412355	461428	1310	176
NT-9	29-Apr-12	573676	5752650	573176	5751871	4:27:00 PM	4:40:00 PM	13.0	461201	502106	1092	147
NT-10	29-Apr-12	573180	5751985	573187	5751173	4:43:00 PM	4:58:00 PM	15.0	502106	547420	1210	163
NT-11	29-Apr-12	573025	5751318	574037	5750951	5:05:00 PM	5:21:00 PM	16.0	547419	600799	1425	192
NT-12	30-Apr-12	573862	5753169	572796	5753395	10:53:00 AM	11:08:00 AM	15.0	600825	656826	1495	201
NT-13	10-May-12	573879	5752830	573529	5751963	9:58:00 AM	10:09:00 AM	11.0	656270	703456	1260	170
NT-14	10-May-12	573483	5751965	573772	5750988	10:18:00 AM	10:36:00 AM	18.0	703456	762240	1570	211
NT-15	10-May-12	573211	5751406	574810	5749995	11:58:00 AM	12:26:00 PM	28.0	762046	858872	2585	349
NT-16	10-May-12	572509	5753762	573338	5753757	2:35:00 PM	2:45:00 PM	10.0	858858	892565	900	121
NT-17	11-May-12	564983	5758508	565334	5759246	12:06:00 PM	12:19:00 PM	13.0	892577	940739	1286	173
NT-18	11-May-12	564933	5758434	564966	5757307	12:28:00 PM	12:42:00 PM	14.0	940738	992206	1374	185
NT-19	11-May-12	566230	5755544	567078	5754807	1:34:00 PM	1:50:00 PM	16.0	992809	49319	1509	203
NT-20	20-May-12	565778	5756252	565080	5757080	9:13:00 AM	9:31:00 AM	18.0	49307	104641	1477	199
NT-21	20-May-12	566322	5755395	566644	5755001	10:13:00 AM	10:31:00 AM	18.0	104659	164975	1610	217

Table 5-26. (continued).

Neuston Tow	Date	Start Location [1]		End Location [1]		Start Time	End Time	Duration (minutes)	Flow Meter Count		Tow Distance [2] (m)	Volume [3] (m^3)
		Easting	Northing	Easting	Northing				Start	End		
NT-22	30-May-12	569512	5754199	570850	5753311	3:09:00 PM	3:31:00 PM	22.0	164859	241694	2051	277
NT-23	30-May-12	570752	5753304	572881	5753418	2:10:00 PM	2:38:00 PM	28.0	241698	342485	2691	363
NT-24	30-May-12	573450	5752267	573190	5753550	5:36:00 PM	5:59:00 PM	23.0	342530	420977	2095	282
NT-25	30-May-12	569353	5754489	567862	5754635	7:00:00 PM	7:21:00 PM	21.0	420989	494460	1962	264
NT-26	30-May-12	567857	5754699	566582	5754707	7:25:00 PM	7:42:00 PM	17.0	494460	556513	1657	223
NT-27	31-May-12	566469	5755146	567555	5754657	4:55:00 PM	5:11:00 PM	16.0	556911	615811	1573	212
NT-28	31-May-12	567549	5754746	566400	5754807	5:15:00 PM	5:31:00 PM	16.0	615810	673389	1537	207
NT-29	31-May-12	566374	5755150	565571	5756316	5:49:00 PM	6:11:00 PM	22.0	673395	744258	1892	255
NT-30	2-Jun-12	580304	5750090	580890	5751069	3:23:00 PM	3:39:00 PM	16.0	744248	803174	1573	212
NT-31	2-Jun-12	580961	5751057	580993	5752734	3:43:00 PM	4:10:00 PM	27.0	803175	889668	2309	311
NT-32	2-Jun-12	580574	5753894	581739	5755329	4:56:00 PM	5:17:00 PM	21.0	889665	970068	2147	289
NT-33	2-Jun-12	581807	5755297	582411	5756610	5:22:00 PM	5:41:00 PM	19.0	970071	40703	1886	254
NT-34	13-Jun-12	565450	5757041	565742	5755729	7:32:00 PM	7:52:00 PM	20.0	40724	98711	1548	209
NT-35	13-Jun-12	565835	5755675	566490	5754756	7:55:00 PM	8:15:00 PM	20.0	98711	150542	1384	187
NT-36	13-Jun-12	566519	5754738	567957	5754428	8:20:00 PM	8:44:00 PM	24.0	150542	217590	1790	242
NT-37	14-Jun-12	564836	5757273	564530	5758570	11:40:00 AM	12:00:00 PM	20.0	217473	285146	1807	244
NT-38	14-Jun-12	564708	5758581	565625	5759623	12:05:00 PM	12:24:00 PM	19.0	285146	332312	1259	170
NT-39	14-Jun-12	568042	5754398	569637	5754220	3:43:00 PM	4:05:00 PM	22.0	330901	402446	1910	258
NT-40	14-Jun-12	569666	5754199	571259	5753433	4:08:00 PM	4:30:00 PM	22.0	402446	452787	1344	181
NT-41	14-Jun-12	571410	5753397	573045	5753532	4:35:00 PM	4:55:00 PM	20.0	452787	526686	1973	266
NT-42	14-Jun-12	573089	5753552	573741	5752600	4:58:00 PM	5:17:00 PM	19.0	526686	588838	1659	224
NT-43	14-Jun-12	573657	5752484	573238	5751182	5:21:00 PM	5:41:00 PM	20.0	588838	632863	1175	159
NT-44 [4]	14-Jun-12	573324	5751100	574483	5750268	5:45:00 PM	6:05:00 PM	20.0	588838	-	-	-

Table 5-26. (continued).

Neuston Tow	Date	Start Location [1]		End Location [1]		Start Time	End Time	Duration (minutes)	Flow Meter Count		Tow Distance [2] (m)	Volume [3] (m^3)
		Easting	Northing	Easting	Northing				Start	End		
NT-45	26-Jun-12	573399	5753500	572064	5753319	7:07:00 PM	7:27:00 PM	20.0	813959	869088	1472	199
NT-46	26-Jun-12	572032	5753364	570689	5753740	7:31:00 PM	7:51:00 PM	20.0	869088	927778	1567	212
NT-47	26-Jun-12	570664	5753786	569219	5754464	7:54:00 PM	8:14:00 PM	20.0	927778	986778	1575	213
NT-48	26-Jun-12	569199	5754491	567890	5754427	8:17:00 PM	8:37:00 PM	20.0	986778	40159	1425	192
NT-49	27-Jun-12	567899	5754435	566720	5754676	5:05:00 PM	5:25:00 PM	20.0	40146	94418	1449	196
NT-50	27-Jun-12	566785	5754738	565857	5755677	5:29:00 PM	5:49:00 PM	20.0	94418	147772	1425	192
NT-51	27-Jun-12	565906	5755787	565176	5757034	5:53:00 PM	6:13:00 PM	20.0	147779	206079	1557	210
NT-52	3-Jul-12	565703	5759808	565234	5759112	6:50:00 PM	7:05:00 PM	15.0	206078	242488	972	131
NT-53	3-Jul-12	565164	5759181	564671	5758257	7:10:00 PM	7:25:00 PM	15.0	242488	272620	805	109
NT-54 [4]	3-Jul-12	564612	5758222	564832	5757269	7:30:00 PM	7:45:00 PM	15.0	272618	-	-	-
NT-55	5-Jul-12	565482	5756876	565701	5755780	5:15:00 PM	5:30:00 PM	15.0	274118	319458	1211	163
NT-56	5-Jul-12	565713	5755738	566291	5755020	5:32:00 PM	5:46:00 PM	14.0	319455	354820	944	127
NT-57	5-Jul-12	566343	5755006	567301	5754448	5:47:00 PM	6:02:00 PM	15.0	354818	398188	1158	156
NT-58	5-Jul-12	567383	5754445	568959	5754400	6:05:00 PM	6:25:00 PM	20.0	398188	457838	1593	215

1 - Locations illustrated in Figure 5-29.

2 - Tow distance (m) calculated as the number of flow meter revolutions x 0.02687.

3 - Volume filtered calculated as the tow distance (m) x 0.135 m^2.

4 - GO Meter lost during retrieval of tow NT-44 and not working properly during tow NT-54; these two tows omitted from further analyses.

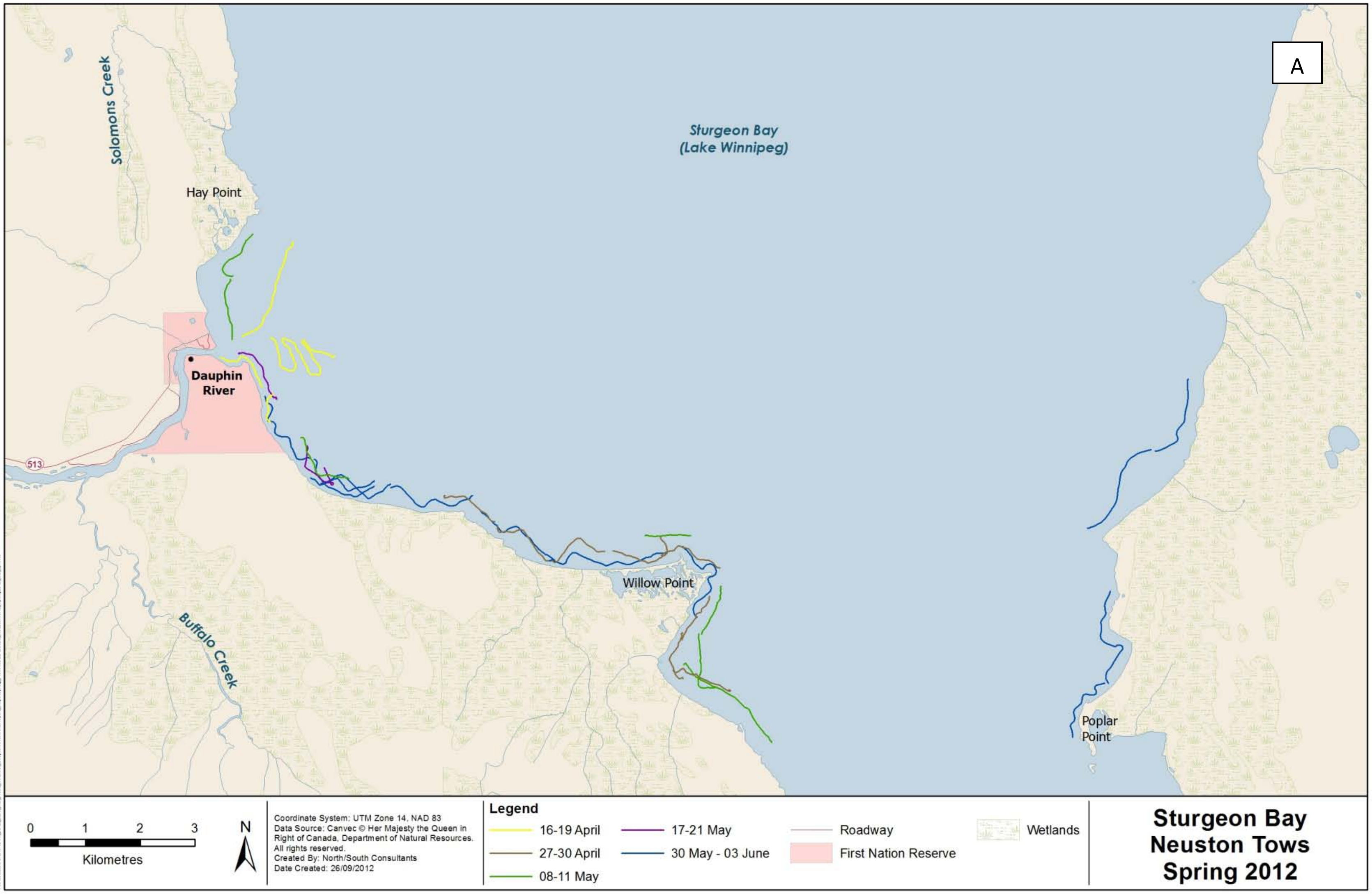

Figure 5-29. Overview of locations (A) and detailed sampling period-specific locations (B, C, D, E, F) where neuston tows were conducted in Lake St. Martin during spring 2012.

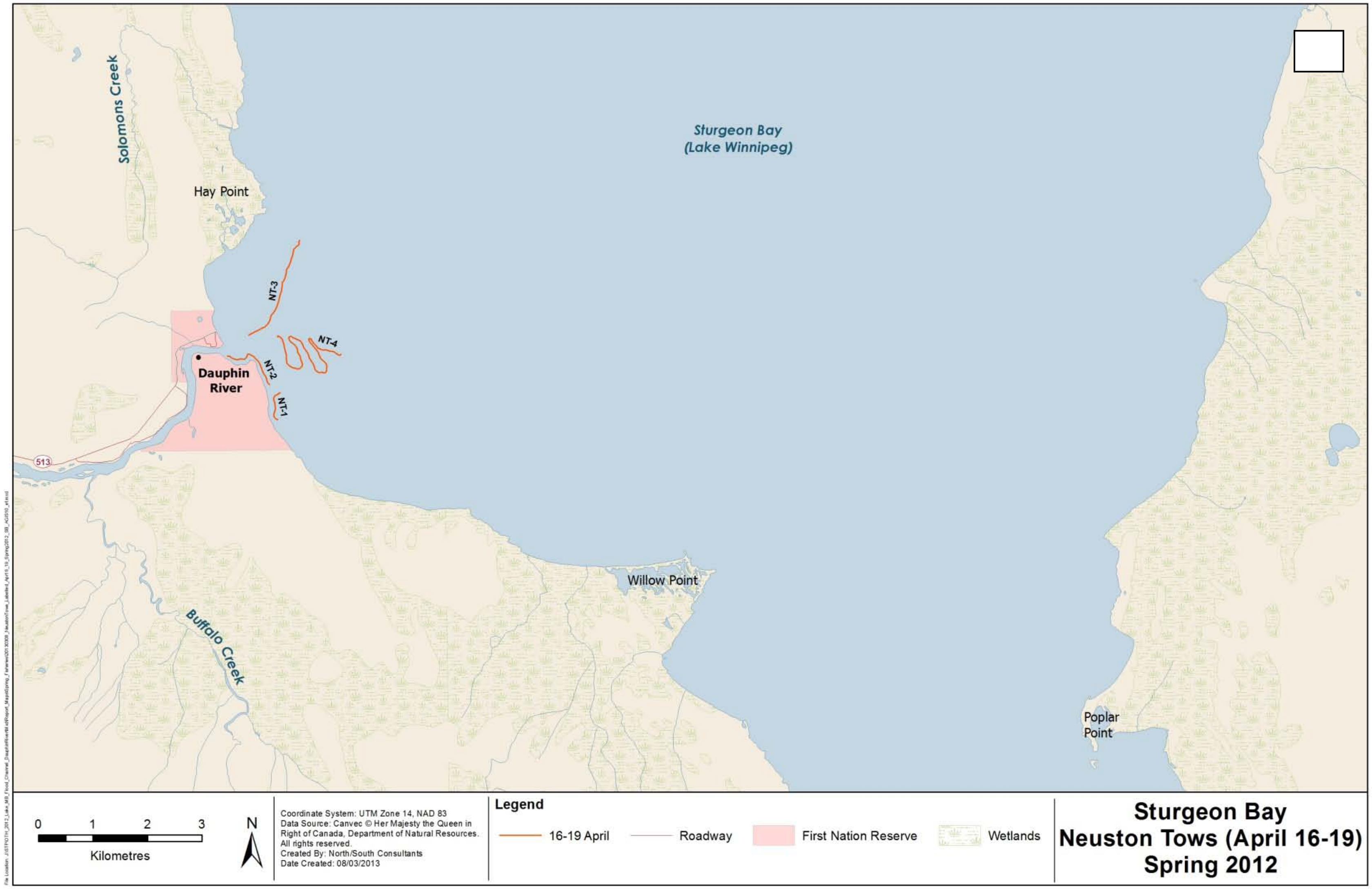

Figure 5-29. (continued).

