Coordinated Aquatic Monitoring Program

CAMP Twelve Year Data Report (2008-2019)

Technical Document 7:

Upper Nelson River Region

Prepared by

Manitoba Hydro

And

North/South Consultants Inc.

2024

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CAMP TWELVE YEAR DATA REPORT (2008-2019)

TECHNICAL DOCUMENT 7: UPPER NELSON RIVER REGION

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EXECUTIVE SUMMARY

This report presents the results of monitoring conducted under the Coordinated Aquatic Monitoring Program (CAMP) for years 1 through 12 (i.e., 2008/2009 through 2019/2020) in the Upper Nelson River Region. The Upper Nelson River Region is composed of a portion of the north basin of Lake Winnipeg near the lake outflows and the Nelson River extending from the outlet of Lake Winnipeg to the Kelsey Generating Station (GS) near Split Lake. The region also includes two off-system lakes: Setting Lake located on the Grass River system, and Walker Lake which flows into the east basin of Cross Lake via the Walker River.

Waterbodies and sites monitored in this region over this period included eight on-system and two off-system waterbodies as follows:

- Lake Winnipeg – Mossy Bay;
- Two-Mile Channel;
- the upper Nelson River at Warren Landing;
- Cross Lake;
- Playgreen Lake;
- Little Playgreen Lake;
- Sipiwesk Lake;
- the upper Nelson River upstream of the Keley GS;
- Setting Lake (off-system); and
- Walker Lake (off-system).

Monitoring on-system waterbodies addresses the primary objective of CAMP – to monitor aquatic ecosystem health along Manitoba Hydro’s hydraulic operating system. The off-system waterbodies were included in CAMP to provide regional information collected in a manner consistent with monitoring of on-system waterbodies that will assist in interpreting any observed environmental changes over time. Such comparisons are intended to help distinguish between hydroelectric-related effects and other external factors (e.g., climate change) in each CAMP region.

Monitoring was conducted annually at some waterbodies and river reaches and on a three-year rotation at other sites. Components monitored under CAMP in the Upper Nelson River Region presented in this report include the physical environment (water regime and sedimentation), water quality, benthic macroinvertebrates, fish community, and mercury in fish. Climatological data for the region are also included to provide supporting information to assist with interpretation of CAMP monitoring results.

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ABBREVIATIONS, ACRONYMS, AND UNITS

ANN	Annual
CAMP	Coordinated Aquatic Monitoring Program
CCME	Canadian Council of Ministers of the Environment
CL(s)	Confidence limit(s)
cms	Cubic metres per second
CONT	Continuous
CPUE	Catch-per-unit-effort
CRD	Churchill River Diversion
CS	Control structure(s)
DELTs	Deformities, Erosion, Lesions, and Tumours
DL(s)	Detection limit(s)
DO	Dissolved oxygen
ECCC	Environment and Climate Change Canada
EPT	Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies)
FA	Fall
FLA	Fork length-at-age
FNU	Formazin nephelometric unit
GN	Standard gang index gill net
GS(s)	Generating station(s)
h	hour
IC	Ice-cover season
IQR	Interquartile range
KF	Fulton's Condition Factor
m	Metre
m^2	Metre squared
max	Maximum
µg/L	Micrograms per litre
mg/L	Milligrams per litre
min	Minimum
mm	Millimetre
MWQSOGs	Manitoba Water Quality Standards, Objectives, and Guidelines
MWS	Manitoba Water Stewardship
n	Sample size or number of samples
n_F	Number of fish
n_S	Number of sites

ND	No data
no.	Number
NS	Nearshore
n_{spp}	Number of species caught in standard and small mesh gill nets
NTU	Nephelometric turbidity units
O+C	Oligochaeta and Chironomidae
OECD	Organization for Economic Cooperation and Development
OS	Offshore
OW	Open-water season
PAL	Protection of aquatic life
ppm	Parts per million
RCEA	Regional cumulative effects assessment
ROT	Rotational
RSA	Relative species abundance
RYCS	Relative year-class strength
SD	Standard deviation
SE	Standard error
SN	Small mesh index gillnet gang
SP	Spring
SU	Summer
T/day	Tonnes per day
TN	Total nitrogen
TOC	Total organic carbon
TP	Total phosphorus
TSS	Total suspended solids
WI	Winter
Wr	Relative weight
°C	Degrees Celsius

WATERBODY ABBREVIATIONS

Abbreviation	Waterbody
LW-MB	Lake Winnipeg – Mossy Bay
LW-22	Lake Winnipeg Site 22
LW-BMP	Lake Winnipeg – Big Mossy Point
2M-IN/2M-OUT	Tw-Mile Channel Inlet and Outlet
NR-WL	Upper Nelson River at Warren Landing
CROSS	Cross Lake
PLAYG	Playgreen Lake
LPLAY	Little Playgreen Lake
SIP	Sipiwesk Lake
UNR	Upper Nelson River Upstream of the Kelsey GS
KELSGS	Kelsey GS
SET	Setting Lake
WLKR	Walker Lake

FISH SPECIES LIST

Abbreviation	Common Species Name	Species Name
BURB	Burbot	*Lota lota*
CARP	Common Carp	*Cyprinus carpio*
CISC	Cisco	*Coregonus artedi*
EMSH	Emerald Shiner	*Notropis atherinoides*
FRDR	Freshwater Drum	*Aplodinotus grunniens*
GOLD	Goldeye	*Hiodon alosoides*
GLSH	Golden Shiner	*Notemigonus crysoleucas*
LGPR	Logperch	*Percina caprodes*
LKCH	Lake Chub	*Couesius plumbeus*
LKST	Lake Sturgeon	*Acipenser fulvescens*
LKWH	Lake Whitefish	*Coregonus clupeaformis*
LNSC	Longnose Sucker	*Catostomus catostomus*
MOON	Mooneye	*Hiodon tergisus*
MTSC	Mottled Sculpin	*Cottus bairdii*
NRPK	Northern Pike	*Esox lucius*
QUIL	Quillback	*Carpiodes cyprinus*
RCBS	Rock Bass	*Ambloplites rupestris*
RNSM	Rainbow Smelt	*Osmerus mordax*
SAUG	Sauger	*Sander canadensis*
SHRD	Shorthead Redhorse	*Moxostoma macrolepidotum*
SLRD	Silver Redhorse	*Moxostoma anisurum*
SLSC	Slimy Sculpin	*Cottus cognatus*
SPSC	Spoonhead Sculpin	*Cottus ricei*
SPSH	Spottail Shiner	*Notropis hudsonius*
TRPR	Trout-perch	*Percopsis omiscomaycus*
WALL	Walleye	*Sander vitreus*
WHSC	White Sucker	*Catostomus commersonii*
YLPR	Yellow Perch	*Perca flavescens*

1.0 INTRODUCTION

This report presents the results of monitoring conducted under the Coordinated Aquatic Monitoring Program (CAMP) for years 1 through 12 (i.e., 2008/2009 through 2019/2020) in the Upper Nelson River Region. The Upper Nelson River Region is composed of a portion of the north basin of Lake Winnipeg near the lake outflows and the Nelson River extending from the outlet of Lake Winnipeg to the Kelsey Generating Station (GS) near Split Lake (Figure 1-1). The region also includes two off-system lakes: Setting Lake located on the Grass River system, and Walker Lake which flows into the east basin of Cross Lake via the Walker River.

Waterbodies and sites monitored in this region over this period included eight on-system and two off-system waterbodies as follows:

- Lake Winnipeg – Mossy Bay;
- Two-Mile Channel;
- the upper Nelson River at Warren Landing;
- Cross Lake;
- Playgreen Lake;
- Little Playgreen Lake;
- Sipiwesk Lake;
- the upper Nelson River upstream of the Keley GS;
- Setting Lake (off-system); and
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Monitoring on-system waterbodies addresses the primary objective of CAMP – to monitor aquatic ecosystem health along Manitoba Hydro's hydraulic operating system. The off-system waterbodies were included in CAMP to provide regional information collected in a manner consistent with monitoring of on-system waterbodies that will assist in interpreting any observed environmental changes over time. Such comparisons are intended to help distinguish between hydroelectric-related effects and other external factors (e.g., climate change) in each CAMP region.

A summary of monitoring conducted by waterbody or river reach presented in this data report is provided in Table 1-1 and monitoring areas are shown in Figure 1-1. As noted in Table 1-1, monitoring was conducted annually at some waterbodies and river reaches and on a three-year rotation at other sites. Components monitored under CAMP in the Upper Nelson River Region presented in this report include the physical environment (water regime and sedimentation), water quality, benthic macroinvertebrates, fish community, and mercury in fish. Climatological data for the region are also included to provide supporting information to assist with interpretation of CAMP monitoring results.

Table 1-1. Upper Nelson River Region CAMP monitoring summary.

Waterbody/ Area	Abbreviation	On/Off-System		Component					
		On-System	Off-System	Water Regime	Sedimentation	Water Quality	Benthic Invertebrates	Fish Community	Fish Mercury
Lake Winnipeg – Mossy Bay	LW-MB	●					ANN	ANN	ROT
Lake Winnipeg - Site 22	LW-22	●				ANN			
Lake Winnipeg - Big Mossy Point	LW-BMP	●				ANN			
Two-Mile Channel Inlet and Outlet	2M-IN/2M-OUT	●				ANN			
Upper Nelson River at Warren Landing	NR-WL	●				ANN			
Jenpeg GS	JENGS	●			CONT				
Cross Lake	CROSS	●		CONT		ANN	ANN	ANN	ROT
Playgreen Lake	PLAYG	●		CONT		ROT	ROT	ROT	ROT
Little Playgreen Lake	LPLAY	●		CONT		ROT	ROT	ROT	ROT
Sipiwesk Lake	SIP	●		CONT		ROT	ROT	ROT	ROT
Upper Nelson River Upstream of the Kelsey GS	UNR	●				ROT	ROT	ROT	
Kelsey GS	KELSGS	●		CONT					
Setting Lake	SET		●	CONT		ANN	ANN	ANN	ROT
Walker Lake	WLKR		●	CONT		ROT	ROT	ROT	

Notes:

1. CONT = site monitored continuously; ANN = site sampled each year; ROT = site sampled every 3 years.

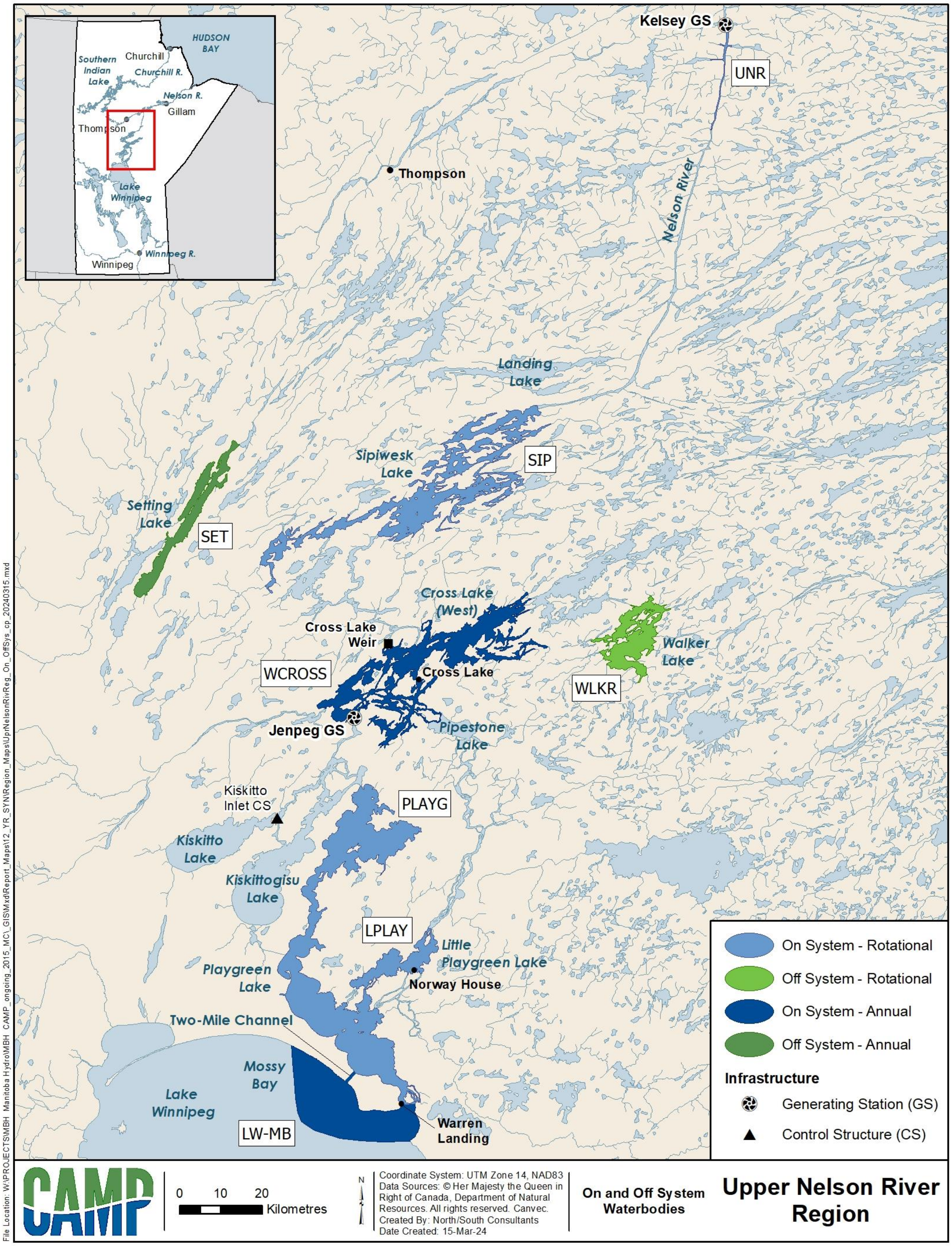


Figure 1-1. On-system and off-system waterbodies and river reaches sampled under CAMP in the Upper Nelson River Region: 2008-2019.

Photograph 1. Lake Winnipeg – Mossy Bay.

Photograph 2. Lake Winnipeg looking into the Nelson River outlet (left) and shoreline of the upper Nelson River near Warren Landing (right).

Photograph 3. Two-Mile Channel inlet (left) and outlet (right).

Photograph 4. Cross Lake.

Photograph 5. Playgreen Lake.

Photograph 6. Little Playgreen Lake.

Photograph 7. Sipiwesk Lake.

Photograph 8. The upper Nelson River upstream of the Kelsey GS.

Photograph 9. Setting Lake.

Photograph 10. Walker Lake.

2.0 PHYSICAL ENVIRONMENT

2.1 INTRODUCTION

The following presents the results of the physical environment monitoring conducted from 2008 to 2019 in the Upper Nelson River Region. Seven waterbodies were monitored in the Upper Nelson River Region: five on-system sites (Playgreen Lake, Little Playgreen Lake, Cross Lake, Sipiwesk Lake, and the Nelson River upstream from the Kelsey GS (Kelsey forebay)) and two off-system sites (Setting Lake and Walker Lake). In addition, a continuous water quality monitoring station is located at the Jenpeg GS. Though CAMP does not directly monitor climate, data from Environment and Climate Change Canada (ECCC) is included in reporting to contextualize the data collected under each CAMP component. For the Upper Nelson River Region, meteorological conditions from ECCC's Norway House station are reported.

Three indicators (climate, water regime, and sedimentation) were selected for detailed reporting (Table 2.1-1). Metrics for these indicators include temperature, precipitation, water flow, level and variability, water temperature, continuous turbidity, and suspended sediment load (Table 2.1-1). A detailed description of these indicators is provided in CAMP (2024).

A detailed description of the program design and sampling methods is provided in Technical Document 1, Sections 2.1 and 2.2.

Table 2.1-1. Physical Environment indicators and metrics.

Indicator	Metric	Units
Climate[1]	• Temperature	Degrees Celsius (°C)
	• Precipitation	Millimetres (mm)
Water Regime	• Flow	Cubic meters per second (cms)
	• Water Level and Variability	Metres (m)
	• Water Temperature	Duration of temperature in 5-degree Celsius increments (#days/5 °C)
Sedimentation	• Continuous Turbidity	Formazin nephelometric unit (FNU)
	• Suspended Sediment Load	Tonnes/day (T/day)

Notes:
1. Climate is not monitored through CAMP; data are included for reporting purposes only.

2.2 CLIMATE

In this section, mean monthly air temperatures and total monthly precipitation for each year in the monitoring program (2008-2020) are compared to ECCC climate normals to provide a summary of the Norway House station meteorological conditions. Climate normals are used to summarize the average climatic conditions of a particular location. As recommended by the World Meteorological Organization, ECCC calculates climate normals using a 30-year period (e.g., 1981-2010). The Norway House station is used herein to illustrate climate conditions in the Upper Nelson River Region.

Historical monthly average air temperature and total monthly precipitation during the monitoring period were calculated based on available daily data from ECCC at multiple stations. It is important to note that the use of multiple stations could introduce inhomogeneities in observations between various stations and the station used for climate normals (Climate ID: 506B047). For instances where datasets were missing more than 10% of the daily data in a month, monthly values were gap-filled using ERA5-Land data (Muñoz Sabater 2019). Seasonal and annual maps derived from ERA5-Land data are also provided in Appendices 2-1 and 2-2 to complement the station data and offer a broader spatial representation of temperature and precipitation conditions across Manitoba. Although the ERA5-Land data correlated reasonably well with the actual observed ECCC data for the Lynn Lake station, it should be noted that ERA5-Land is a gridded reanalysis product, meaning the dataset combines modelled data with observations, and therefore may not provide an entirely accurate representation of observed climate.

2.2.1 TEMPERATURE

Figure 2.2-1 illustrates the mean monthly air temperatures (in ºC) for each year during the monitoring period compared to the 1981-2010 normal mean temperature. As shown, air temperatures at this location follow a distinct seasonal pattern; warmer in the summer (warmest in July) and cooler in the winter (coldest in January). In general, recorded air temperatures for the monitoring period were consistent with the climate normal pattern. Some deviations can be seen, for example, 2010 recorded considerably warmer temperatures from January to April.

Table 2.2-1 summarizes the mean monthly air temperature data and categorizes each month in the monitoring period as "below normal", "near normal" or "above normal" conditions. It should be noted that the "near normal" category was subjectively defined as +/- 1ºC of the ECCC climate normal. Months "below normal" are highlighted in blue, "near normal" are highlighted in grey, and "above normal" are highlighted in orange. Over the monitoring period, the months of January, July, September, and December generally experienced warmer than normal conditions (≥ 7 out of 13 months above normal). On an annual basis, 12 out of 13 years in the monitoring period had near or above normal conditions; 2010 and 2016 had the warmest annual average temperature at 1.7ºC, while 2014 had the coolest annual average temperature at -1.7ºC. The maximum and minimum monthly average air temperatures during the monitoring period were 20.5ºC (July 2012) and -26.1ºC (December 2013), respectively.

Table 2.2-1. Norway House mean monthly and annual air temperature (in ˚C) compared to 1981-2010 normal.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2008	-19.4	-22.5	-14.0	-0.5	7.0	14.7	17.3	18.5	9.6	4.6	-7.2	-24.3	-1.3
2009	-20.8	-19.1	-12.9	0.4	4.9	13.6	15.4	15.3	15.0	1.5	-1.4	-19.4	-0.6
2010	-15.7	-14.1	-3.8	5.4	9.0	14.7	19.0	16.3	5.5	6.0	-6.4	-15.6	1.7
2011	-21.6	-17.9	-14.8	0.2	8.4	15.5	18.8	17.9	13.2	5.3	-6.6	-12.1	0.5
2012	-17.7	-13.4	-4.1	2.0	8.3	15.6	20.5	17.1	11.1	1.9	-10.0	-18.7	1.0
2013	-21.5	-17.1	-12.8	-4.2	6.9	16.2	17.5	17.7	12.9	2.2	-8.6	-26.1	-1.4
2014	-23.7	-21.8	-15.1	-3.7	8.7	13.7	18.1	17.5	9.9	3.7	-13.0	-15.2	-1.7
2015	-20.4	-23.8	-9.6	0.0	6.9	15.1	18.5	16.4	12.0	4.9	-4.2	-10.7	0.4
2016	-16.0	-16.6	-7.1	-1.1	10.6	15.7	18.8	17.1	12.6	2.8	0.8	-16.5	1.7
2017	-14.3	-14.0	-10.2	-0.6	7.2	14.3	19.5	19.2	12.6	5.1	-10.9	-17.8	0.8
2018	-20.2	-19.8	-7.7	-4.5	8.9	17.0	18.7	15.5	7.6	-0.1	-10.4	-14.4	-0.8
2019	-23.3	-22.7	-9.5	-0.2	5.5	14.8	18.1	15.6	10.7	1.6	-9.2	-17.4	-1.3
2020	-16.7	-16.5	-10.9	-4.2	6.1	14.2	19.5	17.1	9.1	-0.5	-9.2	-14.4	-0.5
1981-2010 Normal	-21.5	-17.6	-10.3	-0.2	7.9	14.1	17.6	16.5	9.7	2.0	-8.8	-18.2	-0.7

Below Normal	Near Normal	Above Normal

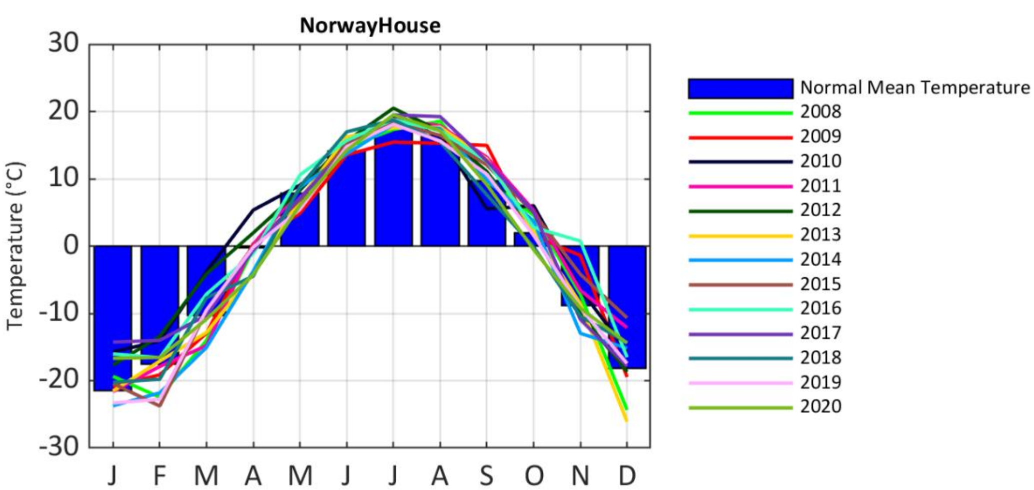


Figure 2.2-1. Norway House mean monthly air temperature (in ºC) compared to 1981-2010 normal.

2.2.2 PRECIPITATION

Figure 2.2-2 illustrates the monthly total precipitation (in mm) for each year during the monitoring period compared to the 1981-2010 normal total precipitation. Total precipitation refers to the water equivalent of all types of precipitation. The total precipitation at Norway House follows a noticeable seasonal pattern, where generally the highest amounts of precipitation fall during the summer months (July and August) and the lowest amounts fall during the winter months (January and February). Overall, recorded precipitation for the monitoring period followed similar patterns to the climate normal, although deviations can be seen, such as 2008, where the recorded total precipitation for July was much higher than normal and for 2013 (July), which recorded total precipitation well below the normal condition. Note that 2019 also recorded well below normal conditions for the summer months, which is discussed in further detail below.

Table 2.2-2 summarizes the total monthly precipitation data and categorizes each month in the monitoring period as “below normal”, “near normal” or “above normal” conditions. It should be noted that the “near normal” was subjectively defined as +/- 10% of the ECCC climate normal. Months “below normal” are highlighted in light brown, “near normal” are highlighted in grey, and “above normal” are highlighted in green. Over the monitoring period, July generally experienced more than normal precipitation (≥ 7 out of 13 months above normal), while February, April, May, June, September, November, and December generally experienced less than normal precipitation (≥ 7 out of 13 months below normal). On an annual basis, no distinct patterns in the data were identified as the majority of years experienced near normal conditions, however there were more years with below normal precipitation than above normal in the monitoring period; 2016 had the highest annual total precipitation (650.6 mm), while 2019 had the lowest annual total precipitation (184.0 mm). The maximum and minimum monthly total precipitation recorded during the monitoring period were 205.5 mm (July 2008) and 0 mm (April 2012, and June – August 2019), respectively. It should be noted that 0 mm of precipitation recorded over June to August 2019 is suspect and the data should be approached with caution. Compared to a climate station 60 km north, Cross Lake Jenpeg 2 station recorded 15.2 mm of precipitation in June (although had 10 days of missing data), 147.8 mm in July, and 189.8 mm in August (2019); ERA5-Land also showed a notable amount of precipitation over the same three-month period.

Table 2.2-2. Norway House total monthly and annual precipitation (in mm) compared to 1981-2010 normal.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2008	20.5	28.5	36.5	5.0	8.5	45.0	205.5	70.5	41.0	31.5	18.0	15.5	526.0
2009	29.5	24.0	40.5	33.0	33.0	34.0	175.0	75.5	64.5	46.3	14.7	12.0	582.0
2010	27.5	14.0	22.5	42.5	70.5	112.9	86.0	162.5	58.0	33.3	5.2	4.2	639.1
2011	19.6	6.0	6.8	38.2	56.7	41.0	122.6	116.4	31.2	35.1	21.5	24.7	519.8
2012	16.7	0.0	31.8	9.9	56.4	45.6	33.6	47.2	26.2	77.9	17.3	52.7	415.2
2013	27.9	4.3	1.5	7.4	63.3	51.5	24.5	34.9	56.0	33.5	23.4	7.9	336.2
2014	38.2	2.9	21.9	16.8	32.1	110.5	115.3	84.2	50.0	43.8	9.2	10.1	535.0
2015	5.9	14.7	13.6	35.1	23.5	53.8	153.0	120.4	94.0	28.3	7.1	4.3	553.7
2016	4.3	4.7	11.0	2.3	18.3	79.1	96.5	147.0	76.7	171.9	17.9	20.9	650.6
2017	22.4	7.7	49.4	46.1	32.5	109.5	53.9	26.7	49.7	67.7	46.5	17.7	529.8
2018	43.4	7.0	8.2	13.2	30.7	110.3	152.1	71.4	61.2	54.9	11.7	1.2	565.4
2019	6.1	2.3	15.2	4.7	54.6	0.0	0.0	0.0	28.3	70.8	1.6	0.4	184.0
2020	0.3	3.8	27.4	27.8	70.2	114.9	65.7	73.2	50.5	17.8	4.3	1.1	457.0
1981-2010 Normal	20.7	23.2	23.8	24.7	50.3	70.0	80.2	75.3	61.2	47.0	29.0	27.1	532.3

Below Normal	Near Normal	Above Normal

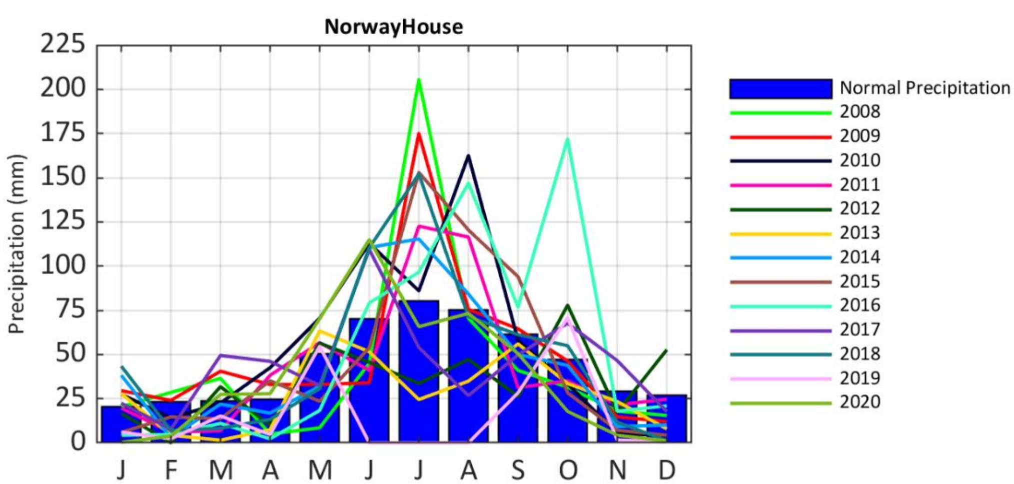


Figure 2.2-2. Norway House total monthly precipitation (in mm) compared to 1981-2010 normal.

2.3 WATER REGIME

Flows in the upper Nelson River are driven mainly by precipitation in the Lake Winnipeg Basin and are also influenced by Lake Winnipeg Regulation (LWR) operation. The majority of Lake Winnipeg's discharge flows through the upper Nelson River's West Channel, which is regulated by operations at the Jenpeg GS for power production purposes and for flood and drought support on Lake Winnipeg. The East Channel is un-regulated and accounts for roughly 15 percent of the total flow. Additional information on the upper Nelson River water regime and LWR can be found in the Physical Environment Part IV section of the Regional Cumulative Effects Assessment – Phase II Report (RCEA 2015).

On-System Sites

On-system CAMP monitoring along the upper Nelson River occurred in the outlets to Lake Winnipeg (Two-Mile Channel and Warren Landing; Figure 2.3-1). CAMP monitoring also occurred on Playgreen Lake, which is the first lake downstream from Lake Winnipeg, and on Little Playgreen Lake, downstream from Playgreen Lake on the upper Nelson River's East Channel. Other on-system monitoring locations include Cross Lake, which is directly downstream from the Jenpeg GS, Sipiwesk Lake, and in the Nelson River upstream from the Kelsey GS (Kelsey forebay). Upper Nelson River flows are reported at the Kelsey GS which is also representative of the general pattern of outflow from Lake Winnipeg.

Continuous water temperature is measured at the Jenpeg GS continuous water quality monitoring site (Figure 2.3-1). Monitoring started in 2017 and consists of measuring water temperature every 5 minutes and monthly site visits to verify the data. For the water temperature indicator, the continuous water temperature and the duration, in days, that water is below 1 °C and five-degree increments is reported.

Off-System Sites

CAMP monitors Setting and Walker lakes as the off-system waterbodies for this region. Setting Lake is located along the Grass River system, northwest of the upper Nelson River (Figure 2.3-1). The Grass River flows into the Nelson River downstream from Kelsey. Walker Lake flows into the west basin of Cross Lake and, although considered off-system, is affected by levels at Cross Lake when water levels exceed about 207.6 m.

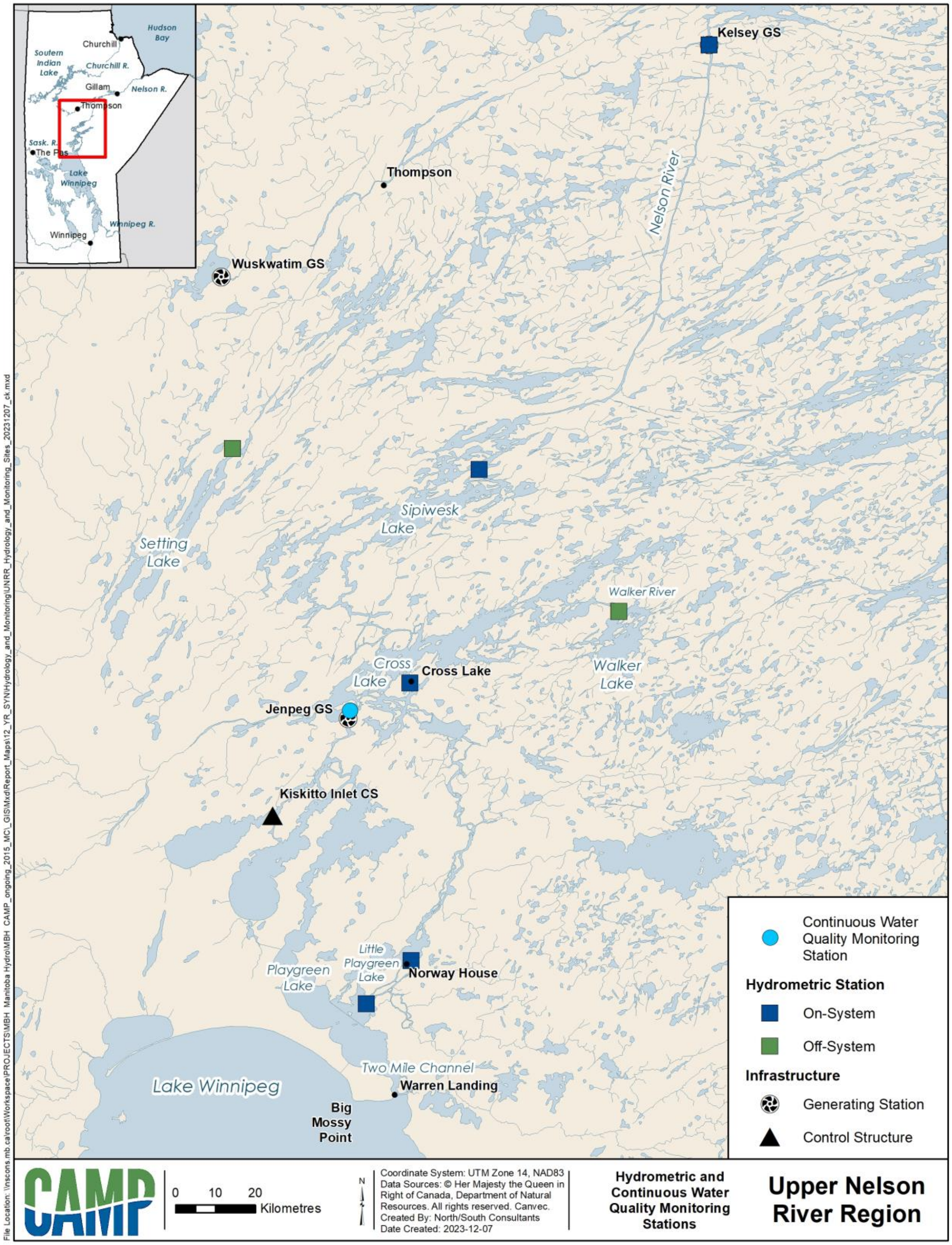


Figure 2.3-1. Hydrometric and continuous water quality monitoring stations in the Upper Nelson River Region.

2.3.1 FLOW

2.3.1.1 ON-SYSTEM SITES

Kelsey Generating Station

From 2008 to 2020, flow conditions on the upper Nelson River ranged from very dry to very wet and were more frequently above average than below average compared to the reference period from 1981 to 2010 (Table 2.3-1 and Figure 2.3-2). Monthly mean flow ranged from 1,486 to 5,450 cms with the overall mean from 2008 to 2020 at 2,935 cms. Very dry flow conditions, defined as lower than 10^{th} percentile, did not occur in any months during the 2008 to 2020 CAMP monitoring period (Table 2.3-1). Flow conditions were very wet, defined as above the 90^{th} percentile, in parts of eight years during CAMP, during the following months; July to September 2008, May to September 2009, July to November 2010, February and May to October 2011, July to August 2013, June to October 2014, July to August 2016, February to August 2017 and May to August 2020 (Table 2.3-1).

2.3.1.2 OFF-SYSTEM SITES

There are no off-system flows reported for this region.

Table 2.3-1. Upper Nelson River monthly average flow (cms).

Year	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	2908	2849	2736	2621	2553	2013	2107	3404	4049	3466	3205	3095	2770
2009	3329	2762	2555	2434	2499	3445	4310	4475	4362	4325	3256	2833	2633
2010	3083	2774	2618	2446	2122	1549	2322	3348	3964	4313	4503	3882	3126
2011	3965	3175	3409	3176	2955	3855	4837	5243	5450	5421	4253	2882	2875
2012	2295	2785	2419	1932	1773	1831	1964	2604	2772	2283	2060	2410	2689
2013	2787	2699	2647	2559	2382	2427	2481	3670	3822	2809	2599	2606	2704
2014	3460	2563	2433	2403	2347	2786	3819	4621	4992	4877	4533	2980	3070
2015	2679	2972	2804	2658	2533	2535	2684	2624	2490	2766	2828	2565	2691
2016	2978	2702	2789	2850	2920	2709	2648	3406	3523	3043	3170	3151	2806
2017	3319	3272	3355	3336	3527	4354	4199	4390	3960	2476	2025	2288	2629
2018	2005	2390	2401	2326	2036	1832	1844	2068	1840	1486	1491	2069	2297
2019	2205	2140	2180	2121	2066	2066	2087	2088	2112	1945	1947	2616	3088
2020	3170	3140	3137	3069	3019	3804	3905	4055	4164	2829	2078	2199	2618

Very Dry Lower than 10th percentile	**Dry** 10th to 30th percentile	**Average** 30th to 70th percentile	**Wet** 70th to 90th percentile	**Very Wet** Higher than 90th percentile

Notes:

1. Percentiles calculated using 1981-2010 as the reference period.

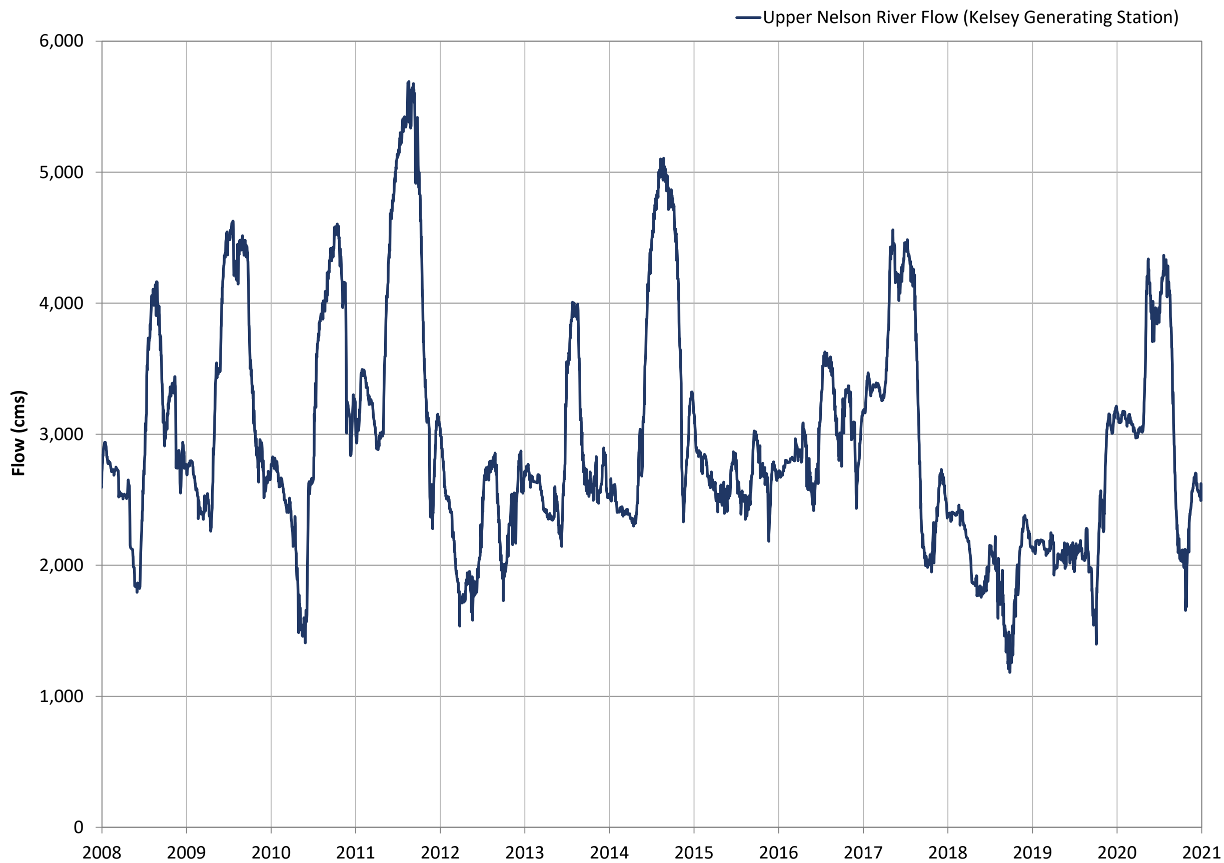


Figure 2.3-2. 2008-2020 Upper Nelson River daily mean flow.