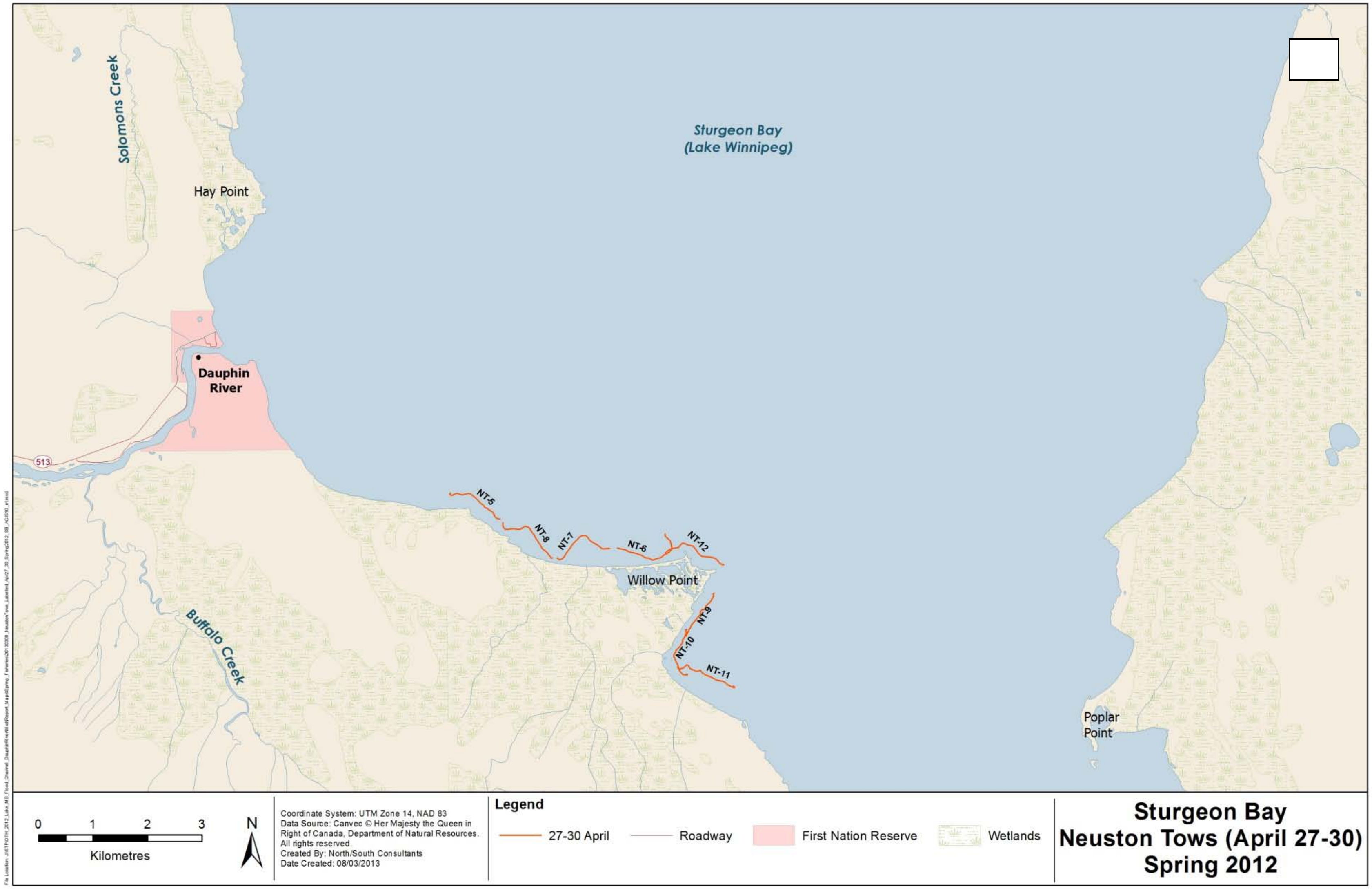

Figure 5-29. (continued).

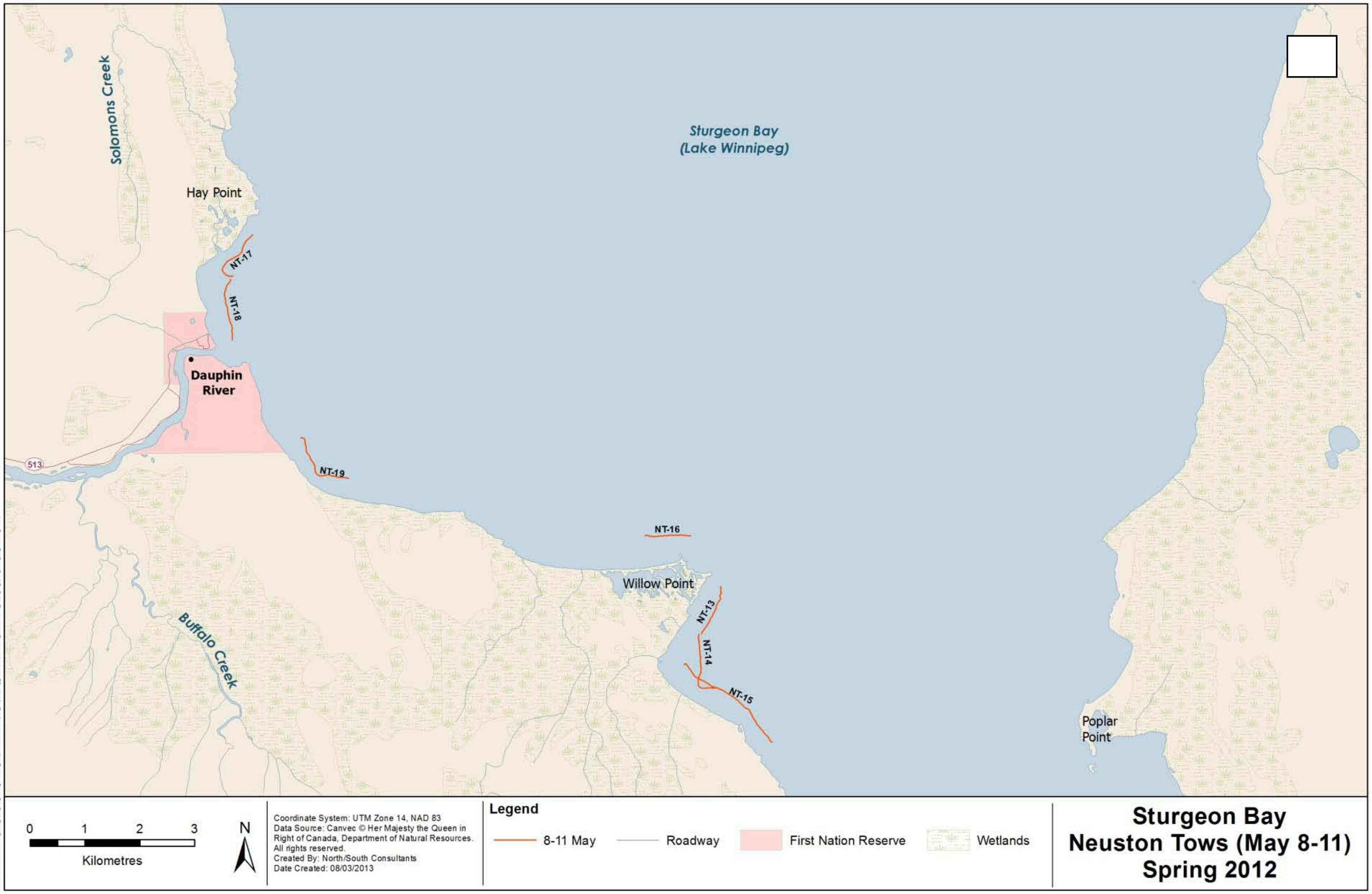

Figure 5-29. (continued).

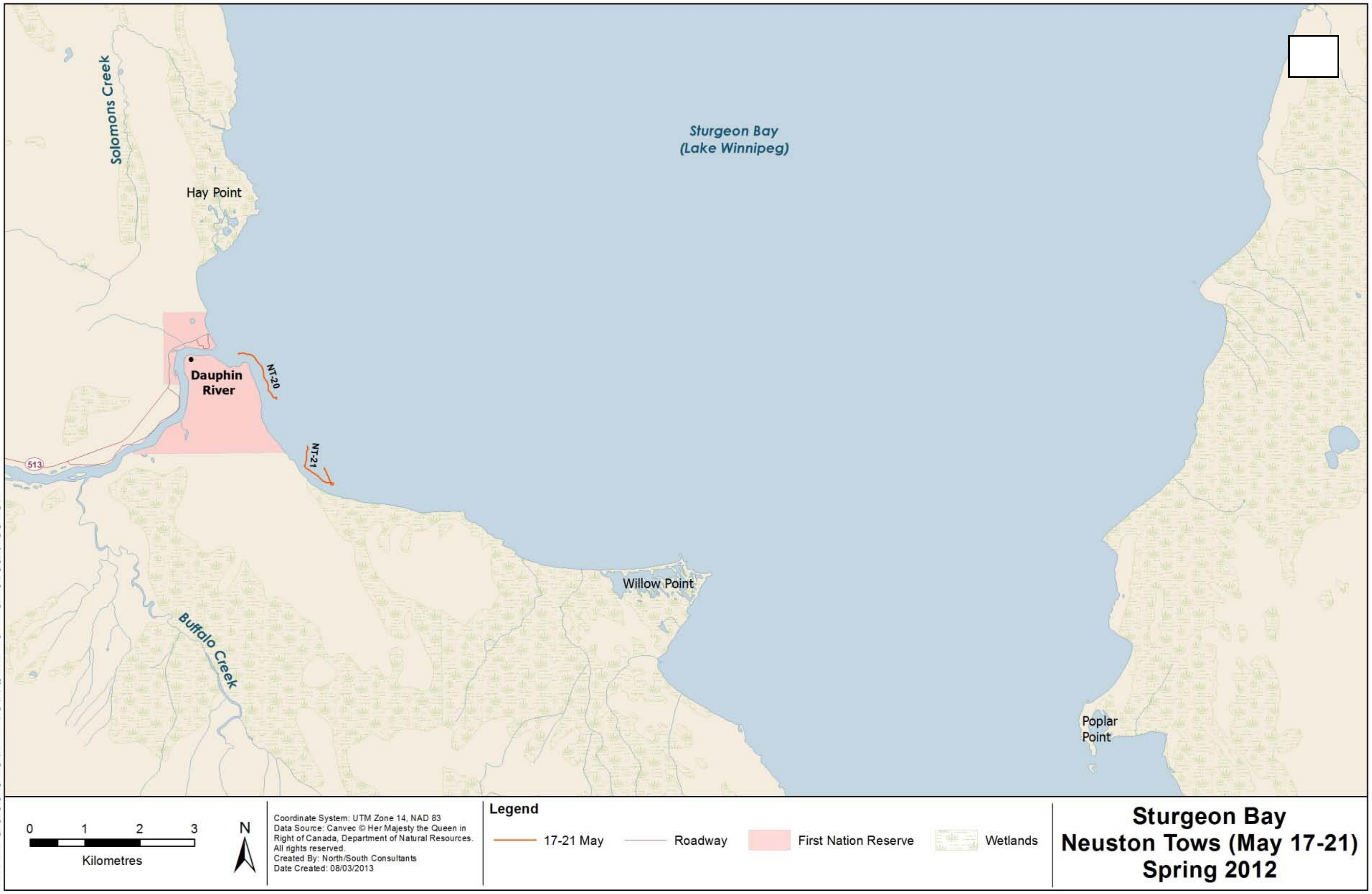

Figure 5-29. (continued).