2.3.2 WATER LEVEL AND VARIABILITY

2.3.2.1 ON-SYSTEM SITES

Cross Lake

Water levels on Cross Lake follow the same pattern as upper Nelson River flow (Figure 2.3-3). During the period from 2008-2020, Cross Lake monthly average water levels were more than 0.5 m above the 2008-2020 average in 22 months and lower than 0.5 m below the 2008-2020 average in 26 months (Table 2.3-2). Cross Lake monthly water level variability was lower (below 0.25 m) in 86 months, moderate (between 0.25 and 0.75 m) in 63 months, and higher (above 0.75 m) in 7 months (Table 2.3-3).

Playgreen Lake

Playgreen Lake water levels are driven by water levels on Lake Winnipeg and are also influenced by Lake Winnipeg Regulation operations at the Jenpeg GS (Figure 2.3-4). During the period from 2008-2020, Playgreen Lake monthly average water levels were more than 0.5 m above the 2008-2020 average in 4 months and lower than 0.5 m below the 2008-2020 average in 4 months (Table 2.3-4). Playgreen Lake monthly water level variability was lower (below 0.25 m) in 96 months, moderate (between 0.25 and 0.75 m) in 58 months, and higher (above 0.75 m) in 2 months (Table 2.3-5).

Little Playgreen Lake

Little Playgreen Lake water levels are driven by water levels on Lake Winnipeg and are also influenced by Lake Winnipeg Regulation operations at the Jenpeg GS (Figure 2.3-5). During the period from 2008-2020, Little Playgreen Lake monthly average water levels were more than 0.5 m above the 2008-2020 average in 4 months and lower than 0.5 m below the 2008-2020 average in 4 months (Table 2.3-6). Little Playgreen Lake monthly water level variability was lower (below 0.25 m) in 79 months, moderate (between 0.25 and 0.75 m) in 73 months, and higher (above 0.75 m) in 3 months (Table 2.3-7).

Sipiwesk Lake

Water levels on Sipiwesk Lake follow the same pattern as upper Nelson River Flow (Figure 2.3-6). During the period from 2008-2020, Sipiwesk Lake monthly average water levels were more than 0.5 m above the 2008-2020 average in 43 months and lower than 0.5 m below the 2008-2020 average in 48 months (Table 2.3-8). Sipiwesk Lake monthly water level variability was lower (below 0.25 m) in 53 months, moderate (between 0.25 and 0.75 m) in 77 months, and higher (above 0.75 m) in 26 months (Table 2.3-9).

Upper Nelson River Upstream of the Kelsey Forebay

Water levels on the Nelson River upstream from the Kelsey GS are typically controlled within a narrow range just below 184.1 m. During the winter, water levels are sometimes drawn down by 0.9-1.2 m to temporarily increase the Kelsey GS outflows for energy production on the lower Nelson River. Outflows are then reduced to refill the Kelsey GS Forebay during periods of lower energy demand (Figure 2.3-7). During the period from 2008-2020, the Kelsey GS Forebay monthly average water levels were never more than 0.5 m above the 2008-2020 average and were lower than 0.5 m below the 2008-2020 average in 17 months (Table 2.3-10). The Kelsey GS Forebay monthly water level variability was lower (below 0.25 m) in 104 months, moderate (between 0.25 and 0.75 m) in 38 months, and higher (above 0.75 m) in 14 months (Table 2.3-11).

2.3.2.2 OFF-SYSTEM SITES

Setting Lake

Water levels on Setting Lake vary with flow in the Grass River, which is driven by precipitation in the Grass River drainage basin (Figure 2.3-8). During the period from 2008-2020, Setting Lake monthly average water levels were more than 0.5 m above the 2008-2020 average in 11 months and lower than 0.5 m below the 2008-2020 average in 2 months (Table 2.3-12). Setting Lake monthly water level variability was lower (below 0.25 m) in 117 months, moderate (between 0.25 and 0.75 m) in 23 months, and higher (above 0.75 m) in 3 months (Table 2.3-13).

Walker Lake

Water levels on Walker Lake vary with flow in the Walker River, which is driven by precipitation in the Walker River drainage basin. Walker Lake water levels are also affected by downstream water levels at Cross Lake when they exceed about 207.6 m (Figure 2.3-9). During the period from 2008-2020, Walker Lake monthly average water levels were more than 0.5 m above the 2008-2020 average in 17 months and lower than 0.5 m below the 2008-2020 average in 1 month (Table 2.3-14). Walker Lake monthly water level variability was lower (below 0.25 m) in 133 months, moderate (between 0.25 and 0.75 m) in 21 months, and higher (above 0.75 m) in 1 month (Table 2.3-15).

Table 2.3-2. Cross Lake monthly average water level (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	208.04	207.94	207.79	207.55	207.23	207.60	208.36	208.54	207.88	208.02	207.91	208.05
2009	208.06	207.86	207.76	207.77	208.36	208.66	208.63	208.59	208.41	207.86	207.78	207.93
2010	208.00	207.81	207.58	207.21	206.93	207.61	208.39	208.44	208.62	208.61	208.33	208.36
2011	208.34	208.18	207.98	207.99	208.61	208.96	209.08	209.10	208.91	208.16	207.84	208.04
2012	207.79	207.59	207.18	207.06	207.07	207.30	207.76	207.78	207.35	207.40	207.69	208.00
2013	207.99	207.85	207.66	207.59	207.57	207.75	208.56	208.25	207.71	207.69	207.79	208.01
2014	207.95	207.94	207.82	207.67	207.73	208.57	208.81	208.91	208.81	208.48	207.93	208.24
2015	208.21	208.08	207.88	207.65	207.60	207.76	207.64	207.59	207.81	207.72	207.73	207.81
2016	207.98	207.93	207.83	207.83	207.72	207.79	208.25	208.18	207.88	207.87	207.97	208.20
2017	208.30	208.17	208.15	208.36	208.72	208.65	208.74	208.25	207.35	207.32	207.83	207.85
2018	207.80	207.80	207.57	207.32	207.14	207.19	207.27	207.08	206.78	206.99	207.55	207.53
2019	207.49	207.58	207.54	207.37	207.27	207.33	207.35	207.32	206.98	207.37	207.94	208.20
2020	208.22	208.18	207.98	207.99	208.26	208.19	208.39	208.33	207.47	207.28	207.68	207.79

Lower Lower than 0.5 m below average	**Average** Within 0.5 m below and above average	**Higher** More than 0.5 m above average

Table 2.3-3. Cross Lake monthly water level range (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	0.11	0.12	0.18	0.42	0.14	0.63	0.69	0.35	0.60	0.27	0.46	0.10
2009	0.14	0.16	0.12	0.31	0.63	0.12	0.15	0.09	0.72	0.45	0.25	0.67
2010	0.20	0.21	0.22	0.46	0.27	1.14	0.27	0.27	0.13	0.40	0.55	0.35
2011	0.17	0.23	0.21	0.33	0.65	0.23	0.11	0.14	0.32	0.90	0.28	0.24
2012	0.18	0.36	0.28	0.15	0.16	0.51	0.16	0.21	0.39	0.38	0.26	0.15
2013	0.08	0.17	0.12	0.05	0.25	0.94	0.09	0.77	0.10	0.15	0.24	0.17
2014	0.20	0.05	0.21	0.08	0.47	0.60	0.33	0.19	0.09	0.78	0.36	0.31
2015	0.23	0.03	0.40	0.08	0.14	0.23	0.25	0.10	0.30	0.18	0.17	0.13
2016	0.14	0.06	0.09	0.10	0.32	0.63	0.17	0.21	0.23	0.20	0.29	0.34
2017	0.25	0.10	0.08	0.51	0.29	0.29	0.10	1.13	0.25	0.19	0.54	0.24
2018	0.09	0.07	0.26	0.33	0.10	0.25	0.15	0.31	0.23	0.59	0.33	0.16
2019	0.08	0.05	0.11	0.27	0.11	0.09	0.09	0.15	0.39	0.81	0.29	0.24
2020	0.07	0.11	0.14	0.09	0.33	0.19	0.34	0.64	0.56	0.27	0.30	0.08

Lower Variability Below 0.25 m	**Moderate Variability** 0.25 to 0.75 m	**Higher Variability** Above 0.75 m

Table 2.3-4. Playgreen Lake monthly average water level (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	217.25	217.28	217.31	217.37	217.53	217.60	217.58	217.66	217.69	217.57	217.34	217.16
2009	217.18	217.20	217.21	217.37	217.59	217.71	217.70	217.65	217.71	217.55	217.52	217.29
2010	217.18	217.19	217.22	217.40	217.58	217.69	217.69	217.70	217.75	217.62	217.64	217.61
2011	217.51	217.46	217.42	217.54	217.81	218.11	218.19	218.09	217.86	217.55	217.42	217.16
2012	217.06	217.05	217.16	217.38	217.47	217.61	217.68	217.61	217.53	217.35	217.26	217.17
2013	217.12	217.11	217.10	217.11	217.29	217.55	217.58	217.56	217.63	217.42	217.26	217.19
2014	217.21	217.21	217.21	217.24	217.53	217.65	217.87	217.98	217.90	217.63	217.52	217.45
2015	217.38	217.36	217.36	217.40	217.45	217.57	217.59	217.63	217.66	217.56	217.38	217.17
2016	217.27	217.32	217.33	217.38	217.60	217.63	217.57	217.56	217.53	217.63	217.81	217.73
2017	217.70	217.65	217.65	217.86	217.82	217.79	217.75	217.56	217.49	217.35	217.11	217.03
2018	217.05	217.06	217.04	217.08	217.23	217.28	217.28	217.26	217.15	217.02	216.84	216.83
2019	216.89	216.94	216.98	217.07	217.32	217.40	217.37	217.28	217.15	217.24	217.51	217.59
2020	217.53	217.48	217.45	217.55	217.71	217.71	217.75	217.59	217.55	217.48	217.18	217.11

Lower	**Average**	**Higher**
Lower than 0.5 m below average	Within 0.5 m below and above average	More than 0.5 m above average

Table 2.3-5. Playgreen Lake monthly water level range (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	0.06	0.07	0.03	0.17	0.15	0.15	0.40	0.55	0.37	0.66	0.40	0.05
2009	0.05	0.05	0.06	0.33	0.36	0.30	0.39	0.23	0.35	0.38	0.30	0.24
2010	0.07	0.05	0.07	0.30	0.52	0.28	0.21	0.57	0.37	0.83	0.28	0.10
2011	0.09	0.07	0.05	0.26	0.38	0.44	0.17	0.26	0.51	0.69	0.36	0.21
2012	0.05	0.04	0.24	0.19	0.27	0.28	0.13	0.36	0.42	0.54	0.31	0.10
2013	0.03	0.04	0.03	0.06	0.39	0.23	0.16	0.29	0.38	0.34	0.35	0.04
2014	0.03	0.04	0.04	0.11	0.35	0.22	0.52	0.39	0.24	0.56	0.54	0.13
2015	0.07	0.04	0.05	0.13	0.28	0.12	0.23	0.38	0.25	0.42	0.55	0.11
2016	0.07	0.03	0.08	0.10	0.15	0.22	0.23	0.24	0.57	0.39	0.25	0.61
2017	0.06	0.05	0.10	0.20	0.21	0.16	0.18	0.21	0.50	0.51	0.25	0.04
2018	0.04	0.04	0.04	0.20	0.15	0.11	0.28	0.23	0.34	0.37	0.39	0.08
2019	0.04	0.07	0.03	0.24	0.18	0.14	0.22	0.35	0.00	0.76	0.24	0.02
2020	0.03	0.08	0.05	0.18	0.15	0.16	0.20	0.23	0.37	0.36	0.07	0.12

Lower Variability	**Moderate Variability**	**Higher Variability**
Below 0.25 m	0.25 to 0.75 m	Above 0.75 m

Table 2.3-6. Little Playgreen Lake monthly average water level (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	217.17	217.20	217.22	217.27	217.43	217.49	217.47	217.61	217.56	217.47	217.26	217.10
2009	217.11	217.11	217.13	217.31	217.51	217.58	217.59	217.52	217.51	217.47	217.47	217.22
2010	217.08	217.08	217.11	217.34	217.47	217.57	217.59	217.56	217.66	217.53	217.55	217.52
2011	217.42	217.37	217.32	217.44	217.70	217.98	218.05	217.96	217.72	217.43	217.31	217.06
2012	216.97	216.99	217.07	217.29	217.36	217.52	217.59	217.54	217.49	217.27	217.16	217.06
2013	217.03	217.02	217.01	217.01	217.21	217.49	217.52	217.48	217.54	217.34	217.19	217.10
2014	217.10	217.12	217.13	217.14	217.44	217.56	217.78	217.87	217.79	217.54	217.43	217.37
2015	217.32	217.29	217.27	217.29	217.36	217.49	217.50	217.53	217.56	217.47	217.30	217.09
2016	217.18	217.23	217.22	217.29	217.43	217.55	217.49	217.47	217.44	217.52	217.72	217.64
2017	217.60	217.54	217.53	217.72	217.70	217.66	217.63	217.47	217.41	217.28	217.03	216.95
2018	216.97	216.96	216.93	216.95	217.06	217.21	217.21	217.20	217.08	216.95	216.77	216.74
2019	216.79	216.84		217.12	217.28	217.35	217.29	217.13	217.14	217.15	217.46	217.57
2020	217.46	217.39	217.35	217.43	217.63	217.66	217.75	217.56	217.54	217.47	217.15	217.01

Lower	Average	Higher
Lower than 0.5 m below average	Within 0.5 m below and above average	More than 0.5 m above average

Notes:

1. Blank cell indicates no data.

Table 2.3-7. Little Playgreen Lake monthly water level range (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	0.04	0.05	0.03	0.16	0.28	0.20	0.41	0.25	0.40	0.67	0.47	0.07
2009	0.05	0.03	0.08	0.32	0.32	0.32	0.40	0.20	0.36	0.37	0.29	0.25
2010	0.07	0.04	0.11	0.27	0.60	0.27	0.16	0.54	0.34	0.84	0.30	0.10
2011	0.09	0.07	0.05	0.26	0.38	0.44	0.19	0.27	0.53	0.70	0.36	0.20
2012	0.04	0.03	0.21	0.21	0.32	0.38	0.17	0.37	0.44	0.55	0.31	0.09
2013	0.04	0.04	0.03	0.05	0.42	0.27	0.19	0.30	0.39	0.35	0.33	0.05
2014	0.03	0.03	0.03	0.10	0.40	0.21	0.57	0.44	0.26	0.55	0.55	0.13
2015	0.06	0.03	0.06	0.14	0.36	0.12	0.24	0.39	0.27	0.42	0.57	0.10
2016	0.07	0.03	0.08	0.12	0.40	0.25	0.24	0.31	0.61	0.52	0.26	0.59
2017	0.06	0.06	0.09	0.20	0.23	0.19	0.19	0.24	0.52	0.54	0.24	0.04
2018	0.03	0.04	0.03	0.13	0.15	0.25	0.42	0.43	0.47	0.49	0.53	0.04
2019	0.05	0.05		0.15	0.21	0.19	0.29	0.78	0.41	1.25	0.32	0.12
2020	0.08	0.09	0.07	0.19	0.25	0.30	0.32	0.46	0.55	0.55	0.29	0.14

Lower Variability Below 0.25 m	**Moderate Variability** 0.25 to 0.75 m	**Higher Variability** Above 0.75 m

Notes:

1. Blank cell indicates no data.

Table 2.3-8. Sipiwesk Lake monthly average water level (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	187.06	186.82	186.45	185.97	185.10	185.67	187.12	187.94	187.02	186.72	186.84	187.02
2009	186.72	186.37	186.23	186.04	186.66	187.92	188.15	188.11	187.91	186.79	186.36	186.45
2010	186.88	186.62	186.36	185.84	185.25	185.44	186.98	187.61	187.97	188.12	187.68	187.81
2011	188.54	188.05	187.17	186.78	187.60	188.51	188.95	189.16	188.93	187.78	186.68	187.16
2012	186.83	186.54	185.99	185.64	185.49	185.58	186.19	186.40	185.88	185.69	186.19	186.55
2013	186.78	186.57	186.18	185.93	186.02	186.14	187.42	187.54	186.37	186.21	186.50	186.65
2014	186.85	186.75	186.75	186.67	186.65	187.50	188.28	188.63	188.51	188.14	187.24	187.38
2015	187.04	186.68	186.27	186.11	186.15	186.29	186.23	186.13	186.37	186.38	186.32	186.69
2016	186.78	186.86	186.66	186.39	186.28	186.25	187.06	187.17	186.70	186.69	186.47	186.81
2017	187.70	187.56	187.28	187.43	188.06	188.16	188.32	187.79	186.00	185.62	186.27	186.58
2018	186.38	186.18	185.85	185.45	185.43	185.47	185.64	185.39	185.01	185.08	185.90	186.16
2019	186.01	185.72	185.56	185.65	185.64	185.66	185.65	185.68	185.28	185.16	186.46	187.14
2020	187.43	187.47	187.35	187.29	187.59	187.45	187.62	187.70	186.30	185.52	186.01	186.59

Lower Lower than 0.5 m below average	**Average** Within 0.5 m below and above average	**Higher** More than 0.5 m above average

Table 2.3-9. Sipiwesk Lake monthly water level range (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	0.25	0.26	0.38	0.90	0.30	1.14	1.52	0.27	1.27	0.41	0.25	0.36
2009	0.47	0.16	0.18	0.39	1.17	0.64	0.14	0.19	0.71	0.85	0.21	0.50
2010	0.16	0.33	0.26	0.74	0.31	0.59	1.54	0.25	0.30	0.23	0.48	0.80
2011	0.46	0.85	0.78	0.17	1.25	0.51	0.32	0.14	0.52	1.74	0.28	0.37
2012	0.58	0.27	0.54	0.21	0.15	0.39	0.51	0.11	0.75	0.40	0.38	0.38
2013	0.16	0.27	0.41	0.14	0.28	0.94	0.93	0.89	0.62	0.05	0.38	0.14
2014	0.19	0.06	0.08	0.06	0.27	1.35	0.45	0.17	0.15	0.87	0.60	0.52
2015	0.48	0.60	0.13	0.10	0.08	0.29	0.38	0.06	0.48	0.27	0.29	0.18
2016	0.24	0.14	0.26	0.24	0.25	0.56	0.59	0.25	0.50	0.32	0.47	0.28
2017	0.24	0.26	0.30	0.67	0.34	0.23	0.11	1.44	1.12	0.11	0.79	0.25
2018	0.06	0.37	0.37	0.31	0.11	0.12	0.13	0.34	0.31	0.58	0.74	0.20
2019	0.14	0.35	0.11	0.09	0.09	0.07	0.14	0.22	1.02	0.96	1.23	0.29
2020	0.14	0.11	0.23	0.09	0.48	0.23	0.44	0.55	1.52	0.34	1.13	0.13

Lower Variability Below 0.25 m	**Moderate Variability** 0.25 to 0.75 m	**Higher Variability** Above 0.75 m

Table 2.3-10. Kelsey GS Forebay monthly average water level (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	184.39	184.27	183.76	183.38	183.69	184.25	184.36	184.36	184.35	184.36	184.19	184.06
2009	184.09	183.80	183.64	183.10	183.40	184.36	184.36	184.36	184.35	184.34	184.35	183.82
2010	184.34	184.19	184.08	184.30	184.29	183.66	184.29	184.34	184.34	184.33	184.23	183.68
2011	184.22	184.00	183.43	183.32	184.34	184.34	184.34	184.34	184.34	184.33	184.33	184.34
2012	184.33	184.34	184.34	184.35	184.33	184.30	184.34	184.34	184.33	184.34	184.10	183.76
2013	184.34	184.02	183.49	183.47	184.15	184.31	184.21	184.34	184.34	184.34	184.23	183.78
2014	184.28	184.32	184.34	184.33	184.35	184.35	184.35	184.34	184.34	184.33	184.34	184.34
2015	184.33	184.04	183.48	183.69	184.33	184.34	184.33	184.33	184.34	184.33	184.33	184.34
2016	184.34	184.12	183.67	183.57	184.24	184.34	184.33	184.33	184.33	184.24	183.89	184.36
2017	184.36	184.21	183.40	183.20	183.58	184.35	184.32	184.30	184.31	184.32	184.33	184.33
2018	184.31	183.97	183.54	183.56	184.27	184.33	184.30	184.24	184.14	184.19	184.33	184.32
2019	184.26	183.72	183.50	183.88	184.32	184.34	184.34	184.34	184.06	183.82	184.23	184.34
2020	184.34	184.33	184.33	184.34	184.34	184.33	184.34	184.32	184.31	184.20	184.27	184.34

Lower Lower than 0.5 m below average	**Average** Within 0.5 m below and above average	**Higher** More than 0.5 m above average

Table 2.3-11. Kelsey GS Forebay monthly water level range (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	0.03	0.42	0.41	0.43	0.54	0.44	0.04	0.03	0.03	0.01	0.59	0.50
2009	0.61	0.03	0.69	0.61	1.52	0.04	0.05	0.03	0.04	0.05	0.04	0.74
2010	0.04	0.29	0.03	0.27	0.18	1.16	0.56	0.09	0.06	0.06	0.74	0.64
2011	0.51	0.06	0.81	1.03	0.18	0.04	0.04	0.03	0.06	0.05	0.08	0.05
2012	0.04	0.03	0.04	0.07	0.11	0.14	0.04	0.04	0.07	0.06	0.89	0.90
2013	0.04	0.55	0.22	0.03	0.88	0.56	0.56	0.05	0.06	0.06	0.47	0.79
2014	0.26	0.13	0.05	0.07	0.07	0.08	0.06	0.07	0.07	0.06	0.06	0.04
2015	0.05	0.87	0.06	0.89	0.06	0.05	0.06	0.05	0.06	0.05	0.08	0.06
2016	0.05	0.39	0.50	0.42	0.50	0.06	0.05	0.06	0.06	0.53	0.89	0.06
2017	0.05	0.30	0.86	0.06	1.19	0.05	0.06	0.08	0.09	0.10	0.08	0.09
2018	0.13	0.56	0.32	0.29	0.57	0.14	0.16	0.20	0.25	0.26	0.13	0.10
2019	0.31	0.54	0.07	0.85	0.20	0.11	0.08	0.10	0.59	0.07	0.51	0.09
2020	0.08	0.07	0.07	0.09	0.09	0.10	0.09	0.07	0.09	0.48	0.25	0.09

Lower Variability Below 0.25 m	**Moderate Variability** 0.25 to 0.75 m	**Higher Variability** Above 0.75 m

Table 2.3-12. Setting Lake monthly average water level (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008											224.50	224.41
2009	224.31	224.26	224.22	224.22	224.53	224.94	225.10	225.15	224.82	224.58	224.51	224.44
2010	224.37	224.33	224.27	224.29	224.43	224.52	224.41	224.37	224.84	225.04	224.89	224.70
2011	224.59		224.33	224.29	224.43	224.49	224.67	225.02	225.12	224.87	224.81	224.72
2012	224.66		224.56	224.69	225.17	225.16	225.01	224.73	224.58	224.47	224.56	224.53
2013	224.45	224.38	224.34	224.29	224.36	224.50	224.60	224.52	224.45	224.58	224.80	224.74
2014	224.57	224.49	224.43	224.41	225.08	225.46	225.23	224.95	224.71	224.63	224.55	224.45
2015	224.38	224.33	224.30	224.34	224.65	224.88	224.90	225.11	225.19	225.19	224.99	224.83
2016	224.68	224.55	224.47	224.44	224.59	224.90	224.96	225.03	224.83	225.18	225.46	225.21
2017	224.92	224.76	224.66	224.70	225.39	225.69	225.61	225.10	224.78	224.74	224.72	
2018	224.49	224.43	224.39	224.37	224.58	224.77	225.16	225.34	225.27	225.22	225.07	224.87
2019	224.67	224.59	224.52	224.51	224.87	225.02	224.98	224.97	225.04	224.97	224.87	224.72
2020	224.59	224.50	224.43	224.42	224.95	225.78	225.76	225.56	225.38	225.25	225.13	225.03

Lower	Average	Higher
Lower than 0.5 m below average	Within 0.5 m below and above average	More than 0.5 m above average

Notes:

1. Blank cell indicates no data.

Table 2.3-13. Setting Lake monthly water level range (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008											0.07	0.11
2009	0.08	0.03	0.04	0.08	0.49	0.23	0.30	0.30	0.31	0.15	0.05	0.08
2010	0.03	0.07	0.04	0.08	0.31	0.09	0.13	0.29	0.50	0.15	0.19	0.16
2011	0.06		0.09	0.07	0.13	0.04	0.22	0.38	0.28	0.11	0.08	0.10
2012	0.03		0.04	0.36	0.30	0.07	0.31	0.20	0.23	0.10	0.05	0.08
2013	0.07	0.06	0.05	0.04	0.19	0.15	0.06	0.10	0.11	0.35	0.07	0.13
2014	0.11	0.07	0.07	0.03	1.20	0.31	0.18	0.32	0.17	0.10	0.10	0.08
2015	0.06	0.05	0.02	0.12	0.38	0.15	0.13	0.18	0.24	0.24	0.16	0.14
2016	0.16	0.10	0.04	0.05	0.27	0.22	0.18	0.20	0.16	0.63	0.13	0.34
2017	0.19	0.14	0.09	0.22	0.84	0.14	0.41	0.45	0.14	0.06	0.05	
2018	0.07	0.08	0.03	0.07	0.24	0.21	0.46	0.14	0.17	0.16	0.20	0.17
2019	0.05	0.09	0.05	0.10	0.46	0.09	0.11	0.15	0.07	0.12	0.14	0.16
2020	0.10	0.08	0.06	0.03	1.21	0.21	0.16	0.24	0.14	0.19	0.08	0.13

Lower Variability	Moderate Variability	Higher Variability
Below 0.25 m	0.25 to 0.75 m	Above 0.75 m

Notes:

1. Blank cell indicates no data.

Table 2.3-14. Walker Lake monthly average water level (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	208.05	207.97	207.92	207.76	207.72	207.60	208.01	208.55	208.32	208.12	208.05	208.02
2009	208.07	207.96	207.83	207.78	208.12	208.59	208.62	208.57	208.53	208.20	208.01	207.95
2010	208.03	207.91	207.77	207.68	207.60	207.54	207.82	208.30	208.58	208.65	208.48	208.34
2011	208.32	208.20	208.01	207.89	208.35	208.85	209.01	209.07	208.97	208.57	208.23	208.08
2012	207.94	207.81	207.70	207.67	207.67	207.68	207.72	207.74	207.64	207.51	207.56	207.79
2013	207.94	207.91	207.78	207.69	207.67	207.76	208.10	208.35	208.01	207.79	207.78	207.89
2014	207.98	207.93	207.88	207.74	207.82	208.24	208.72	208.86		208.48	208.22	208.19
2015	208.20	208.08	207.97	207.84	207.79	207.74	207.72	207.66	207.74	207.81	207.77	207.76
2016	207.87	207.89	207.83	207.76	207.75	207.77	208.07	208.18	207.99	208.03	208.13	208.16
2017	208.29	208.17	208.11	208.23	208.69	208.63	208.74	208.51	208.07	207.85	207.79	207.89
2018	207.82	207.79	207.71	207.61	207.65	207.61	207.77	207.95	207.96	207.90	207.84	207.76
2019	207.67	207.62	207.58	207.55	207.62	207.61	207.55	207.56	207.72	207.76	207.92	208.12
2020	208.19	208.16	208.04	207.95	208.30	208.48	208.49	208.47	208.22	208.04	207.96	207.89

Lower Lower than 0.5 m below average	**Average** Within 0.5 m below and above average	**Higher** More than 0.5 m above average

Notes:

1. Blank cell indicates no data.

Table 2.3-15. Walker Lake monthly water level range (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	0.11	0.11	0.11	0.04	0.10	0.07	0.83	0.11	0.30	0.08	0.13	0.07
2009	0.07	0.13	0.11	0.14	0.55	0.23	0.12	0.14	0.21	0.28	0.14	0.17
2010	0.07	0.14	0.13	0.08	0.10	0.05	0.49	0.38	0.14	0.12	0.19	0.13
2011	0.13	0.15	0.20	0.10	0.69	0.22	0.14	0.09	0.30	0.41	0.24	0.09
2012	0.14	0.12	0.09	0.02	0.04	0.04	0.03	0.04	0.17	0.08	0.10	0.29
2013	0.05	0.11	0.13	0.04	0.00	0.11	0.48	0.22	0.31	0.12	0.06	0.20
2014	0.09	0.02	0.13	0.10	0.23	0.59	0.29	0.07		0.12	0.30	0.15
2015	0.11	0.12	0.16	0.07	0.09	0.08	0.11	0.03	0.20	0.08	0.03	0.04
2016	0.13	0.03	0.10	0.03	0.06	0.18	0.32	0.10	0.19	0.21	0.02	0.15
2017	0.10	0.12	0.06	0.36	0.33	0.12	0.07	0.42	0.33	0.16	0.15	0.08
2018	0.05	0.02	0.13	0.07	0.04	0.08	0.34	0.05	0.08	0.09	0.07	0.09
2019	0.07	0.04	0.05	0.03	0.09	0.07	0.06	0.12	0.10	0.16	0.14	0.23
2020	0.04	0.05	0.17	0.05	0.59	0.12	0.06	0.19	0.22	0.16	0.06	0.07

Lower Variability Below 0.25 m	**Moderate Variability** 0.25 to 0.75 m	**Higher Variability** Above 0.75 m

Notes:

1. Blank cell indicates no data.

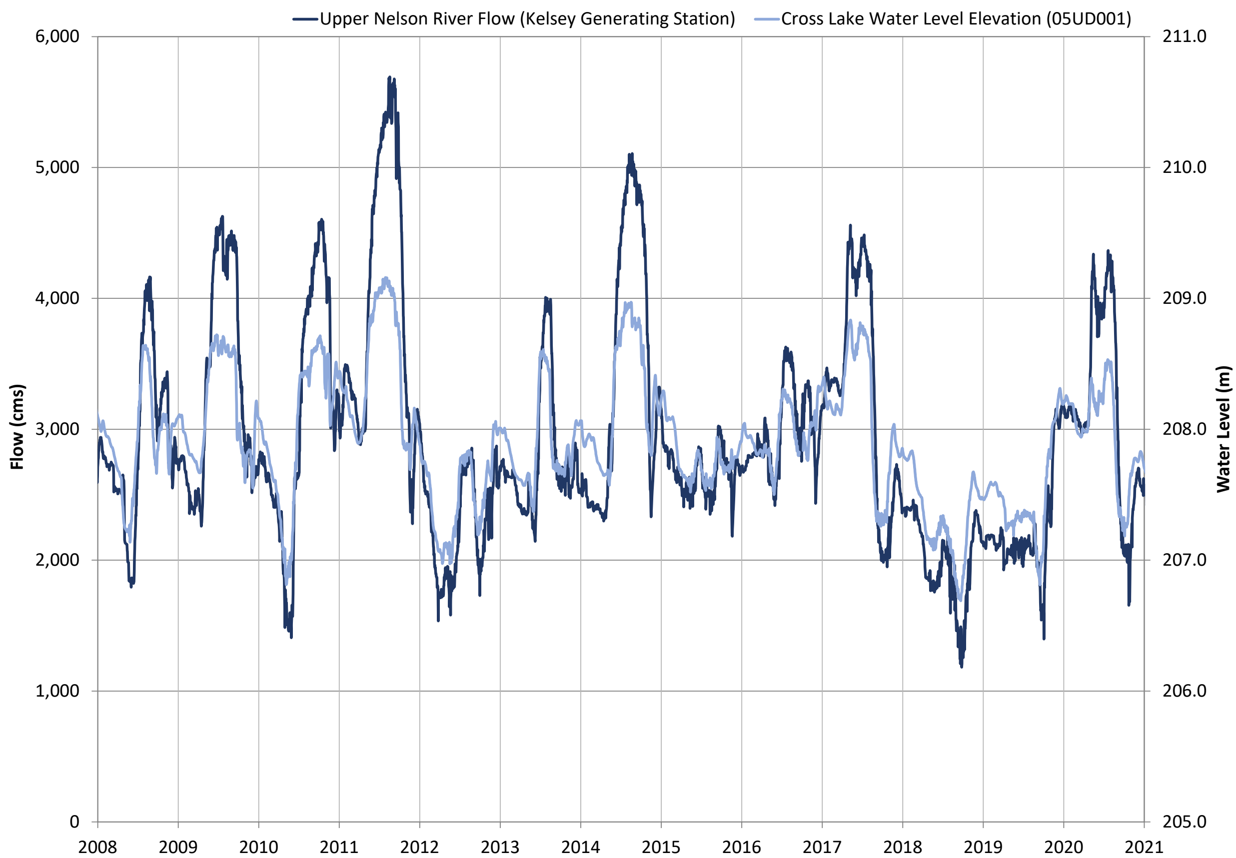


Figure 2.3-3. 2008-2020 Upper Nelson River daily mean flow and Cross Lake daily mean water level.

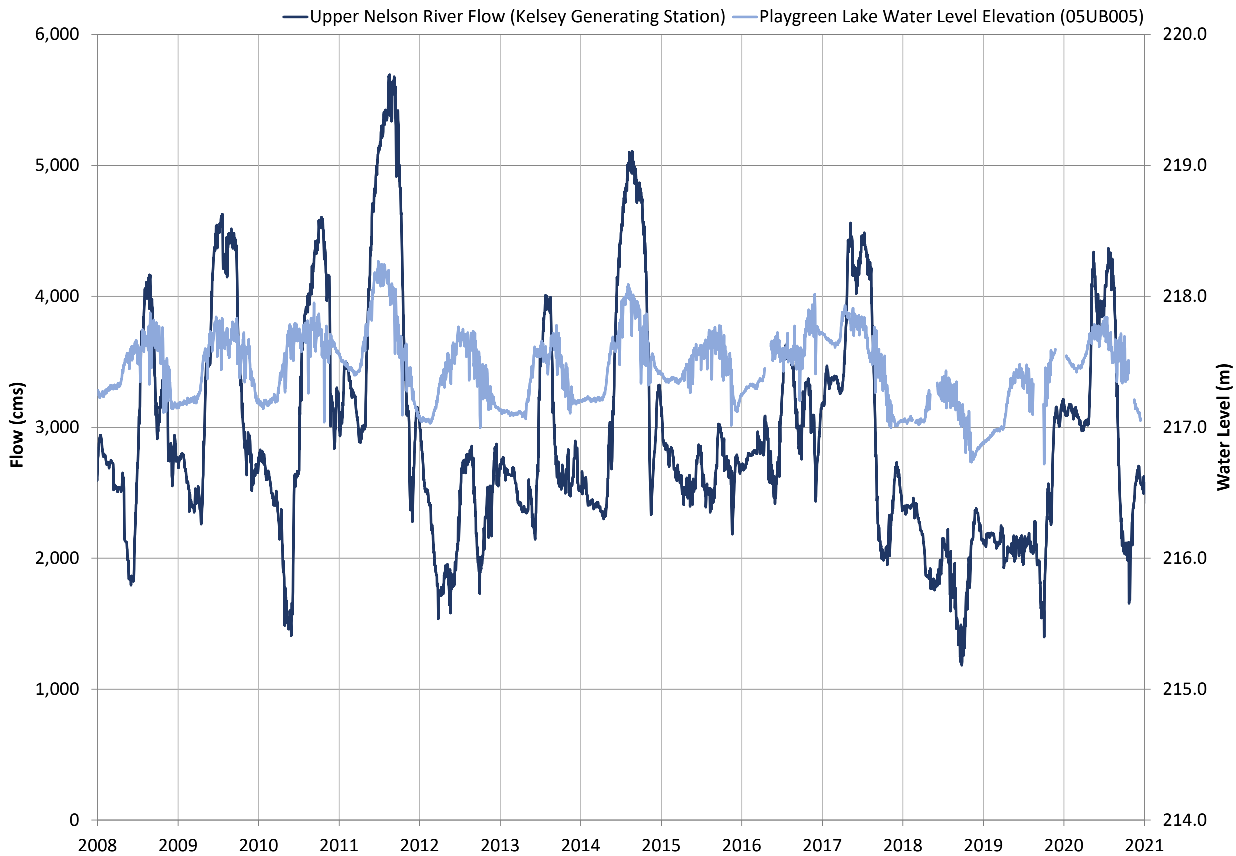


Figure 2.3-4. 2008-2020 Upper Nelson River daily mean flow and Playgreen Lake daily mean water level.

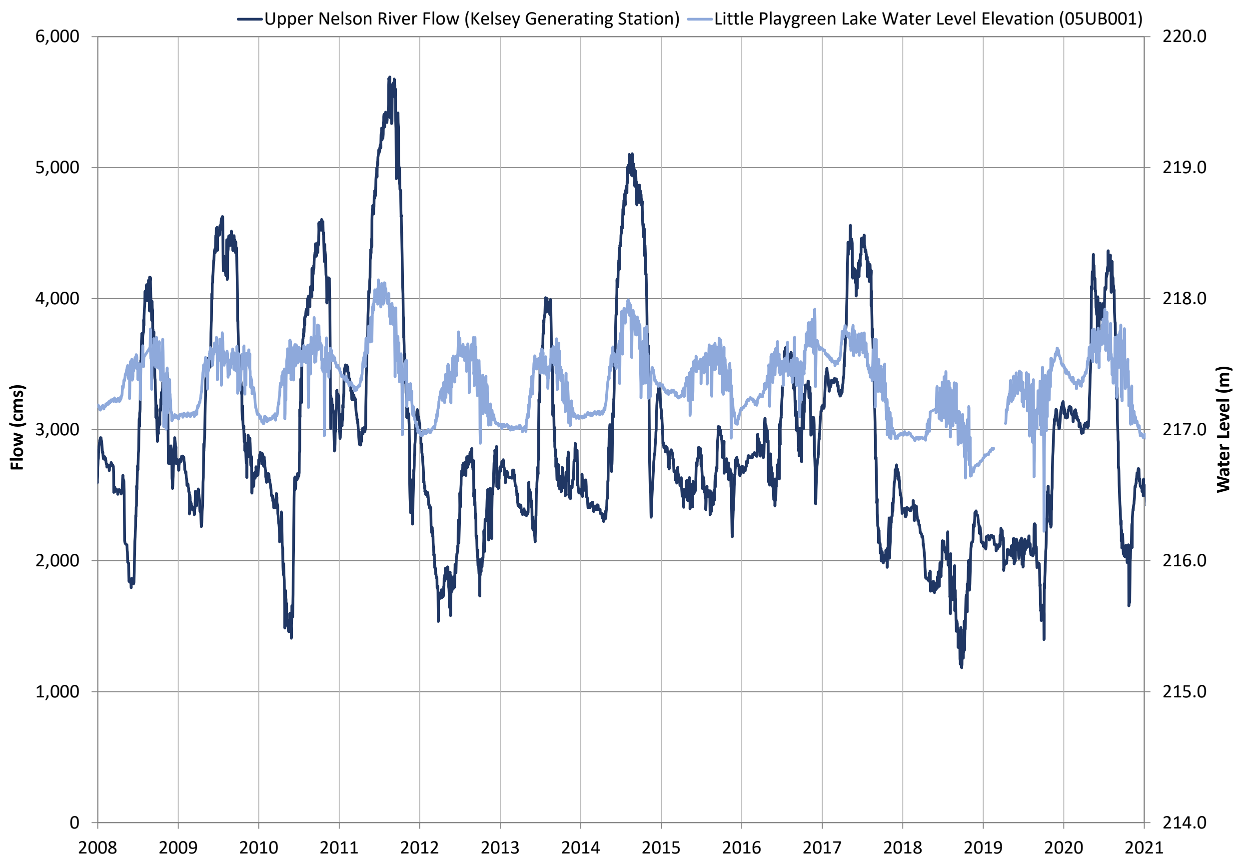


Figure 2.3-5. 2008-2020 Upper Nelson River daily mean flow and Little Playgreen Lake daily mean water level.