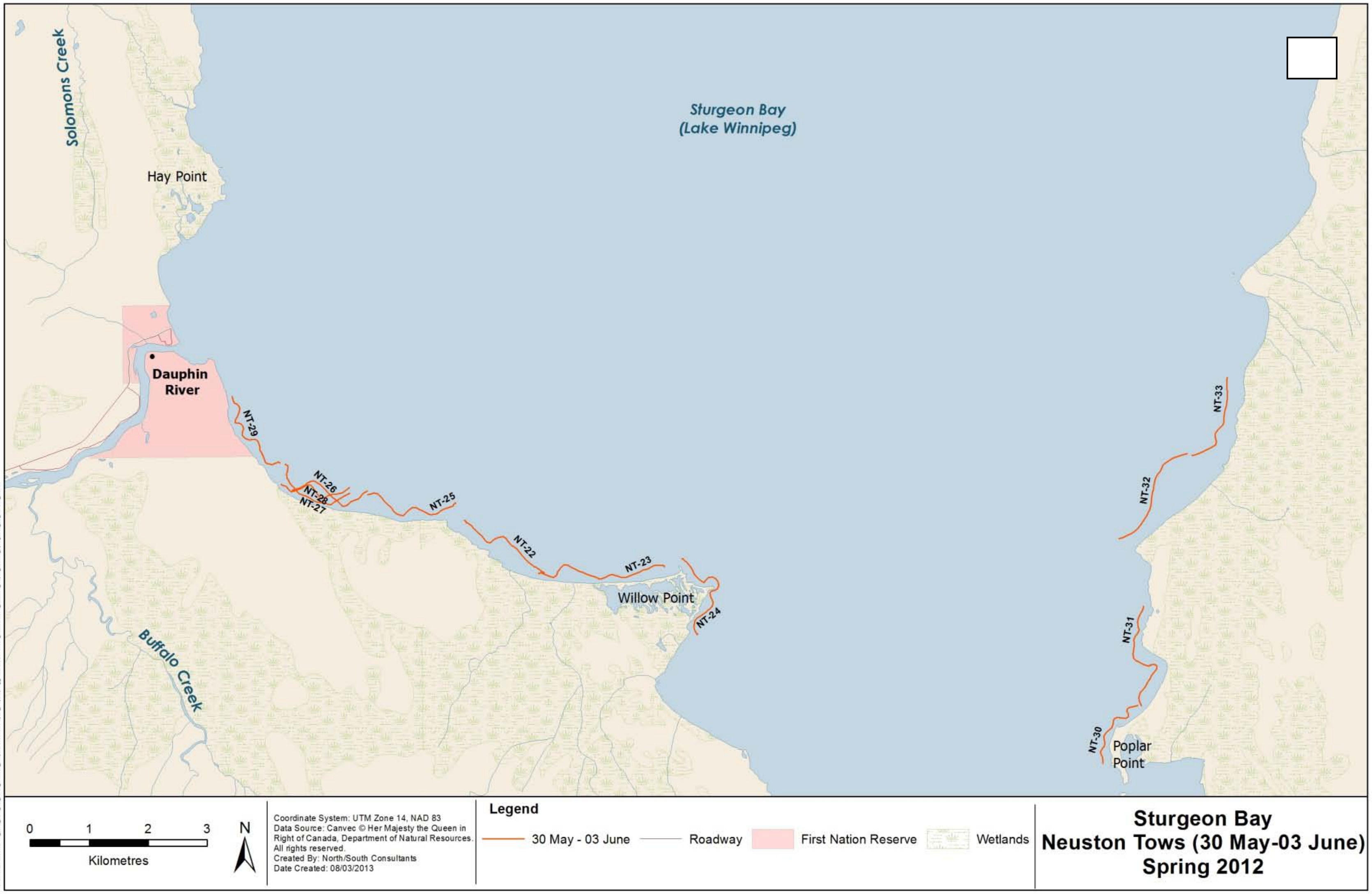

Figure 5-29. (continued).

Table 5-27. Tow-specific catch of larval fish from neuston tows conducted in Sturgeon Bay during spring 2012.

Neuston Tow [1]	Date	Larval Fish							Total
		Lake Whitefish	Cisco	Minnow [2]	Sucker [2]	White Bass	Percid [3]	Yellow Perch	
NT-1	18-Apr-12	1	-	-	-	-	-	-	1
NT-2	18-Apr-12	-	-	-	-	-	-	-	0
NT-3	18-Apr-12	-	-	-	-	-	-	-	0
NT-4	19-Apr-12	1	-	-	-	-	-	-	1
NT-5	28-Apr-12	5	10	-	-	-	-	-	15
NT-6	28-Apr-12	14	36	-	-	-	-	-	50
NT-7	28-Apr-12	1	18	-	-	-	-	-	19
NT-8	28-Apr-12	6	21	-	-	-	-	-	27
NT-9	29-Apr-12	3	-	-	-	-	-	-	3
NT-10	29-Apr-12	9	1	-	-	-	-	-	10
NT-11	29-Apr-12	1	-	-	-	-	-	-	1
NT-12	30-Apr-12	21	1	-	-	-	-	-	11
NT-13	10-May-12	-	-	-	-	-	-	-	0
NT-14	10-May-12	-	-	-	-	-	-	-	0
NT-15	10-May-12	2	-	-	-	-	-	-	2
NT-16	10-May-12	-	-	-	-	-	-	-	0
NT-17	11-May-12	-	-	-	-	-	-	-	0
NT-18	11-May-12	-	-	-	-	-	-	-	0
NT-19	11-May-12	-	-	-	-	-	-	-	0
NT-20	20-May-12	-	-	-	14	-	-	-	14
NT-21	20-May-12	-	-	-	-	-	-	-	0
NT-22	30-May-12	-	-	-	15	-	-	46	61
NT-23	30-May-12	3	-	-	-	-	-	13	16
NT-24	30-May-12	2	-	-	6	-	-		8
NT-25	30-May-12	-	-	-	1	-	-	6	7
NT-26	30-May-12	-	-	-	1	-	-	5	6
NT-27	31-May-12	5	-	-	-	-	-	25	30
NT-28	31-May-12	11	-	-	-	-	-	-	11
NT-29	31-May-12	4	-	-	-	-	-	-	4
NT-30	2-Jun-12	1	-	-	-	-	-	-	1
NT-31	2-Jun-12	-	-	-	-	-	-	2	2
NT-32	2-Jun-12	-	-	-	1	-	-	6	7
NT-33	2-Jun-12	-	-	-	-	-	-	-	0

Table 5-27. (continued).

Neuston Tow [1]	Date	Larval Fish							Total
		Lake Whitefish	Cisco	Minnow [2]	Sucker [2]	White Bass	Percid [3]	Yellow Perch	
NT-34	13-Jun-12	-	-	-	-	-	-	-	0
NT-35	13-Jun-12	-	-	-	-	-	2	-	2
NT-36	13-Jun-12	-	-	-	5	-	-	-	5
NT-37	14-Jun-12	-	-	-	5	-	-	1	6
NT-38	14-Jun-12	-	-	-	10	-	3	-	13
NT-39	14-Jun-12	-	-	-	2	-	-	40	42
NT-40	14-Jun-12	-	-	-	-	-	-	27	27
NT-41	14-Jun-12	-	-	-	1	-	19	-	20
NT-42	14-Jun-12	-	-	1	-	-	2	-	3
NT-43	14-Jun-12	-	-	-	-	-	-	-	0
NT-44	14-Jun-12	-	-	-	-	-	-	1	1
NT-45	26-Jun-12	-	-	-	-	4	-	-	4
NT-46	26-Jun-12	-	-	-	-	7	-	-	7
NT-47	26-Jun-12	-	-	1	-	6	-	-	7
NT-48	26-Jun-12	-	-	-	-	5	-	-	5
NT-49	27-Jun-12	-	-	-	-	-	-	-	0
NT-50	27-Jun-12	-	-	-	-	-	-	1	1
NT-51	27-Jun-12	-	-	-	1	-	-	-	1
NT-52	3-Jul-12	-	-	1	1	-	-	-	2
NT-53	3-Jul-12	-	-	8	-	-	-	-	8
NT-54	3-Jul-12	-	-	2	5	12	-	-	19
NT-55	5-Jul-12	-	-	-	1	-	-	-	1
NT-56	5-Jul-12	-	-	-	1	-	-	-	1
NT-57	5-Jul-12	-	-	-	-	-	-	-	0
NT-58	5-Jul-12	-	-	-	1	-	-	-	1
Total		90	87	13	71	34	26	173	494

1 - Neuston tow locations illustrated in Figure 5-29.

2 - Several minnow and sucker species were captured in Sturgeon Bay during spring 2012; White Sucker were the most abundant sucker species captured and it is thought that sucker larvae captured were White Suckers; adults of several minnow species were captured and it is unknown which ones are represented by captured larvae.

3 - Percid larvae are likely Yellow Perch, but Walleye could not be completely ruled out.

Table 5-28. Tow-specific catch-per-unit-effort (# fish/100 m^3) of larval fish from neuston tows conducted in Sturgeon Bay during spring 2012.

Neuston Tow [1]	Date	Larval Fish							Total
		Lake Whitefish	Cisco	Minnow	Sucker	White Bass	Percid	Yellow Perch	
NT-1	18-Apr-12	1.37	-	-	-	-	-	-	1.37
NT-2	18-Apr-12	-	-	-	-	-	-	-	0.00
NT-3	18-Apr-12	-	-	-	-	-	-	-	0.00
NT-4	19-Apr-12	0.19	-	-	-	-	-	-	0.19
NT-5	28-Apr-12	2.82	5.65	-	-	-	-	-	8.47
NT-6	28-Apr-12	7.28	18.72	-	-	-	-	-	26.01
NT-7	28-Apr-12	0.59	10.69	-	-	-	-	-	11.28
NT-8	28-Apr-12	3.39	11.87	-	-	-	-	-	15.26
NT-9	29-Apr-12	2.03	-	-	-	-	-	-	2.03
NT-10	29-Apr-12	5.51	0.61	-	-	-	-	-	6.12
NT-11	29-Apr-12	0.52	-	-	-	-	-	-	0.52
NT-12	30-Apr-12	10.40	0.50	-	-	-	-	-	10.90
NT-13	10-May-12	-	-	-	-	-	-	-	0.00
NT-14	10-May-12	-	-	-	-	-	-	-	0.00
NT-15	10-May-12	0.57	-	-	-	-	-	-	0.57
NT-16	10-May-12	-	-	-	-	-	-	-	0.00
NT-17	11-May-12	-	-	-	-	-	-	-	0.00
NT-18	11-May-12	-	-	-	-	-	-	-	0.00
NT-19	11-May-12	-	-	-	-	-	-	-	0.00
NT-20	20-May-12	-	-	-	7.02	-	-	-	7.02
NT-21	20-May-12	-	-	-	-	-	-	-	0.00
NT-22	30-May-12	-	-	-	5.42	-	-	16.61	22.03
NT-23	30-May-12	0.83	-	-	-	-	-	3.58	4.40
NT-24	30-May-12	0.71	-	-	2.12	-	-	-	2.83
NT-25	30-May-12	-	-	-	0.38	-	-	2.27	2.64
NT-26	30-May-12	-	-	-	0.45	-	-	2.24	2.68
NT-27	31-May-12	2.36	-	-	-	-	-	11.78	14.13
NT-28	31-May-12	5.30	-	-	-	-	-	-	5.30
NT-29	31-May-12	1.57	-	-	-	-	-	-	1.57
NT-30	2-Jun-12	0.47	-	-	-	-	-	-	0.47
NT-31	2-Jun-12	-	-	-	-	-	-	0.64	0.64
NT-32	2-Jun-12	-	-	-	0.35	-	-	2.07	2.42
NT-33	2-Jun-12	-	-	-	-	-	-	-	0.00

Table 5-28. (continued).

Neuston Tow	Date	Larval Fish							Total
		Lake Whitefish	Cisco	Minnow	Sucker	White Bass	Percid	Yellow Perch	
NT-34	13-Jun-12	-	-	-	-	-	-	-	0.00
NT-35	13-Jun-12	-	-	-	-	-	1.07	-	1.07
NT-36	13-Jun-12	-	-	-	2.07	-	-	-	2.07
NT-37	14-Jun-12	-	-	-	2.05	-	-	0.41	2.46
NT-38	14-Jun-12	-	-	-	5.88	-	1.76	-	7.65
NT-39	14-Jun-12	-	-	-	0.78	-	-	15.51	16.29
NT-40	14-Jun-12	-	-	-	-	-	-	14.88	14.88
NT-41	14-Jun-12	-	-	-	0.38	-	7.13	-	7.51
NT-42	14-Jun-12	-	-	0.45	-	-	0.89	-	1.34
NT-43	14-Jun-12	-	-	-	-	-	-	-	0.00
NT-44 [2]	14-Jun-12	-	-	-	-	-	-	-	-
NT-45	26-Jun-12	-	-	-	-	2.01	-	-	2.01
NT-46	26-Jun-12	-	-	-	-	3.31	-	-	3.31
NT-47	26-Jun-12	-	-	0.47	-	2.82	-	-	3.29
NT-48	26-Jun-12	-	-	-	-	2.60	-	-	2.60
NT-49	27-Jun-12	-	-	-	-	-	-	-	0.00
NT-50	27-Jun-12	-	-	-	-	-	-	0.52	0.52
NT-51	27-Jun-12	-	-	-	0.48	-	-	-	0.48
NT-52	3-Jul-12	-	-	0.76	0.76	-	-	-	1.52
NT-53	3-Jul-12	-	-	7.37	-	-	-	-	7.37
NT-54 [2]	3-Jul-12	-	-	-	-	-	-	-	-
NT-55	5-Jul-12	-	-	-	0.61	-	-	-	0.61
NT-56	5-Jul-12	-	-	-	0.78	-	-	-	0.78
NT-57	5-Jul-12	-	-	-	-	-	-	-	0.00
NT-58	5-Jul-12	-	-	-	0.47	-	-	-	0.47
Total		0.76	0.73	0.11	0.60	0.29	0.22	1.45	4.15

1 - Neuston tow locations illustrated in Figure 5-29.

2 - GO Meter lost during retrieval of tow NT-44 and not working properly during tow NT-54; these two tows omitted from further analyses.

Table 5-29. Tow-specific catch of juvenile and adult fish from neuston tows conducted in Sturgeon Bay during spring 2012.

Neuston Tow [1]	Date	Juvenile/Adult Fish				Total
		Emerald Shiner	Spottail Shiner	Rainbow Smelt	Ninespine Stickleback	
NT-1	18-Apr-12	1	-	-	-	1
NT-2	18-Apr-12	-	-	-	-	0
NT-3	18-Apr-12	-	-	-	-	0
NT-4	19-Apr-12	4	-	-	-	4
NT-5	28-Apr-12	70	-	-	-	70
NT-6	28-Apr-12	925	-	-	-	925
NT-7	28-Apr-12	164	-	-	-	164
NT-8	28-Apr-12	634	-	-	-	634
NT-9	29-Apr-12	399	-	1	-	400
NT-10	29-Apr-12	177	-	-	-	177
NT-11	29-Apr-12	57	-	-	-	57
NT-12	30-Apr-12	184	-	-	-	184
NT-13	10-May-12	2	-	-	-	2
NT-14	10-May-12	8	-	-	-	8
NT-15	10-May-12	12	-	-	-	12
NT-16	10-May-12	16	-	-	-	16
NT-17	11-May-12	5	-	-	-	5
NT-18	11-May-12	-	-	-	-	0
NT-19	11-May-12	11	-	-	-	11
NT-20	20-May-12	1	-	-	-	1
NT-21	20-May-12	7	-	-	-	7
NT-22	30-May-12	37	-	-	-	37
NT-23	30-May-12	50	-	-	-	50
NT-24	30-May-12	22	-	-	-	22
NT-25	30-May-12	150	-	-	-	150
NT-26	30-May-12	202	-	-	-	202
NT-27	31-May-12	9	-	-	-	9
NT-28	31-May-12	24	-	-	-	24
NT-29	31-May-12	7	-	-	-	7
NT-30	2-Jun-12	3	-	-	-	3
NT-31	2-Jun-12	7	-	-	-	7
NT-32	2-Jun-12	-	-	-	-	0
NT-33	2-Jun-12	1	-	-	-	1

Table 5-29. (continued).

Neuston Tow [1]	Date	Juvenile/Adult Fish				Total
		Emerald Shiner	Spottail Shiner	Rainbow Smelt	Ninespine Stickleback	
NT-34	13-Jun-12	7	-	-	1	8
NT-35	13-Jun-12	5	1	-	-	6
NT-36	13-Jun-12	5	-	-	-	5
NT-37	14-Jun-12	14	-	-	1	15
NT-38	14-Jun-12	22	-	-	-	22
NT-39	14-Jun-12	-	-	-	-	0
NT-40	14-Jun-12	-	-	-	-	0
NT-41	14-Jun-12	2	-	-	-	2
NT-42	14-Jun-12	6	-	-	-	6
NT-43	14-Jun-12	12	-	-	-	12
NT-44	14-Jun-12	23	-	-	-	23
NT-45	26-Jun-12	1	-	-	-	1
NT-46	26-Jun-12	2	-	-	-	2
NT-47	26-Jun-12	-	-	-	-	0
NT-48	26-Jun-12	2	-	-	-	2
NT-49	27-Jun-12	4	-	-	-	4
NT-50	27-Jun-12	9	-	-	-	9
NT-51	27-Jun-12	9	-	-	-	9
NT-52	3-Jul-12	2	1	-	-	3
NT-53	3-Jul-12	2	-	-	3	5
NT-54	3-Jul-12	3	-	-	3	6
NT-55	5-Jul-12	-	-	-	1	1
NT-56	5-Jul-12	-	-	-	-	0
NT-57	5-Jul-12	-	-	-	-	0
NT-58	5-Jul-12	-	-	-	-	0
Total		3319	2	1	9	3331

1 - Neuston tow locations illustrated in Figure 5-29.

Table 5-30. Tow-specific catch-per-unit-effort (# fish/100 m^3) of juvenile and adult fish from neuston tows conducted in Sturgeon Bay during spring 2012.

Neuston Tow	Date	Juvenile/Adult Fish				Total
		Emerald Shiner	Spottail Shiner	Rainbow Smelt	Ninespine Stickleback	
NT-1	18-Apr-12	1.37	-	-	-	1.37
NT-2	18-Apr-12	-	-	-	-	0.00
NT-3	18-Apr-12	-	-	-	-	0.00
NT-4	19-Apr-12	0.76	-	-	-	0.76
NT-5	28-Apr-12	39.53	-	-	-	39.53
NT-6	28-Apr-12	481.12	-	-	-	481.12
NT-7	28-Apr-12	97.36	-	-	-	97.36
NT-8	28-Apr-12	358.43	-	-	-	358.43
NT-9	29-Apr-12	270.61	-	0.68	-	271.29
NT-10	29-Apr-12	108.37	-	-	-	108.37
NT-11	29-Apr-12	29.62	-	-	-	29.62
NT-12	30-Apr-12	91.15	-	-	-	91.15
NT-13	10-May-12	1.18	-	-	-	1.18
NT-14	10-May-12	3.78	-	-	-	3.78
NT-15	10-May-12	3.44	-	-	-	3.44
NT-16	10-May-12	13.17	-	-	-	13.17
NT-17	11-May-12	2.88	-	-	-	2.88
NT-18	11-May-12	-	-	-	-	0.00
NT-19	11-May-12	5.40	-	-	-	5.40
NT-20	20-May-12	0.50	-	-	-	0.50
NT-21	20-May-12	3.22	-	-	-	3.22
NT-22	30-May-12	13.36	-	-	-	13.36
NT-23	30-May-12	13.76	-	-	-	13.76
NT-24	30-May-12	7.78	-	-	-	7.78
NT-25	30-May-12	56.64	-	-	-	56.64
NT-26	30-May-12	90.31	-	-	-	90.31
NT-27	31-May-12	4.24	-	-	-	4.24
NT-28	31-May-12	11.56	-	-	-	11.56
NT-29	31-May-12	2.74	-	-	-	2.74
NT-30	2-Jun-12	1.41	-	-	-	1.41
NT-31	2-Jun-12	2.25	-	-	-	2.25
NT-32	2-Jun-12	-	-	-	-	0.00
NT-33	2-Jun-12	0.39	-	-	-	0.39

Table 5-30. (continued).

Neuston Tow [1]	Date	Juvenile/Adult Fish				Total
		Emerald Shiner	Spottail Shiner	Rainbow Smelt	Ninespine Stickleback	
NT-34	13-Jun-12	3.35	-	-	0.48	3.83
NT-35	13-Jun-12	2.68	0.54	-	-	3.21
NT-36	13-Jun-12	2.07	-	-	-	2.07
NT-37	14-Jun-12	5.74	-	-	0.41	6.15
NT-38	14-Jun-12	12.94	-	-	-	12.94
NT-39	14-Jun-12	-	-	-	-	0.00
NT-40	14-Jun-12	-	-	-	-	0.00
NT-41	14-Jun-12	0.75	-	-	-	0.75
NT-42	14-Jun-12	2.68	-	-	-	2.68
NT-43	14-Jun-12	7.56	-	-	-	7.56
NT-44						
NT-45	26-Jun-12	0.50	-	-	-	0.50
NT-46	26-Jun-12	0.95	-	-	-	0.95
NT-47	26-Jun-12	-	-	-	-	0.00
NT-48	26-Jun-12	1.04	-	-	-	1.04
NT-49	27-Jun-12	2.04	-	-	-	2.04
NT-50	27-Jun-12	4.68	-	-	-	4.68
NT-51	27-Jun-12	4.28	-	-	-	4.28
NT-52	3-Jul-12	1.52	0.76	-	-	2.29
NT-53	3-Jul-12	1.84	-	-	2.76	4.60
NT-55	5-Jul-12	-	-	-	0.61	0.61
NT-56	5-Jul-12	-	-	-	-	0.00
NT-57	5-Jul-12	-	-	-	-	0.00
NT-58	5-Jul-12	-	-	-	-	0.00
Total		27.90	0.02	0.01	0.08	28.00

1 - Neuston tow locations illustrated in Figure 5-29.

5.2.3.3 Adult Fish

Gillnetting

A total of 18 experimental gill nets were set in Sturgeon Bay during spring (Table 5-31; Figure 5-30). With the exception of two overnight sets, nets were set for less than five hours to minimize fish mortality.

The gillnet catch totalled 766 fish, representing 12 species (Table 5-32). Yellow Perch was the most abundant species making up 50.3% of the total catch (n = 385), followed by Northern Pike (n = 139; 18.1%), Walleye (n = 62; 8.1%), White Sucker (n = 59; 7.7%), and Lake Whitefish (n = 56; 7.3%). Smaller numbers of other species were captured. Twenty-four Walleye were marked with Floy tags during gillnetting surveys of Sturgeon Bay (Appendix 5-1).

Most species were captured throughout the study area, but some changes in catch composition were observed between sampling periods. Catch-per-unit-effort of Cisco, Lake Whitefish, and Northern Pike declined after the end of April, while the abundance of Yellow Perch and Walleye increased (Table 5-33).

Table 5-31. Location, water depth, water temperature, and set duration for experimental gill nets set in Sturgeon Bay during spring 2012.

Site	Location [1]		Water Depth (m)	Water Temperature (°C)	Set Date	Set Time	Pull Date	Pull Time	Duration (hrs)
	Easting	Northing							
GN-1	565740	5758472	3.5-3.9	1.0	17-Apr-12	16:15	18-Apr-12	13:00	20.7
GN-2	565547	5756417	1.5-2.4	1.0	18-Apr-12	17:05	19-Apr-12	12:00	18.9
GN-3	565713	5756309	3.0-3.0	8.0	28-Apr-12	10:30	28-Apr-12	15:11	4.7
GN-4	569104	5754573	2.2-2.4	8.0	28-Apr-12	16:20	28-Apr-12	17:45	1.4
GN-5	569104	5754573	2.2-2.4	8.0	28-Apr-12	18:20	28-Apr-12	19:55	1.6
GN-6	573755	5752625	2.6-2.2	7.0	30-Apr-12	8:56	30-Apr-12	10:00	1.1
GN-7	573881	5752081	2.4-2.5	10.0	10-May-12	9:36	10-May-12	10:45	1.1
GN-8	574207	5751514	3.2-3.3	10.0	10-May-12	11:53	10-May-12	12:45	0.9
GN-9	572512	5753775	3.7-3.9	10.0	10-May-12	14:41	10-May-12	15:00	0.3
GN-10	564740	5758379	1.0-1.5	12.5	11-May-12	12:00	11-May-12	12:45	0.8
GN-11	566171	5755670	2.3-3.0	12.5	11-May-12	13:30	11-May-12	14:25	0.9
GN-12	565853	5756096	3.0-3.0	13.0	20-May-12	9:00	20-May-12	9:45	0.8
GN-13	566518	5755249	3.2-3.2	13.0	20-May-12	10:00	20-May-12	10:54	0.9
GN-14	569694	5754368	2.1-2.7	16.5	30-May-12	14:57	30-May-12	15:40	0.7
GN-15	570501	5753592	1.3-2.1	16.5	30-May-12	16:05	30-May-12	18:11	2.1
GN-16	566357	5755067	2.1-2.8	17.0	31-May-12	16:45	31-May-12	17:50	1.1
GN-17	580053	5750114	2.5-2.8	20.0	02-Jun-12	15:11	02-Jun-12	16:25	1.2
GN-18	580655	5753775	4.2-4.6	20.0	02-Jun-12	16:50	02-Jun-12	17:56	1.1

1 - UTM coordinates; NAD 83 Zone 14U; site-specific locations illustrated on Figure 5-30.

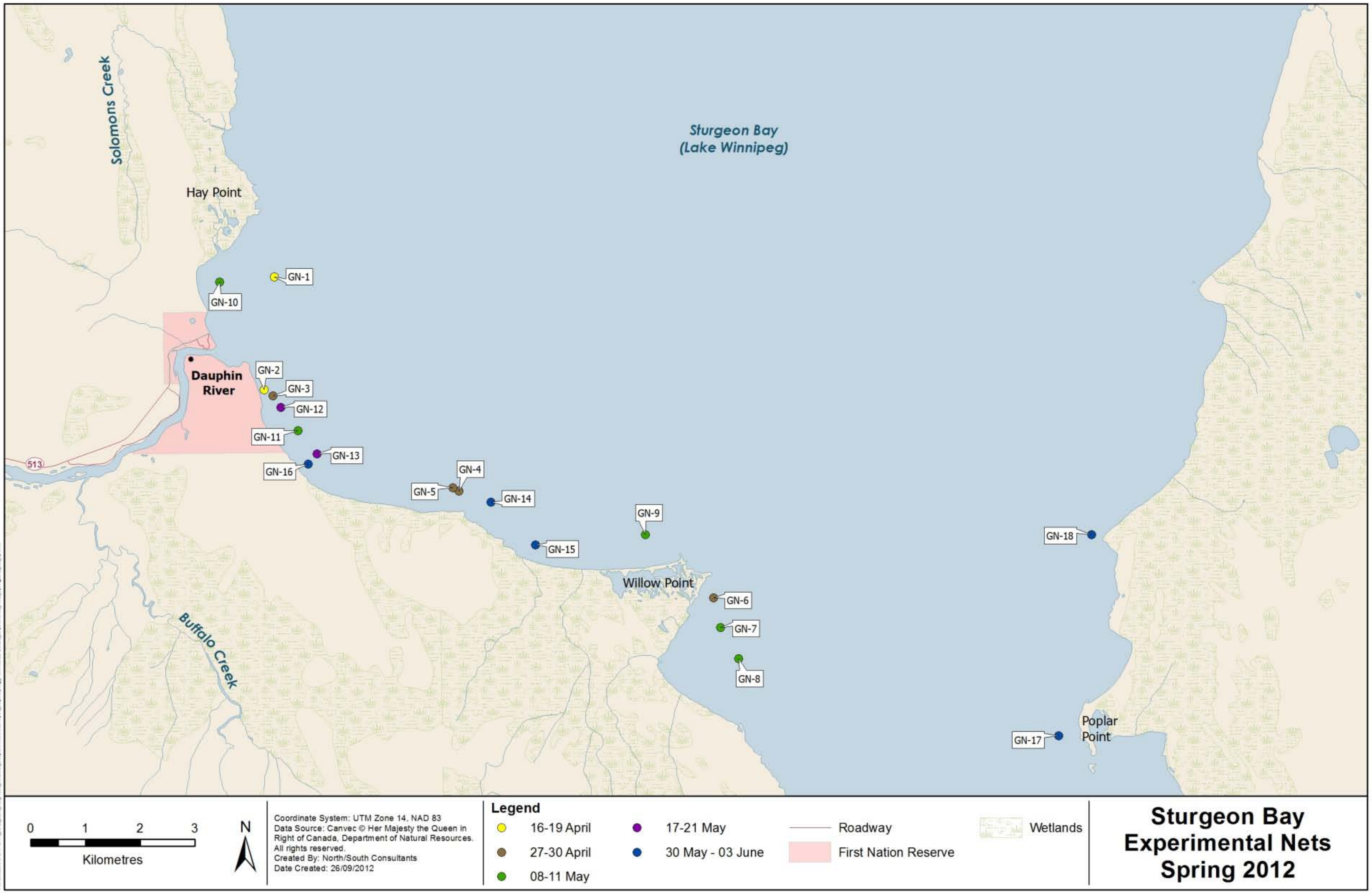

Figure 5-30. Location of experimental nets set in Sturgeon Bay during spring 2012.