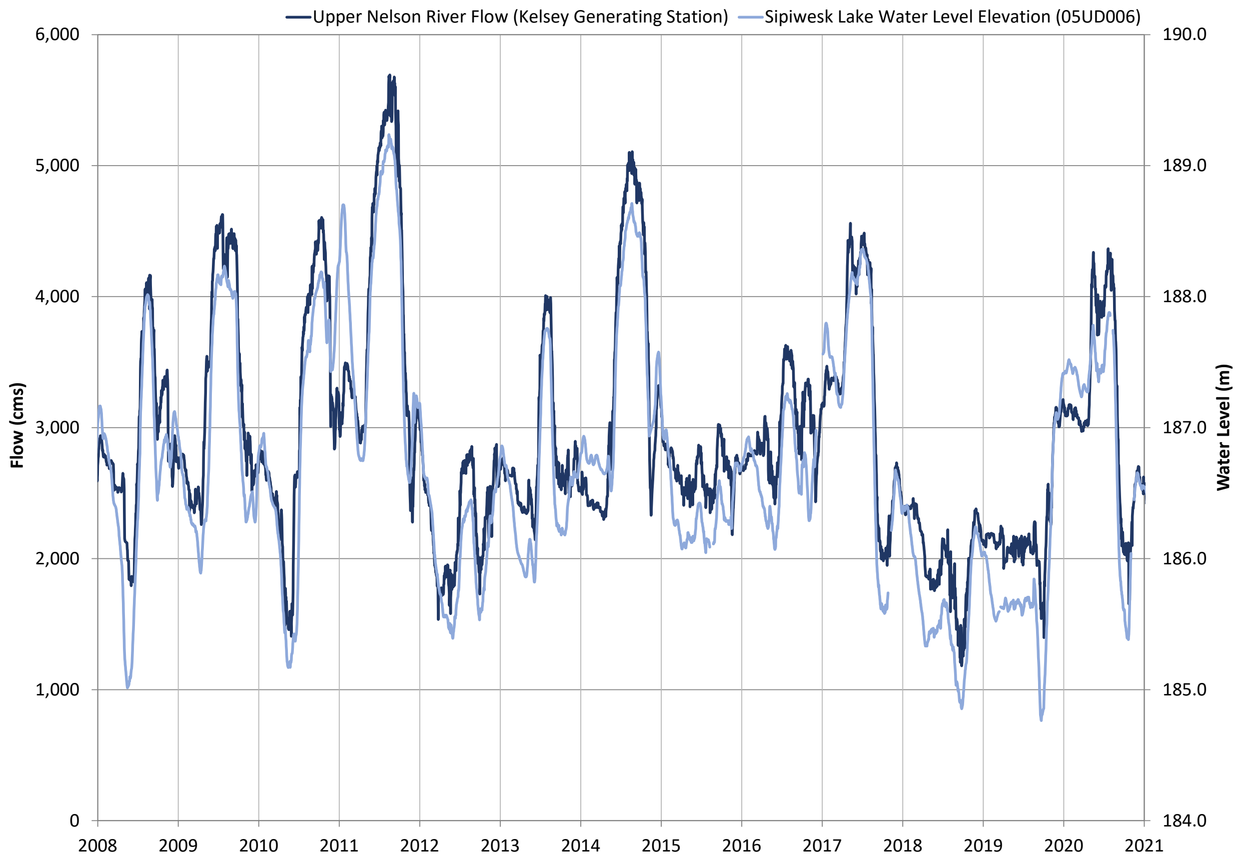


Figure 2.3-6. 2008-2020 Upper Nelson River daily mean flow and Sipiwesk Lake daily mean water level.

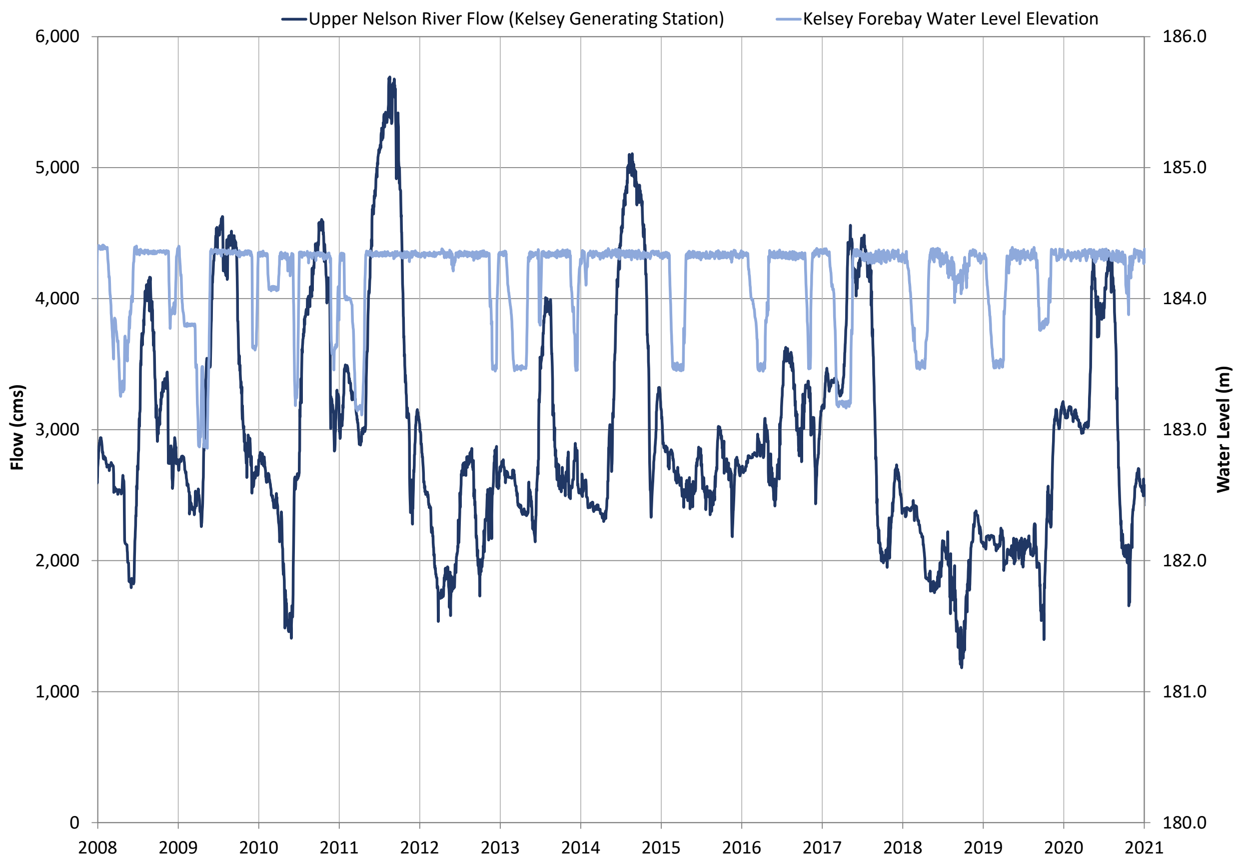


Figure 2.3-7. 2008-2020 Upper Nelson River daily mean flow and Kelsey GS Forebay daily mean water level.

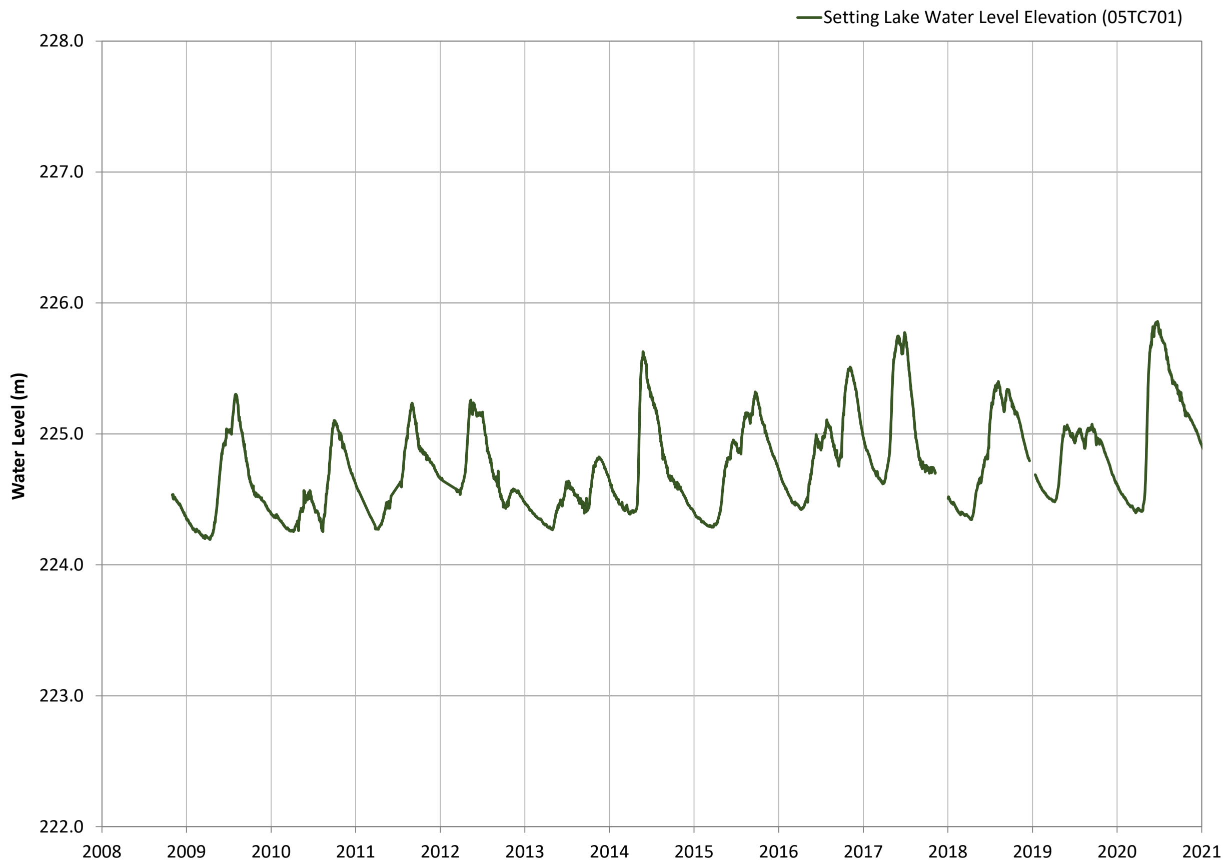


Figure 2.3-8. 2008-2020 Setting Lake daily mean water level.

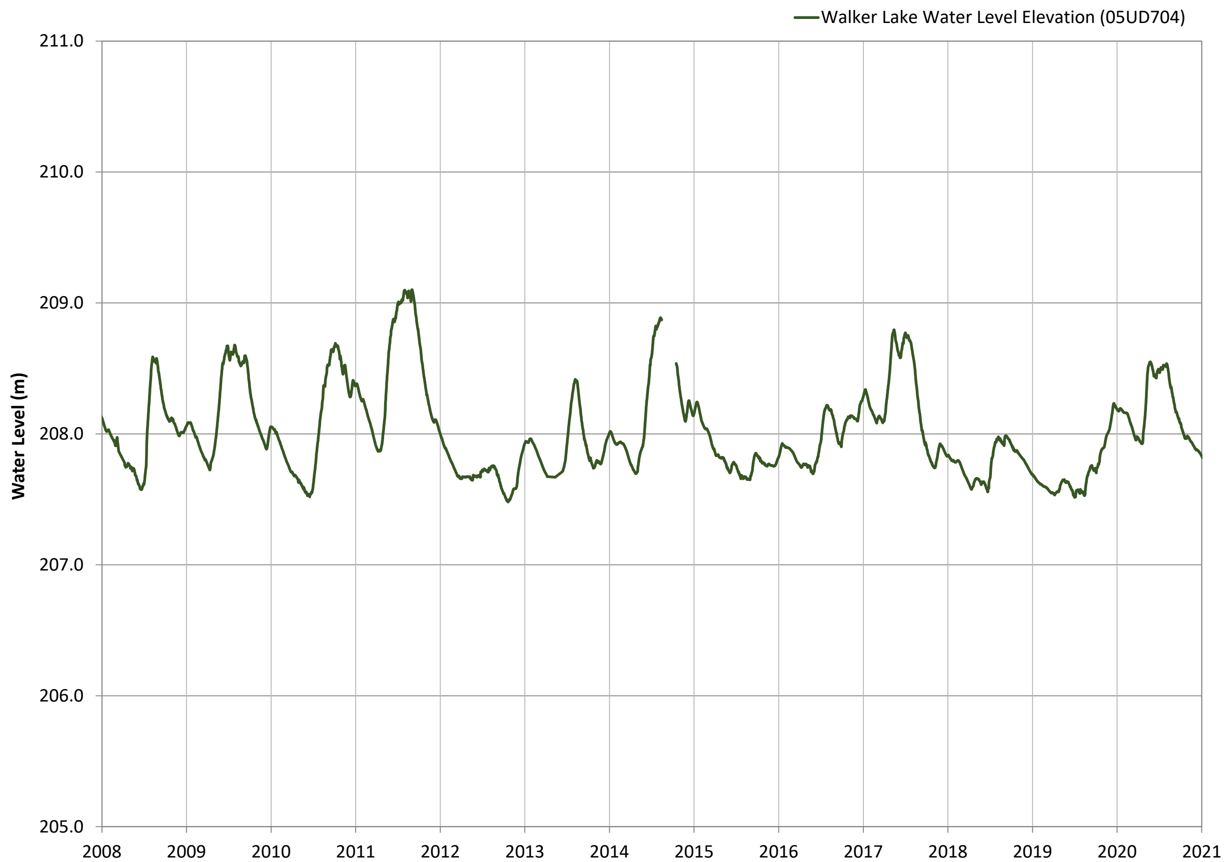


Figure 2.3-9. 2008-2020 Walker Lake Daily Mean Water Level

2.3.3 WATER TEMPERATURE

2.3.3.1 ON-SYSTEM SITES

Jenpeg Generating Station

Water temperature in the Upper Nelson River Region is monitored at the continuous water quality monitoring station located at the Jenpeg GS (Figure 2.3-1). Water temperatures drop to near 0°C during the winter period and begin to increase in late April/early May. Temperatures peaked around 22 and 23°C in late July/early August during the three summers since monitoring has started, returning to near 0°C in early November (Figure 2.3-10).

The duration, in days, that water temperature is within different temperature ranges is used as a metric (Table 2.3-16). The number of days that the water temperature was below 1°C, which is used as a proxy-metric for the duration of the ice-covered period, ranged from 182 to 198 days. In summer, the number of days above 20°C ranged from 24 to 29 days.

2.3.3.2 OFF-SYSTEM SITES

There are no off-system continuous monitoring sites in this region.

Table 2.3-16. 2017-19 Jenpeg GS water temperature ranges.

Monitoring Year[1]	Number of days in Temperature Range[2]					
	< 1 °C	1-5 °C	5-10 °C	10-15 °C	15-20 °C	>20°C
2017	185	-	-	-	-	-
2018	182	37	21	43	53	29
2019	198	31	27	51	54	24

Notes:

1. Period <1°C is for the entire winter period (e.g., 2017 monitoring year is from Nov 2017 to May 2018).
2. The duration has been estimated using data from nearby gauging stations to infill missing data when available.

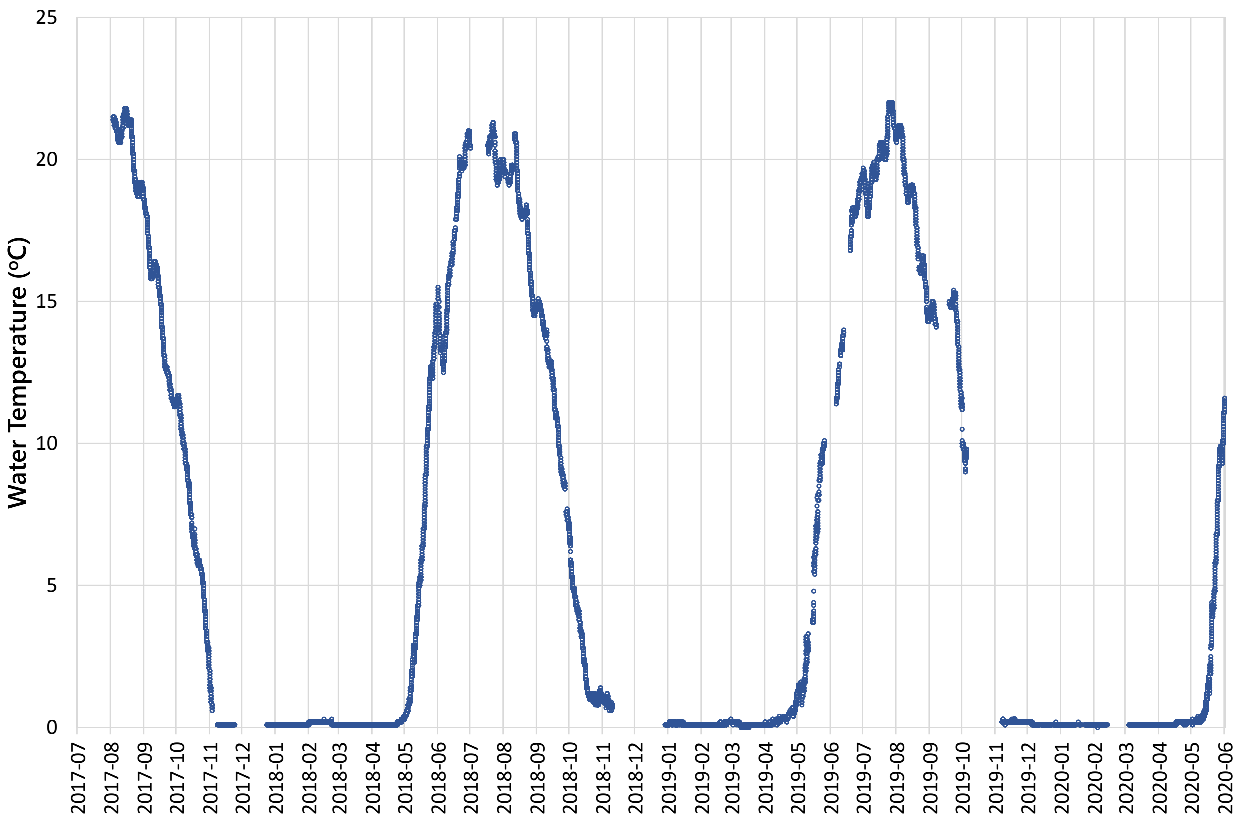


Figure 2.3-10. 2017-2019 Jenpeg GS continuous water temperature.

2.4 SEDIMENTATION

The following presents the results of sedimentation monitoring conducted in the Upper Nelson River Region. Monitoring occurred on-system at the continuous water quality monitoring site located at the Jenpeg GS (Figure 2.3-1). Monitoring started in 2017 (Table 2.4-1) and consists of measuring turbidity every 5 minutes and monthly site visits to verify the data and collect water samples for measuring total suspended solids used in calculating the sediment load. For the sedimentation indicator, two metrics (continuous turbidity and suspended sediment load) were selected for detailed reporting (Table 2.4-2).

Table 2.4-1. 2008-2019 sedimentation sampling inventory.

Waterbody/ Area	Sampling Year											
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Jenpeg GS										●	●	●

Table 2.4-2. Sedimentation indicators and metrics.

Indicator	Metric	Units
Sedimentation	Continuous turbidity	FNU
	Suspended sediment load	T/day

2.4.1 CONTINUOUS TURBIDITY

2.4.1.1 ON-SYSTEM SITES

Jenpeg Generating Station

Turbidity in the Upper Nelson River Region is monitored at the continuous water quality monitoring station located at the Jenpeg GS (Figure 2.3-1). The average monthly turbidity ranged from 5.3 to 47.8 FNU (Table 2.4-3, Figure 2.4-1) with the hourly turbidity ranging from 4 to 70 FNU (Figure 2.4-3). The highest turbidity was recorded in November 2017 when it was near 70 FNU, while in the other years the peak ranged from about 16 to 26 FNU. Turbidity (Figure 2.4-2) steadily decreased from November to May reaching the lower range values near 5 to 6 FNU each winter. During the summer open-water periods, several peaks in turbidity are observed in a given year, with November having the highest monthly average turbidity each year (Table 2.4-3).

Table 2.4-3. 2017-2019 Jenpeg GS average monthly turbidity.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017								21.2	22.8	31.2	47.8	
2018	10.4	7.8	7.1	6.0	9.7	14.4		17.8	13.3	13.8	21.0	14.3
2019	8.4	7.0	6.1	4.8	6.0	10.3	13.5	12.5	9.4		15.8	9.8
2020	7.2	5.3	5.5	6.0								

Notes:

1. Monthly data only shown for months with more than 15 days of data.

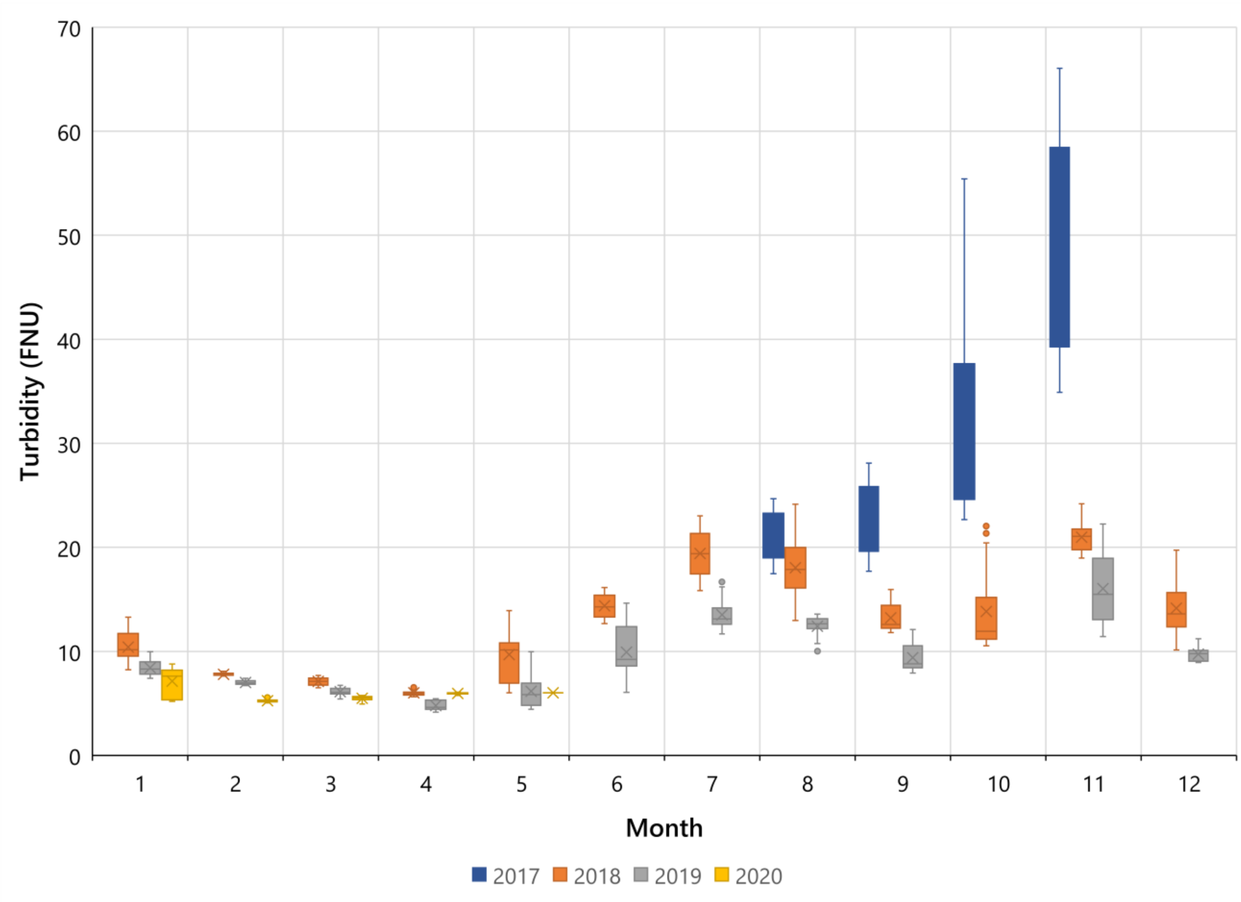


Figure 2.4-1. 2017-2019 Jenpeg GS monthly turbidity.

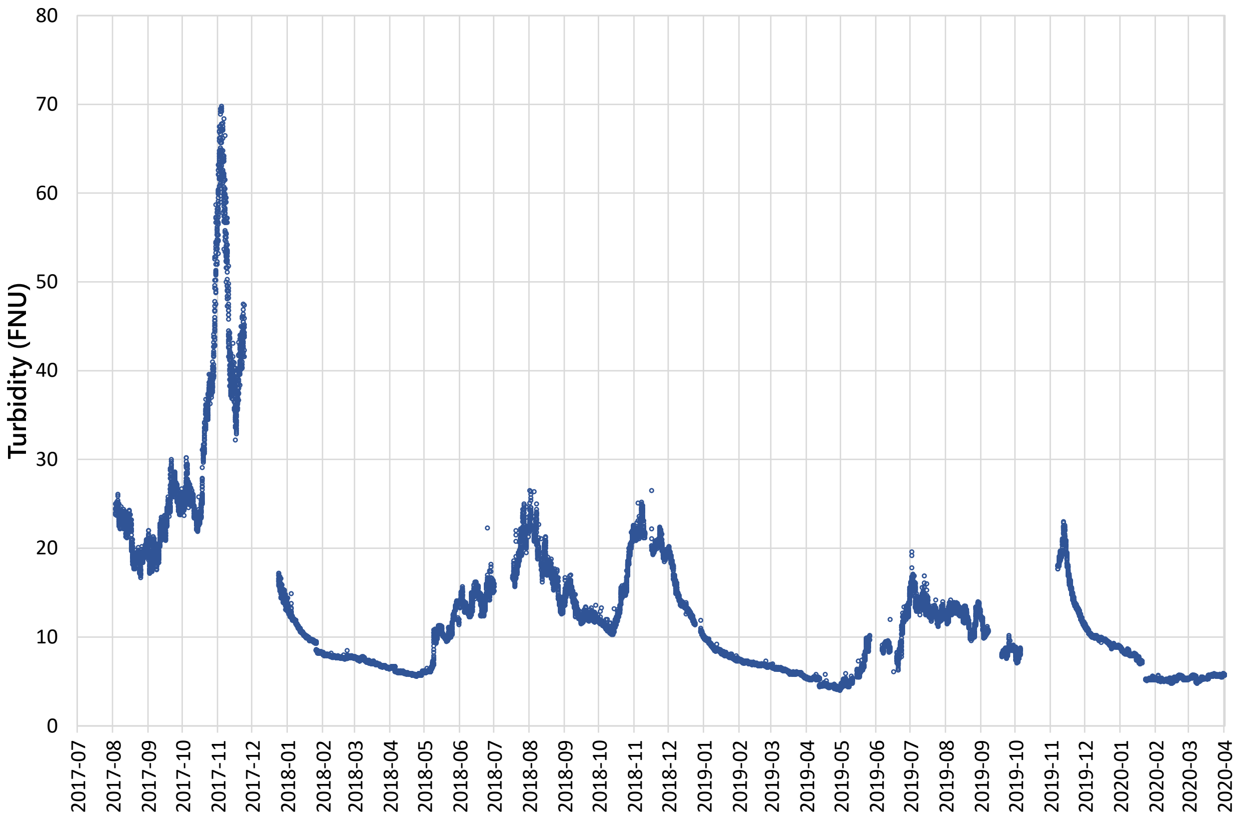


Figure 2.4-2. 2017-2019 Jenpeg GS continuous turbidity.

2.4.2 SUSPENDED SEDIMENT LOAD

2.4.2.1 ON-SYSTEM SITES

Jenpeg Generating Station

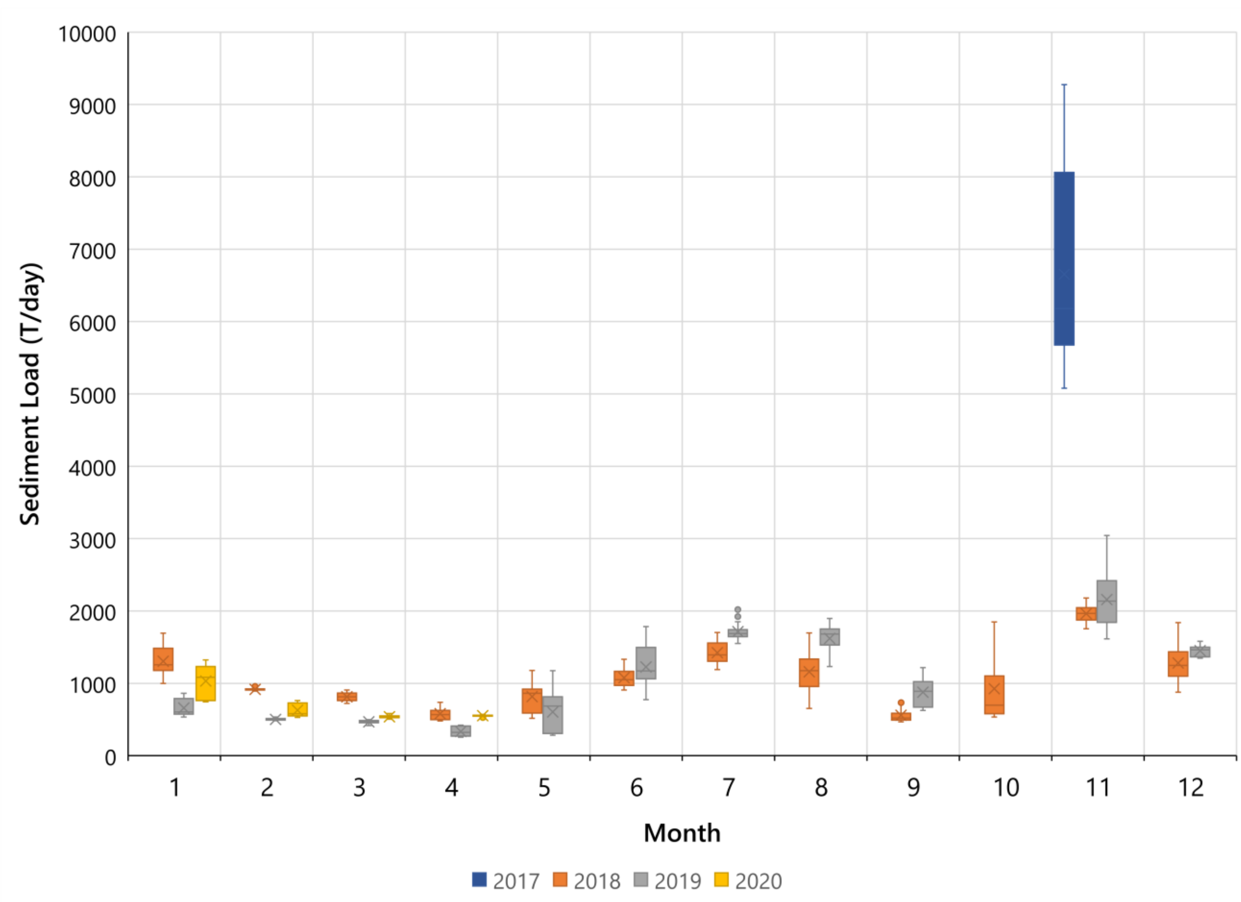
Sediment load is estimated using the discharge data, continuous turbidity data (Figure 2.4-2) and water samples collected to correlate the turbidity to total suspended solids (TSS). The average monthly sediment load ranged from 334 to 6,655 T/day (Table 2.4-4, Figure 2.4-3). While there are only a few sampling years, the average monthly sediment load is observed gradually decreasing from November to April each year. Additionally, two peaks are observed at Jenpeg GS, the first in July/August and the second in November (Figure 2.4-4).

Table 2.4-4. 2017-19 Jenpeg GS average monthly sediment load.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017											6655	
2018	1304	916	814	579	816	1078	1424	1158	558	925	1964	1282
2019	658	502	469	334	603	1225	1716	1621	876		2157	1450
2020	1033	625	538	555								

Notes:

1. Monthly average only shown for months with more than 15 days of data.
2. Some months are missing TSS measurements to estimate the load.



Notes:

1. Monthly data only shown for months with more than 15 days of data.

Figure 2.4-3. 2017-2019 Jenpeg GS monthly sediment load.