Table 5-32. Site-specific catch and relative abundance (%) of each fish species captured in experimental gill nets set in Sturgeon Bay during spring 2012.

Date	Site [1]	Number of Fish												Total
		Cisco	Freshwater Drum	Lake Whitefish	Longnose Sucker	Northern Pike	Sauger	Shorthead Redhorse	Trout-perch	Walleye	White Bass	White Sucker	Yellow Perch	
18-Apr-12	GN-1	15	-	19	2	15	-	-	-	4	-	20	2	77
19-Apr-12	GN-2	2	-	7	-	52	-	1	-	-	-	10	-	72
	Total	**17**	**0**	**26**	**2**	**67**	**0**	**1**	**0**	**4**	**0**	**30**	**2**	**149**
	RA	**11.4**	**0.0**	**17.4**	**1.3**	**45.0**	**0.0**	**0.7**	**0.0**	**2.7**	**0.0**	**20.1**	**1.3**	**100**
28-Apr-12	GN-3	8	-	25	-	16	-	2	-	-	-	6	1	58
28-Apr-12	GN-4	2	-	2	-	4	-	-	-	5	-	-	-	13
28-Apr-12	GN-5	1	-	1	1	8	-	-	-	2	-	1	2	16
30-Apr-12	GN-6	-	-	1	2	12	1	1	1	1	1	1	6	27
	Total	**11**	**0**	**29**	**3**	**40**	**1**	**3**	**1**	**8**	**1**	**8**	**9**	**114**
	RA	**9.6**	**0.0**	**25.4**	**2.6**	**35.1**	**0.9**	**2.6**	**0.9**	**7.0**	**0.9**	**7.0**	**7.9**	**100**
10-May-12	GN-7	-	-	-	-	3	-	-	-	9	-	3	42	57
10-May-12	GN-8	-	-	-	-	3	1	-	-	-	-	2	264	270
10-May-12	GN-9	-	-	-	-	-	-	-	-	-	-	4	34	38
11-May-12	GN-10	5	-	-	-	10	-	-	-	-	-	-	-	15
11-May-12	GN-11	-	-	-	-	1	-	2	-	23	4	1	1	32
	Total	**5**	**0**	**0**	**0**	**17**	**1**	**2**	**0**	**32**	**4**	**10**	**341**	**412**
	RA	**1.2**	**0.0**	**0.0**	**0.0**	**4.1**	**0.2**	**0.5**	**0.0**	**7.8**	**1.0**	**2.4**	**82.8**	**100**
20-May-12	GN-12	-	-	-	-	-	-	-	-	-	-	2	4	6
20-May-12	GN-13	-	-	-	-	1	-	1	-	2	-	-	4	8
	Total	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**2**	**0**	**2**	**8**	14
	RA	**0.0**	**0.0**	**0.0**	**0.0**	**7.1**	**0.0**	**7.1**	**0.0**	**14.3**	**0.0**	**14.3**	**57.1**	**100**

Table 5-32. (continued).

Sampling Period	Site	Number of Fish												Total
		Cisco	Freshwater Drum	Lake Whitefish	Longnose Sucker	Northern Pike	Sauger	Shorthead Redhorse	Trout-perch	Walleye	White Bass	White Sucker	Yellow Perch	
30-May-12	GN-14	-	-	-	-	-	-	-	-	2	-	-	2	4
30-May-12	GN-15	1	2	-	-	9	-	1	-	10	-	2	5	30
31-May-12	GN-16	-	-	1	-	2	-	-	-	-	1	-	6	10
02-Jun-12	GN-17	-	-	-	-	3	2	2	-	3	2	3	4	19
02-Jun-12	GN-18	-	-	-	-	-	-	1	-	1	-	4	8	14
	Total	**1**	**2**	**1**	**0**	**14**	**2**	**4**	**0**	**16**	**3**	**9**	**25**	**77**
	RA	**1.3**	**2.6**	**1.3**	**0.0**	**18.2**	**2.6**	**5.2**	**0.0**	**20.8**	**3.9**	**11.7**	**32.5**	**100**
Overall	***Total***	***34***	***2***	***56***	***5***	***139***	***4***	***11***	***1***	***62***	***8***	***59***	***385***	***766***
	RA	***4.4***	***0.3***	***7.3***	***0.7***	***18.1***	***0.5***	***1.4***	***0.1***	***8.1***	***1.0***	***7.7***	***50.3***	***100***

1 - UTM coordinates; NAD 83 Zone 14U; site-specific locations illustrated on Figure 5-30.

Table 5-33. Catch-per-unit-effort (CPUE) for each fish species captured in experimental gill nets set in Sturgeon Bay during spring 2012.

Set Type	Sampling Period	Site [1]	Duration (hrs)	CPUE					
				Cisco	Freshwater Drum	Lake Whitefish	Longnose Sucker	Northern Pike	Sauger
Long Set [2]	**1**	GN-1	20.7	12.68	0.00	16.06	1.69	12.68	0.00
		GN-2	18.9	1.85	0.00	6.48	0.00	48.14	0.00
			Average	**7.27**	**0.00**	**11.27**	**0.85**	**30.41**	**0.00**
			SD [3]	**7.66**	**0.00**	**6.77**	**1.20**	**25.08**	**0.00**
	Overall Long Set		***Average***	***7.27***	***0.00***	***11.27***	***0.85***	***30.41***	***0.00***
			SD	***7.66***	***0.00***	***6.77***	***1.20***	***25.08***	***0.00***
Short Set [4]	**2**	GN-3	4.7	1.24	0.00	3.88	0.00	2.48	0.00
		GN-4	1.4	1.04	0.00	1.04	0.00	2.08	0.00
		GN-5	1.6	0.46	0.00	0.46	0.46	3.65	0.00
		GN-6	1.1	0.00	0.00	0.66	1.33	7.95	0.66
			Average	**0.68**	**0.00**	**1.51**	**0.45**	**4.04**	**0.17**
			SD	**0.57**	**0.00**	**1.60**	**0.62**	**2.69**	**0.33**
	3	GN-7	1.1	0.00	0.00	0.00	0.00	2.98	0.00
		GN-8	0.9	0.00	0.00	0.00	0.00	3.65	1.22
		GN-9	0.3	0.00	0.00	0.00	0.00	0.00	0.00
		GN-10	0.8	4.56	0.00	0.00	0.00	9.11	0.00
		GN-11	0.9	0.00	0.00	0.00	0.00	0.81	0.00
			Average	**0.91**	**0.00**	**0.00**	**0.00**	**3.31**	**0.24**
			SD	**2.04**	**0.00**	**0.00**	**0.00**	**3.57**	**0.54**
	4	GN-12	0.8	0.00	0.00	0.00	0.00	0.00	0.00
		GN-13	0.9	0.00	0.00	0.00	0.00	0.81	0.00
			Average	**0.00**	**0.00**	**0.00**	**0.00**	**0.41**	**0.00**
			SD	**0.00**	**0.00**	**0.00**	**0.00**	**0.57**	**0.00**
	5	GN-14	0.7	0.00	0.00	0.00	0.00	0.00	0.00
		GN-15	2.1	0.35	0.69	0.00	0.00	3.12	0.00
		GN-16	1.1	0.00	0.00	0.66	0.00	1.33	0.00
		GN-17	1.2	0.00	0.00	0.00	0.00	1.82	1.22
		GN-18	1.1	0.00	0.00	0.00	0.00	0.00	0.00
			Average	**0.07**	**0.14**	**0.13**	**0.00**	**1.25**	**0.24**
			SD	**0.16**	**0.31**	**0.30**	**0.00**	**1.32**	**0.54**
	Overall Short Set		**Average**	**0.48**	**0.04**	**0.42**	**0.11**	**2.49**	**0.19**
			SD	***1.16***	***0.17***	***0.98***	***0.34***	***2.70***	***0.43***

Table 5-33. (continued).

Set Type	Sampling Period	Site [1]	Duration (hrs)	CPUE						
				Shorthead Redhorse	Trout-perch	Walleye	White Bass	White Sucker	Yellow Perch	Total
Long Set [2]	**1**	GN-1	20.7	0.00	0.00	3.38	0.00	16.91	1.69	**65.09**
		GN-2	18.9	0.93	0.00	0.00	0.00	9.26	0.00	**66.66**
			Average	**0.46**	**0.00**	**1.69**	**0.00**	**13.08**	**0.85**	**65.87**
			SD [3]	**0.65**	**0.00**	**2.39**	**0.00**	**5.41**	**1.20**	**1.11**
	Overall Long Set		***Average***	***0.46***	***0.00***	***1.69***	***0.00***	***13.08***	***0.85***	***65.87***
			SD	***0.65***	***0.00***	***2.39***	***0.00***	***5.41***	***1.20***	***1.11***
Short Set [4]	**2**	GN-3	4.7	0.31	0.00	0.00	0.00	0.93	0.16	**9.00**
		GN-4	1.4	0.00	0.00	2.60	0.00	0.00	0.00	**6.77**
		GN-5	1.6	0.00	0.00	0.91	0.00	0.46	0.91	**7.29**
		GN-6	1.1	0.66	0.66	0.66	0.66	0.66	3.98	**17.90**
			Average	**0.24**	**0.17**	**1.04**	**0.17**	**0.51**	**1.26**	**10.24**
			SD	**0.32**	**0.33**	**1.11**	**0.33**	**0.39**	**1.85**	**5.19**
	3	GN-7	1.1	0.00	0.00	8.95	0.00	2.98	41.76	**56.67**
		GN-8	0.9	0.00	0.00	0.00	0.00	2.43	320.79	**328.08**
		GN-9	0.3	0.00	0.00	0.00	0.00	14.58	123.94	**138.52**
		GN-10	0.8	0.00	0.00	0.00	0.00	0.00	0.00	**13.67**
		GN-11	0.9	1.62	0.00	18.63	3.24	0.81	0.81	**25.92**
			Average	**0.32**	**0.00**	**5.52**	**0.65**	**4.16**	**97.46**	**112.57**
			SD	**0.72**	**0.00**	**8.29**	**1.45**	**5.95**	**134.65**	**129.94**
	4	GN-12	0.8	0.00	0.00	0.00	0.00	1.82	3.65	**5.47**
		GN-13	0.9	0.81	0.00	1.62	0.00	0.00	3.24	**6.48**
			Average	**0.41**	**0.00**	**0.81**	**0.00**	**0.91**	**3.44**	**5.97**
			SD	**0.57**	**0.00**	**1.15**	**0.00**	**1.29**	**0.29**	**0.72**
	5	GN-14	0.7	0.00	0.00	2.08	0.00	0.00	2.08	**4.17**
		GN-15	2.1	0.35	0.00	3.47	0.00	0.69	1.74	**10.42**
		GN-16	1.1	0.00	0.00	0.00	0.66	0.00	3.98	**6.63**
		GN-17	1.2	1.22	0.00	1.82	1.22	1.82	2.43	**11.54**
		GN-18	1.1	0.66	0.00	0.66	0.00	2.65	5.30	**9.28**
			Average	**0.45**	**0.00**	**1.61**	**0.38**	**1.03**	**3.11**	**8.41**
			SD	**0.51**	**0.00**	**1.34**	**0.55**	**1.17**	**1.50**	**2.99**
	Overall Short Set		**Average**	**0.35**	**0.04**	**2.59**	**0.36**	**1.87**	**32.17**	**41.11**
			SD	***0.51***	***0.17***	***4.84***	***0.85***	***3.54***	***83.09***	***83.59***

1 - UTM coordinates; NAD 83 Zone 14U; site-specific locations illustrated on Figure 5-30.

2 - Long sets (>5 hr) CPUE expressed as # fish/100m net/24 hr.

3 - SD = standard deviation.

4 - Short sets (<5 hr) CPUE expressed as # fish/100m net/1 hr.

Based upon the extrusion of gametes, six species of fish captured in experimental gill nets set in Sturgeon Bay showed evidence of spawning during spring 2012 (Table 5-34). These included Longnose Sucker, Northern Pike, Sauger, Walleye, White Sucker, and Yellow Perch.

Two male Longnose Suckers captured at the end of April were determined to be in an early pre-spawn state. Female and male White Suckers were in an advanced pre-spawn condition by mid-May.

Female Northern Pike for which sex and state of maturity could be determined were in an early pre-spawn condition through the end of April, and most were in an advanced pre-spawn condition during May. Similarly, most male pike were in an early pre-spawn condition through the end of April, and were in an advanced pre-spawn condition during May. A single male Northern Pike in post-spawn condition was captured in late May.

Most male Walleye for which sex and state of maturity could be determined were in early pre-spawn condition at the beginning of spring monitoring and most were in an advanced pre-spawn condition by the first week of May. Sex and state of maturity was not determined for any female Walleye.

A large number of female and male Yellow Perch were captured. Females were in an advanced pre-spawn state by 10 May and most males were in an advanced pre-spawn state 20 May. A small number of male Yellow Perch determined to be in a post-spawn condition were captured by the end of May.

The following sections describe the overall metrics of each species where the number of fish captured was greater than ten. Condition factors were calculated for each species based on length and weight measurements (Table 5-35).

Cisco

Cisco (n = 34) were captured during four out of the five sampling periods (Table 5-32). Mean CPUE in mid-April was 7.27 fish/100 m gang / 24h, and by the start of June Mean CPUE was 0.48 fish/100 m gang/ 1h (Table 5-33). Mean fork length was 202 mm (Table 5-35); because no weights were recorded, condition factors could not be calculated. Captured Cisco had a narrow length-frequency distribution, with a modal interval of 175-199 mm (47.06% of the catch) and more than 88% of the catch between 175 and 224 mm in length (Figure 5-31)

Lake Whitefish

Lake Whitefish (n = 51) were captured during the first two sampling periods in early April, and the last sampling period in late May and early June (Table 5-32). Lake Whitefish CPUE was higher during the first two sampling periods at 11.27 fish/100 m gang /24 hr (long set) and 1.51 fish/100 m gang /hour (short set) than during the last sampling period (0.42 fish/100 m gang /hour) (Table 5-33). Mean fork length, weight and condition factor were 392 mm, 967 g and 1.58, respectively (Table 5-35). The modal fork length interval for Lake Whitefish was 400-424 mm and approximately 80% of the catch was 350-424 mm (Figure 5-32).

Table 5-34. Sex and maturity status of fish species captured during experimental gill nets set in Sturgeon Bay during spring 2012.

Sex & Maturity	Species						Total
	Northern Pike	Walleye	White Sucker	Longnose Sucker	Sauger	Yellow Perch	
Female							
Preparing to spawn	21	-	11	2	-	-	34
Ripe	10	-	1	-	-	3	14
Total	***31***	-	***12***	***2***	-	***3***	***48***
Male							
Preparing to Spawn	37	4	18	1	-	2	62
Ripe	10	8	2	-	1	122	143
Spent	2	-	-	-	-	3	5
Total	***49***	***12***	***20***	***1***	***1***	***127***	***210***
Unknown							
Immature	-	1	-	-	-	-	1
Total	***-***	***1***	***-***	***-***	***-***	***-***	***1***

Table 5-35. Fork length (mm), weight (g) and condition factor (K) for fish species captured in experimental gill nets set in Sturgeon Bay during spring 2012.

Species	Fork Length (mm)				Weight (g)				K			
	n	Mean	SD [1]	Range	n	Mean	SD	Range	n	Mean	SD	Range
Cisco	34	202	21	175 - 264	-	-	-	-	-	-	-	-
Lake Whitefish	51	392	35	290 - 478	51	967	231	350 - 1500	51	1.58	0.23	1.10 - 2.14
Northern Pike	137	557	117	217 - 919	136	1623	937	100 - 6450	136	0.85	0.13	0.41 - 1.51
Walleye	61	420	74	228 - 530	61	1033	497	100 - 2250	61	1.27	0.15	0.84 - 1.64
White Sucker	52	419	60	172 - 510	51	1356	489	450 - 2450	51	1.71	0.17	1.37 - 2.10

1 - SD = standard deviation

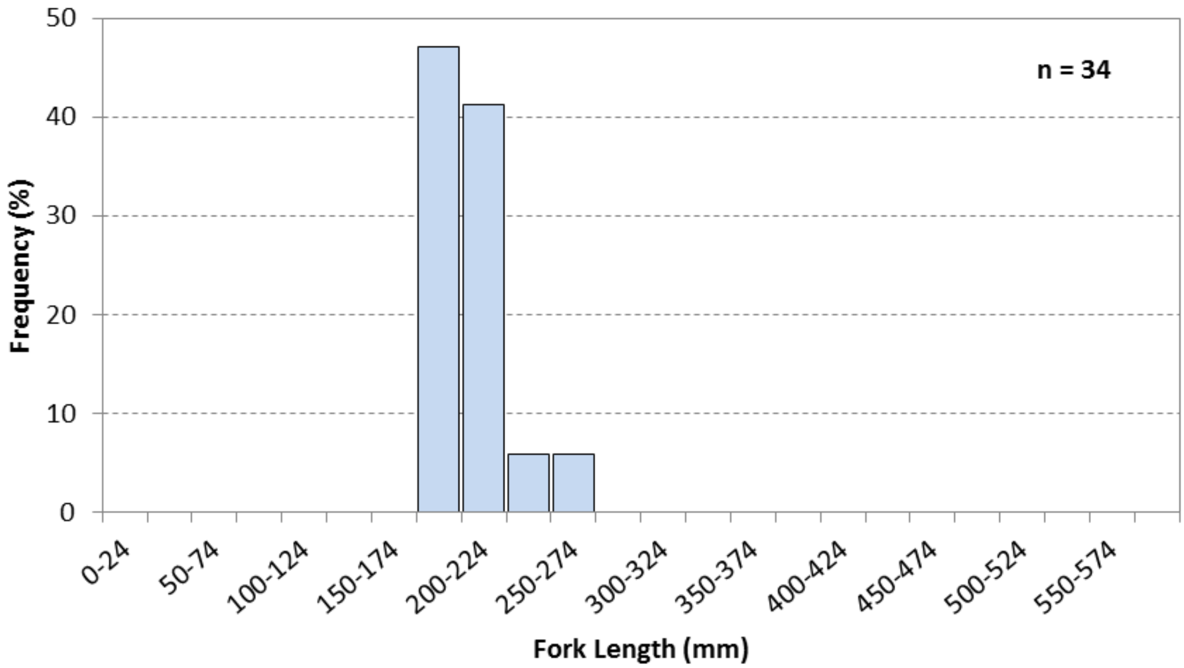

Figure 5-31. Length-frequency distribution for Cisco captured in experimental gill nets set in Sturgeon Bay during spring 2012.

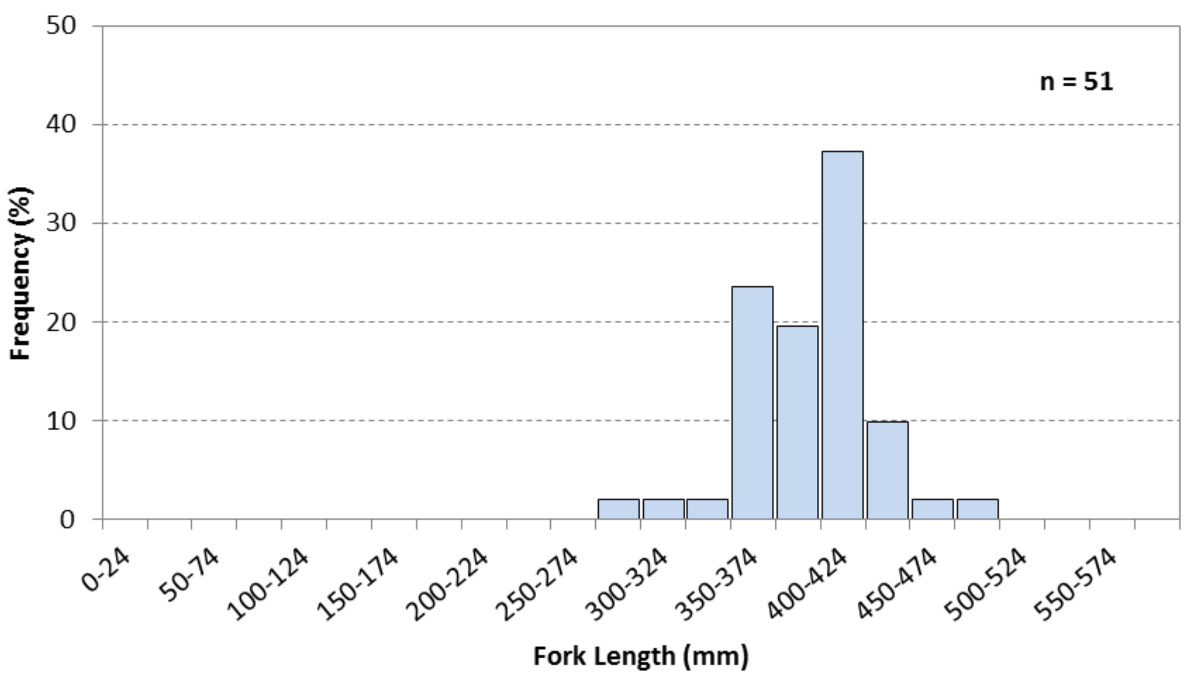

Figure 5-32. Length-frequency distribution for Lake Whitefish captured in experimental gill nets set in Sturgeon Bay during spring 2012.

Northern Pike

Northern Pike (n = 137) were captured during all five sampling periods (Table 5-32). Mean CPUE for the long duration sets in early May was 30.41 fish/100 m gang /24 h, and mean CPUE for the short duration sets during the remainder of sampling was 2.49 fish/100 m gang /hour (Table 5-33). Mean length, weight and condition factor were 557 mm, 1,623 g and 0.85, respectively (Table 5-35). Northern Pike had modal fork length intervals of 500-549 mm and 550-599 mm, with each representing 18.25% of the catch (Figure 5-33). Size classes from 450 to 699 each comprise 10-20% of the total catch.

Walleye

Walleye (n = 61) were captured during all five sampling periods (Table 5-32). Mean CPUE for the first sampling period was 1.69 fish/100 m gang /24 h (Table 5-33). Mean CPUE for the duration of sampling was 2.59 fish/100 m gang /hour with the highest CPUE occurring during the third sampling period in early May (CPUE = 5.52 fish/100 m gang /hour) (Table 5-33). Mean length, weight and condition factor were 420 mm, 1,033 g and 1.27, respectively (Table 5-35). The length-frequency distribution for Walleye was broad with almost 20% of the catch in the 300-349 mm range and another approximately 56% ranging from 425-524 mm (Figure 5-34).

White Sucker

White Sucker (n = 52) were captured during all five sampling periods (Table 5-32). Mean CPUE was 13.08 fish/100 m gang /24 h during the first sampling period, while mean CPUE for the duration of sampling was 1.87 fish/100 m gang /hour (Table 5-33). Mean fork length, weight and condition factor were 419 mm, 1,356 g and 1.71, respectively (Table 5-35). The modal fork length intervals for White Sucker were 375-399 mm and 450-474 mm, with each length interval representing 21.15% of the catch (Figure 5-35).

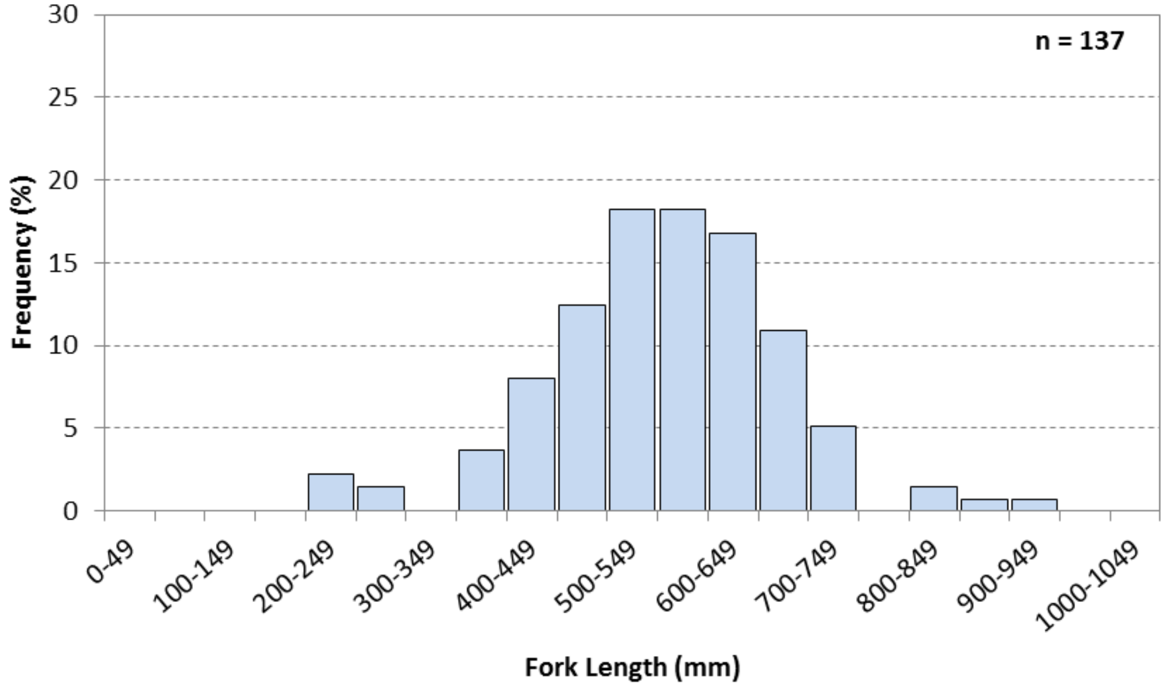

Figure 5-33. Length-frequency distribution for Northern Pike captured in experimental gill nets set in Sturgeon Bay during spring 2012.

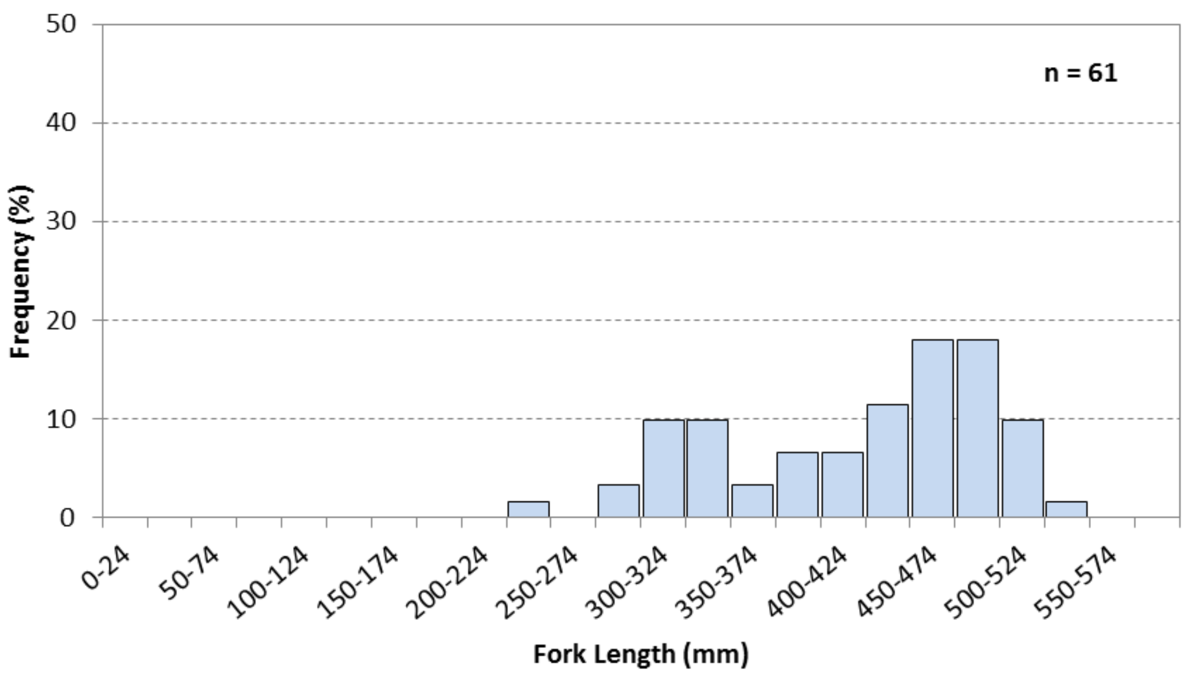

Figure 5-34. Length-frequency distribution for Walleye captured in experimental gill nets set in Sturgeon Bay during spring 2012.