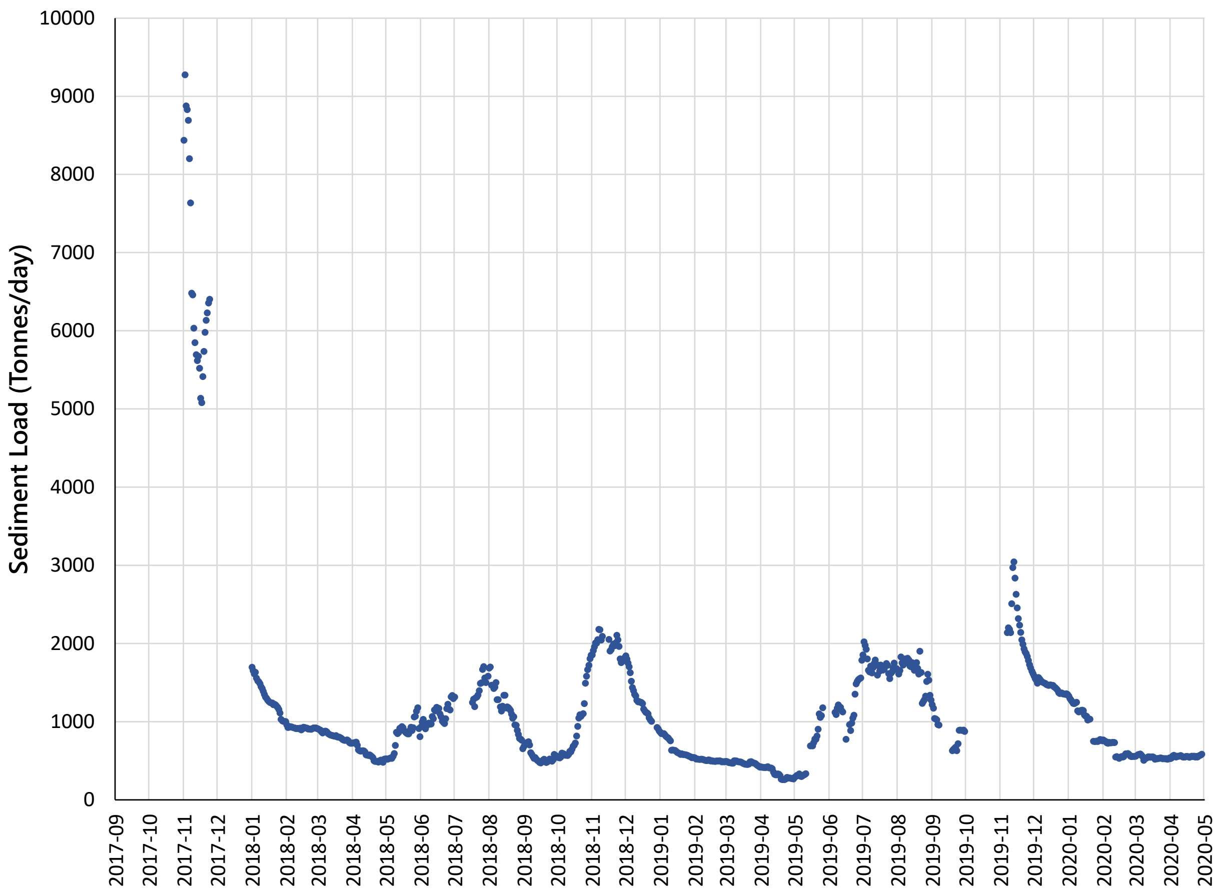
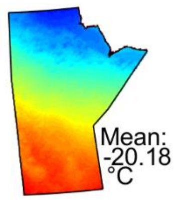
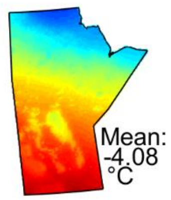
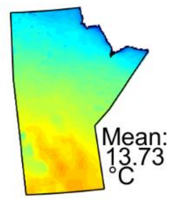
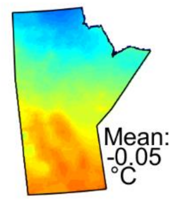
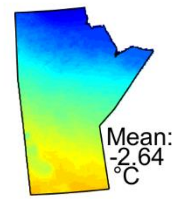
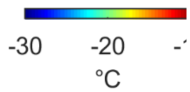
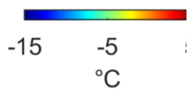
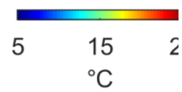
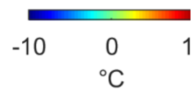
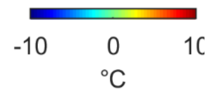
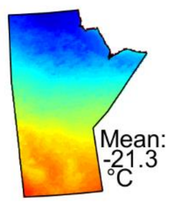
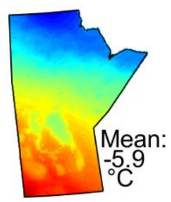
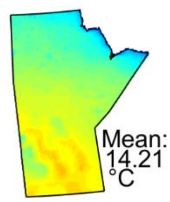
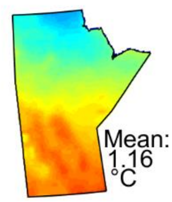
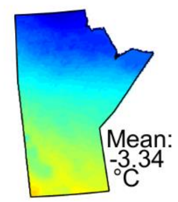
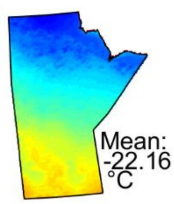
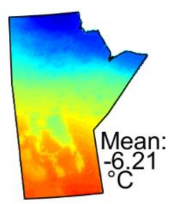
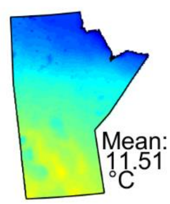
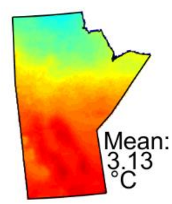
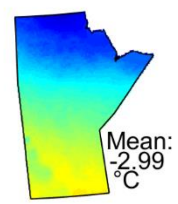
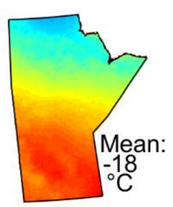
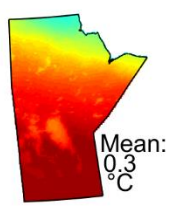
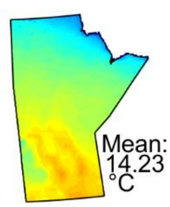
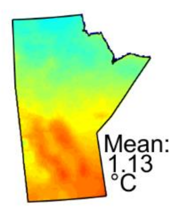
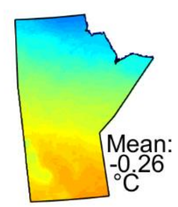
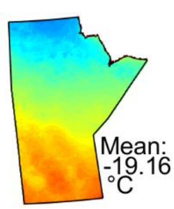
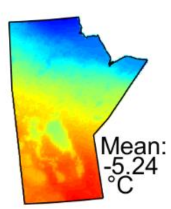
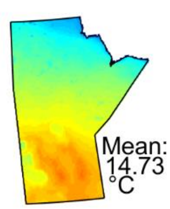
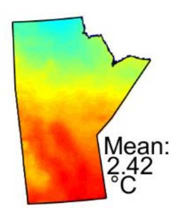
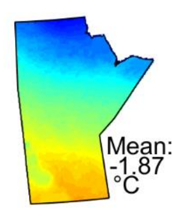
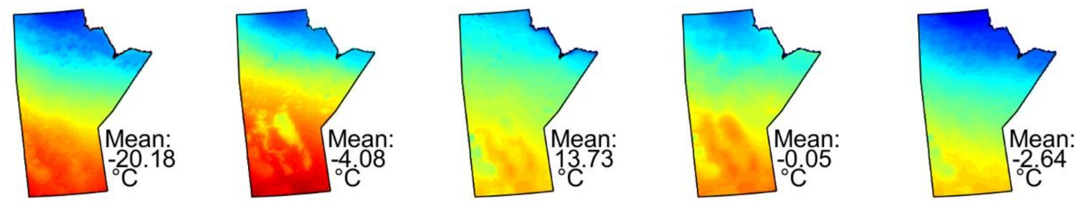
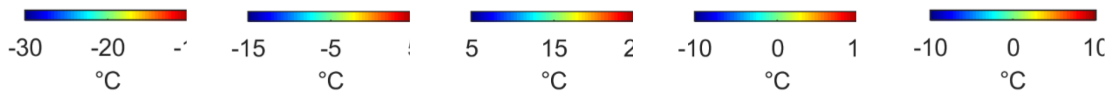
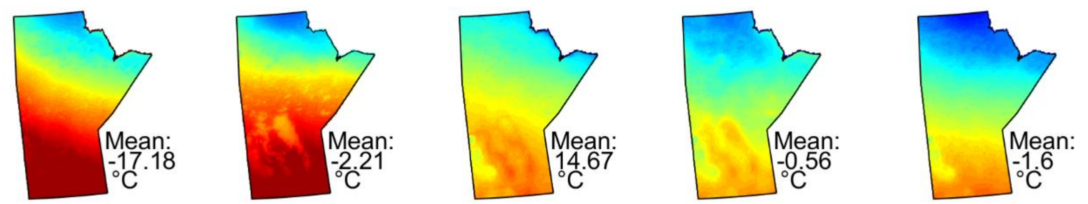
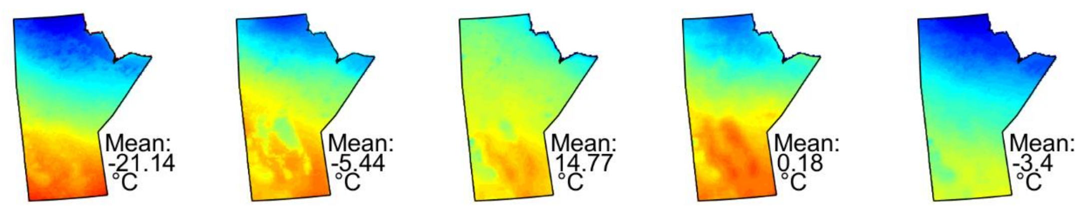
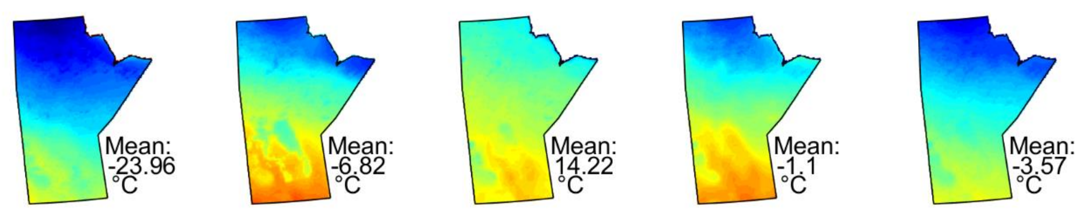
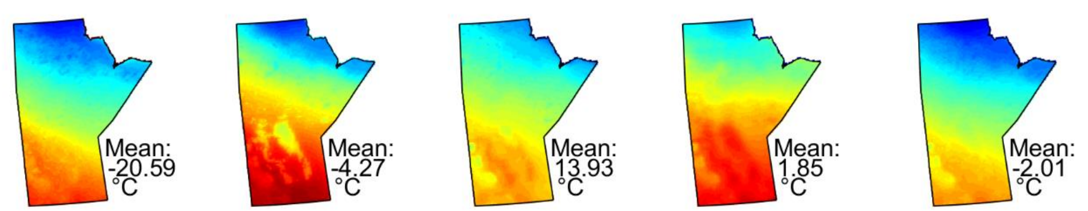
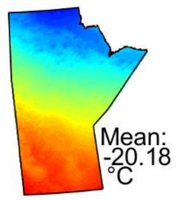
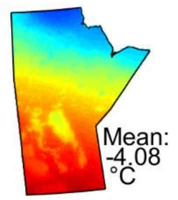
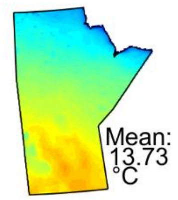
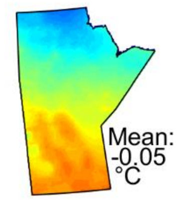
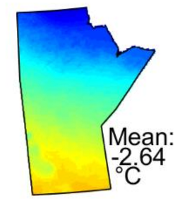
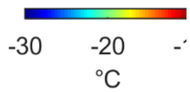
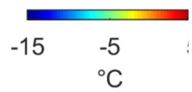
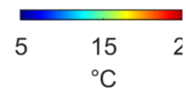
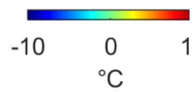
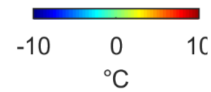
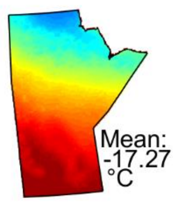
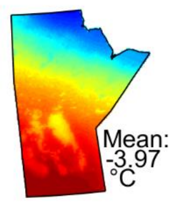
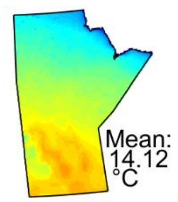
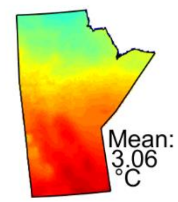
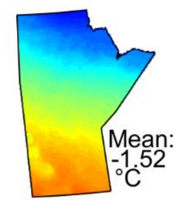
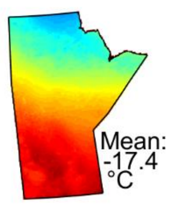
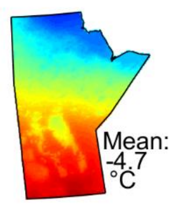
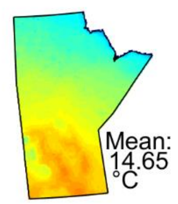
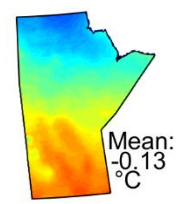
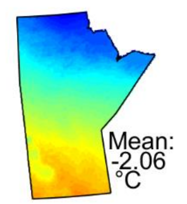
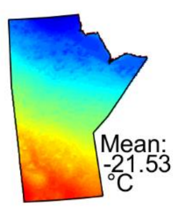
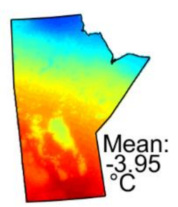
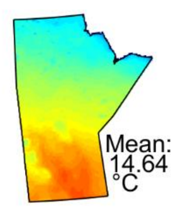
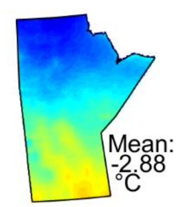
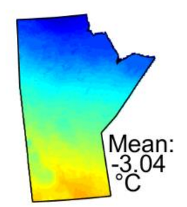
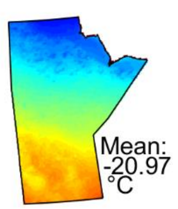
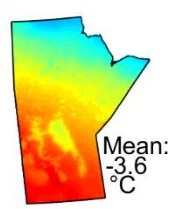
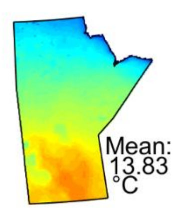
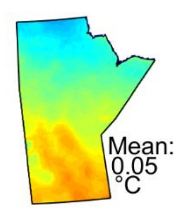
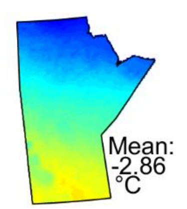
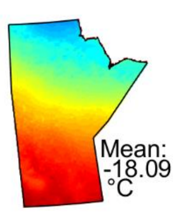
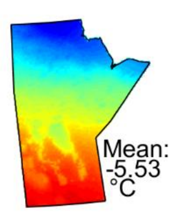
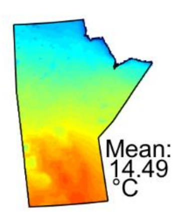
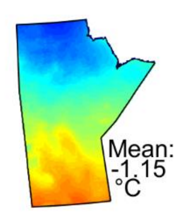
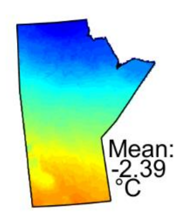


Figure 2.4-4. 2017-2019 Jenpeg GS daily sediment load.

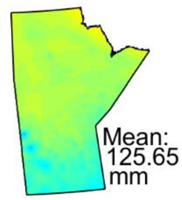
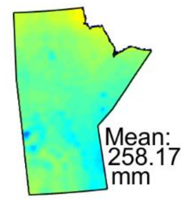
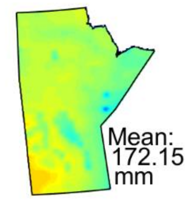
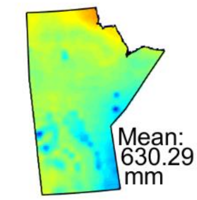
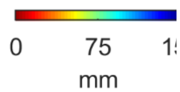
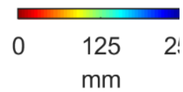
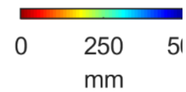
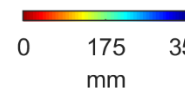
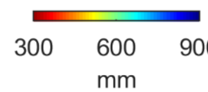
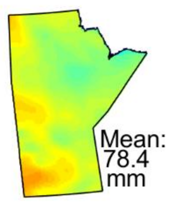
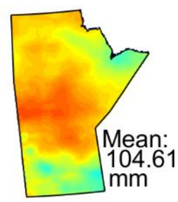
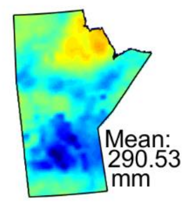
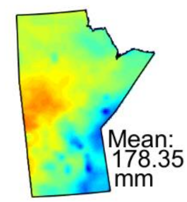
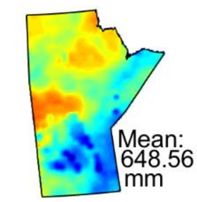
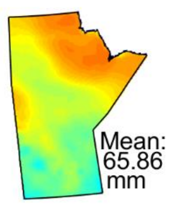
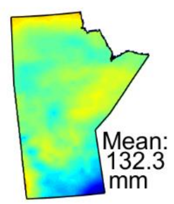
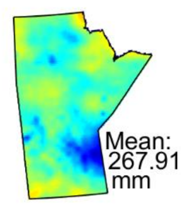
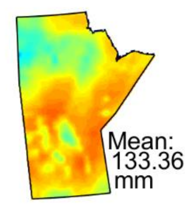
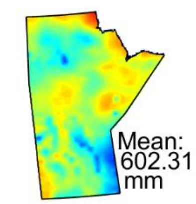
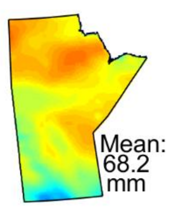
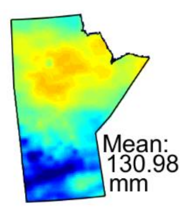
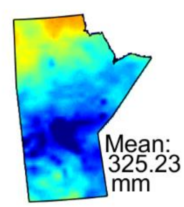
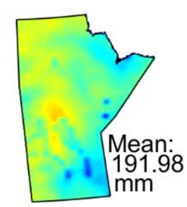
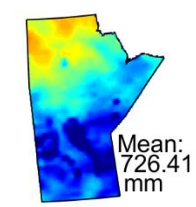
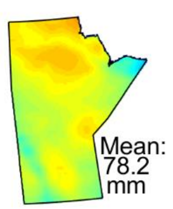
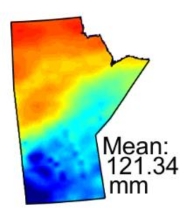
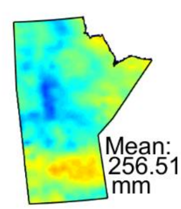
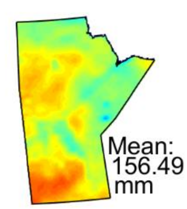
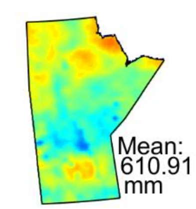
APPENDIX 2-1. SEASONAL AND ANNUAL TEMPERATURE NORMALS DERIVED FROM ERA5-LAND DATA

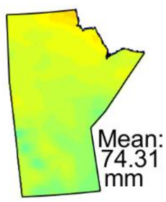
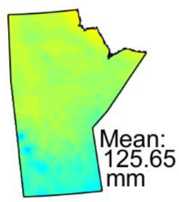
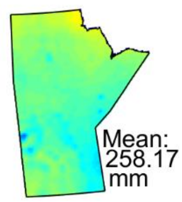
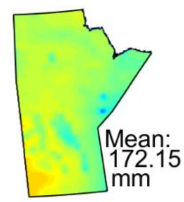
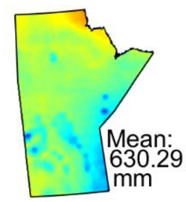
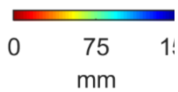
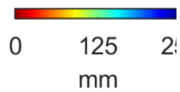
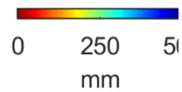
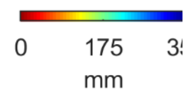
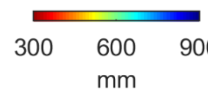
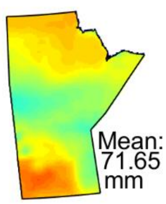
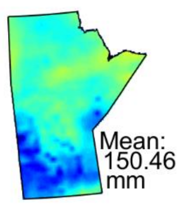
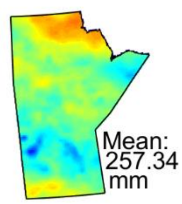
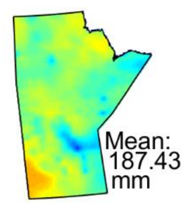
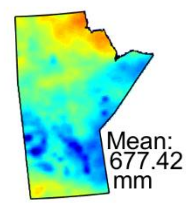
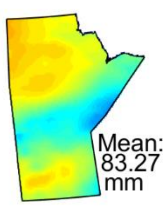
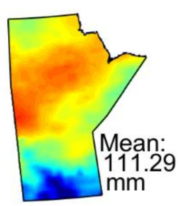
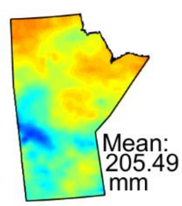
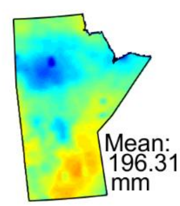
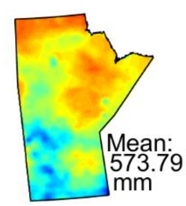
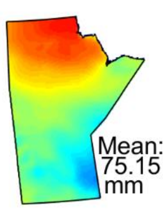
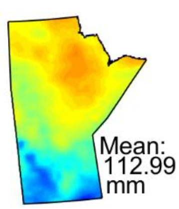
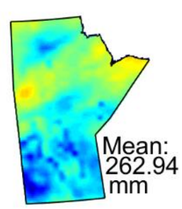
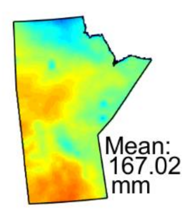
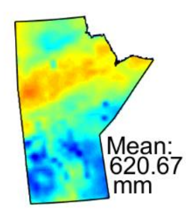
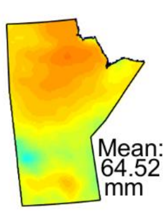
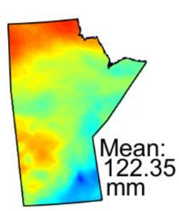
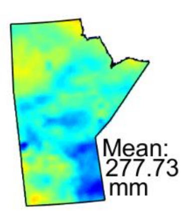
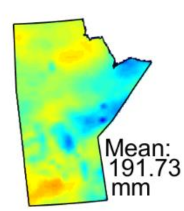
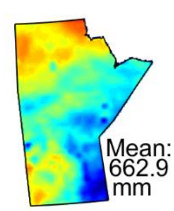
Year	Winter (DJF)	Spring (MAM)	Summer (JJA)	Fall (SON)	Annual
Normals (1981-2010)					
					
2008					
2009					
2010					
2011					

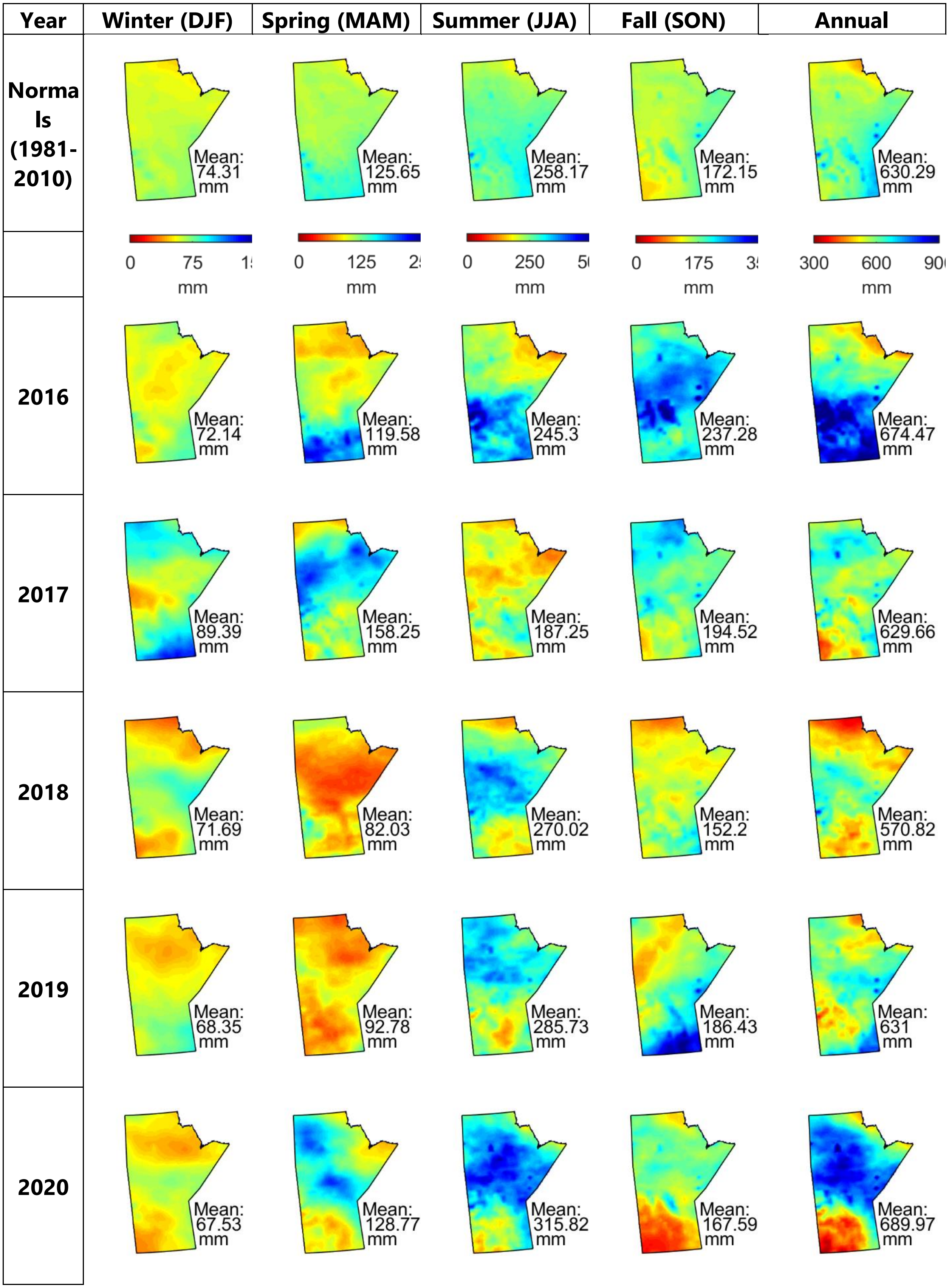
Year	Winter (DJF)	Spring (MAM)	Summer (JJA)	Fall (SON)	Annual
Normals (1981-2010)					
					
2012					
2013					
2014					
2015					

Year	Winter (DJF)	Spring (MAM)	Summer (JJA)	Fall (SON)	Annual
Normals (1981-2010)					
					
2016					
2017					
2018					
2019					
2020					

APPENDIX 2-2. SEASONAL AND PRECIPITATION NORMALS DERIVED FROM ERA5-LAND DATA

Year	Winter (DJF)	Spring (MAM)	Summer (JJA)	Fall (SON)	Annual
Normals (1981-2010)					
					
2008					
2009					
2010					
2011					

Year	Winter (DJF)	Spring (MAM)	Summer (JJA)	Fall (SON)	Annual
Normals (1981-2010)					
					
2012					
2013					
2014					
2015					


Year
Winter (DJF)
Spring (MAM)
Summer (JJA)
Fall (SON)
Annual
Normals (1981-2010)
Mean: 74.31 mm
Mean: 125.65 mm
Mean: 258.17 mm
Mean: 172.15 mm
Mean: 630.29 mm
0 75 mm
0 125 mm
0 250 mm
0 175 mm
300 600 mm
2016
Mean: 72.14 mm
Mean: 119.58 mm
Mean: 245.3 mm
Mean: 237.28 mm
Mean: 674.47 mm
2017
Mean: 89.39 mm
Mean: 158.25 mm
Mean: 187.25 mm
Mean: 194.52 mm
Mean: 629.66 mm
2018
Mean: 71.69 mm
Mean: 82.03 mm
Mean: 270.02 mm
Mean: 152.2 mm
Mean: 570.82 mm
2019
Mean: 68.35 mm
Mean: 92.78 mm
Mean: 285.73 mm
Mean: 186.43 mm
Mean: 631 mm
2020
Mean: 67.53 mm
Mean: 128.77 mm
Mean: 315.82 mm
Mean: 167.59 mm
Mean: 689.97 mm

3.0 WATER QUALITY

3.1 INTRODUCTION

The following presents the results of water quality monitoring conducted from 2008 to 2019 in the Upper Nelson River Region. Twelve sites were monitored in the Upper Nelson River Region: six on-system annual sites (Lake Winnipeg - Big Mossy Point, Lake Winnipeg - Site 22, Nelson River near Warren Landing, Two-Mile Channel Inlet, Two-Mile Channel Outlet, and Cross Lake) and four on-system rotational sites (Playgreen Lake, Little Playgreen Lake, Sipiwesk Lake, and upper Nelson River upstream of the Kelsey GS); and, one off-system annual site (Setting Lake) and one off-system rotational site (Walker Lake; Table 3.1-1 and Figure 3.1-1). Annual sites are sampled each year, whereas rotational sites are sampled once every three years on a rotational basis and are therefore limited to three or four years of data for the 12-year period.

The CAMP water quality program includes four sampling periods (referred to as spring, summer, fall, and winter) per monitoring year (i.e., April-March) at a single location within each waterbody or area of a waterbody/river reach. Over the 12-year period, water quality sampling was conducted at each sampling location during each sampling period (i.e., n=48 for annual sites) with the following exceptions (Table 3.1-1; Appendix 3-1):

- the Lake Winnipeg outlet area sites are not sampled in winter;
- annual sampling was initiated in 2012, 2013, and 2017 at sites in the Lake Winnipeg outlet area including,
  - the Nelson River near Warren Landing, which was added in 2012 (*in situ* monitoring started in 2013),
  - Two-Mile Channel Inlet and Outlet sites, which were added in 2013, and
  - Lake Winnipeg at Big Mossy Point and Lake Winnipeg at Site 22, which were added in 2017; and
- due to repairs to the ship (i.e., the Motor Vessel *Namao*) used for Lake Winnipeg monitoring, some Lake Winnipeg research surveys were delayed or cancelled such that,
  - Lake Winnipeg outlet area sites were not sampled in spring 2014,
  - sampling at Nelson River near Warren Landing, and Two-Mile Channel Inlet and Outlet was delayed until mid-July in spring 2018, and
  - Lake Winnipeg at Big Mossy Point and Site 22 were not sampled in spring 2018.

A detailed description of the program design and sampling methods is provided in Technical Document 1, Section 2.3.

Three indicators (dissolved oxygen (DO); water clarity; and nutrients/trophic status) were selected for detailed reporting (Table 3.1-2). Metrics for these indicators include DO and its supporting metric temperature/stratification, Secchi disk depth, turbidity, TSS, total phosphorus (TP), total nitrogen (TN), and chlorophyll *a* (Table 3.1-2). A detailed description of these indicators is provided in CAMP (2024).

Table 3.1-1. 2008-2019 water quality sampling inventory.

Waterbody/ Area	Sampling Year [1]											
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
LW-BMP [2]										●	●[3]	●
LW-22 [2]										●	●[3]	●
NR-WL [2]					●[4]	●	●[3]	●	●	●	●[5]	●
2M-IN [2]						●	●[3]	●	●	●	●[5]	●
2M-OUT [2]						●	●[3]	●	●	●	●[5]	●
CROSS	●	●	●	●	●	●	●	●	●	●	●	●
PLAYG		●			●			●			●	
LPLAY			●			●			●			●
SIP				●			●			●		
UNR				●			●			●		
SET	●	●	●	●	●	●	●	●	●	●	●	●
WLKR			●			●			●			●

Notes:

1. Sampling year is from April-March.
2. Site not sampled in winter.
3. No spring sampling due to repairs to the Motor Vessel Namao.
4. *In situ* monitoring started in 2013.
5. Spring sampling occurred late (mid-July) due to repairs to the Motor Vessel Namao.

Table 3.1-2. Water quality indicators and metrics.

Indicator	Metric	Units
Dissolved Oxygen	• Dissolved oxygen (DO)	milligrams per litre (mg/L) and percent (%) saturation
	• Temperature/stratification [1]	°C
Water Clarity	• Secchi disk depth	m
	• Turbidity	Nephelometric turbidity units (NTU)
	• Total suspended solids (TSS)	mg/L
Nutrients and Trophic Status	• Total phosphorus (TP)	mg/L
	• Total nitrogen (TN)	mg/L
	• Chlorophyll *a*	micrograms per litre (µg/L)

Notes:

1. Supporting metric.

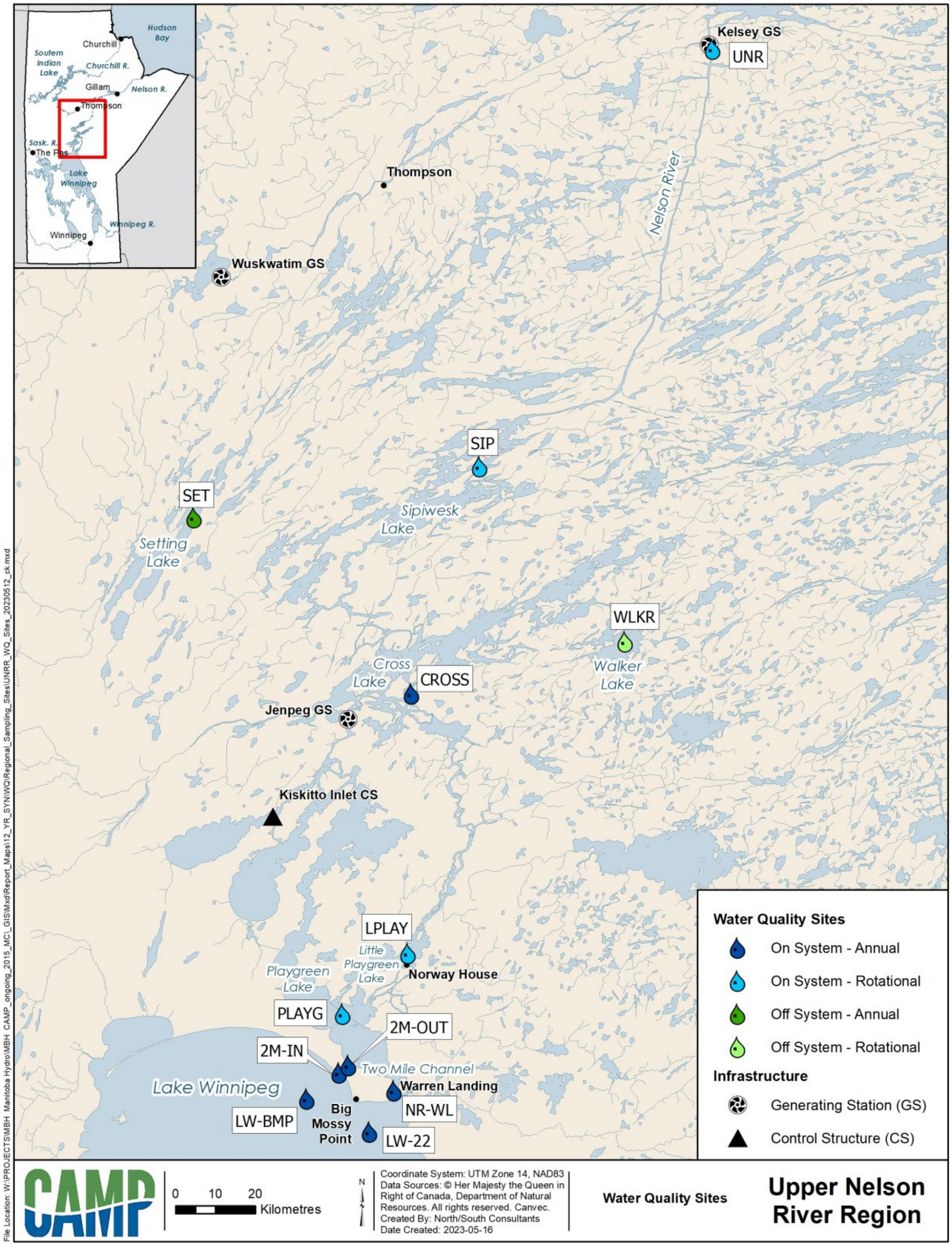


Figure 3.1-1. 2008-2019 Upper Nelson River Region water quality sites.

3.2 DISSOLVED OXYGEN

3.2.1 DISSOLVED OXYGEN

3.2.1.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg Outlet Area

Lake Winnipeg - Big Mossy Point

Lake Winnipeg at Big Mossy Point was well-oxygenated and DO concentrations throughout the water column consistently met the Manitoba Water Quality Standards, Objectives, and Guidelines (MWQSOGs) instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water season (Manitoba Water Stewardship [MWS] 2011; Table 3.2-1). No data are available for the ice-cover season as this site is not sampled in winter.

Lake Winnipeg at Big Mossy Point was, with one exception, isothermal. The exception was summer 2017 when thermal stratification was observed (Table 3.2-1 and Figure 3.2-1).

DO concentrations were similar throughout the water column during each sampling period (Figure 3.2-2). During the open-water season, DO concentrations ranged from 9.16 to 11.45 mg/L at the surface and 7.86 to 12.44 mg/L near the bottom (maximum site water depth = 14.6 m; Table 3.2-2 and Figure 3.2-3).

During the open-water season, surface DO saturation ranged from 81.2 to 107.0% with a mean of 95.5% and a median of 96.3% over the three years of monitoring. Mean annual surface DO saturation levels ranged from 90.1 to 99.9% and were within or near the interquartile range (IQR) of 90.5 to 100.3%. Bottom DO saturation ranged from 71.8 to 100.3% with a mean of 90.8% and a median of 93.1% over the three years of monitoring. Mean annual bottom DO saturation levels ranged from 85.1 to 96.0% and were within or near the IQR of 86.7 to 98.4% (Table 3.2-2 and Figure 3.2-4).

Lake Winnipeg - Site 22

Lake Winnipeg at Site 22 was well-oxygenated and DO concentrations throughout the water column consistently met the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water season (Table 3.2-1). No data are available for the ice-cover season as this site is not sampled in winter.

Lake Winnipeg at Site 22 was isothermal (i.e., thermal stratification was not observed) and DO concentrations were similar throughout the water column during each sampling period (Figures 3.2-1 and 3.2-2). During the open-water season, DO concentrations ranged from 9.49 to 12.42 mg/L at the surface and 7.79 to 12.53 mg/L near the bottom (maximum site water depth = 15.2 m; Table 3.2-2 and Figure 3.2-5).

During the open-water season, surface DO saturation ranged from 84.3 to 112.8% with a mean of 99.7% and a median of 99.2% over the three years of monitoring. Mean annual surface DO saturation levels ranged from 96.7 to 101.1% and were within the IQR of 94.4 to 106.0% in all years. Bottom DO saturation ranged from 82.0 to 101.5% with a mean of 91.6% and a median of 94.0% over the three years of monitoring. Mean annual bottom DO saturation levels ranged from 82.2 to 97.9% and were within or near the IQR of 85.7 to 96.2% (Table 3.2-2 and Figure 3.2-4).

Nelson River near Warren Landing

The Nelson River near Warren Landing was well-oxygenated and DO concentrations near the surface consistently met the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water season (Table 3.2-1). No data are available for the ice-cover season and only surface data are available for this site.

During the open-water season, surface DO concentrations ranged from 8.45 to 12.93 mg/L over the seven years of monitoring (Table 3.2-2 and Figure 3.2-6). DO concentrations varied between seasons, with seasonal mean DO concentrations being higher in spring and fall when the water was cooler, and lower in the summer when the water was warmer (Figure 3.2-7).

DO saturation was near 100% at the surface during each season sampled (Figure 3.2-7). DO saturation ranged from 81.7 to 122.5% with a mean of 102.6% and a median of 101.5% over the seven years of monitoring. Mean annual surface DO saturation levels ranged from 87.3 to 117.1% and were within the IQR (96.7 to 109.2%) in most years. Mean DO concentrations were below the IQR in 2013 and above the IQR in 2014 (Table 3.2-2 and Figure 3.2-8).

Two-Mile Channel

Two-Mile Channel Inlet

Two-Mile Channel Inlet was well-oxygenated and DO concentrations near the surface consistently met the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water season (Table 3.2-1). No data are available for the ice-cover season and only surface data are available for this site.

During the open-water season, surface DO concentrations ranged from 9.01 to 13.11 mg/L over the six years of monitoring (no data are available for 2014; Table 3.2-2 and Figure 3.2-9).

DO saturation ranged from 82.8 to 111.4% over the six years of monitoring. The mean was 99.1%, the median was 99.5%, and the IQR was 97.2 to 101.5%. Mean annual surface DO saturation levels ranged from 91.6 to 104.2% and were within or near the IQR in all years (Table 3.2-2 and Figure 3.2-8).

Two-Mile Channel Outlet

Two-Mile Channel Outlet was well-oxygenated and DO concentrations near the surface consistently met the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water season (Table 3.2-1). No data are available for the ice-cover season and only surface data are available for this site.

During the open-water season, surface DO concentrations ranged from 9.06 to 13.49 mg/L over the six years of monitoring (no data are available for 2014; Table 3.2-2 and Figure 3.2-10).

DO saturation ranged from 83.0 to 115.3% over the six years of monitoring. The mean was 99.4%, the median was 99.9%, and the IQR was 97.2 to 101.8. Mean annual surface DO saturation levels ranged from 83.0 to 105.7% and were within or near the IQR in most years. The exception was 2012 when the spring DO saturation level was below the IQR; there are no other DO data available for 2012 (Table 3.2-2 and Figure 3.2-8).

Cross Lake

Cross Lake was well-oxygenated year-round and, with one exception, DO concentrations throughout the water column met the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water and ice-cover seasons. The exception occurred in winter 2008 when DO was below the instantaneous minimum objective for cold-water aquatic life (8.0 mg/L) at both the surface and bottom (Table 3.2-1).

Cross Lake was isothermal (i.e., thermal stratification was not observed) and DO concentrations were similar throughout the water column during each sampling period (Figures 3.2-1 and 3.2-2). During the open-water season, DO concentrations ranged from 7.96 to 11.28 mg/L at the surface and 7.64 to 11.36 mg/L near the bottom (maximum site water depth = 14.5 m). During the ice-cover season, DO concentrations ranged from 7.09 to 14.37 mg/L at the surface and 5.58 to 14.07 mg/L near the bottom (Table 3.2-2 and Figure 3.2-11).

DO concentrations varied between seasons with seasonal mean DO concentrations being higher in winter when the water was cooler, and lower in the open-water season when the water was warmer (Figure 3.2-12).

DO saturation was near 100%, on average, at both the surface and near the bottom during each season sampled (Figure 3.2-13). During the open-water season, surface DO saturation ranged from 89.5 to 112.0% with a mean of 98.8% and a median of 98.2% over the 12 years of monitoring. Mean surface DO saturation levels in the open-water season were similar from year to year ranging from 93.0 to 105.7% and were within or near the IQR of 94.6 to 102.8%. Bottom DO saturation during the open-water season ranged from 81.5 to 108.8% with a mean of 95.0% and a median of 94.0% over the 12 years of monitoring. Mean bottom DO saturation levels in the open-water season ranged from 84.1 to 101.3% and were within or near the IQR (91.0 to 99.7%) in most years. The exception was 2012 when it was below the IQR (Table 3.2-2 and Figure 3.2-14).

During the ice-cover season, DO saturation at the surface ranged from 52.6 to 105.8% with a mean of 89.5% and a median of 92.2%. The IQR was 88.9 to 94.2%. DO saturation at the surface was within or near the IQR except in 2008 when it was below the IQR. Bottom DO saturation during the ice-cover season ranged from 41.8 to 103.6% with a mean of 87.7% and a median of 92.1%. The IQR was 88.5 to 93.1%. DO saturation at the bottom was within or near the IQR except in 2008 when it was below the IQR (Table 3.2-2 and Figure 3.2-14).

ROTATIONAL SITES

Playgreen Lake

Playgreen Lake was well-oxygenated year-round and DO concentrations throughout the water column consistently met the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water and ice-cover seasons (Table 3.2-1).

Playgreen Lake was isothermal and DO concentrations were similar throughout the water column during each season sampled (Table 3.2-1, and Figures 3.2-1 and 3.2-2). During the open-water season, DO concentrations ranged from 8.34 to 11.48 mg/L at the surface and 8.26 to 11.49 mg/L near the bottom (maximum site water depth = 6.8 m). During the ice-cover season, DO concentrations ranged from 13.26 to 15.34 mg/L at the surface and 13.22 to 15.33 mg/L near the bottom (Table 3.2-2 and Figure 3.2-15).

DO saturation in Playgreen Lake was near 100% at both the surface and near the bottom of the water column during each sampling period. During the open-water season, surface DO saturation ranged from 91.2 to 111.4% with a mean of 101.2% and a median of 100.3% over the four years of monitoring. Mean surface DO saturation levels in the open-water season ranged from 95.7 to 106.4% and were within or near the IQR of 98.8 to 102.6%. Bottom DO saturation during the open-water season ranged from 90.3 to 111.4% with a mean of 99.5% and a median of 99.0% over the four years of monitoring. Mean bottom DO saturation levels in the open-water season ranged from 92.8 to 104.4% and were within or near the IQR of 93.4 to 102.6% (Table 3.2-2 and Figure 3.2-16).

During the ice-cover season, DO saturation at the surface ranged from 93.5 to 113.5% with a mean of 103.1%. Bottom DO saturation during the ice-cover season ranged from 93.2 to 113.4% with a mean of 102.7% (Table 3.2-2 and Figure 3.2-17).

Little Playgreen Lake

Little Playgreen was well-oxygenated year-round and DO concentrations throughout the water column consistently met the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water and ice-cover seasons (Table 3.2-1).

Little Playgreen Lake was isothermal and DO concentrations were similar throughout the water column during each sampling period (Table 3.2-1, and Figures 3.2-1 and 3.2-2). During the open-water season, DO concentrations ranged from 8.51 to 10.47 mg/L at the surface and 8.35 to

10.34 mg/L near the bottom (maximum site water depth = 8.9 m). During the ice-cover season, DO concentrations ranged from 12.28 to 14.09 mg/L at the surface and 12.25 to 13.97 mg/L near the bottom (Table 3.2-2 and Figure 3.2-18).

DO saturation in Little Playgreen Lake was near 100% at both the surface and near the bottom of the water column during each season sampled. During the open-water season, surface DO saturation ranged from 90.8 to 104.6% with a mean of 98.7% and a median of 98.6% over the four years of monitoring. Mean surface DO saturation levels in the open-water season ranged from 96.9 to 100.6% and were within or near the IQR of 97.3 to 101.4%. Bottom DO saturation during the open-water season ranged from 90.1 to 101.6% with a mean of 96.5% and a median of 96.8% over the four years of monitoring. Mean bottom DO saturation levels in the open-water season ranged from 94.6 to 97.8% and were within or near the IQR of 95.1 to 98.1% (Table 3.2-2 and Figure 3.2-16).

During the ice-cover season, DO saturation at the surface ranged from 85.7 to 97.5% with a mean of 93.3%. Bottom DO saturation during the ice-cover season ranged from 85.5 to 96.7% with a mean of 92.4% (Table 3.2-2 and Figure 3.2-17).

Sipiwesk Lake

Sipiwesk Lake was well-oxygenated year-round and DO concentrations throughout the water column consistently met the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water and ice-cover seasons (Table 3.2-1).

Sipiwesk Lake was isothermal and DO concentrations were similar throughout the water column during each sampling period (Table 3.2-1, and Figures 3.2-1 and 3.2-2). During the open-water season, DO concentrations ranged from 8.35 to 9.80 mg/L at the surface and 8.18 to 9.92 mg/L near the bottom (maximum site water depth = 15.0 m). During the ice-cover season, DO concentrations ranged from 13.82 to 15.62 mg/L at the surface and 14.82 to 15.79 mg/L near the bottom (Table 3.2-2 and Figure 3.2-19).

DO saturation in Sipiwesk Lake was near 100% at both the surface and near the bottom of the water column during each sampling period. During the open-water season, surface DO saturation ranged from 93.8 to 99.2% with a mean of 96.9% and a median of 96.5% over the three years of monitoring. Mean surface DO saturation levels in the open-water season ranged from 93.8 to 97.7% and were within or near the IQR of 95.6 to 98.8%. Bottom DO saturation during the open-water season ranged from 91.5 to 100.1% with a mean of 95.4% and a median of 94.2% over the three years of monitoring. Mean bottom DO saturation levels in the open-water season ranged from 91.5 to 96.2% and were within or near the IQR of 93.3 to 97.6% (Table 3.2-2 and Figure 3.2-16).

During the ice-cover season, DO saturation at the surface was 101.5% in 2011 and 109.2% in 2017 with a mean of 105.3%. Bottom DO saturation during the ice-cover season was 108.8% in 2011 and 110.3% in 2017 with a mean of 109.6% (Table 3.2-2 and Figure 3.2-17).

Upper Nelson River Upstream of the Kelsey GS

The upper Nelson River upstream of the Kelsey GS was well-oxygenated year-round and DO concentrations throughout the water column consistently met the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water and ice-cover seasons (Table 3.2-1).

The upper Nelson River upstream of the Kelsey GS was isothermal and DO concentrations were similar throughout the water column during each sampling period (Table 3.2-1, and Figures 3.2-1 and 3.2-2). During the open-water season, DO concentrations ranged from 7.65 to 11.29 mg/L at the surface and 7.56 to 10.11 mg/L near the bottom (maximum site water depth = 32.0 m). During the ice-cover season, the DO concentration was 15.05 mg/L at the surface and 15.08 mg/L near the bottom in 2017 (Table 3.2-2 and Figure 3.2-20).

DO saturation in the upper Nelson River upstream of the Kelsey GS was near 100% at both the surface and near the bottom of the water column during each season sampled. During the open-water season, surface DO saturation ranged from 87.4 to 110.9% with a mean of 95.4% and a median of 93.7% over the three years of monitoring. Mean surface DO saturation levels in the open-water season ranged from 91.6 to 102.1% and were within or near the IQR of 88.4 to 98.2%. Bottom DO saturation during the open-water season ranged from 87.0 to 99.4% with a mean of 92.3% and a median of 91.1% over the three years of monitoring. Mean bottom DO saturation levels in the open-water season ranged from 90.9 to 93.6% and were within the IQR of 87.7 to 95.9% (Table 3.2-2 and Figure 3.2-16).

During the ice-cover season, the DO saturation was 104.5% at the surface and 105.0% near the bottom in 2017 (Table 3.2-2 and Figure 3.2-17).

3.2.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Setting Lake was well-oxygenated near the surface and DO concentrations met the MWQSOGs during all sampling periods. DO concentrations decreased with water depth and fell below the MWQSOGs instantaneous minimum objectives for cool- and/or cold-water aquatic life during some open-water and ice-cover sampling events.

Setting Lake was thermally stratified during a least one open-water sampling event in each of the 12 years of monitoring (Figure 3.2-1). Specifically, stratification was observed in nine spring monitoring events (2008, 2009 2010, 2011, 2012, 2013, 2015, 2016, and 2018) and during six summer sampling events (2008, 2009, 2014, 2015, 2017, and 2019); notably, stratification was not observed during any of the fall sampling events (Table 3.2-3).

During the open-water season Setting Lake was well-oxygenated near the surface. However, DO concentrations decreased down the water column to levels below one or more of the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life at approximately 15-23 m from the surface during some summers (Figure 3.2-2). Specifically, DO concentrations near the bottom were below the MWQSOGs instantaneous minimum objective for cool-water aquatic life (5.0 mg/L) in the summers of 2008, 2009, 2014, 2015, and 2017; as well as the MWQSOGs instantaneous minimum objective for cold-water aquatic life (4.0 mg/L) in the summers for 2008, 2015, and 2017 (Table 3.2-3 and Figure 3.2-21). During the open-water season, DO concentrations ranged from 8.01 to 11.46 mg/L at the surface and from 1.88 to 11.92 mg/L near the bottom (maximum site water depth = 25.6 m; Table 3.2-4 and Figure 3.2-21).

Similarly, during the ice-cover season Setting Lake was well-oxygenated near the surface while DO concentrations decreased with depth and fell below the MWQSOGs instantaneous minimum objectives for cold-water aquatic life near the bottom of the water column in most winters (Figure 3.2-2). Specifically, DO concentrations near the bottom were below the MWQSOGs instantaneous minimum objectives for cold-water aquatic life (8.0 mg/L) in the winters of 2008, 2009, 2011, 2012, 2013, 2017, and 2019 (Table 3.2-3). In the ice-cover season, DO concentrations ranged from 12.94 to 14.82 mg/L at the surface and from 3.88 to 9.70 mg/L near the bottom (Table 3.2-4 and Figure 3.2-21). The decrease in DO concentrations with depth occurred despite the lake being isothermal in winter (Table 3.2-3 and Figure 3.2-1).

DO concentrations varied between seasons with seasonal mean DO concentrations being higher in winter when the water was cooler, and lower in the open-water season when the water was warmer (Figure 3.2-22).

DO saturation was near 100% at the surface during each season sampled (Figure 3.2-23). In the open-water season, surface DO saturation ranged from 84.5 to 111.9% with a mean of 97.9% and a median of 96.1% over the 12 years of monitoring. Mean surface DO saturation levels in the open-water season were similar from year to year ranging from 93.3 to 105.2% and were within or near the IQR of 92.2 to 101.9% (Table 3.2-4 and Figure 3.2-24). During the ice-cover season, surface DO saturation ranged from 95.4 to 109.5% with a mean of 100.5% and a median of 99.5%. The IQR for the ice-cover season was 96.4 to 103.2% (Table 3.2-4 and Figure 3.2-25).

Seasonal differences in both DO concentration and percent saturation occurred near the bottom of the water column where mean DO saturation was lower in summer and winter (53.4 and 54.5%, respectively) and higher in spring and fall (85.4 and 89.2%, respectively; Figures 3.2-22 and 3.2-23). During the open-water season, bottom DO saturation ranged from 17.2 to 101.9% with a mean of 76.0% and a median of 82.6% over the 12 years of monitoring (Table 3.2-4). Bottom DO saturation tended to be below the IQR for the open-water season (72.7 to 89.8%) in summer (Figure 3.2-24). During the ice-cover season, bottom DO saturation ranged from 31.0 to 73.1% with a mean of 54.5% and a median of 55.6%. The IQR for the ice-cover season was 48.5 to 60.4% (Table 3.2-4 and Figure 3.2-25).

ROTATIONAL SITES

Walker Lake

Walker Lake was well-oxygenated near the surface and DO concentrations near the surface met the MWQSOGs during all sampling periods. DO concentrations decreased with water depth and fell below the MWQSOGs instantaneous minimum objective for cold-water aquatic life in the ice-cover season.

Walker Lake was isothermal with the exception of two spring sampling events over the four years of monitoring. Specifically, stratification was observed in spring 2010 and spring 2013 (Table 3.2-3 and Figure 3.2-1).

DO concentrations were similar throughout the water column in spring and fall but decreased with water depth during some summer sampling events (Figure 3.2-2). Specifically, DO concentrations were lower near the bottom than at the surface in the summers of 2010 and 2016. However, DO concentrations near both the surface and bottom met MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life (5.0 and 4.0 mg/L, respectively) during all open-water monitoring events over the four years of monitoring (Table 3.2-3). During the open-water season, DO concentrations ranged from 8.30 to 10.76 mg/L at the surface and 5.99 to 10.16 mg/L near the bottom (maximum site water depth = 11.0 m; Table 3.2-4, and Figure 3.2-26).

During the ice-cover season, Walker Lake was well-oxygenated near the surface while DO concentrations decreased with water depth and fell below the MWQSOGs instantaneous minimum objectives for cold-water aquatic life near the bottom of the water column (Figure 3.2-2). Specifically, DO concentrations near the bottom were below the MWQSOGs instantaneous minimum objectives for cold-water aquatic life (8.0 mg/L) in the winters of 2013, 2016, and 2019 (Table 3.2-3). In the ice-cover season, DO concentrations ranged from 12.28 to 13.36 mg/L at the surface and 5.02 to 7.40 mg/L near the bottom (Table 3.2-4 and Figure 3.2-26). The decrease in DO concentrations with depth occurred despite the lake being isothermal in winter (Table 3.2-3 and Figure 3.2-1).

During the open-water season, surface DO saturation ranged from 92.1 to 112.3% with a mean of 100.5% and a median of 100.6% over the four years of monitoring. Mean surface DO saturation levels in the open-water season ranged from 97.6 to 103.9% and were within the IQR of 96.4 to 104.4%. Bottom DO saturation during the open-water season ranged from 65.1 to 102.6% with a mean of 91.3% and a median of 94.7% over the four years of monitoring. Mean bottom DO saturation levels in the open-water season ranged from 87.0 to 97.5% and were within the IQR (91.9 to 98.0%) in two of four years. Mean DO saturation levels near the bottom were below the IQR in 2010 and 2016 (Table 3.2-4 and Figure 3.2-24).

During the ice-cover season, DO saturation at the surface ranged from 87.0 to 98.7% with a mean of 93.1%. Bottom DO saturation during the ice-cover season ranged from 37.7 to 55.3% with a mean of 48.7% (Table 3.2-4 and Figure 3.2-25).

Table 3.2-1. 2008-2019 On-system sites summary of thermal stratification and DO concentrations.

Metric	Sampling Year	Surface or Bottom [1]	LW-BMP				LW-22				NR-WL				2M-IN				2M-OUT			
			Open-Water			Ice-Cover	Open-Water			Ice-Cover	Open-Water			Ice-Cover	Open-Water			Ice-Cover	Open-Water			Ice-Cover
			SP	SU	FA	WI	SP	SU	FA	WI	SP	SU	FA	WI	SP	SU	FA	WI	SP	SU	FA	WI
Thermal Stratification	2008										No Data				No Data				No Data			
	2009																					
	2010																					
	2011																					
	2012																					
	2013																					
	2014																					
	2015																					
	2016																					
	2017		No	2017	No		No	No	No													
	2018			No	No			No	No													
	2019		No	ND	No		No	ND	No													
DO within MWQSOGs PAL objectives	2008	Surface																				
		Bottom																				
	2009	Surface																				
		Bottom																				
	2010	Surface																				
		Bottom																				
	2011	Surface																				
		Bottom																				
	2012	Surface									ND	ND	ND									
		Bottom																				
	2013	Surface									Yes	Yes	ND		Yes	Yes	ND		Yes	ND	ND	
		Bottom																				
	2014	Surface									ND	Yes	Yes		ND	ND	ND		ND	ND	ND	
		Bottom																				
	2015	Surface									Yes	Yes	Yes		ND	Yes	ND		ND	Yes	ND	
		Bottom																				
	2016	Surface									Yes	Yes	Yes		Yes	Yes	Yes		Yes	Yes	Yes	
		Bottom																				
	2017	Surface	Yes	Yes	Yes		Yes	Yes	Yes		Yes	Yes	Yes		Yes	Yes	Yes		Yes	Yes	Yes	
		Bottom	Yes	Yes	Yes		Yes	Yes	Yes													
	2018	Surface		Yes	Yes			Yes	Yes		Yes	Yes	Yes		Yes	Yes	Yes		Yes	Yes	Yes	
		Bottom		Yes	Yes			Yes	Yes													
	2019	Surface	Yes	Yes	Yes		Yes	Yes	Yes		ND	Yes	Yes		ND	Yes	Yes		ND	Yes	Yes	
		Bottom	Yes	ND	Yes		Yes	ND	Yes													

Table 3.2.1. continued.

Metric	Sampling Year	Surface or Bottom [1]	CROSS				PLAYG				LPLAY				SIP				UNR			
			Open-Water			Ice-Cover	Open-Water			Ice-Cover	Open-Water			Ice-Cover	Open-Water			Ice-Cover	Open-Water			Ice-Cover
			SP	SU	FA	WI	SP	SU	FA	WI	SP	SU	FA	WI	SP	SU	FA	WI	SP	SU	FA	WI
Thermal Stratification	2008		No	No	No	No																
	2009		No	No	ND	No	No	No	ND	No												
	2010		No	No	No	No					No	No	No	No								
	2011		No	No	No	No									No	No	No	No	No	No	No	No
	2012		No	No	ND	No	No	No	No	No												
	2013		No	No	No	No					No	No	No	No								
	2014		ND	No	No	No									ND	No	No	No	No	No	No	No
	2015		No	No	No	No	No	No	No	No												
	2016		No	No	No	No					No	No	No	No								
	2017		No	No	No	No									No	No	No	No	No	No	No	No
	2018		No	No	No	No	No	No	No	No												
	2019		No	No	No	No					No	No	No	No								
DO within MWQSOGs PAL objectives	2008	Surface	Yes	ND	Yes	2008																
		Bottom	Yes	ND	Yes	2008																
	2009	Surface	Yes	Yes	ND	Yes	ND	Yes	ND	Yes												
		Bottom	Yes	Yes	ND	Yes	ND	Yes	ND	Yes												
	2010	Surface	Yes	Yes	Yes	ND					Yes	Yes	Yes	ND								
		Bottom	Yes	Yes	Yes	ND					Yes	Yes	Yes	ND								
	2011	Surface	Yes	Yes	Yes	Yes									Yes	Yes	Yes	Yes	Yes	Yes	Yes	ND
		Bottom	Yes	Yes	Yes	Yes									Yes	Yes	Yes	Yes	Yes	Yes	Yes	ND
	2012	Surface	Yes	Yes	ND	Yes	Yes	Yes	Yes	Yes												
		Bottom	Yes	Yes	ND	Yes	Yes	Yes	Yes	Yes												
	2013	Surface	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes								
		Bottom	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes								
	2014	Surface	ND	Yes	ND	ND									ND	Yes	ND	ND	Yes	Yes	Yes	ND
		Bottom	ND	Yes	ND	ND									ND	Yes	ND	ND	Yes	Yes	Yes	ND
	2015	Surface	Yes	ND	Yes	Yes	Yes	Yes	Yes	Yes												
		Bottom	Yes	ND	Yes	Yes	Yes	Yes	Yes	Yes												
	2016	Surface	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes								
		Bottom	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes								
	2017	Surface	Yes	Yes	Yes	Yes									Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Bottom	Yes	Yes	Yes	Yes									Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	2018	Surface	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes												
		Bottom	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes												
	2019	Surface	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes								
		Bottom	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes								

Notes:

1. SP = spring; SU = summer; FA = fall; WI = winter.
2. ND = No data.
3. MWQSOGs = Manitoba Water Quality Standards, Objectives, and Guidelines; PAL = Protection of aquatic life.
4. DO concentrations were compared to the most stringent MWQSOGs instantaneous minimum PAL objectives for each season; i.e., 5 mg/L for cool-water early life for the open-water season and 8 mg/L for cold-water early life the ice-cover season..
5. Cells with a year indicated denote instances of stratification or non-compliance with MWQSOGs instantaneous minimum objectives.
6. [ ] = Sampling did not occur.

Table 3.2-2. 2008-2019 On-system sites DO, water depth, and ice thickness summary statistics.

Site	Statistic	Dissolved Oxygen								Water Depth at Site (m)		Ice Thickness at Site (m)
		DO - Surface (mg/L)		DO - Bottom (mg/L)		DO Saturation - Surface (%)		DO Saturation - Bottom (%)				
		OW	IC	OW	IC	OW	IC	OW	IC	OW	IC	IC
LW-BMP	Mean	9.87	-	9.78	-	95.5	-	90.8	-	13.8	-	-
	Median	9.61	-	9.24	-	96.3	-	93.1	-	13.9	-	-
	Minimum	9.16	-	7.86	-	81.2	-	71.8	-	13.4	-	-
	Maximum	11.45	-	12.44	-	107.0	-	100.3	-	14.6	-	-
	SD	0.790	-	1.62	-	8.38	-	10.4	-	0.41	-	-
	SE	0.279	-	0.613	-	2.96	-	3.94	-	0.14	-	-
	Lower Quartile	9.38	-	8.93	-	90.5	-	86.7	-	13.6	-	-
	Upper Quartile	10.04	-	10.55	-	100.3	-	98.4	-	14.0	-	-
	n	8	-	7	-	8	-	7	-	8	-	-
	% Detections	100	-	100	-	100	-	100	-	-	-	-
LW-22	Mean	10.28	-	9.90	-	99.7	-	91.6	-	14.5	-	-
	Median	10.08	-	9.63	-	99.2	-	94.0	-	14.3	-	-
	Minimum	9.49	-	7.79	-	84.3	-	82.0	-	14.0	-	-
	Maximum	12.42	-	12.53	-	112.8	-	101.5	-	15.2	-	-
	SD	0.974	-	1.65	-	9.49	-	7.49	-	0.43	-	-
	SE	0.344	-	0.625	-	3.35	-	2.83	-	0.15	-	-
	Lower Quartile	9.57	-	8.95	-	94.4	-	85.7	-	14.2	-	-
	Upper Quartile	10.37	-	10.71	-	106.0	-	96.2	-	14.7	-	-
	n	8	-	7	-	8	-	7	-	8	-	-
	% Detections	100	-	100	-	100	-	100	-	-	-	-
NR-WL	Mean	10.41	-	-	-	102.6	-	-	-	5.3	-	-
	Median	10.24	-	-	-	101.5	-	-	-	5.1	-	-
	Minimum	8.45	-	-	-	81.7	-	-	-	2.3	-	-
	Maximum	12.93	-	-	-	122.5	-	-	-	8.5	-	-
	SD	1.31	-	-	-	9.21	-	-	-	1.8	-	-
	SE	0.308	-	-	-	2.17	-	-	-	0.38	-	-
	Lower Quartile	9.48	-	-	-	96.7	-	-	-	4.0	-	-
	Upper Quartile	11.15	-	-	-	109.2	-	-	-	6.7	-	-
	n	18	-	-	-	18	-	-	-	23	-	-
	% Detections	100	-	-	-	100	-	-	-	-	-	-

Table 3.2-2. continued.

Site	Statistic	Dissolved Oxygen								Water Depth at Site (m)		Ice Thickness at Site (m)
		DO - Surface (mg/L)		DO - Bottom (mg/L)		DO Saturation - Surface (%)		DO Saturation - Bottom (%)				
		OW	IC	OW	IC	OW	IC	OW	IC	OW	IC	IC
2M-IN	Mean	10.04	-	-	-	99.1	-	-	-	7.1	-	-
	Median	9.53	-	-	-	99.5	-	-	-	9.4	-	-
	Minimum	9.01	-	-	-	82.8	-	-	-	2.3	-	-
	Maximum	13.11	-	-	-	111.4	-	-	-	11.0	-	-
	SD	1.23	-	-	-	6.19	-	-	-	3.8	-	-
	SE	0.328	-	-	-	1.65	-	-	-	0.86	-	-
	Lower Quartile	9.12	-	-	-	97.2	-	-	-	3.0	-	-
	Upper Quartile	10.27	-	-	-	101.5	-	-	-	10.7	-	-
	n	14	-	-	-	14	-	-	-	20	-	-
	% Detections	100	-	-	-	100	-	-	-	-	-	-
2M-OUT	Mean	10.20	-	-	-	99.4	-	-	-	10.4	-	-
	Median	9.52	-	-	-	99.9	-	-	-	10.7	-	-
	Minimum	9.06	-	-	-	83.0	-	-	-	5.0	-	-
	Maximum	13.49	-	-	-	115.3	-	-	-	11.6	-	-
	SD	1.33	-	-	-	7.22	-	-	-	1.3	-	-
	SE	0.370	-	-	-	2.00	-	-	-	0.30	-	-
	Lower Quartile	9.24	-	-	-	97.2	-	-	-	10.4	-	-
	Upper Quartile	10.63	-	-	-	101.8	-	-	-	10.8	-	-
	n	13	-	-	-	13	-	-	-	20	-	-
	% Detections	100	-	-	-	100	-	-	-	-	-	-
CROSS	Mean	9.38	12.29	9.09	12.14	98.8	89.5	95.0	87.7	4.7	3.5	0.66
	Median	9.37	12.65	9.20	12.61	98.2	92.2	94.0	92.1	4.2	3.8	0.61
	Minimum	7.96	7.09	7.64	5.58	89.5	52.6	81.5	41.8	1.8	2.4	0.27
	Maximum	11.28	14.37	11.36	14.07	112.0	105.8	108.8	103.6	14.5	4.3	1.00
	SD	0.759	1.95	0.897	2.38	5.22	14.3	6.58	17.1	2.2	0.55	0.21
	SE	0.139	0.616	0.164	0.753	0.952	4.52	1.20	5.40	0.37	0.16	0.06
	Lower Quartile	8.93	12.27	8.22	12.52	94.6	88.9	91.0	88.5	3.5	3.2	0.55
	Upper Quartile	9.92	12.78	9.76	13.06	102.8	94.2	99.7	93.1	5.0	3.8	0.78
	n	30	10	30	10	30	10	30	10	35	12	12
	% Detections	100	100	100	100	100	100	100	100	-	-	-

Table 3.2-2. continued.

Site	Statistic	Dissolved Oxygen								Water Depth at Site (m)		Ice Thickness at Site (m)
		DO - Surface (mg/L)		DO - Bottom (mg/L)		DO Saturation - Surface (%)		DO Saturation - Bottom (%)				
		OW	IC	OW	IC	OW	IC	OW	IC	OW	IC	IC
PLAYG	Mean	9.91	14.09	9.77	14.04	101.2	103.1	99.5	102.7	3.7	5.0	0.70
	Median	9.87	-	9.79	-	100.3	-	99.0	-	3.4	-	-
	Minimum	8.34	13.26	8.26	13.22	91.2	93.5	90.3	93.2	1.5	4.1	0.57
	Maximum	11.48	15.34	11.49	15.33	111.4	113.5	111.4	113.4	6.8	6.0	0.83
	SD	0.864	0.916	0.855	0.943	5.87	8.35	7.07	8.50	1.3	0.80	0.12
	SE	0.273	0.458	0.270	0.472	1.86	4.17	2.24	4.25	0.38	0.40	0.06
	Lower Quartile	9.51	-	9.30	-	98.8	-	93.4	-	3.2	-	-
	Upper Quartile	10.41	-	10.08	-	102.6	-	102.6	-	3.9	-	-
	n	10	4	10	4	10	4	10	4	12	4	4
	% Detections	100	100	100	100	100	100	100	100	-	-	-
LPLAY	Mean	9.57	13.16	9.44	13.04	98.7	93.3	96.5	92.4	3.9	7.1	0.81
	Median	9.69	-	9.73	-	98.6	-	96.8	-	3.1	-	-
	Minimum	8.51	12.28	8.35	12.25	90.8	85.7	90.1	85.5	2.4	5.5	0.53
	Maximum	10.47	14.09	10.34	13.97	104.6	97.5	101.6	96.7	8.9	8.2	0.91
	SD	0.636	0.906	0.642	0.869	4.18	6.56	3.31	6.04	2.1	1.1	0.19
	SE	0.183	0.523	0.185	0.501	1.21	3.79	0.956	3.49	0.62	0.56	0.09
	Lower Quartile	9.29	-	8.89	-	97.3	-	95.1	-	2.8	-	-
	Upper Quartile	9.95	-	9.84	-	101.4	-	98.1	-	3.6	-	-
	n	12	3	12	3	12	3	12	3	12	4	4
	% Detections	100	100	100	100	100	100	100	100	-	-	-
SIP	Mean	9.00	14.72	8.90	15.31	96.9	105.3	95.4	109.6	12.5	9.6	0.56
	Median	8.87	-	8.73	-	96.5	-	94.2	-	13.3	-	-
	Minimum	8.35	13.82	8.18	14.82	93.8	101.5	91.5	108.8	8.4	8.0	0.50
	Maximum	9.80	15.62	9.92	15.79	99.2	109.2	100.1	110.3	15.0	12.5	0.62
	SD	0.576	1.27	0.662	0.686	2.07	5.45	3.14	1.04	2.1	2.5	0.06
	SE	0.218	0.900	0.250	0.485	0.783	3.86	1.19	0.735	0.69	1.5	0.03
	Lower Quartile	8.56	-	8.42	-	95.6	-	93.3	-	12.0	-	-
	Upper Quartile	9.45	-	9.31	-	98.8	-	97.6	-	13.4	-	-
	n	7	2	7	2	7	2	7	2	9	3	3
	% Detections	100	100	100	100	100	100	100	100	-	-	-

Table 3.2-2. continued.

Site	Statistic	Dissolved Oxygen								Water Depth at Site (m)		Ice Thickness at Site (m)
		DO - Surface (mg/L)		DO - Bottom (mg/L)		DO Saturation - Surface (%)		DO Saturation - Bottom (%)				
		OW	IC	OW	IC	OW	IC	OW	IC	OW	IC	IC
UNR	Mean	9.18	15.05	8.86	15.08	95.4	104.5	92.3	105.0	19.9	14.6	0.62
	Median	9.13	-	9.11	-	93.7	-	91.1	-	18.7	-	-
	Minimum	7.65	15.05	7.56	15.08	87.4	104.5	87.0	105.0	10.0	13.7	0.40
	Maximum	11.29	15.05	10.11	15.08	110.9	104.5	99.4	105.0	32.0	15.5	0.95
	SD	1.22	-	0.873	-	7.98	-	4.67	-	7.9	0.93	0.29
	SE	0.408	-	0.291	-	2.66	-	1.56	-	2.6	0.53	0.17
	Lower Quartile	8.23	-	8.13	-	88.4	-	87.7	-	12.3	-	-
	Upper Quartile	9.88	-	9.27	-	98.2	-	95.9	-	24.3	-	-
	n	9	1	9	1	9	1	9	1	9	3	3
	% Detections	100	100	100	100	100	100	100	100	-	-	-

Notes:

1. OW = Open-water season; IC = Ice-cover season.
2. SD = standard deviation; SE = standard error; n = number of sample.

Table 3.2-3. 2008-2019 Off-system sites summary of thermal stratification and DO concentrations.

Metric	Sampling Year	Surface or Bottom	SET				WLKR			
			Open-Water			Ice-Cover	Open-Water			Ice-Cover
			SP	SU	FA	WI	SP	SU	FA	WI
Thermal Stratification	2008		2008	2008	No	No				
	2009		2009	2009	ND	No				
	2010		2010	No	No	No	2010	No	No	No
	2011		2011	No	No	No				
	2012		2012	No	No	No				
	2013		2013	No	No	No	2013	No	No	No
	2014		No	2014	No	No				
	2015		2015	2015	No	No				
	2016		2016	ND	No	No	No	No	No	No
	2017		No	2017	No	No				
	2018		2018	No	No	No				
	2019		No	2019	No	No	No	No	No	No
DO within MWQSOGs PAL objectives[2]	2008	Surface	Yes	Yes	Yes	Yes				
		Bottom	Yes	2008	Yes	2008				
	2009	Surface	Yes	Yes	ND	Yes				
		Bottom	Yes	2009	ND	2009				
	2010	Surface	Yes	Yes	Yes	ND	Yes	Yes	Yes	ND
		Bottom	Yes	Yes	Yes	ND	Yes	Yes	Yes	ND
	2011	Surface	Yes	Yes	Yes	Yes				
		Bottom	Yes	Yes	Yes	2011				
	2012	Surface	Yes	Yes	Yes	Yes				
		Bottom	Yes	Yes	Yes	2012				
	2013	Surface	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Bottom	ND	Yes	Yes	2013	Yes	Yes	Yes	2013
	2014	Surface	Yes	Yes	Yes	ND				
		Bottom	Yes	2014	Yes	ND				
	2015	Surface	Yes	Yes	Yes	Yes				
		Bottom	Yes	2015	Yes	Yes				
	2016	Surface	Yes	ND	Yes	Yes	Yes	Yes	Yes	Yes
		Bottom	Yes	ND	Yes	Yes	Yes	Yes	Yes	2016
	2017	Surface	Yes	Yes	Yes	Yes				
		Bottom	Yes	2017	Yes	2017				
	2018	Surface	Yes	Yes	Yes	Yes				
		Bottom	Yes	Yes	Yes	Yes				
	2019	Surface	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Bottom	Yes	Yes	Yes	2019	Yes	Yes	Yes	2019

Notes:

1. SP = spring; SU = summer; FA = fall; WI = winter; DO = dissolved oxygen; MWQSOG = Manitoba Water Quality Standards, Objectives, and Guidelines; PAL = Protection of Aquatic Life.
2. ND = No data.
3. DO concentrations were compared to the most stringent MWQSOGs instantaneous minimum PAL objectives for each season; i.e., 5 mg/L for cool-water early life for the open-water season and 8 mg/L for cold-water early life the ice-cover season.
4. Cells with a year indicated denote instances of stratification or non-compliance with MWQSOGs instantaneous minimum objectives.
5. [ ] = Sampling did not occur.

Table 3.2-4. 2008-2019 Off-system sites DO, water depth, and ice thickness summary statistics.

Site	Statistic	Dissolved Oxygen (DO)								Water Depth at Site (m)		Ice Thickness at Site (m)
		DO - Surface (mg/L)		DO - Bottom (mg/L)		DO Saturation - Surface (%)		DO Saturation - Bottom (%)				
		OW	IC	OW	IC	OW	IC	OW	IC	OW	IC	IC
SET	Mean	9.42	14.01	7.91	7.06	97.9	100.5	76.0	54.5	18.2	18.2	0.73
	Median	9.32	14.31	8.74	7.08	96.1	99.5	82.6	55.6	18.3	18.1	0.71
	Minimum	8.01	12.94	1.88	3.88	84.5	95.4	17.2	31.0	8.0	17.4	0.61
	Maximum	11.46	14.82	11.92	9.70	111.9	109.5	101.9	73.1	25.6	19.5	1.00
	SD	0.866	0.718	2.30	1.86	7.32	4.83	20.9	13.4	3.8	0.66	0.12
	SE	0.149	0.227	0.400	0.587	1.26	1.53	3.63	4.25	0.64	0.19	0.03
	Lower Quartile	8.91	13.48	6.78	6.15	92.2	96.4	72.7	48.5	17.5	17.7	0.64
	Upper Quartile	9.87	14.53	9.26	8.03	101.9	103.2	89.8	60.4	19.8	18.5	0.80
	n	34	10	33	10	34	10	33	10	36	12	12
	% Detections	100	100	100	100	100	100	100	100	-	-	-
WLKR	Mean	9.64	12.98	8.99	6.42	100.5	93.1	91.3	48.7	9.7	8.9	0.81
	Median	9.89	-	9.61	-	100.6	-	94.7	-	9.6	-	-
	Minimum	8.30	12.28	5.99	5.02	92.1	87.0	65.1	37.7	9.0	7.0	0.62
	Maximum	10.76	13.36	10.16	7.40	112.3	98.7	102.6	55.3	11.0	10.4	0.90
	SD	0.768	0.607	1.42	1.25	5.77	5.87	12.2	9.61	0.56	1.4	0.13
	SE	0.222	0.350	0.410	0.719	1.67	3.39	3.53	5.55	0.16	0.70	0.07
	Lower Quartile	9.08	-	8.66	-	96.4	-	91.9	-	9.4	-	-
	Upper Quartile	10.02	-	9.84	-	104.4	-	98.0	-	9.9	-	-
	n	12	3	12	3	12	3	12	3	12	4	4
	% Detections	100	100	100	100	100	100	100	100	-	-	-

Notes:

1. OW = Open-water season; IC = Ice-cover season.
2. SD = standard deviation; SE = standard error; n = number of samples.

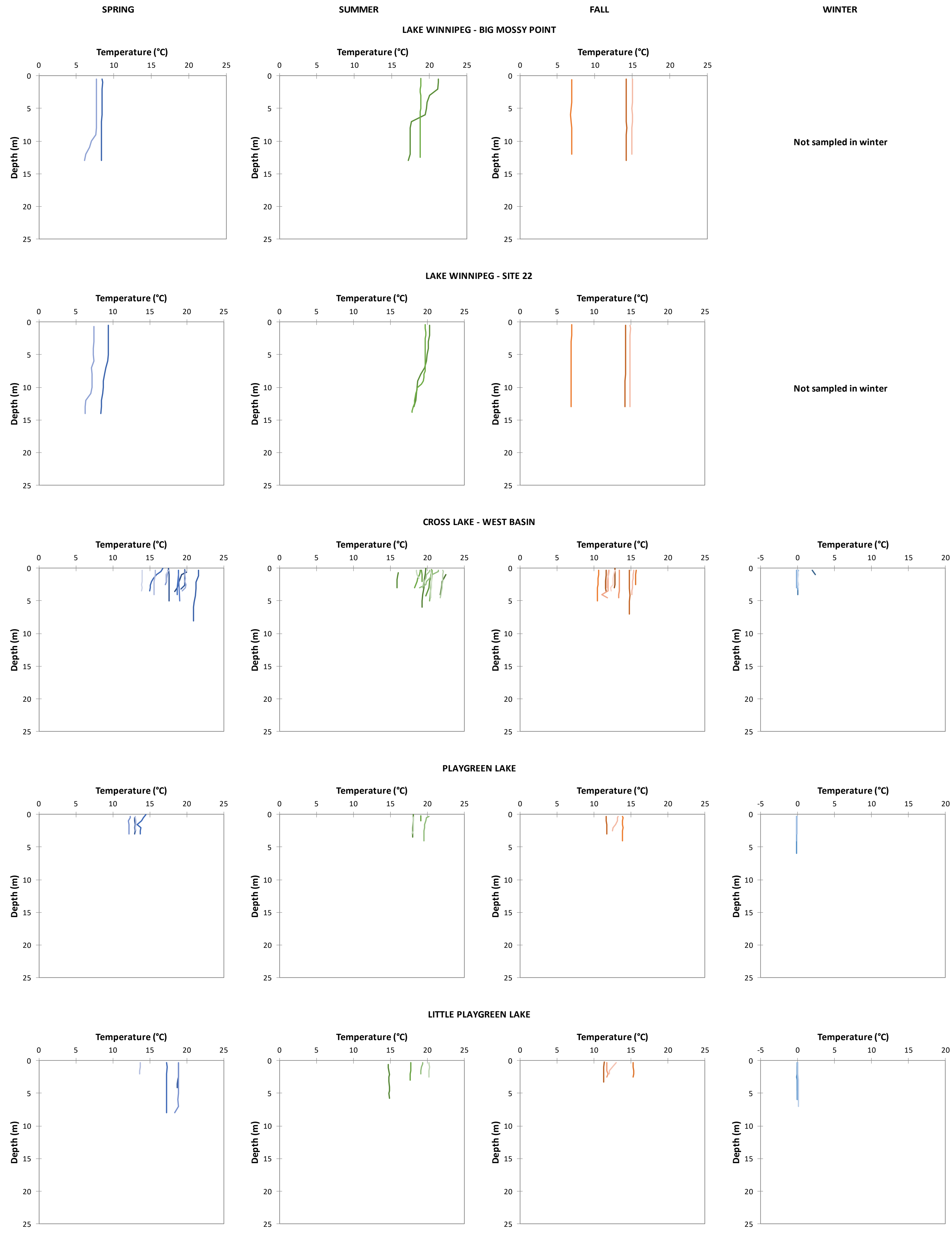


Figure 3.2-1 2008-2019 On-system and off-system water temperature depth profiles.