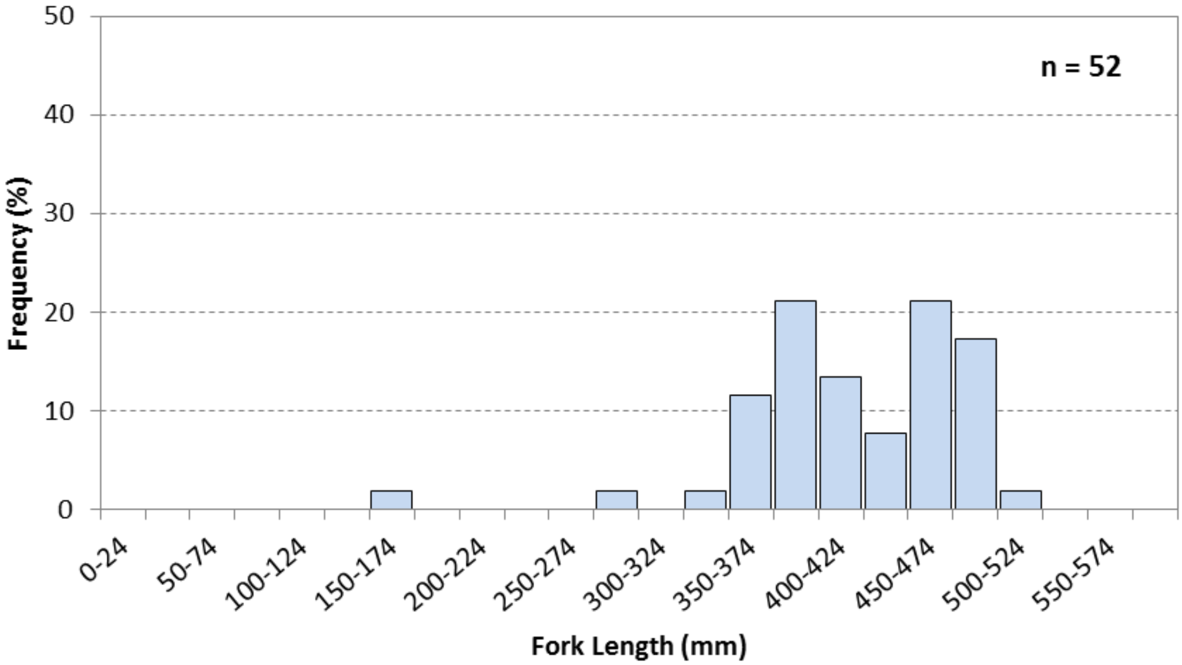

Figure 5-35. Length-frequency distribution for White Sucker captured in experimental gill nets set in Sturgeon Bay during spring 2012.

5.2.3.4 Debris Monitoring

Debris information was obtained from 16 of 18 experimental gill nets set in Sturgeon Bay during five discrete sampling periods between 17 April and 02 June, 2012 (Figure 9). The majority of short-duration experimental nets (n = 10) contained no debris, while the remaining nets (n = 6) contained a low level of debris (Table 5-36). Over half of the debris observed in nets consisted of sticks (58%), and the rest of the debris was composed of 25% other (e.g., rocks) and 17% terrestrial vegetation (grass) (Table 5-36; Figure 5-36). Debris observations for the two long-duration experimental nets (GN-01 and GN-02) were not completed.

Table 5-36. Net-specific debris level and composition in experimental gill nets set in Sturgeon Bay during spring 2012.

Site	Set Duration (hrs)	Debris Level [1]	Debris Type (% of total debris per net)							Comments
			Terrestrial Vegetation	Terrestrial Moss	Sticks	Aquatic Vegetation	Algae	Silt/Mud	Other	
GN-01 [2]	20.7	-	-	-	-	-	-	-	-	-
GN-02 [2]	18.9	-	-	-	-	-	-	-	-	-
GN-03	4.7	Low	-	-	100%	-	-	-	-	10 small sticks
GN-04	1.4	Low	-	-	100%	-	-	-	-	2 small sticks
GN-05	1.6	None	-	-	-	-	-	-	-	-
GN-06	1.1	Low	-	-	-	-	-	-	100%	1 rock
GN-07	1.1	None	-	-	-	-	-	-	-	-
GN-08	0.9	None	-	-	-	-	-	-	-	-
GN-09	0.3	None	-	-	-	-	-	-	-	-
GN-10	0.8	Low	100%	-	-	-	-	-	-	clumps of grass
GN-11	0.9	None	-	-	-	-	-	-	-	-
GN-12	0.8	None	-	-	-	-	-	-	-	-
GN-13	0.9	None	-	-	-	-	-	-	-	-
GN-14	0.7	Low	-	-	100%	-	-	-	-	1 small stick
GN-15	2.1	Low	-	-	50%	-	-	-	50%	small stick, 1 rock
GN-16	1.1	None	-	-	-	-	-	-	-	-
GN-17	1.2	None	-	-	-	-	-	-	-	-
GN-18	1.1	None	-	-	-	-	-	-	-	-

1 - Debris level categories defined in Section 5.1.4.

2 - Debris levels not recorded.

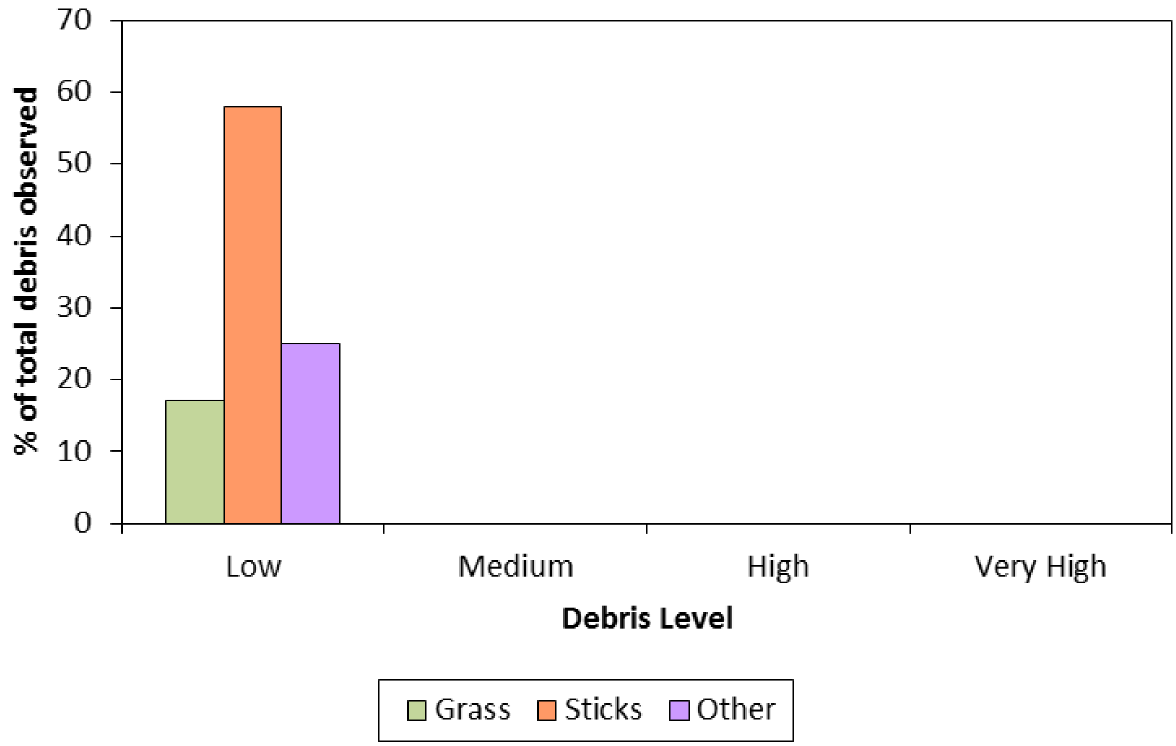

Figure 5-36. Relative composition of debris observed in six experimental gill nets set in Sturgeon Bay during spring 2012. Note that 10 of 16 nets for which debris information was recorded had no debris in them.

5.2.4 Grand Rapids

Neuston Tows

At Grand Rapids, field investigations focused on conducting neuston tows to capture larval Lake Whitefish to provide information to compare against similar information collected in Sturgeon Bay. Local knowledge suggested that Lake Whitefish may spawn in the vicinity of Horsehead Island, located approximately 13 km north of the mouth of the Saskatchewan River, so sampling efforts were focused in that area. A total of 12 neuston tows were conducted from 31 May to 01 June (Table 5-37; Figure 5-37). Tow duration ranged from 20-30 minutes and the volume of water filtered ranged from 192-333 m^3.

A total of 244 larval fish were captured in the tows (Table 5-38). Larvae from at least three species of fish were captured. Larval Lake Whitefish were most abundant (n = 229) with only small numbers of Cisco (n = 11) and minnow (n = 4) larvae captured.

Larval Lake Whitefish were captured in six of the 12 tows, but were most abundant in the catches from NT-8 and NT-9, each of which had a CPUE of more than 30 fish/100 m^3 (Table 5-39). These two sites were nearest to the Saskatchewan River suggesting that spawning either occurred in the area or the larvae were transported downstream from Cedar Lake. Relatively few Lake Whitefish larvae were recovered from tows conducted near Horsehead Island. Cisco were captured at five sites and minnows at one site all with relatively low CPUE values (tables 5-37 and 5-38). In contrast with Lake Whitefish, Cisco larvae were most abundant in tows conducted near Horsehead Island. Only two species of juvenile/adult fish, Rainbow Smelt and Emerald Shiner, were captured in neuston tows (Table 5-37). Catch rates were low for both species (Table 5-38).

Table 5-37. The location, time and duration of neuston tows conducted at Grand Rapids during spring 2012.

Neuston Tow	Date	Start Location [1]		End Location [1]		Start Time	End Time	Duration (minutes)	Flow Meter Count		Tow Distance [2] (m)	Volume [3] (m^3)
		Easting	Northing	Easting	Northing				Start	End		
NT-1	31-May-12	493587	5912000	491883	5910723	9:55:00 AM	10:25:00 AM	30.0	874908	966937	2457	332
NT-2	31-May-12	491531	5908835	491610	5906488	10:50:00 AM	11:20:00 AM	30.0	966938	1059252	2465	333
NT-3	31-May-12	490803	5906968	488769	5907494	11:40:00 AM	12:10:00 PM	30.0	59250	146758	2336	315
NT-4	31-May-12	486711	5905858	485693	5904369	12:30:00 PM	1:00:00 PM	30.0	146769	224649	2079	281
NT-5	31-May-12	485913	5904468	487958	5903631	1:10:00 PM	1:40:00 PM	30.0	224638	311929	2331	315
NT-6	31-May-12	490268	5903498	492667	5903921	2:00:00 PM	2:30:00 PM	30.0	311929	404268	2465	333
NT-7	31-May-12	486663	5899649	485520	5898646	3:15:00 PM	3:45:00 PM	30.0	404269	475044	1890	255
NT-8	31-May-12	484055	5896973	483590	5895293	3:55:00 PM	4:20:00 PM	25.0	475063	558476	2227	301
NT-9	31-May-12	483177	5893626	485313	5894110	4:40:00 PM	5:10:00 PM	30.0	558478	645999	2337	315
NT-10	1-Jun-12	488165	5889589	487410	5890901	8:06:00 AM	8:26:00 AM	20.0	645978	705828	1598	216
NT-11	1-Jun-12	487211	5891298	486361	5891605	8:35:00 AM	8:55:00 AM	20.0	705829	759010	1420	192
NT-12	1-Jun-12	486413	5891636	486185	5893044	9:00:00 AM	9:20:00 AM	20.0	759009	813976	1468	198

1 - Locations illustrated in Figure 5-37.

2 - Tow distance (m) calculated as the number of flow meter revolutions x 0.02687.

3 - Volume filtered calculated as the tow distance (m) x 0.135 m^2.