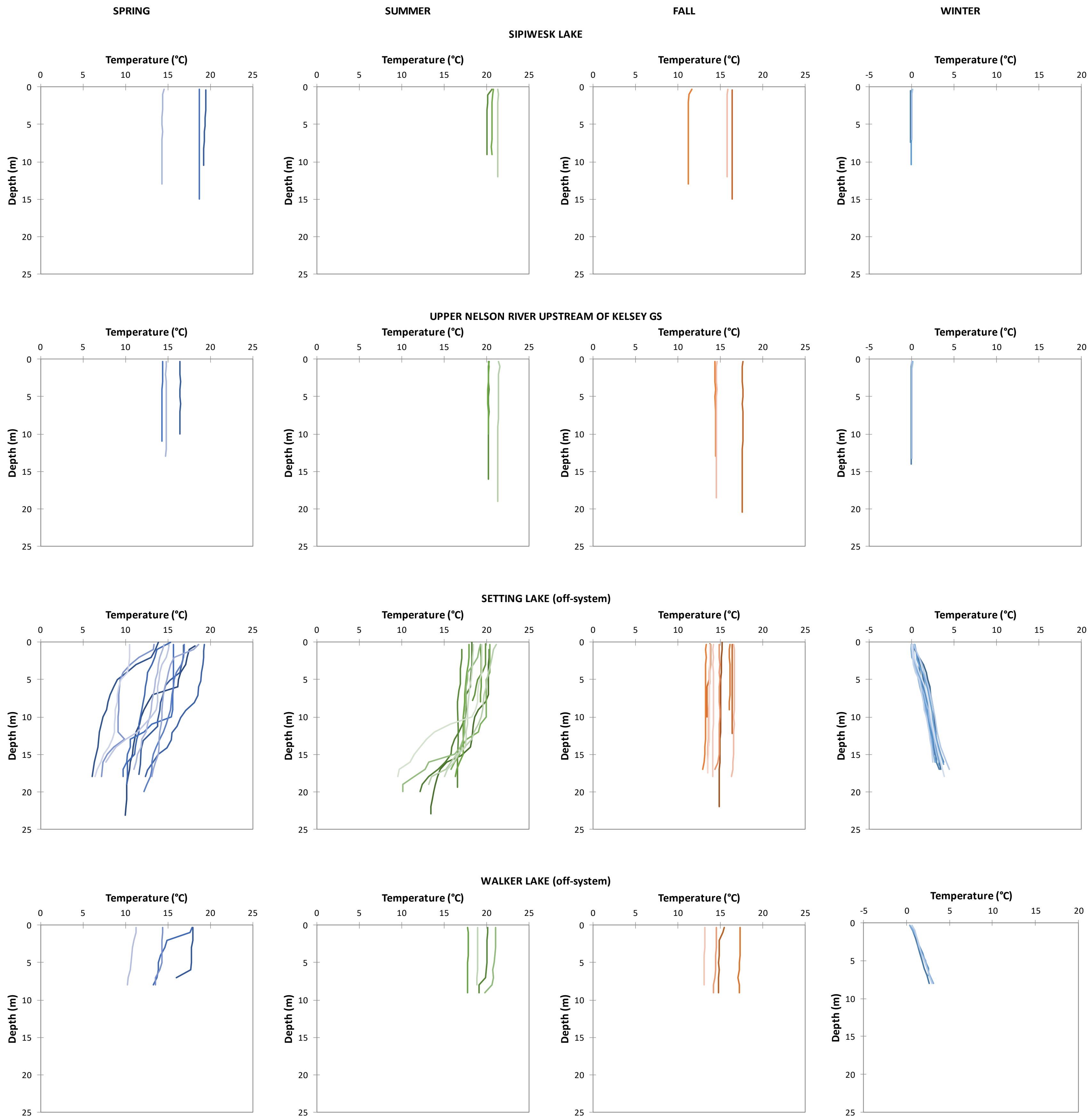


Figure 3.2-1 continued.

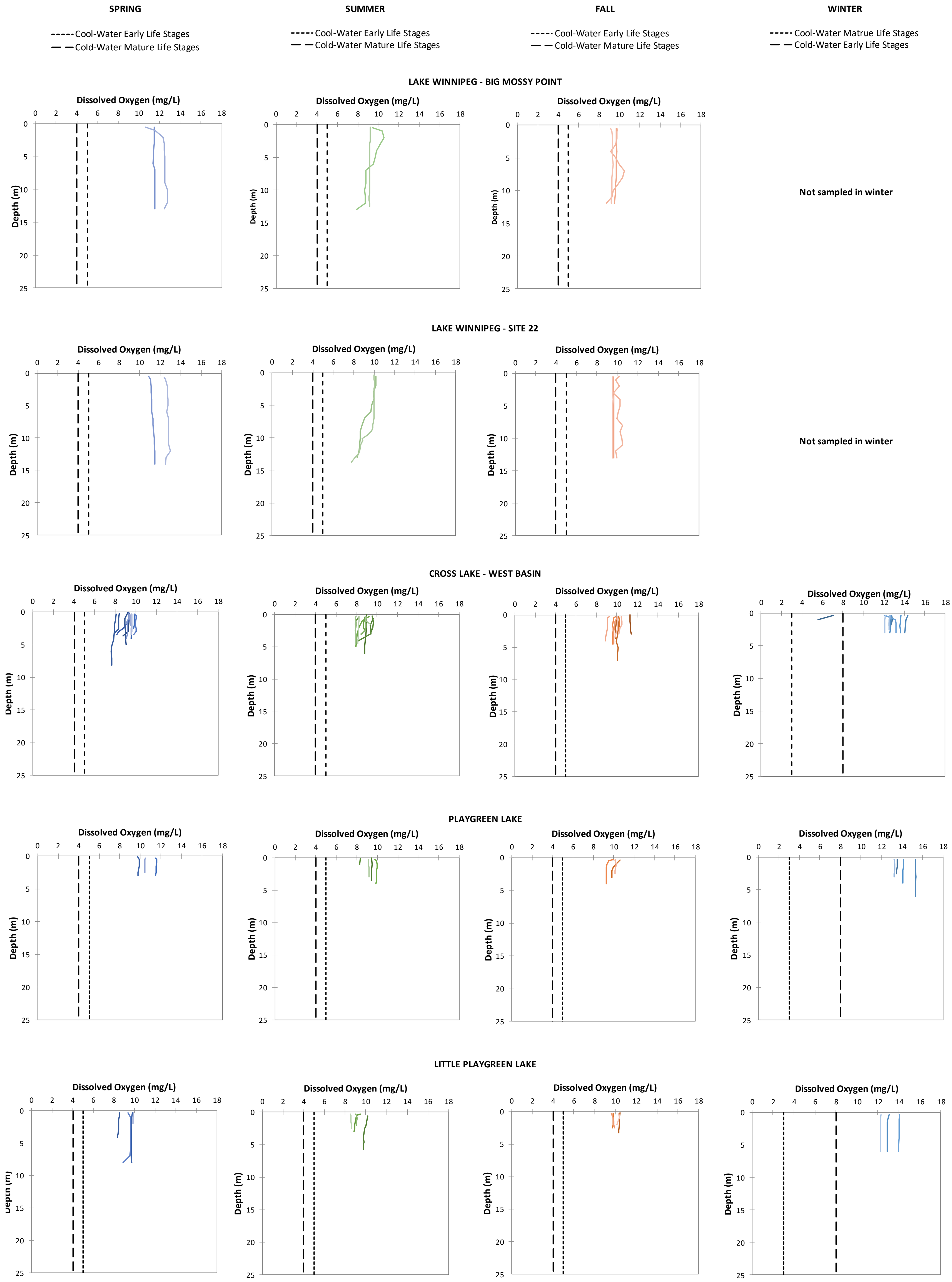


Figure 3.2-2. 2008-2019 On-system and off-system dissolved oxygen depth profiles and comparison to instantaneous minimum objectives for the protection of aquatic life.

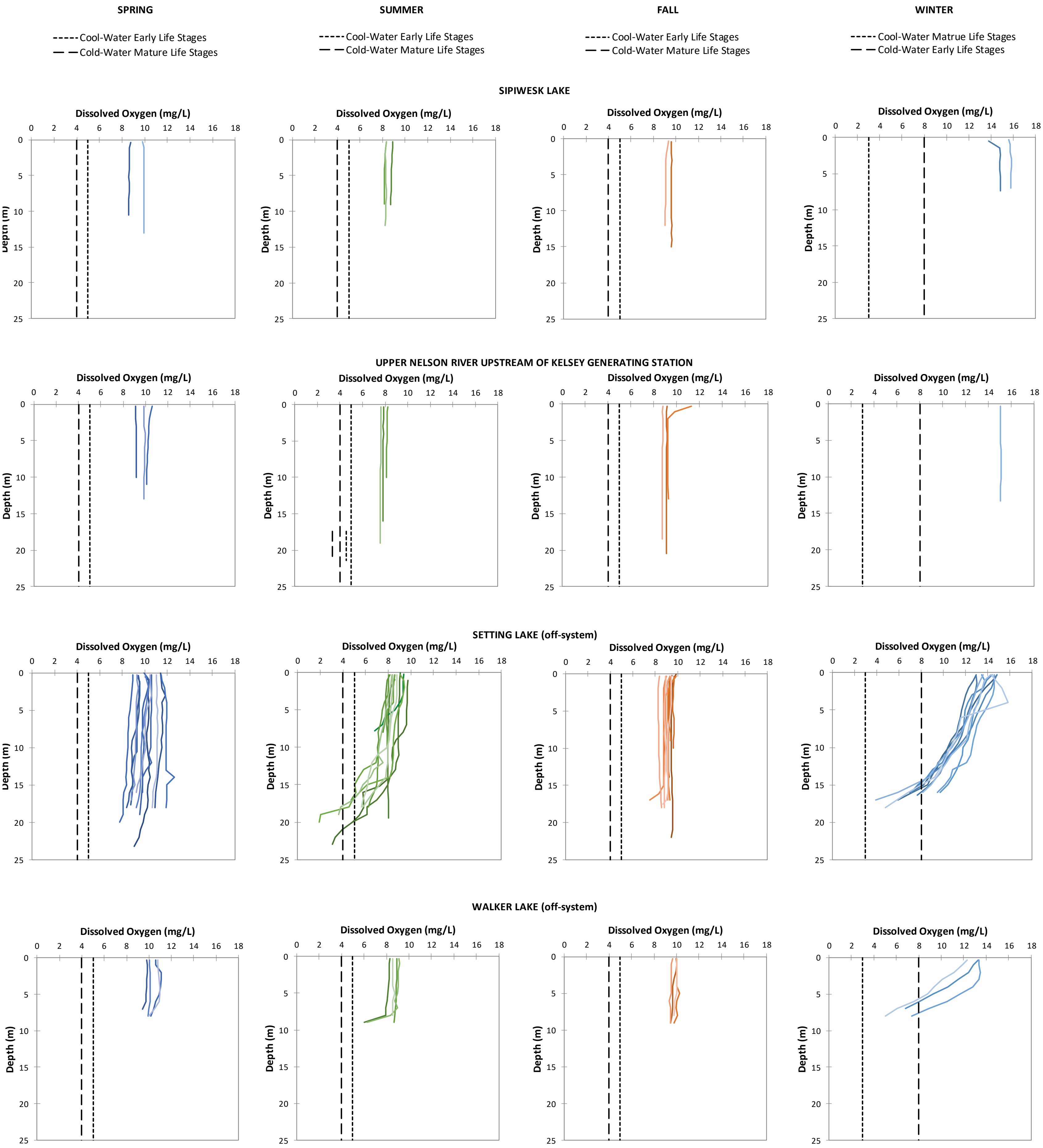


Figure 3.2-2. continued.

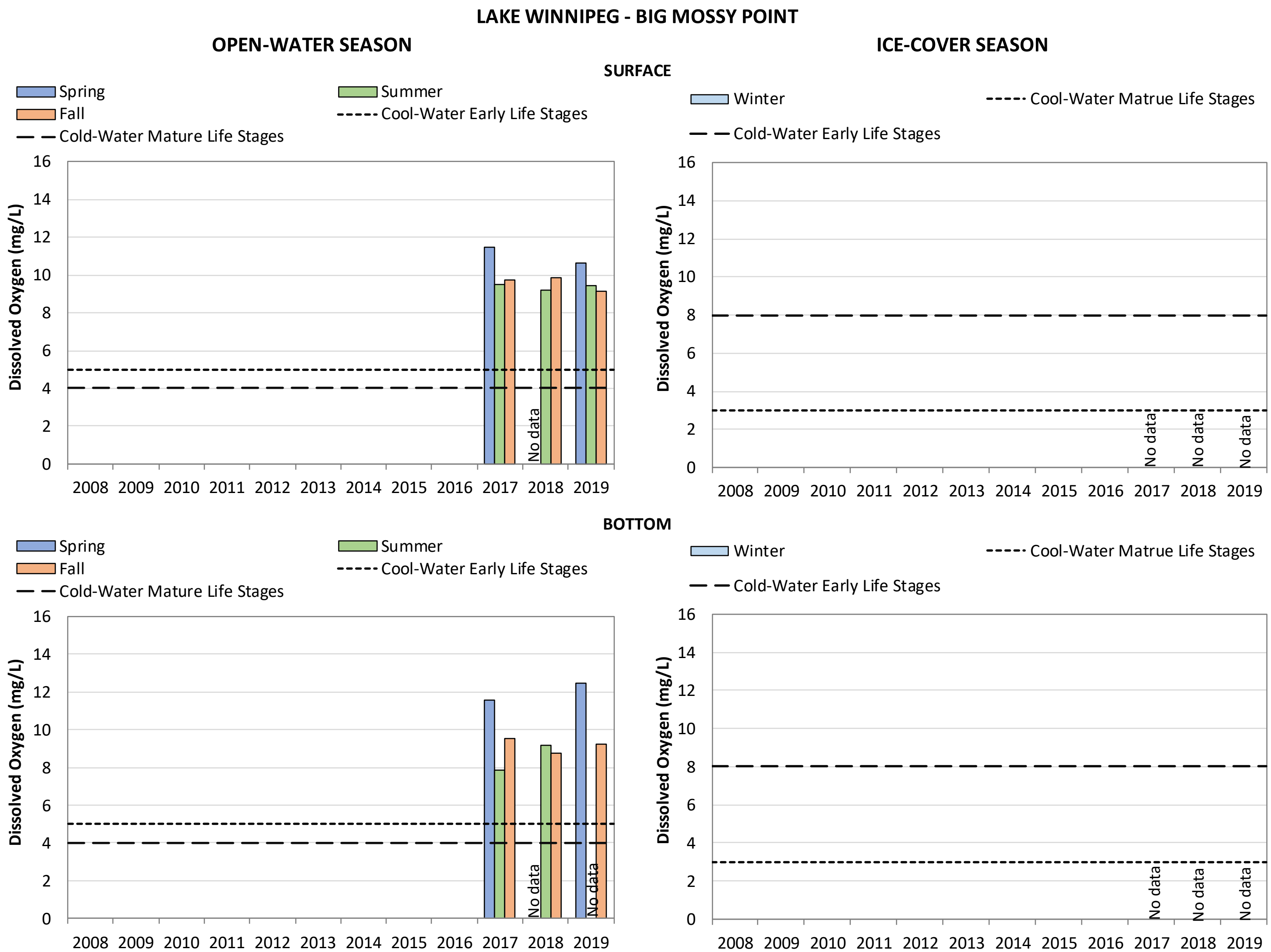


Figure 3.2-3. 2008-2019 Lake Winnipeg - Big Mossy Point surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

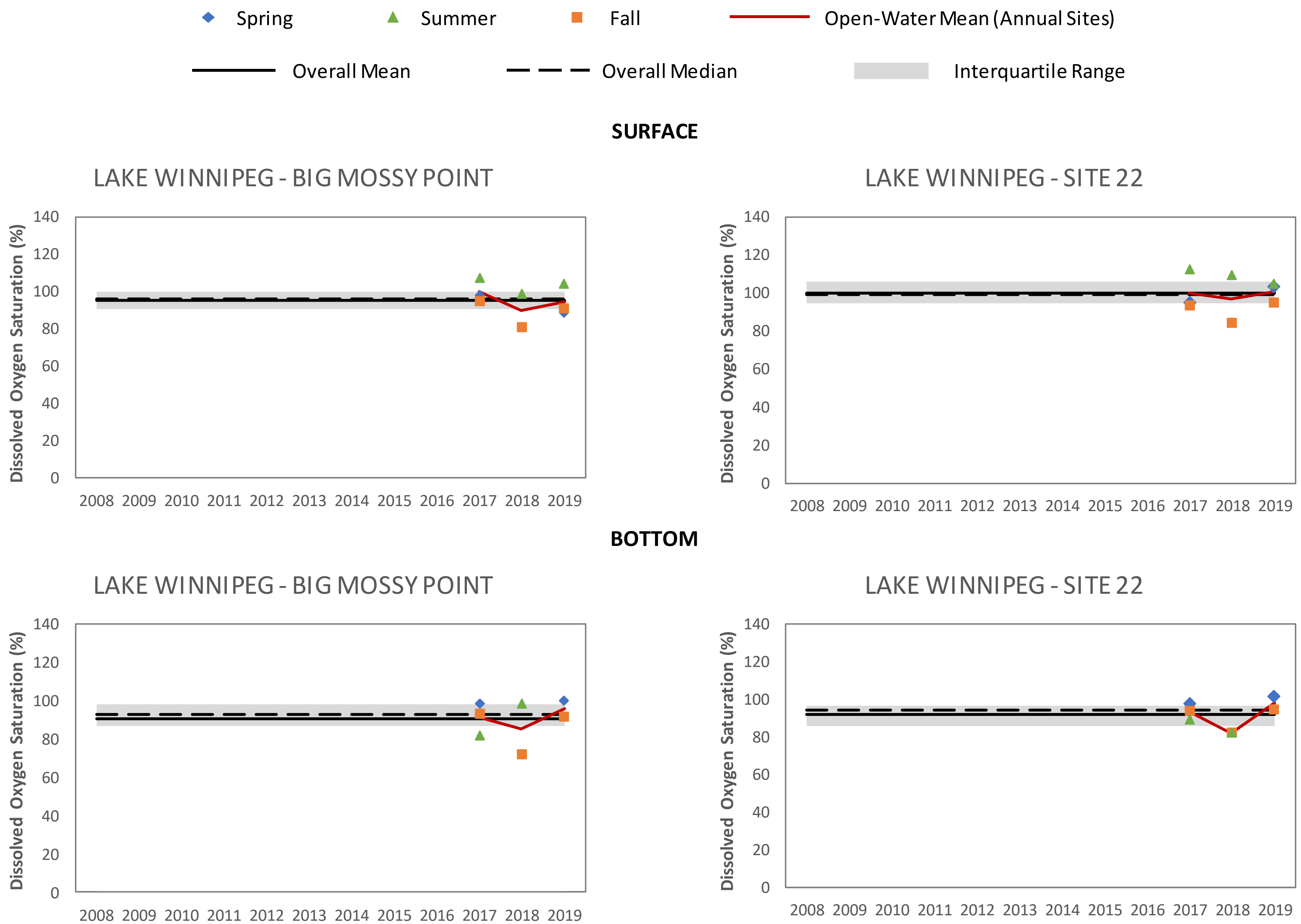


Figure 3.2-4. 2008-2019 Lake Winnipeg outlet area lacustrine sites open-water season surface and bottom dissolved oxygen saturation.

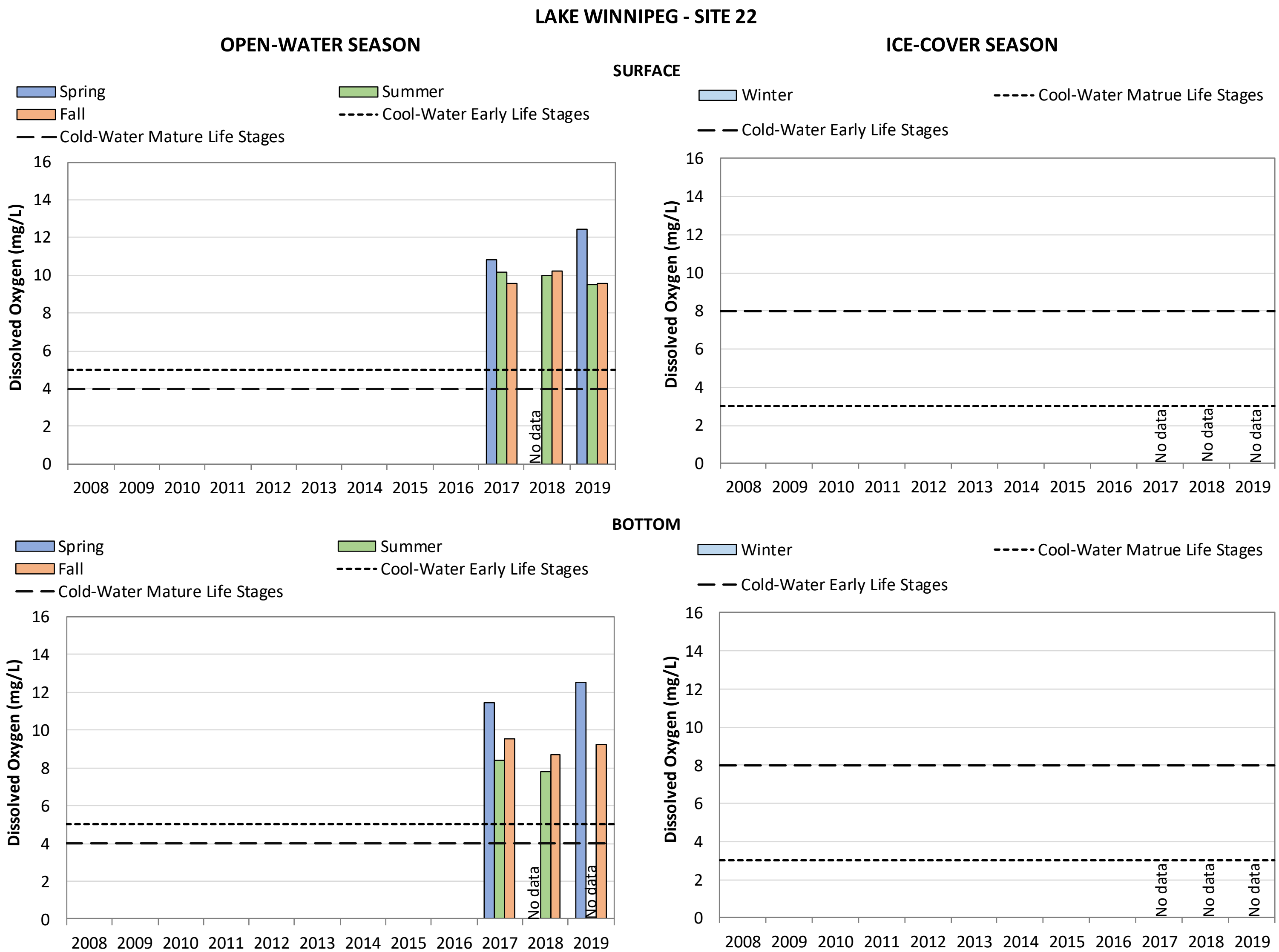


Figure 3.2-5. 2008-2019 Lake Winnipeg - Site 22 surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

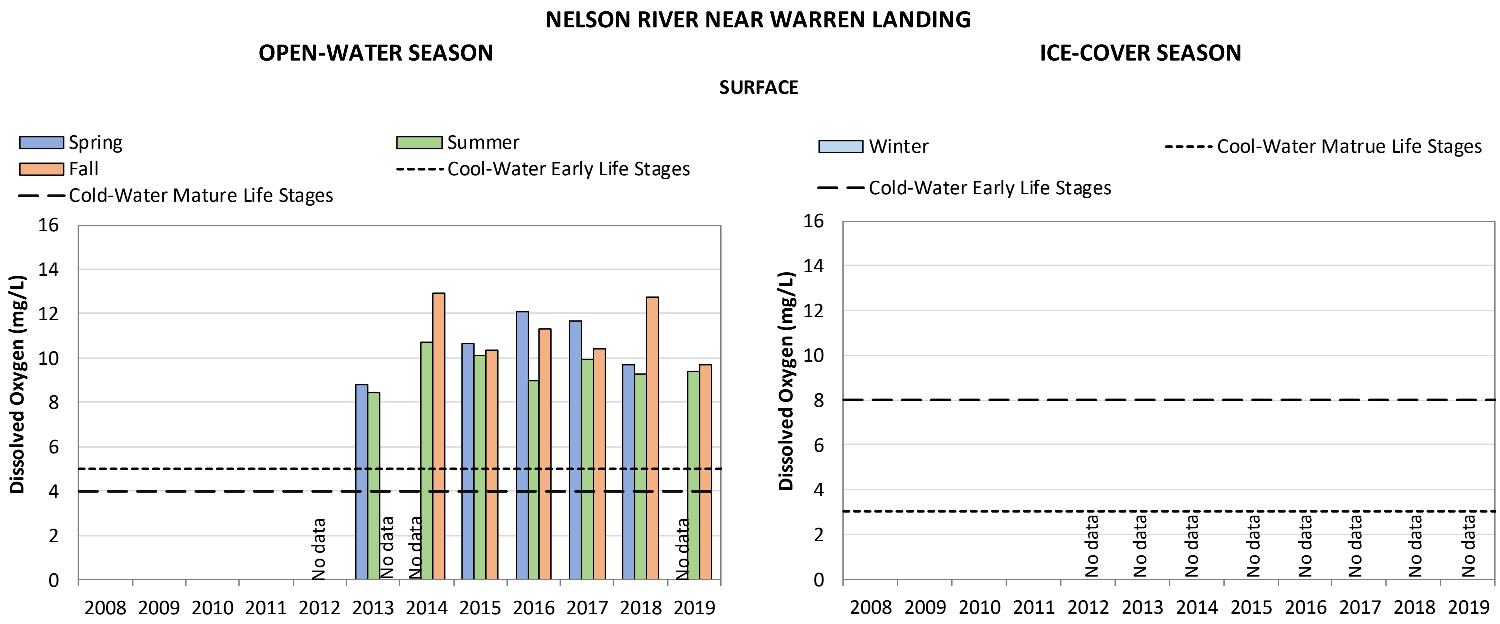


Figure 3.2-6. 2008-2019 Nelson River near Warren Landing surface dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

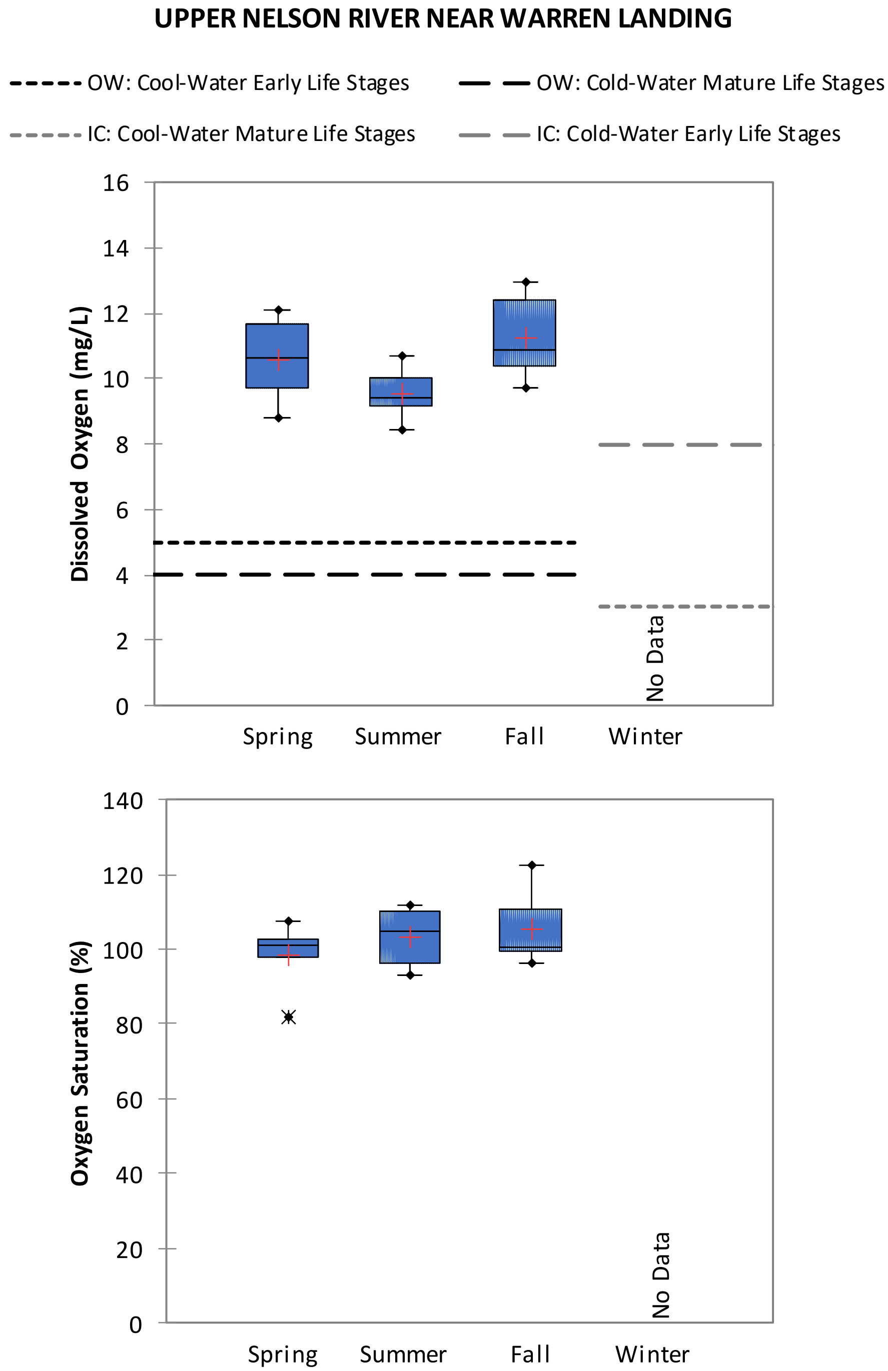


Figure 3.2-7. 2013-2019 Nelson River near Warren Landing seasonal surface dissolved oxygen concentrations and dissolved oxygen saturation with comparison to instantaneous minimum objectives for the protection of aquatic life.

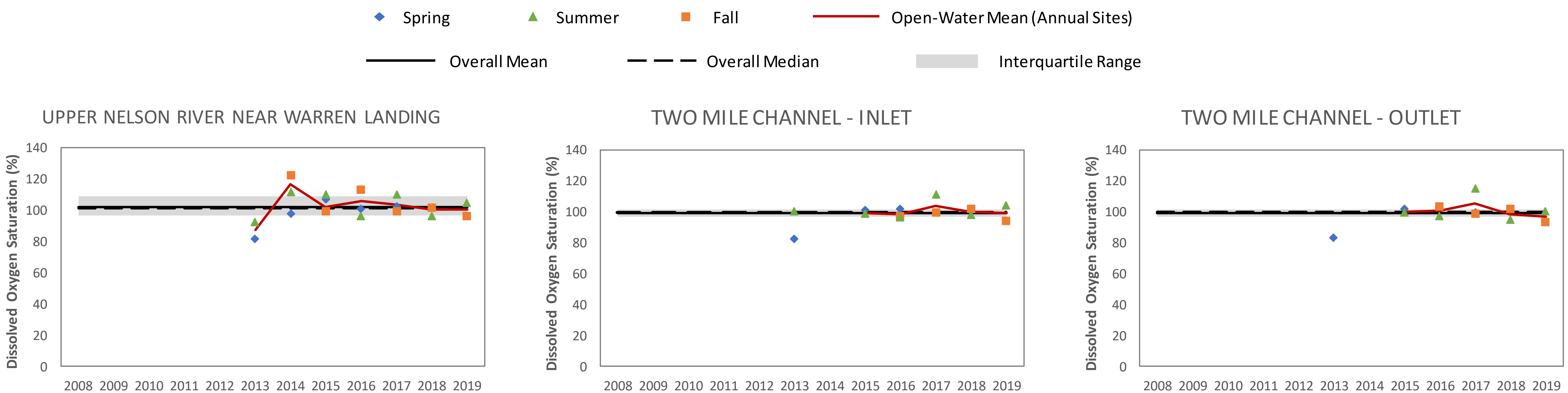


Figure 3.2-8. 2008-2019 Lake Winnipeg outlet area riverine sites open-water season surface dissolved oxygen saturation.

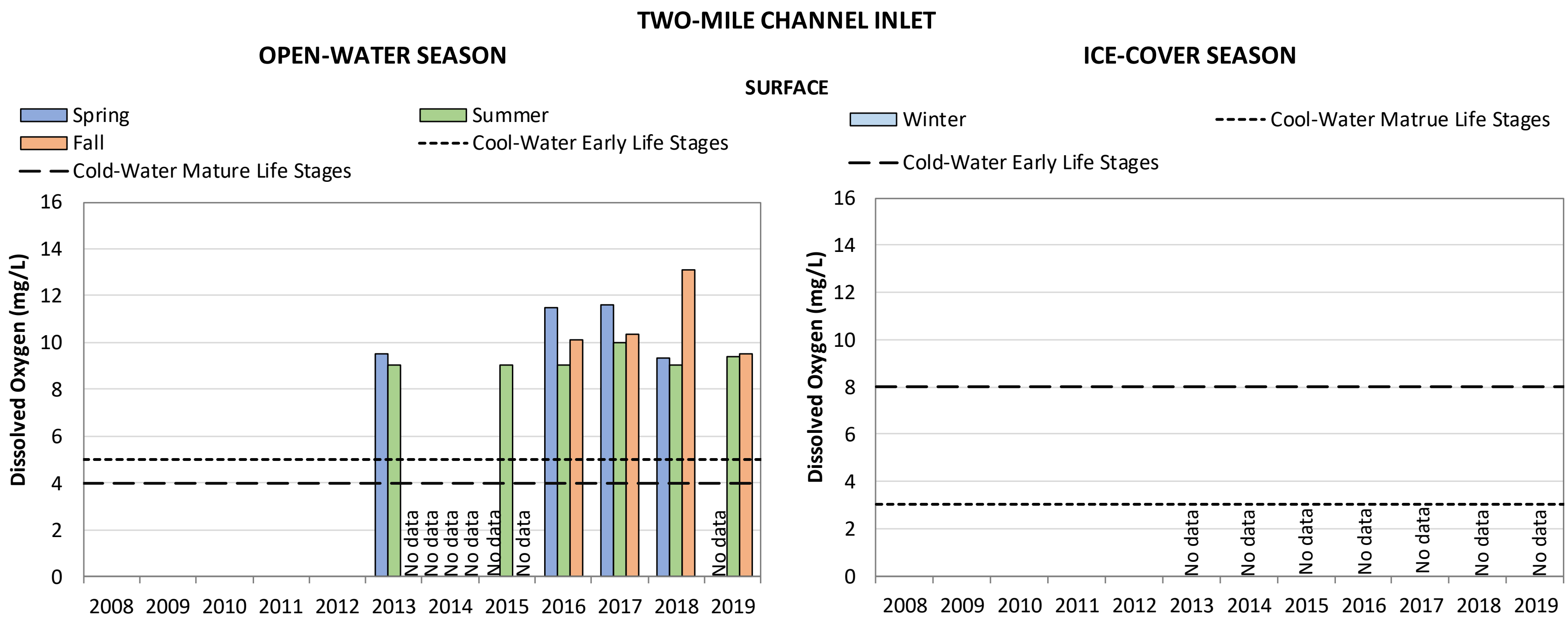
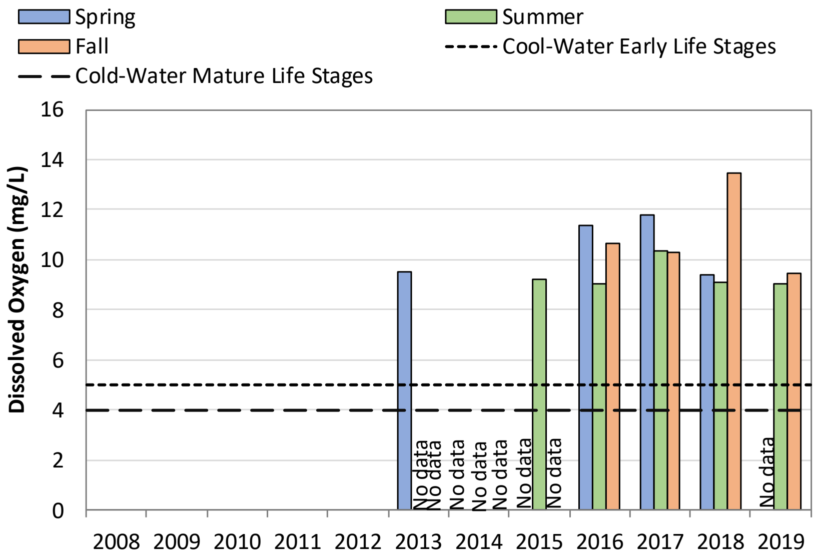


Figure 3.2-9. 2008-2019 Two Mile Channel Inlet surface dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

TWO-MILE CHANNEL OUTLET

OPEN-WATER SEASON **ICE-COVER SEASON**

SURFACE



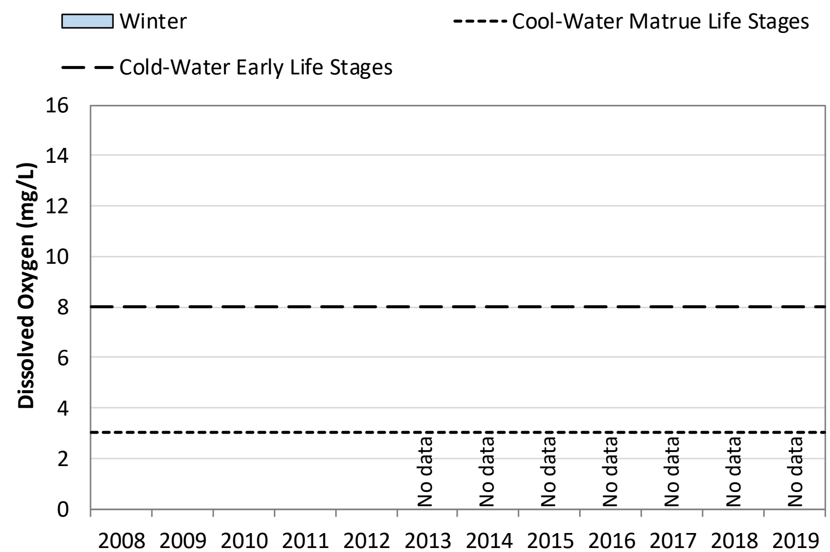


Figure 3.2-10. 2008-2019 Two Mile Channel Outlet surface dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

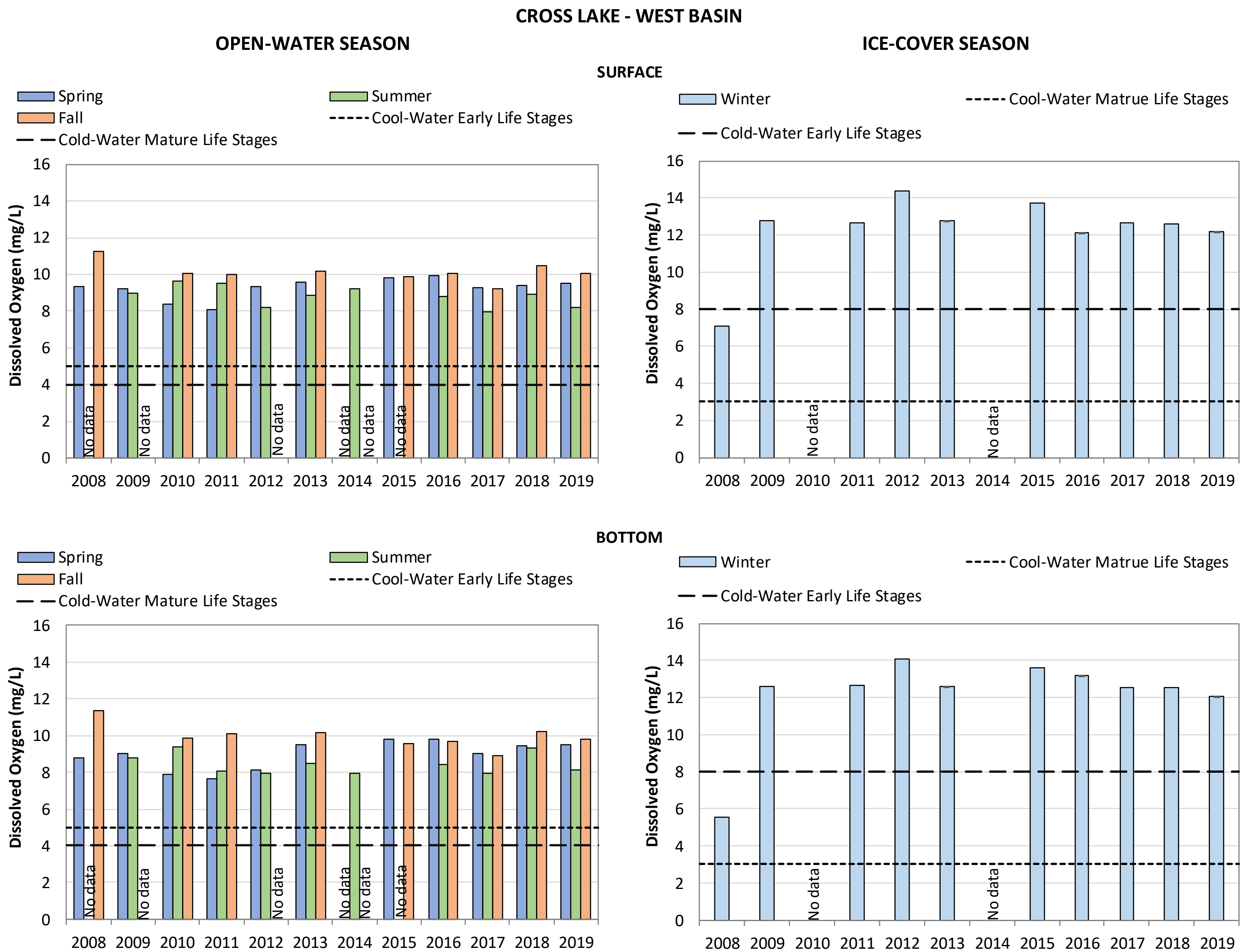


Figure 3.2-11. 2008-2019 Cross Lake surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

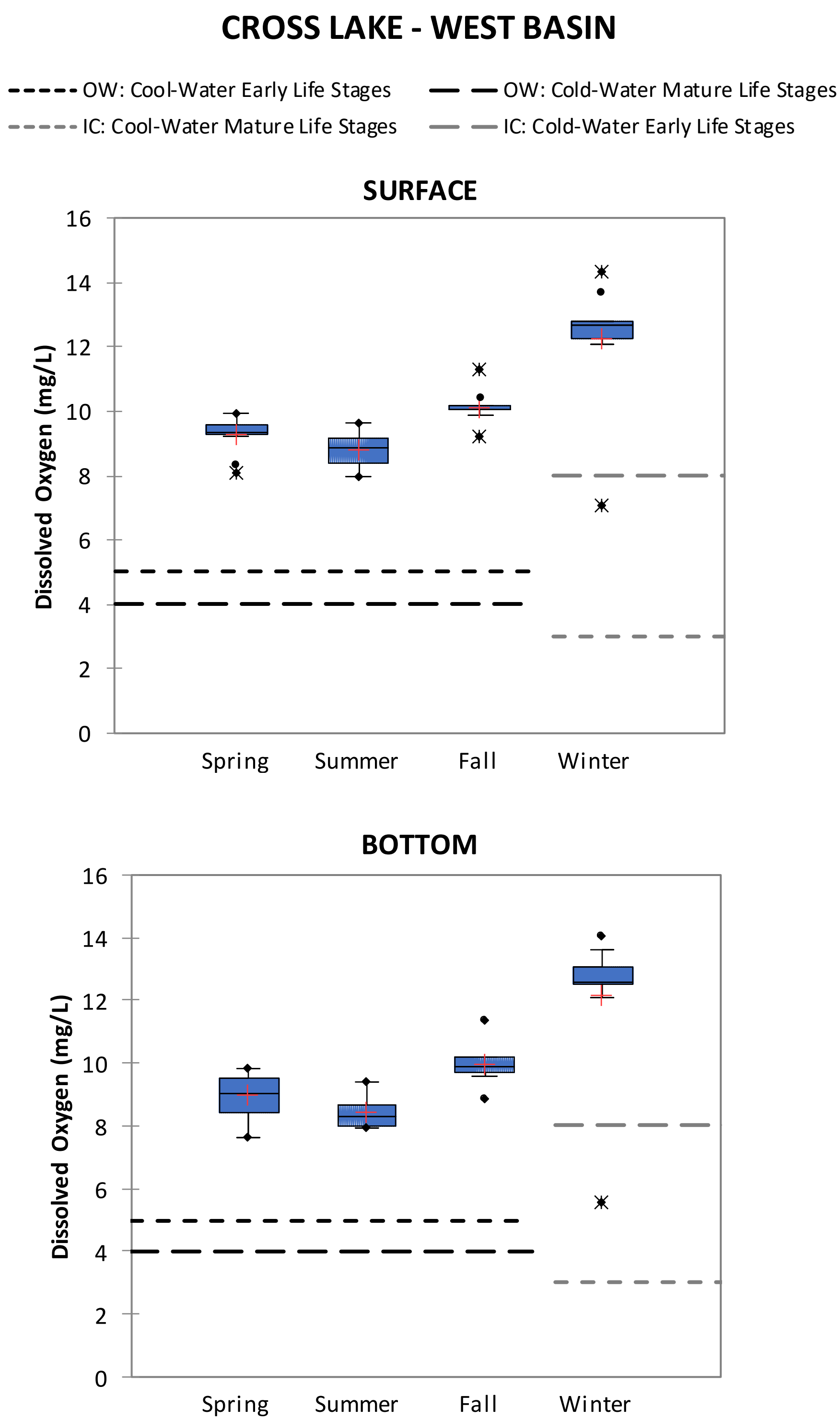
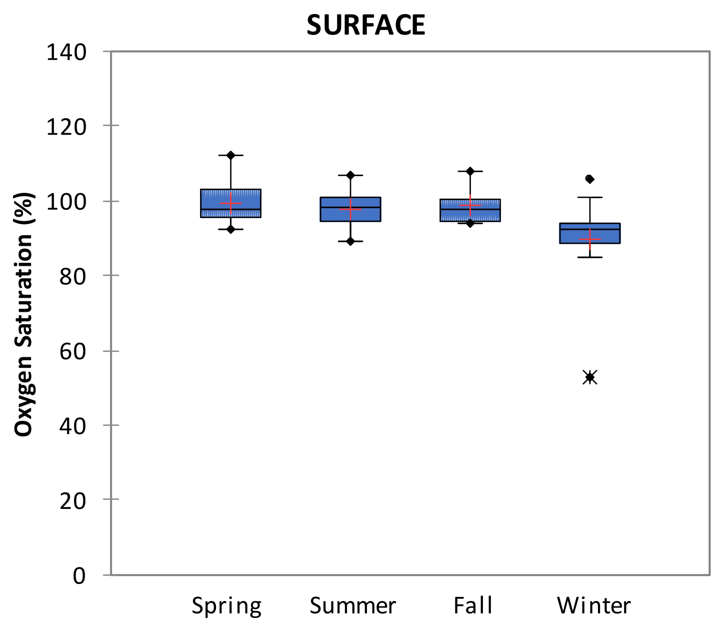


Figure 3.2-12. 2008-2019 Cross Lake seasonal surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

CROSS LAKE - WEST BASIN



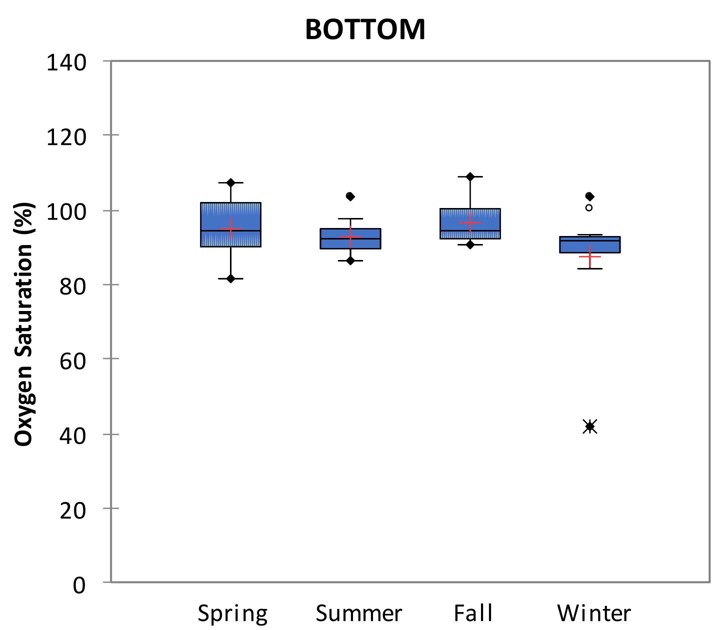


Figure 3.2-13. 2008-2019 Cross Lake seasonal surface and bottom dissolved oxygen saturation.

Figure 3.2-14. 2008-2019 Cross Lake open-water season and ice-cover season surface and bottom dissolved oxygen saturation.

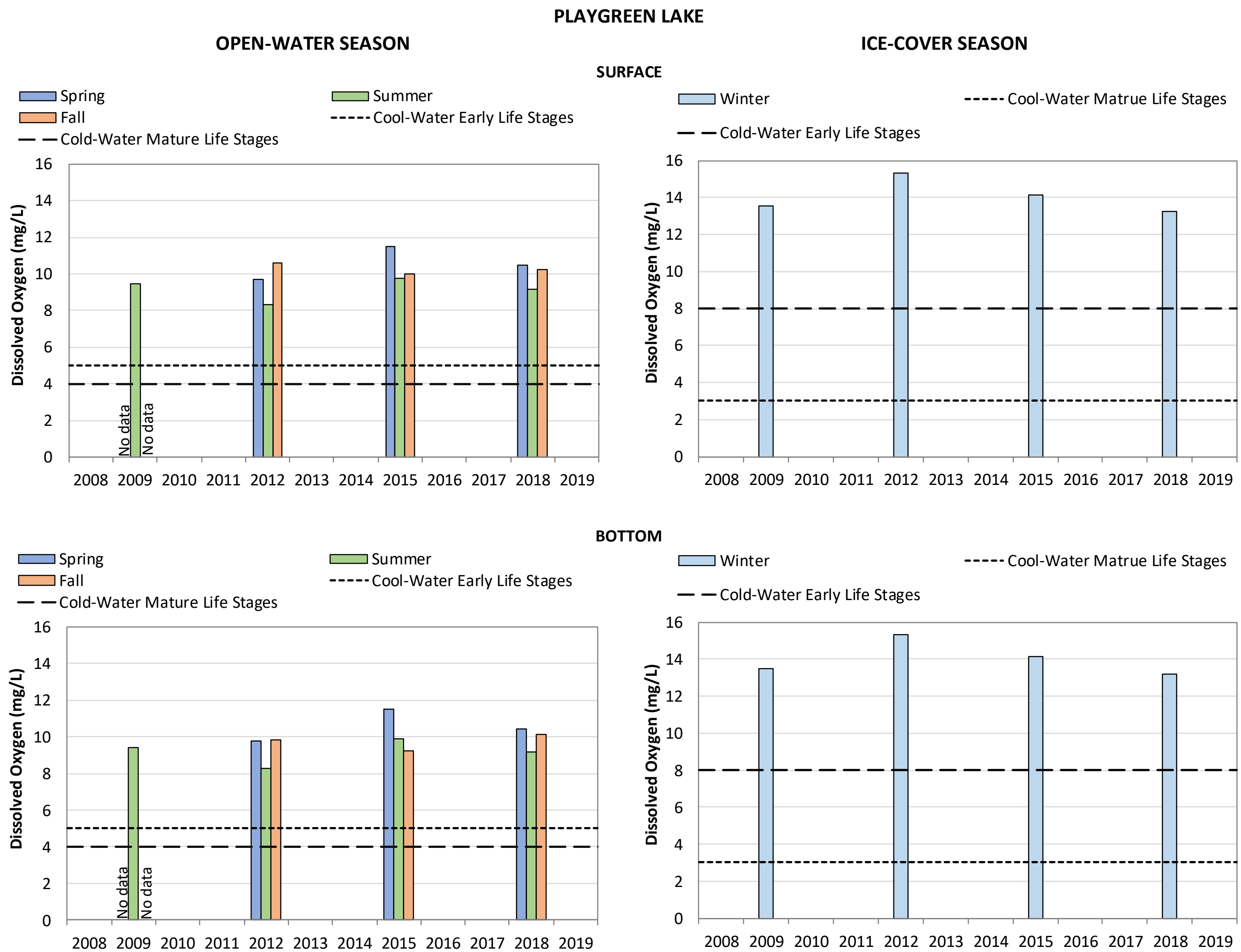


Figure 3.2-15. 2008-2019 Playgreen Lake surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

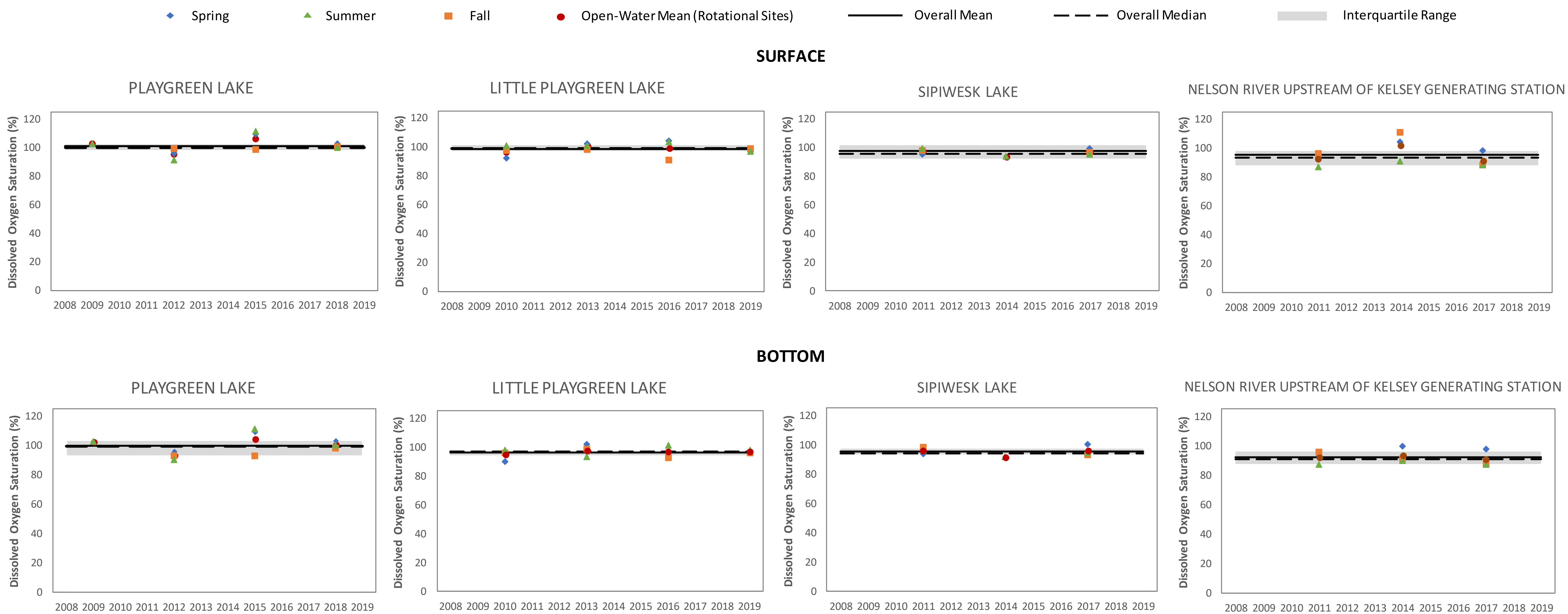


Figure 3.2-16. 2008-2019 On-system rotational sites open-water season surface and bottom dissolved oxygen saturation.

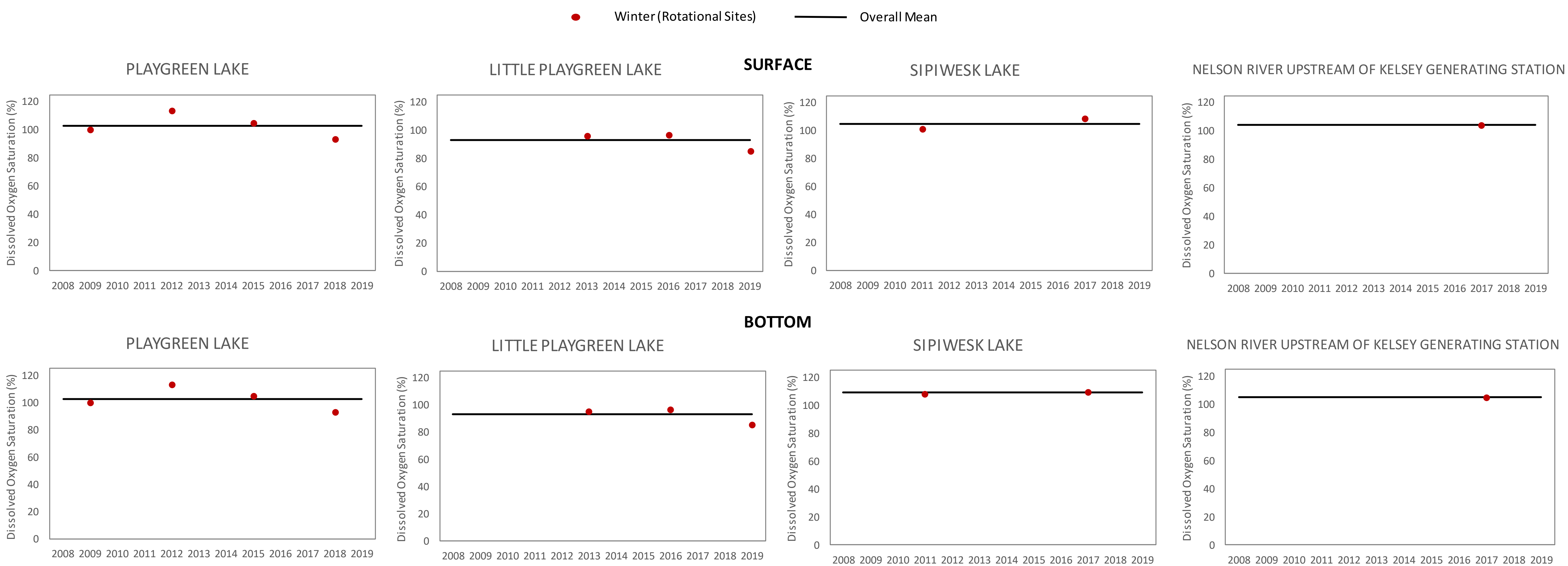


Figure 3.2-17. 2008-2019 On-system rotational sites ice-cover season surface and bottom dissolved oxygen saturation.

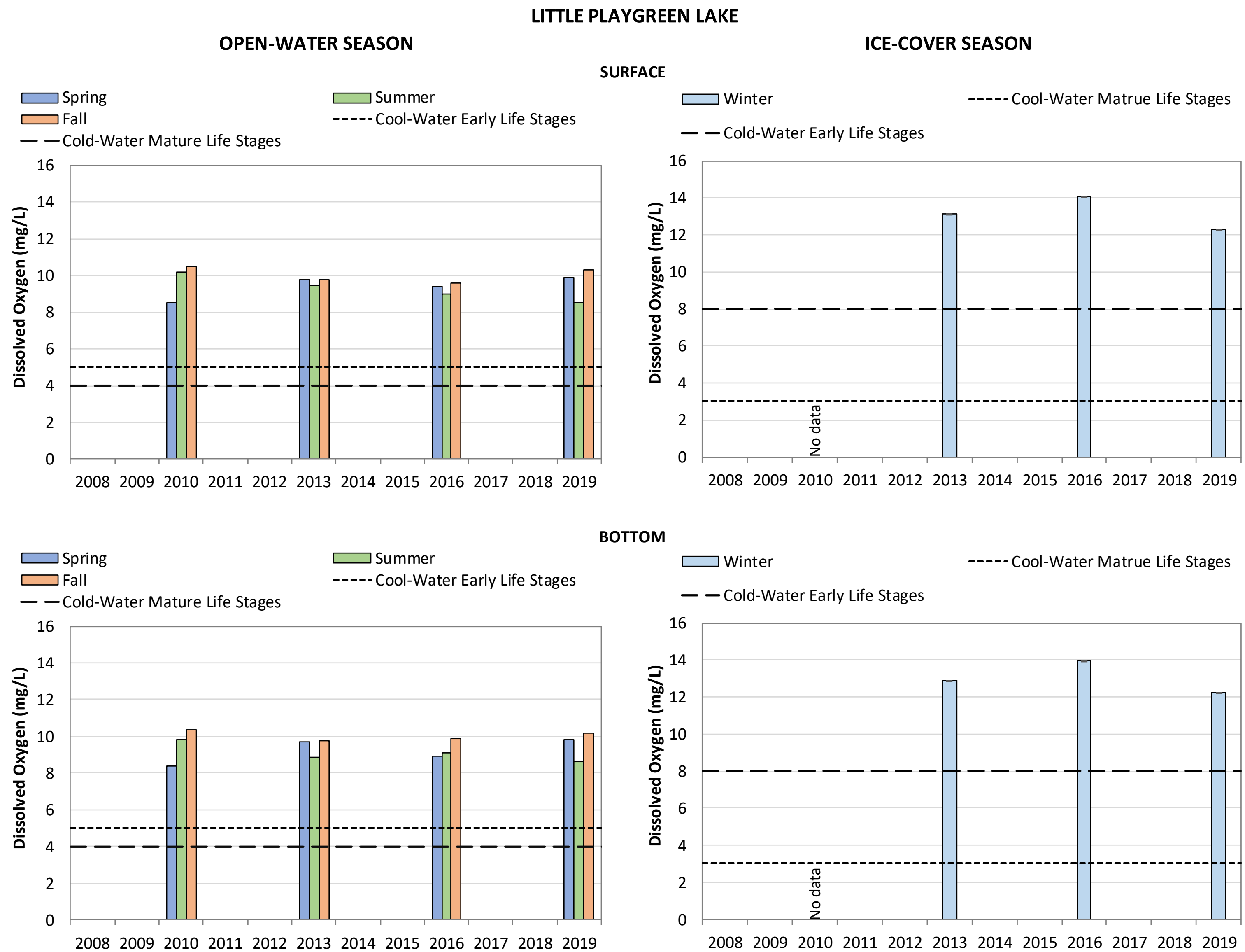


Figure 3.2-18. 2008-2019 Little Playgreen Lake surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

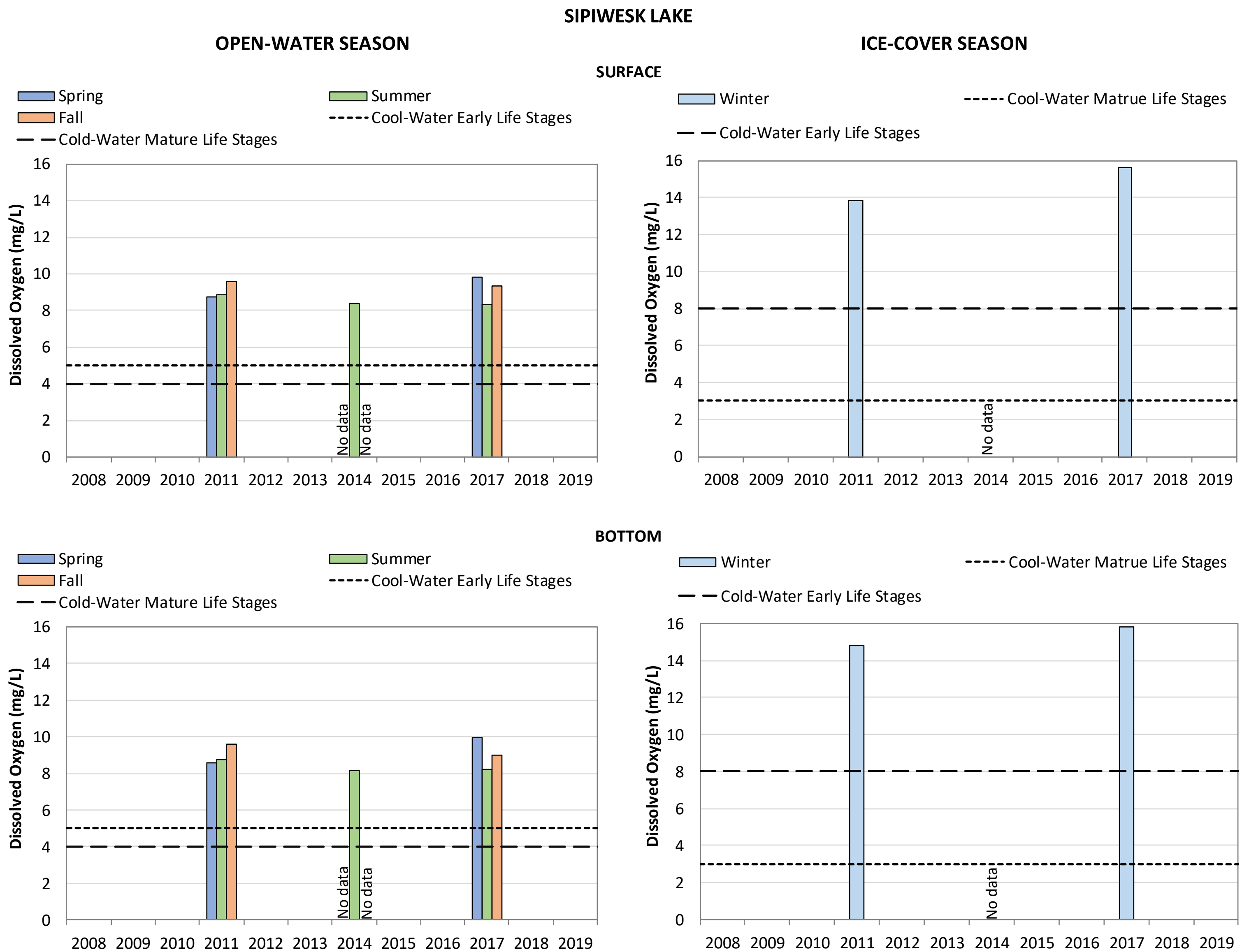


Figure 3.2-19. 2008-2019 Sipiwesk Lake surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

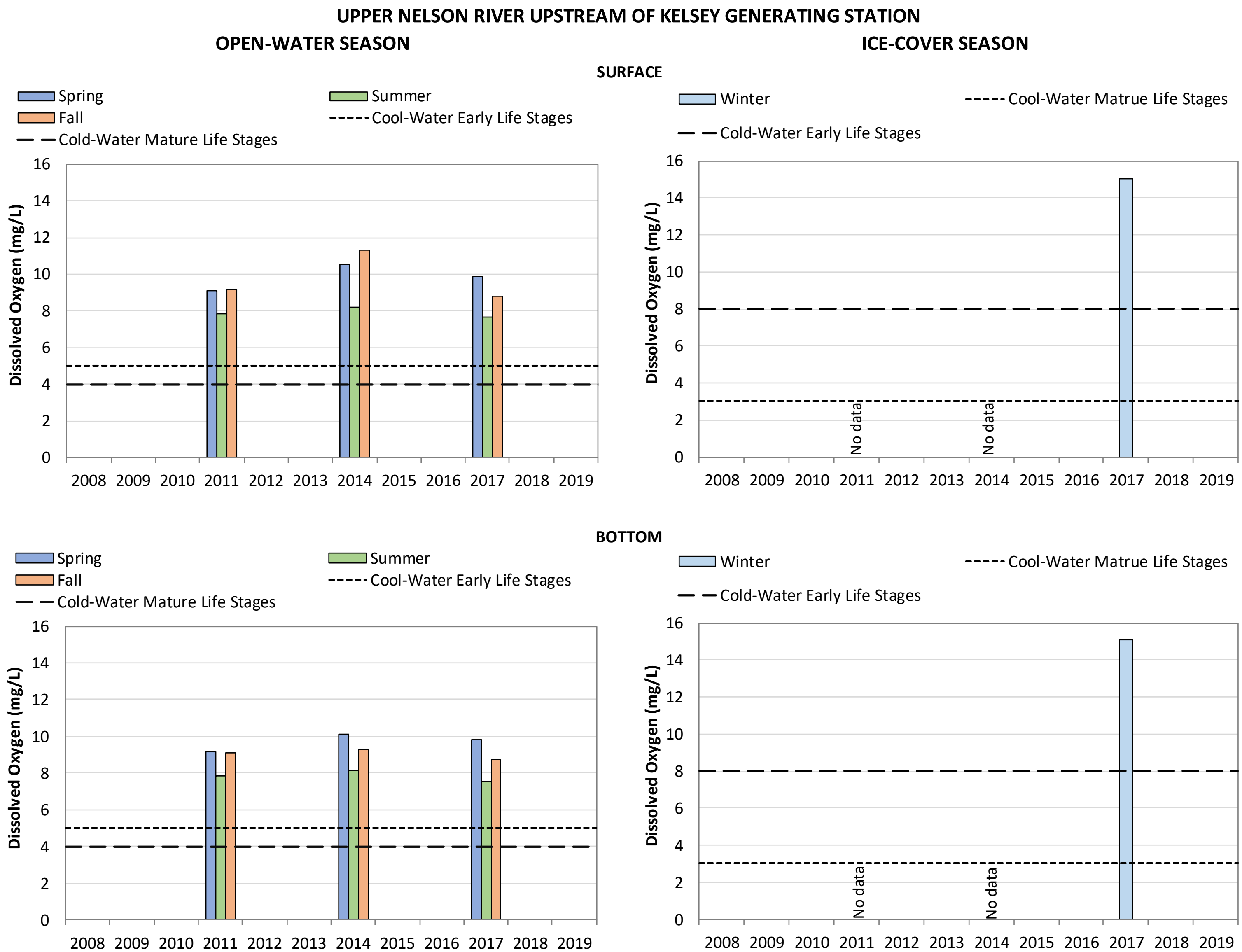


Figure 3.2-20. 2008-2019 Upper Nelson River upstream of the Kelsey GS surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

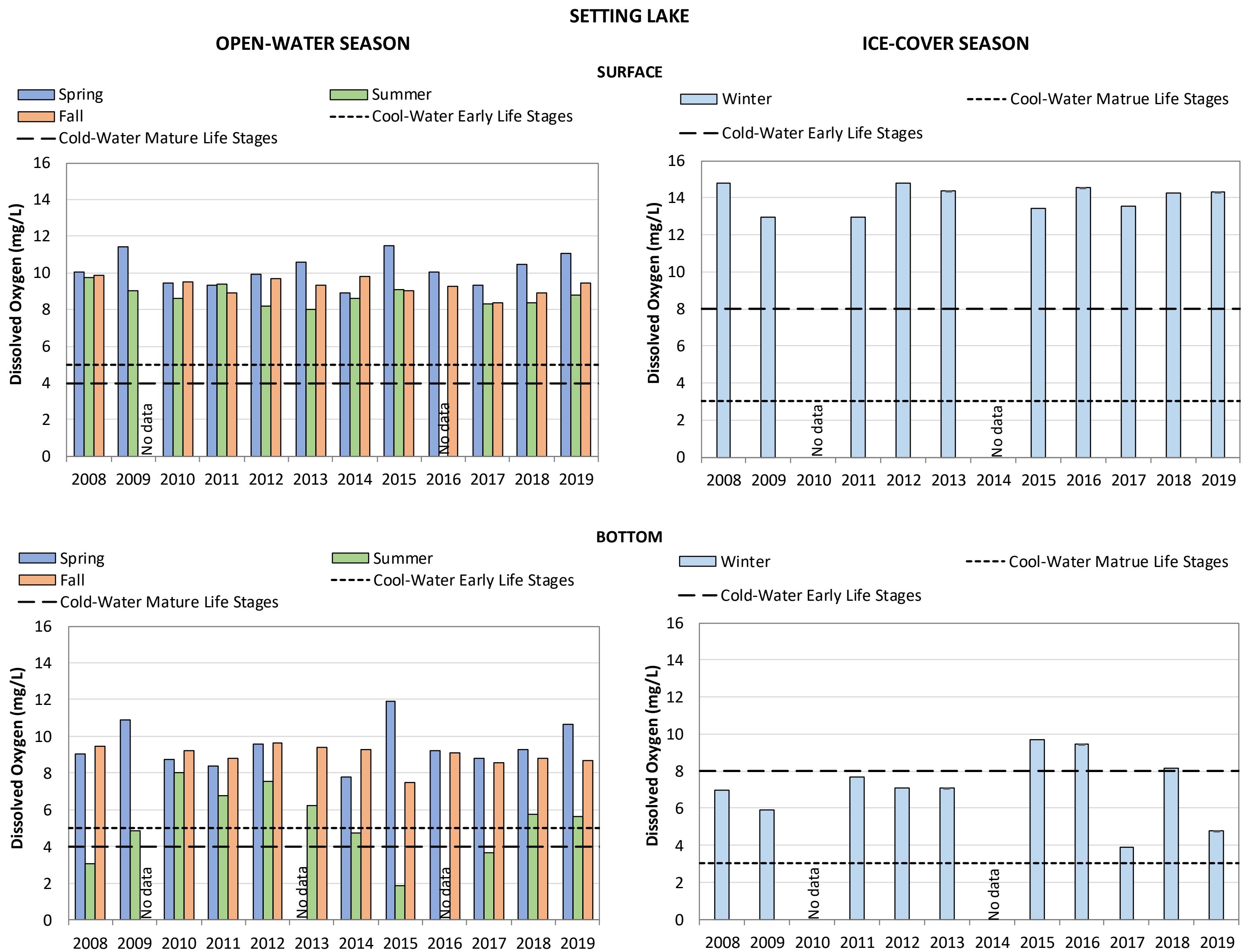


Figure 3.2-21. 2008-2019 Setting Lake surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

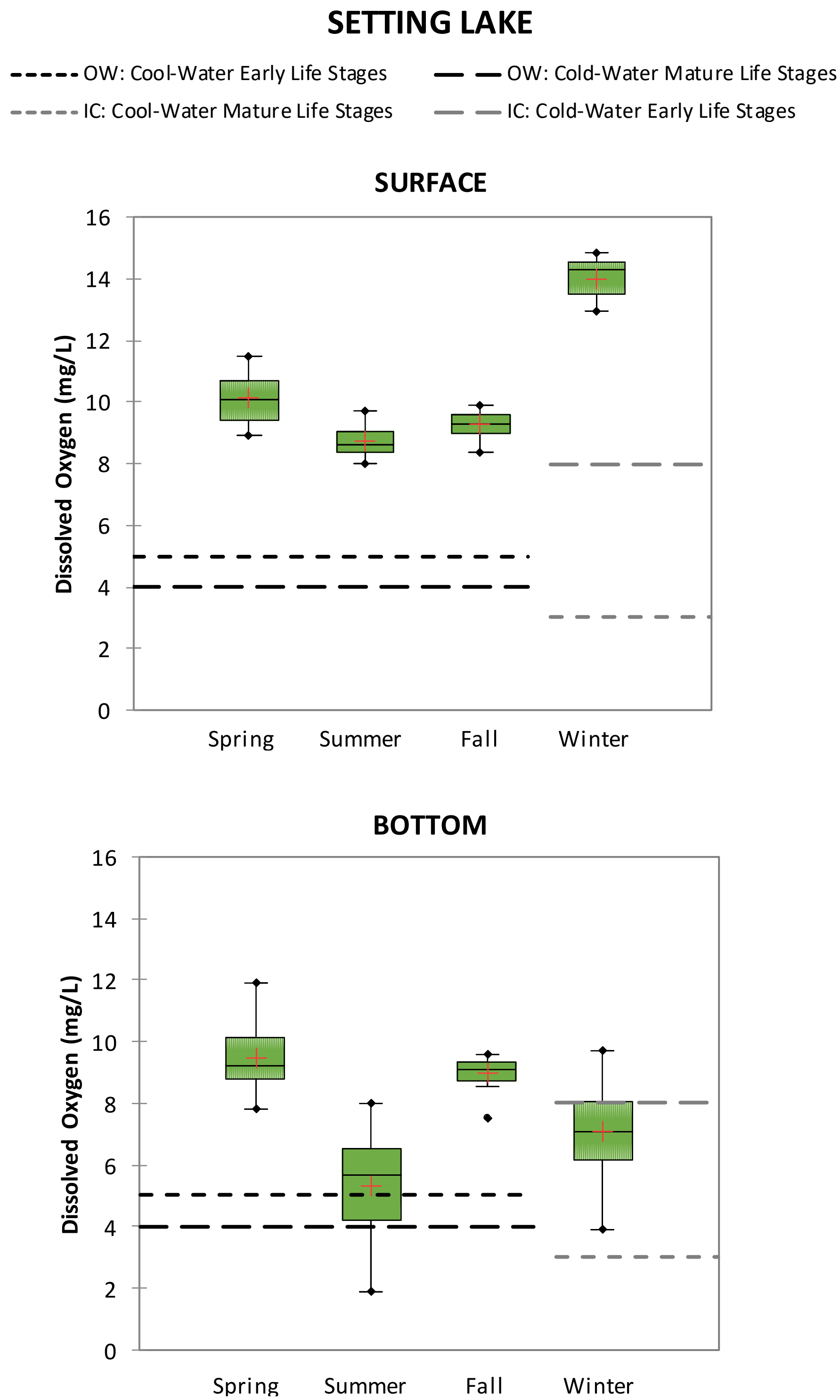
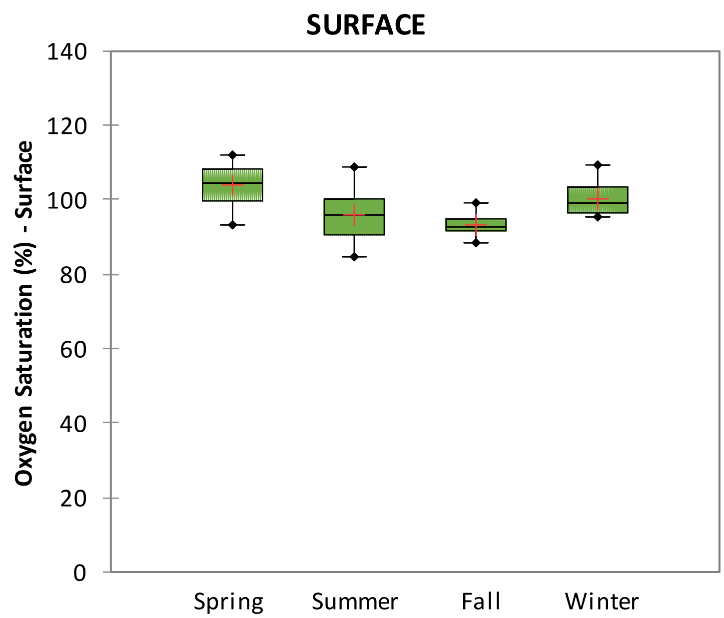


Figure 3.2-22. 2008-2019 Off-system seasonal surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

SETTING LAKE



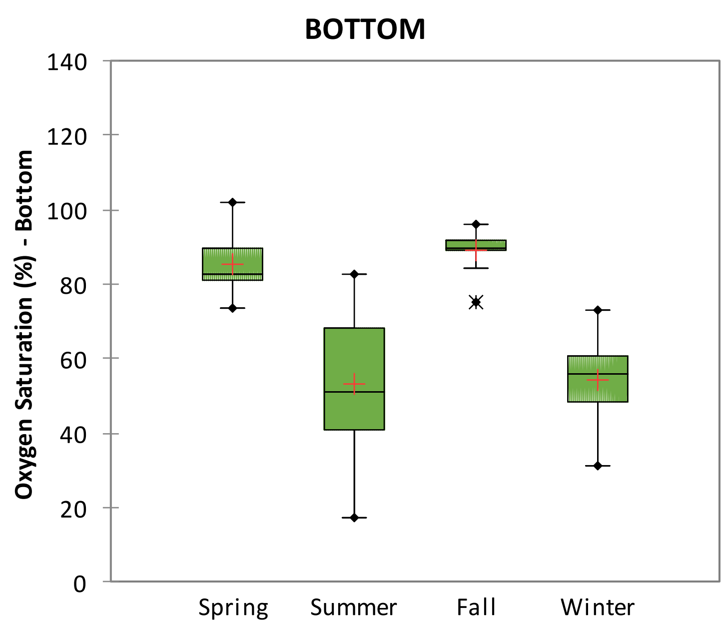


Figure 3.2-23. 2008-2019 Off-system seasonal surface and bottom dissolved oxygen saturation.