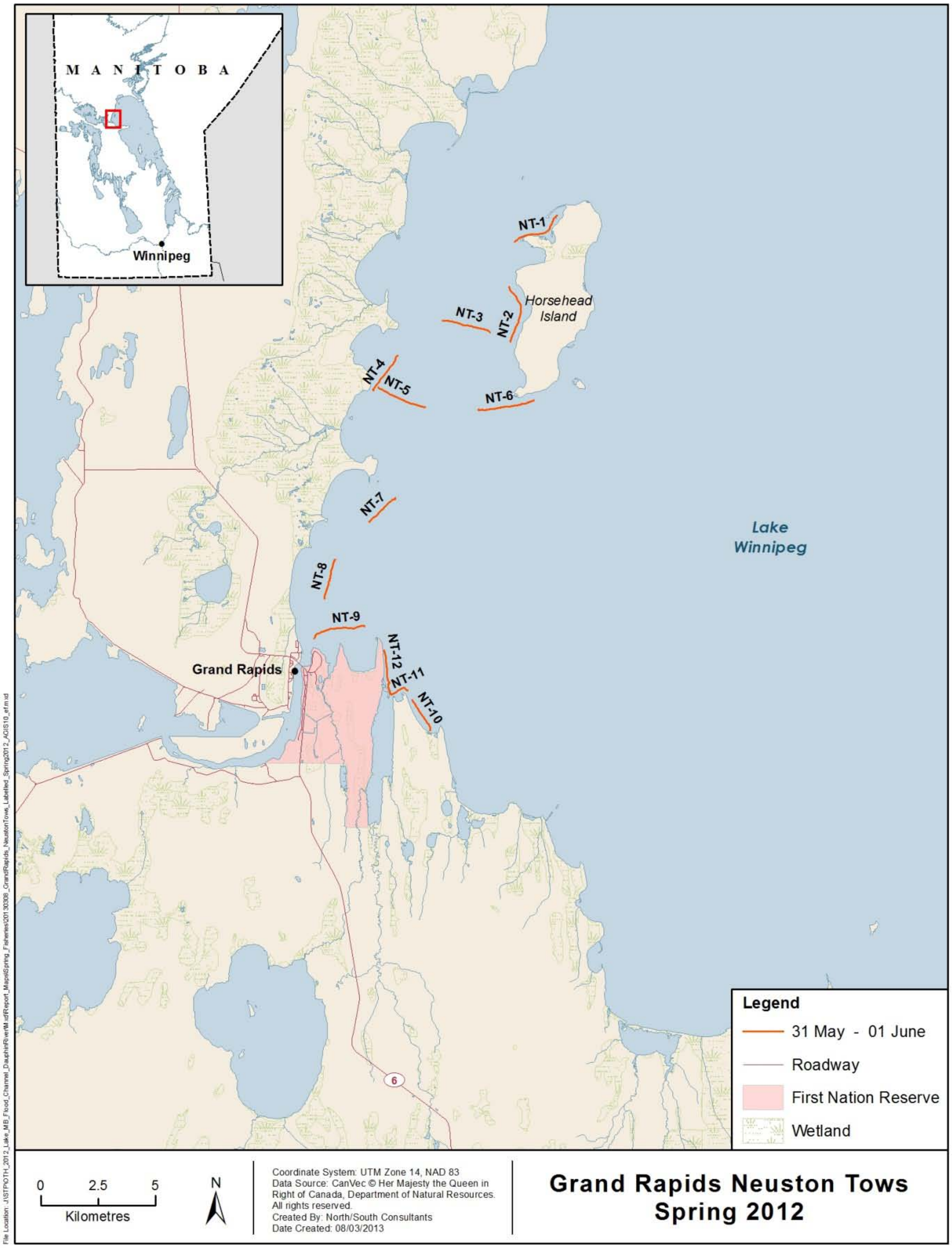

Figure 5-37. Location of neuston tows conducted in Lake Winnipeg near Grand Rapids during spring 2012.

Table 5-38. Tow-specific catch of larval, juvenile and adult fish from neuston tows conducted at Grand Rapids during spring 2012.

Neuston Tow [1]	Date	Larval Fish			Juvenile/Adult Fish		Total
		Lake Whitefish	Cisco	Minnow [2]	Rainbow Smelt	Emerald Shiner	
NT-1	31-May-12	1	2	-	8	1	12
NT-2	31-May-12	-	5	-	3	-	8
NT-3	31-May-12	-	-	-	1	-	1
NT-4	31-May-12	-	-	-	-	-	0
NT-5	31-May-12	-	1	-	-	-	1
NT-6	31-May-12	1	2	-	-	-	3
NT-7	31-May-12	28	-	-	-	-	28
NT-8	31-May-12	101	1	-	-	1	103
NT-9	31-May-12	96	-	-	-	1	97
NT-10	1-Jun-12	-	-	-	-	-	0
NT-11	1-Jun-12	2	-	4	-	3	9
NT-12	1-Jun-12	-	-	-	1	-	1
All Tows Combined		229	11	4	13	6	263

1 - Neuston tow locations illustrated in Figure 5-37.

2 - Several minnow species can be found in the vicinity of Grand Rapids and it is unknown which one(s) are represented by captured larvae.

Table 5-39. Tow-specific catch-per-unit-effort (# fish/100 m^3) of larval, juvenile and adult fish from neuston tows conducted at Grand Rapids during spring 2012.

Neuston Tow	Date	Larval Fish			Juvenile/Adult Fish		Total
		Lake Whitefish	Cisco	Minnow	Rainbow Smelt	Emerald Shiner	
NT-1	31-May-12	0.30	0.60	-	2.41	0.30	3.62
NT-2	31-May-12	-	1.50	-	0.90	-	2.40
NT-3	31-May-12	-	-	-	0.32	-	0.32
NT-4	31-May-12	-	-	-	-	-	-
NT-5	31-May-12	-	0.32	-	-	-	0.32
NT-6	31-May-12	0.30	0.60	-	-	-	0.90
NT-7	31-May-12	10.98	-	-	-	-	10.98
NT-8	31-May-12	33.59	0.33	-	-	0.33	34.26
NT-9	31-May-12	30.43	-	-	-	0.32	30.75
NT-10	1-Jun-12	-	-	-	-	-	-
NT-11	1-Jun-12	1.04	-	2.09	-	1.57	4.70
NT-12	1-Jun-12	-	-	-	0.50	-	0.50
All Tows Combined		6.77	0.32	0.12	0.38	0.18	7.77

5.3 SUMMARY

Spring fisheries investigations focussed on a suite of tasks, including documenting fish use, spring fish movements, and spawning activity in Lake St. Martin, the Dauphin River and Buffalo Creek, and Sturgeon Bay. The nature of the study objectives and the timing of the biological activities to be documented dictated that field investigations be conducted at specific and different times during the course of the spring. Consequently, numerous short-duration field campaigns (sampling periods) were conducted which provided snapshots of biological activity over a broader time period and allowed field investigations to target specific biological occurrences, as well as document general spring fish activity and habitat use as spring progressed.

Data collected here will be used to supplement previously collected data and, in conjunction with data to be collected following closure of Reach 1, will be used to help understand the effects that operation of Reach 1 may have had on fish populations in Sturgeon Bay. The following sections provide a summary of fisheries investigation results for each general area, followed by a brief discussion of results pertinent to Lake Whitefish and Walleye spawning in the area.

5.3.1 Lake St. Martin

In Lake St. Martin, larval drift traps set in the entrance to the Dauphin River and the entrance to Reach 1 documented the movement of larval fish out of Lake St. Martin, the presence of juvenile or adult small-bodied fish species, and, through the capture of fish eggs, provided direct evidence of spawning by suckers. The capture of larval Lake Whitefish and Cisco (both fall spawning species) in neuston tows indicate that some portion of eggs spawned during fall 2011 successfully incubated through winter 2011/2012. Larvae from several spring-spawning fish species (including suckers, Yellow Perch, and minnow and darter species) were also captured. Experimental gillnetting documented the presence of several fish species in pre-spawn condition (Longnose Sucker, Northern Pike, Walleye, White Sucker, and Yellow Perch) and helped provide information to identify a spawning area for White Sucker at the entrance to Reach 1 and pre-spawning staging areas for White Suckers near the mouth of a creek entering Lake St. Martin to the south of the Reach 1 entrance.

5.3.2 Dauphin River and Buffalo Creek

The capture of eggs on egg mats and larvae in drift traps illustrated that White Sucker spawning occurred during spring 2012 in the Dauphin River immediately upstream and downstream of the confluence of Buffalo Creek, as well as within the lower reaches of Buffalo Creek. The same areas were utilized for spawning by Lake Whitefish during fall 2011. The capture of larval Lake Whitefish in drift traps set in spring 2012 indicate that some portion of eggs spawned during fall 2011 successfully incubated through winter 2011/2012. Larval Lake Whitefish were captured in drift traps set upstream and downstream of the confluence of Buffalo Creek, as well as within Buffalo Creek. Aside from whitefish and suckers, numerous other species were captured. Larval Cisco, Yellow Perch, Northern Pike, unidentified percids, and small bodied species such as sculpins and minnows were captured in traps set in both Buffalo Creek and the Dauphin River. White Bass larvae were captured in Buffalo Creek during mid-June, when drift traps were not set in the Dauphin River.

Boat-based electrofishing provided a chronology of use of the lower reaches of the Dauphin River by fish through spring and documented the presence of large numbers of White Sucker in pre-spawn condition. Smaller numbers of Carp, Longnose Sucker, Northern Pike, and Shorthead Redhorse in pre-spawn condition were also observed. Few Walleye were captured.

5.3.3 Sturgeon Bay

Egg mats set in Sturgeon Bay did not provide evidence to indicate Walleye spawning locations, but did identify areas where Yellow Perch and White Bass spawning occurred. Neuston tow data showed that larval Lake Whitefish and Cisco were distributed along nearshore areas of Sturgeon Bay in most areas sampled, including to the east and west of Willow Point. Because larvae were distributed throughout the approximately even concentrations, it is difficult to determine whether these fish were spawned and hatched locally, or had drifted into the area from the Dauphin River. Larval Yellow Perch, suckers, and White Bass were also captured, indicating successful egg incubation by those species.

In Sturgeon Bay, experimental gillnetting documented fish use of nearshore areas during spring 2012 by Longnose Sucker, Northern Pike, Sauger, Walleye, White Sucker, and Yellow Perch that were in pre-spawn condition. However, large concentrations of fish in a particular area that could be indicative of spawning locations were not documented. Few Walleye were captured.

5.3.4 Lake Winnipeg at Grand Rapids

At Grand Rapids, field investigations focused on conducting neuston tows to capture larval Lake Whitefish to provide information to compare against similar information collected in Sturgeon Bay. Local knowledge suggested that Lake Whitefish may spawn in the vicinity of Horsehead Island, located approximately 13 km north of the Saskatchewan River, so sampling efforts were focused in that area. Larval Lake Whitefish were captured in six of 12 tows, but were most abundant in catches nearest to the mouth of the Saskatchewan River, suggesting that spawning either occurred in the immediate area or the larvae were transported downstream from Cedar Lake.

5.3.5 Lake Whitefish Spawning

Lake Whitefish are locally and regionally important as a targeted commercial species. Large numbers of Lake Whitefish migrate up the Dauphin River from Lake Winnipeg each fall to spawn on extensive gravel bars in the northeast basin of Lake St. Martin before returning to Lake Winnipeg (Stone 1965; Cook and MacKenzie 1979; Kristofferson and Clayton 1990). Local knowledge has suggested that Lake Whitefish spawning may also occur in the Dauphin River between Lake St. Martin and Sturgeon Bay, but the extent to which this occurs has not been well documented.

Aquatic monitoring conducted during fall 2011 documented large numbers of Lake Whitefish moving into the Dauphin River during late fall. Extensive spawning by Lake Whitefish occurred in the lower reaches of the Dauphin River, particularly in the vicinity of the confluence with Buffalo Creek including the lower reach of the creek itself (North/South Consultants Inc. 2011c). The capture of larval Lake Whitefish in Lake St. Martin during spring 2012 suggests that at least some were able to access the lake during fall 2011. A Lake Whitefish tagged at the mouth of the Dauphin River during late fall 2011 and recaptured in Lake St. Martin during winter 2012 suggests that at least some of these fish were able to move into Lake St. Martin from Sturgeon Bay during fall 2011.

Results from monitoring conducted during spring 2012 and presented here reveal that some portion of Lake Whitefish eggs spawned in fall 2011 successfully incubated through the winter and hatched in spring 2012. Larval Lake Whitefish were captured in Lake St. Martin, the Dauphin River, and Sturgeon Bay.

With respect to assessing the effects of Reach 1 operation, it is of interest that large numbers of larval Lake Whitefish were captured immediately at, and downstream of, the confluence of Buffalo Creek and the Dauphin River, where spawning occurred during fall 2011. At the onset of spring monitoring in 2012, the size of larval whitefish captured at this location indicated that they had only recently hatched. This provides some evidence to suggest that those fish had hatched in the immediate vicinity of the drift traps, further suggesting that at least some of the Lake Whitefish eggs spawned near the Buffalo Creek confluence during fall 2011 successfully incubated and hatched.

Larval Lake Whitefish and Cisco were captured drifting out of Buffalo Creek at the onset of spring monitoring during 2012. However, spawning Cisco (also a fall spawning species) were not documented moving into the Dauphin River or Buffalo Creek during fall 2011. Both coregonine species were also captured drifting into Reach 1 from Lake St. Martin during this study. It is therefore possible that larval Lake Whitefish and Cisco captured drifting out of Buffalo Creek may have originated in Lake St. Martin, and drifted downstream through the system to the lower reaches of Buffalo Creek.

5.3.6 Walleye Spawning

Walleye are locally and regionally important as a targeted commercial species. Doan (1945) reported that large numbers of spawning Walleye enter the Dauphin River at spring break-up. Adult Walleye gather in the lower part of the river during late winter, remaining there until the ice begins to break up. Pollard (1973) indicated that the Dauphin River is an important Walleye spawning area. Commercial fishers have also indicated that Walleye spawn on a large reef that extends from Hay Point to Willow Point (see Figure 2) and in nearshore areas of Sturgeon Bay to the east and south of Dauphin River. Local knowledge has also suggested that Walleye used to winter in some areas of the Dauphin River, but it is not certain whether this still occurs.

Fisheries investigations conducted during spring 2012 did not reveal large aggregations of Walleye at the mouth of the Dauphin River in early spring, and Walleye composed only a very small component of the electrofishing catch. As the Dauphin River was ice free at the onset on spring monitoring, it is possible that Walleye may have moved up the Dauphin River prior to the onset of monitoring.

Walleye in a pre-spawn condition were captured in Sturgeon Bay during spring monitoring, but the location of spawning areas was not identified. Examination of Walleye captured during the spring spawning program and during a summer debris monitoring program conducted with commercial gill nets (North/South Consultants Inc. 2012c) suggests that spawning took place during early to late May. No larval Walleye were confirmed from the drift and neuston catches, but the unidentified percids in these samples may have included some Walleye.

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