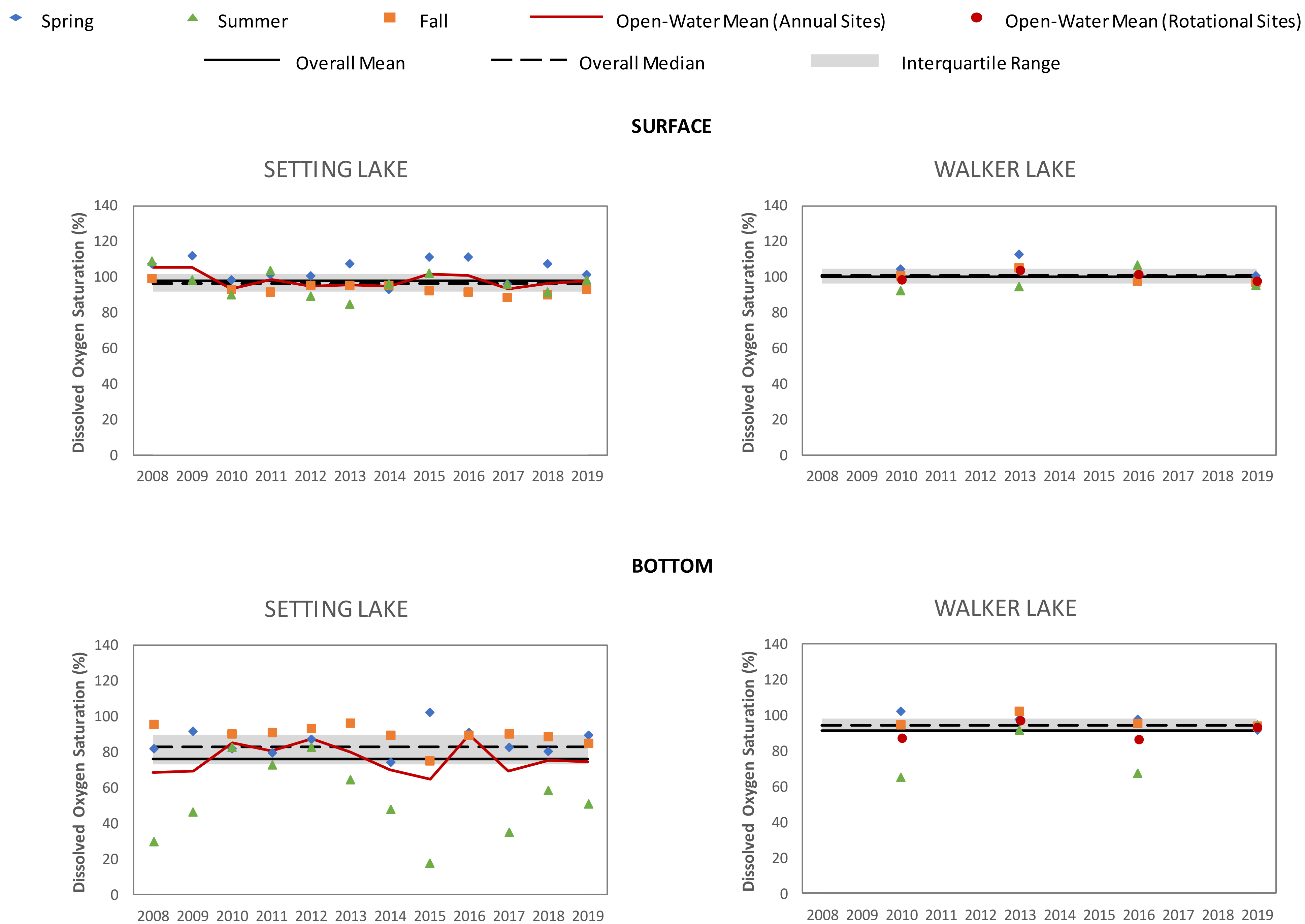


Figure 3.2-24. 2008-2019 Off-system open-water season surface and bottom dissolved oxygen saturation.

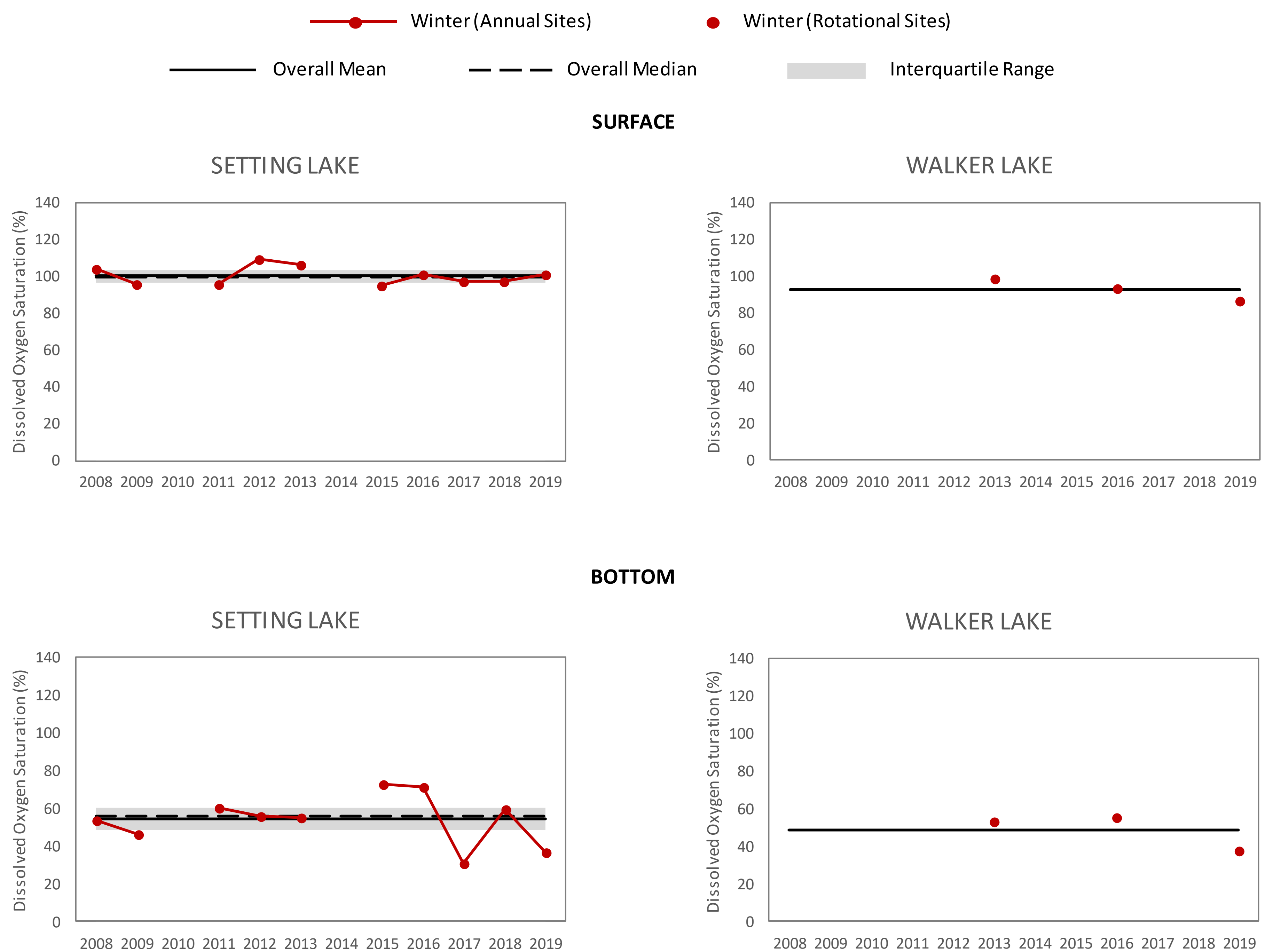


Figure 3.2-25. 2008-2019 Off-system ice-cover season surface and bottom dissolved oxygen saturation.

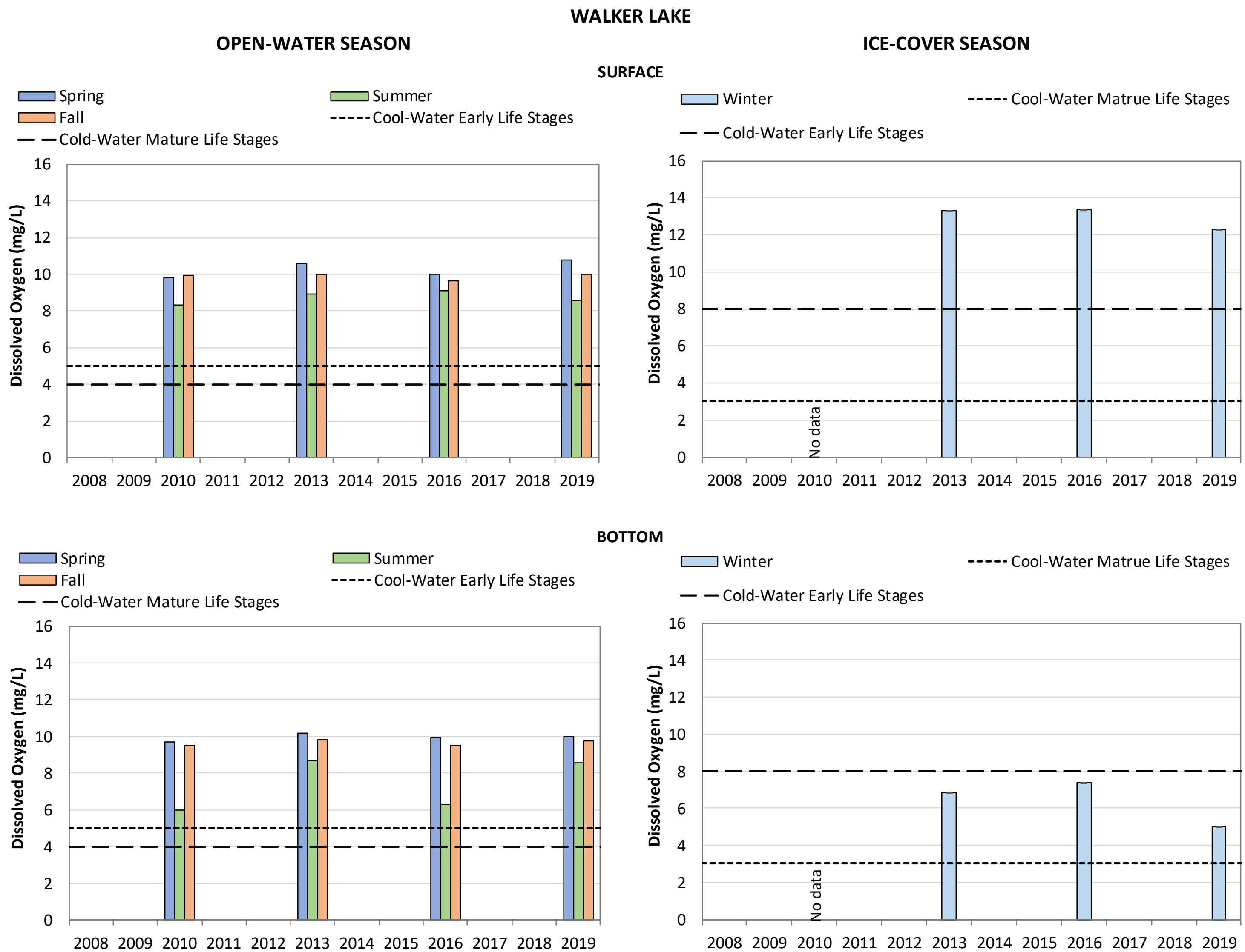


Figure 3.2-26. 2008-2019 Walker Lake surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

3.3 WATER CLARITY

3.3.1 SECCHI DISK DEPTH

3.3.1.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg Outlet Area

Big Mossy Point

Secchi disk depths in Lake Winnipeg at Big Mossy Point ranged from 0.50 to 2.50 m during the open-water season. The mean was 1.44 m, the median was 1.45 m, and the IQR was 0.95 to 1.80 m for the three years of monitoring. Mean annual Secchi disk depths ranged from 1.25 to 1.67 m and were within the IQR in all years (Table 3.3-1 and Figure 3.3-1).

Site 22

Secchi disk depths in Lake Winnipeg at Site 22 ranged from 1.00 to 3.25 m during the open-water season. The mean was 1.78 m, the median was 1.70 m, and the IQR was 1.35 to 2.00 m for the three years of monitoring. Mean annual Secchi disk depths ranged from 1.47 to 2.15 m and were within the IQR in 2017 and 2018 but above the IQR in 2019 (Table 3.3-1 and Figure 3.3-1).

Nelson River near Warren Landing

Secchi disk depth data are not available for riverine sites therefore there are no data for this site.

2-Mile Channel

2-Mile Channel Inlet

Secchi disk depth data are not available for riverine sites therefore there are no data for this site.

2-Mile Channel Outlet

Secchi disk depth data are not available for riverine sites therefore there are no data for this site.

Cross Lake

Secchi disk depth in Cross Lake ranged from 0.40 to 1.90 m during the open-water season. The mean and median measurements for the 12 years of monitoring were 0.73 and 0.65 m, respectively. Mean annual Secchi disk depths ranged from 0.49 to 1.15 m and were within the IQR (0.50 to 0.78 m) in 8 of the 12 years. Mean Secchi disk depths were below the IQR in 2018 and above the IQR in 2008, 2009, and 2015 (Table 3.3-1 and Figure 3.3-2).

No clear seasonality was observed for Secchi disk depth in Cross Lake over the 12 years of monitoring. However, the largest mean Secchi disk depth occurred in summer (0.81 m) and the smallest in spring (0.60 m; Figure 3.3-3).

ROTATIONAL SITES

Playgreen Lake

Secchi disk depths in Playgreen Lake ranged from 0.20 to 0.92 m during the open-water season. The mean was 0.63 m, the median was 0.70 m, and the IQR was 0.44 to 0.87 m for the four years of monitoring. Mean annual Secchi disk depths ranged from 0.38 to 0.81 m and were within the IQR in 2009, 2012, and 2015 but below the IQR in 2018 (Table 3.3-1 and Figure 3.3-4).

Little Playgreen Lake

Secchi disk depths in Little Playgreen Lake ranged from 0.40 to 2.00 m during the open-water season. The mean was 0.83 m, the median was 0.75 m, and the IQR was 0.58 to 0.82 m for the four years of monitoring. Mean annual Secchi disk depths ranged from 0.47 to 1.15 m and were within the IQR in 2010 but below the IQR in 2016 and above the IQR in 2013 and 2019 (Table 3.3-1 and Figure 3.3-4).

Sipiwesk Lake

Secchi disk depths in Sipiwesk Lake ranged from 0.26 to 0.78 m during the open-water season. The mean was 0.45 m, the median was 0.40 m, and the IQR was 0.37 to 0.45 m for the three years of monitoring. Mean annual Secchi disk depths ranged from 0.40 to 0.54 m and were within the IQR in 2011 and 2017 but above the IQR in 2014 (Table 3.3-1 and Figure 3.3-4).

Upper Nelson River Upstream of the Kelsey GS

Secchi disk depths in the upper Nelson River upstream of the Kelsey GS ranged from 0.31 to 0.90 m during the open-water season. The mean was 0.53 m, the median was 0.50 m, and the IQR was 0.48 to 0.55 m for the three years of monitoring. Mean annual Secchi disk depths ranged from

0.45 to 0.67 m and were within the IQR in 2011 and 2014 but above the IQR in 2017 (Table 3.3-1 and Figure 3.3-4).

3.3.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Secchi disk depth in Setting Lake ranged from 0.95 to 2.38 m during the open-water season. The mean and median measurements for the 12 years of monitoring were 1.60 and 1.57 m, respectively. Mean annual Secchi disk depths ranged from 1.13 to 2.08 m and were within the IQR (1.36 to 1.90 m) in 7 of the 12 years. Mean Secchi disk depths were below the IQR in 2016, and 2017 and above the IQR in 2008, 2010, and 2013 (Table 3.3-2 and Figure 3.3-5).

No clear seasonality was observed for Secchi disk depth in Setting Lake over the 12 years of monitoring. However, the largest mean Secchi disk depth occurred in summer (1.65 m) and the smallest in fall (1.53 m; Figure 3.3-6).

ROTATIONAL SITES

Walker Lake

Secchi disk depths in Walker Lake ranged from 1.55 to 3.27 m during the open-water season. The mean was 2.25 m, the median was 2.08 m, and the IQR was 1.95 to 2.56 m for the four years of monitoring. Mean annual Secchi disk depths ranged from 1.98 to 2.53 m and were within the IQR in all years (Table 3.3-2 and Figure 3.3-5).

Table 3.3-1. 2008-2019 On-system sites water clarity summary statistics.

Site	Statistic	Secchi Disk Depth (m)		Turbidity (NTU)		TSS (mg/L)	
		OW	IC	OW	IC	OW	IC
LW-BMP	Mean	1.44	-	6.80	-	4.1	-
	Median	1.45	-	3.78	-	2.2	-
	Minimum	0.50	-	0.75	-	<2.0	-
	Maximum	2.50	-	20.1	-	11.4	-
	SD	0.667	-	6.49	-	3.91	-
	SE	0.236	-	2.29	-	1.38	-
	Lower Quartile	0.95	-	2.69	-	<2.0	-
	Upper Quartile	1.80	-	9.99	-	6.7	-
	n	8	-	8	-	8	-
	% Detections	100	-	100	-	63	-
LW-22	Mean	1.78	-	4.90	-	4.1	-
	Median	1.70	-	4.29	-	3.3	-
	Minimum	1.00	-	1.17	-	<2.0	-
	Maximum	3.25	-	8.66	-	8.9	-
	SD	0.701	-	2.74	-	2.92	-
	SE	0.248	-	0.968	-	1.03	-
	Lower Quartile	1.35	-	3.17	-	2.4	-
	Upper Quartile	2.00	-	7.13	-	5.4	-
	n	8	-	8	-	8	-
	% Detections	100	-	100	-	75	-
NR-WL	Mean	-	-	10.9	-	11.4	-
	Median	-	-	7.00	-	8.0	-
	Minimum	-	-	2.60	-	2.0	-
	Maximum	-	-	35.1	-	31.2	-
	SD	-	-	8.99	-	8.18	-
	SE	-	-	1.92	-	1.74	-
	Lower Quartile	-	-	4.55	-	5.0	-
	Upper Quartile	-	-	13.2	-	18.0	-
	n	-	-	22	-	22	-
	% Detections	-	-	100	-	100	-
2M-IN	Mean	-	-	44.9	-	35.2	-
	Median	-	-	13.3	-	12.6	-
	Minimum	-	-	3.40	-	2.8	-
	Maximum	-	-	324	-	228	-
	SD	-	-	76.8	-	55.3	-
	SE	-	-	17.6	-	12.7	-
	Lower Quartile	-	-	8.09	-	8.3	-
	Upper Quartile	-	-	35.7	-	27.7	-
	n	-	-	19	-	19	-
	% Detections	-	-	100	-	100	-
2M-OUT	Mean	-	-	28.2	-	25.0	-
	Median	-	-	16.0	-	15.8	-
	Minimum	-	-	4.80	-	4.0	-
	Maximum	-	-	148	-	147	-
	SD	-	-	35.6	-	34.0	-
	SE	-	-	8.17	-	7.79	-
	Lower Quartile	-	-	8.90	-	9.4	-
	Upper Quartile	-	-	23.9	-	19.4	-
	n	-	-	19	-	19	-
	% Detections	-	-	100	-	100	-

Table 3.3-1. continued.

Site	Statistic	Secchi Disk Depth (m)		Turbidity (NTU)		TSS (mg/L)	
		OW	IC	OW	IC	OW	IC
CROSS	Mean	0.73	-	10.4	7.60	8.7	2.7
	Median	0.65	-	9.85	7.64	8.4	2.9
	Minimum	0.40	-	5.00	0.80	3.7	<2.0
	Maximum	1.90	-	20.0	14.0	18.0	4.4
	SD	0.335	-	3.58	2.99	3.16	1.29
	SE	0.056	-	0.596	0.863	0.527	0.372
	Lower Quartile	0.50	-	8.05	6.79	6.3	<2.0
	Upper Quartile	0.78	-	11.8	8.52	10.8	3.7
	n	36	-	36	12	36	12
	% Detections	100	-	100	100	100	75
PLAYG	Mean	0.63	-	16.8	4.70	19.0	<2.0
	Median	0.70	-	11.5	-	13.8	-
	Minimum	0.20	-	6.14	4.03	4.4	<2.0
	Maximum	0.92	-	56.3	5.34	95.2	2.0
	SD	0.265	-	14.2	0.726	24.6	-
	SE	0.080	-	4.09	0.363	7.09	-
	Lower Quartile	0.44	-	8.88	-	6.8	-
	Upper Quartile	0.87	-	16.4	-	17.3	-
	n	11	-	12	4	12	4
	% Detections	100	-	100	100	100	25
LPLAY	Mean	0.83	-	9.56	7.28	9.7	3.0
	Median	0.75	-	10.1	-	10.0	-
	Minimum	0.40	-	3.53	4.00	4.0	<2.0
	Maximum	2.00	-	15.9	11.7	14.2	4.8
	SD	0.430	-	3.78	3.41	3.42	1.61
	SE	0.124	-	1.09	1.70	0.987	0.804
	Lower Quartile	0.58	-	7.44	-	7.3	-
	Upper Quartile	0.82	-	12.3	-	12.4	-
	n	12	-	12	4	12	4
	% Detections	100	-	100	100	100	75
SIP	Mean	0.45	-	20.0	8.03	13.1	2.7
	Median	0.40	-	18.8	-	15.0	-
	Minimum	0.26	-	14.8	7.56	<2.0	<2.0
	Maximum	0.78	-	30.3	8.28	18.2	3.6
	SD	0.152	-	4.94	0.405	5.52	1.45
	SE	0.051	-	1.65	0.234	1.84	0.835
	Lower Quartile	0.37	-	17.4	-	10.4	-
	Upper Quartile	0.45	-	21.0	-	17.6	-
	n	9	-	9	3	9	3
	% Detections	100	-	100	100	89	67
UNR	Mean	0.53	-	21.3	7.70	14.9	<2.0
	Median	0.50	-	19.0	-	14.4	-
	Minimum	0.31	-	12.7	6.84	8.5	<2.0
	Maximum	0.90	-	29.3	8.29	25.2	2.2
	SD	0.159	-	6.03	0.764	5.51	-
	SE	0.053	-	2.01	0.441	1.84	-
	Lower Quartile	0.48	-	16.9	-	10.8	-
	Upper Quartile	0.55	-	26.9	-	18.4	-
	n	9	-	9	3	9	3
	% Detections	100	-	100	100	100	33

Notes:

1. OW = Open-water season; IC = Ice-cover season.
2. SD = standard deviation; SE = standard error; n = number of samples.

Table 3.3-2. 2008-2019 Off-system sites water clarity metric summary statistics.

Site	Statistic	Secchi Disk Depth (m)		Turbidity (NTU)		TSS (mg/L)	
		OW	IC	OW	IC	OW	IC
SET	Mean	1.60	-	3.25	1.94	2.4	<2.0
	Median	1.57	-	3.20	1.98	2.4	<2.0
	Minimum	0.95	-	1.82	1.26	<2.0	<2.0
	Maximum	2.38	-	6.58	3.11	8.1	2.0
	SD	0.385	-	1.09	0.494	1.54	-
	SE	0.064	-	0.182	0.143	0.256	-
	Lower Quartile	1.36	-	2.38	1.60	<2.0	<2.0
	Upper Quartile	1.90	-	3.85	2.17	3.1	<2.0
	n	36	-	36	12	36	12
	% Detections	100	-	100	100	64	8
WLKR	Mean	2.25	-	1.91	0.66	2.7	<2.0
	Median	2.08	-	1.86	-	2.3	-
	Minimum	1.55	-	1.14	0.30	<2.0	<2.0
	Maximum	3.27	-	3.24	1.54	6.5	<2.0
	SD	0.554	-	0.648	0.595	1.89	-
	SE	0.160	-	0.187	0.298	0.545	-
	Lower Quartile	1.95	-	1.53	-	<2.0	-
	Upper Quartile	2.56	-	2.18	-	3.4	-
	n	12	-	12	4	12	4
	% Detections	100	-	100	100	67	0

Notes:

1. OW = Open-water season; IC = Ice-cover season.
2. SD = standard deviation; SE = standard error; n = number of samples.

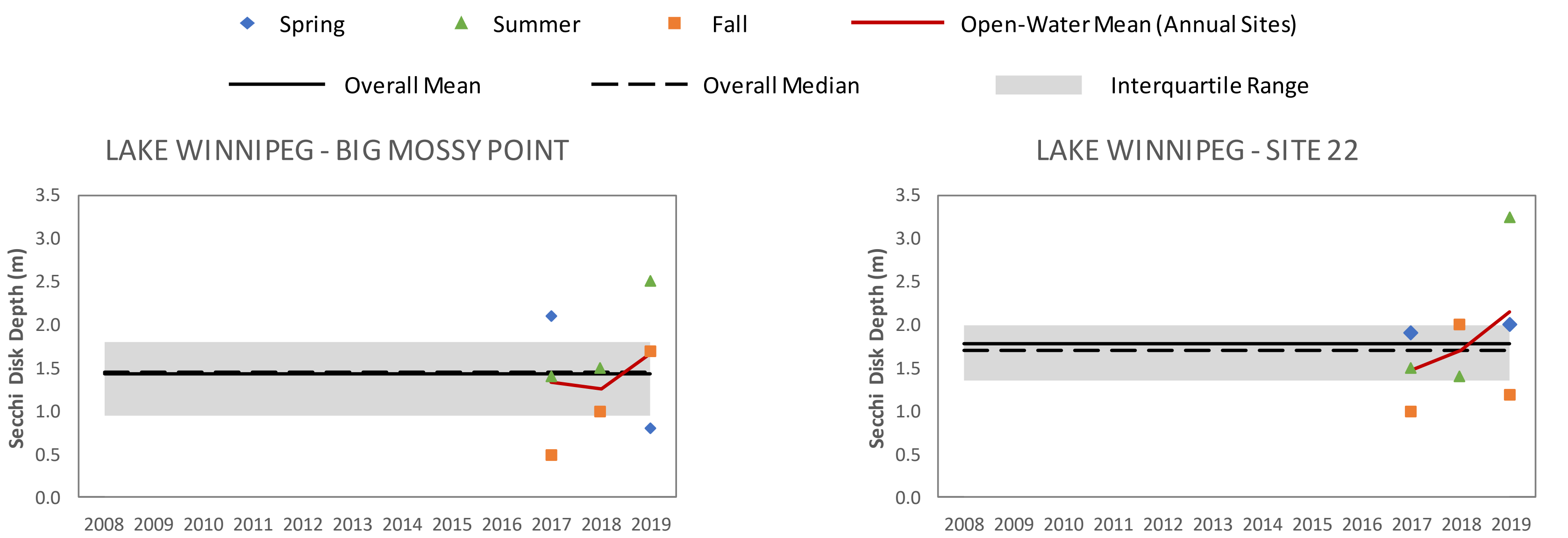


Figure 3.3-1. 2008-2019 Lake Winnipeg outlet area sites open-water season Secchi disk depths.

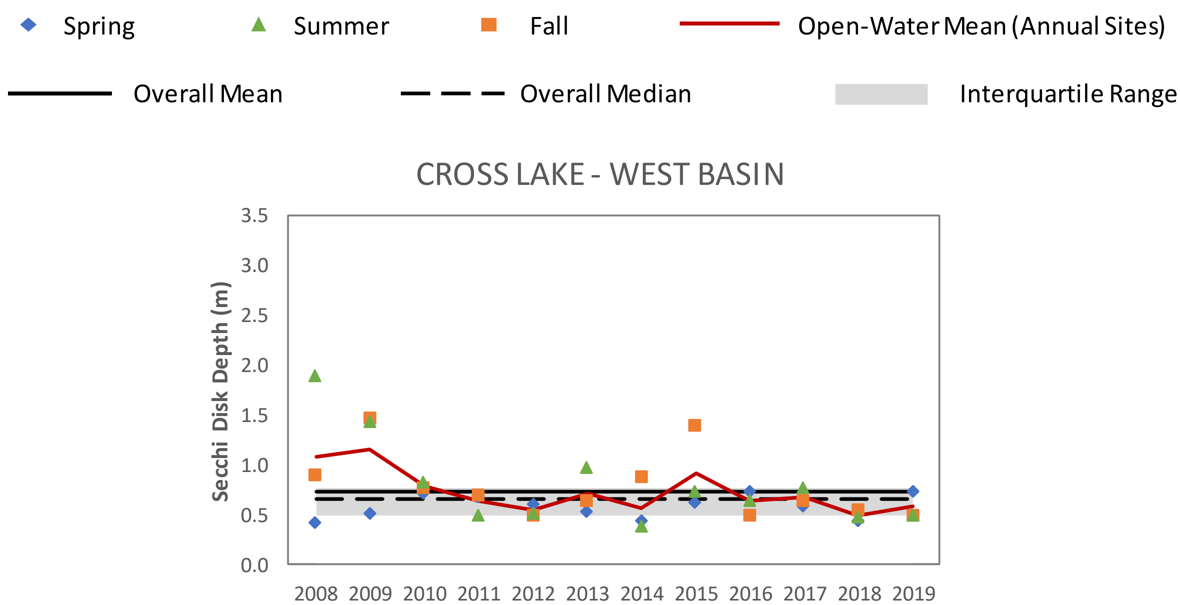


Figure 3.3-2. 2008-2019 Cross Lake – West Basin open-water season Secchi disk depths.

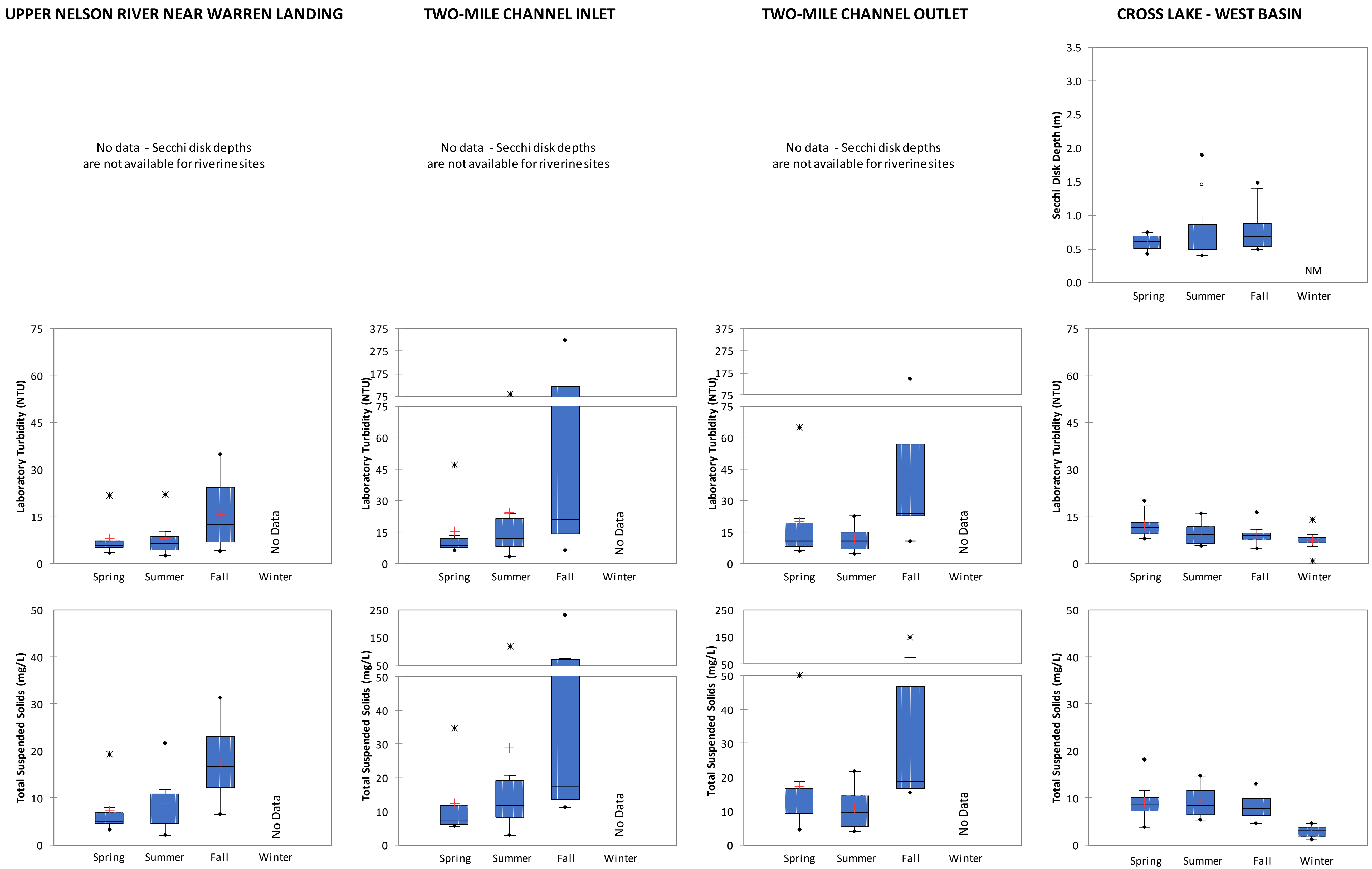


Figure 3.3-3. 2008-2019 On-system seasonal Secchi disk depth, turbidity, and TSS concentrations.

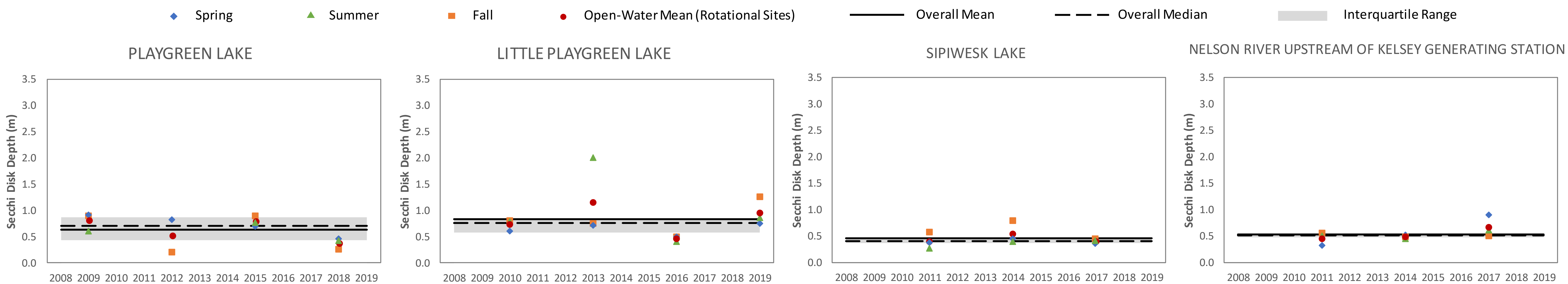


Figure 3.3-4. 2008-2019 On-system rotational sites open-water season Secchi disk depths.

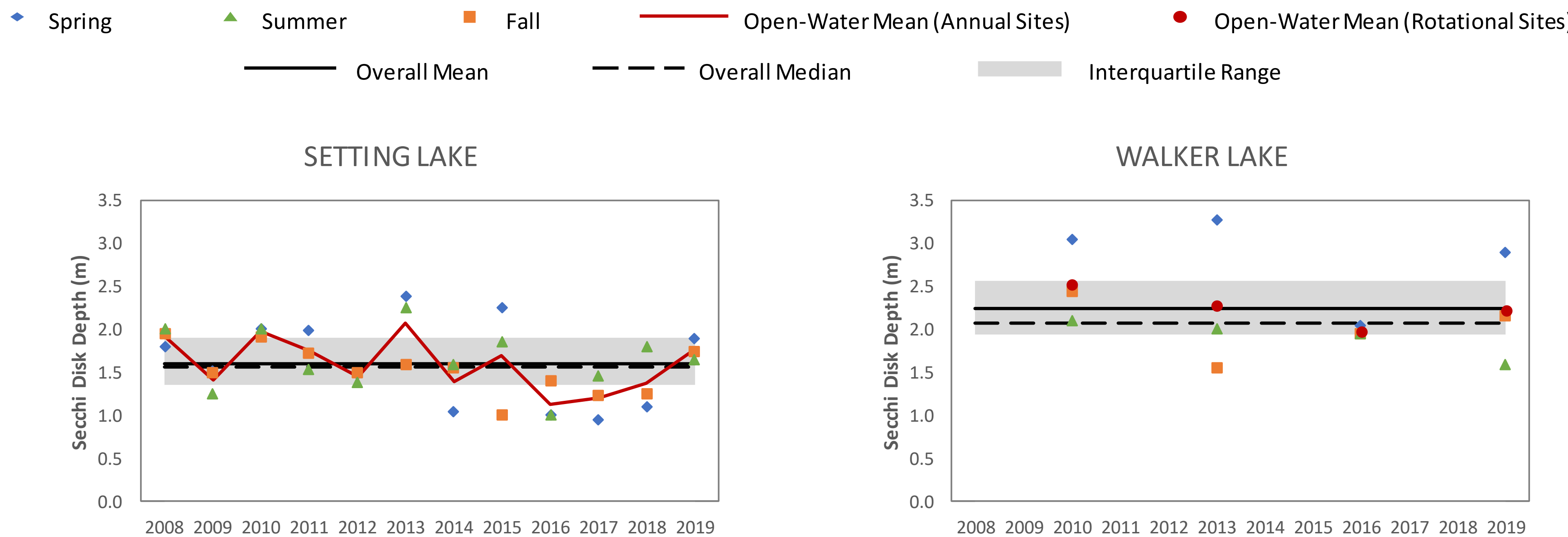


Figure 3.3-5. 2008-2019 Off-system open-water season Secchi disk depths.

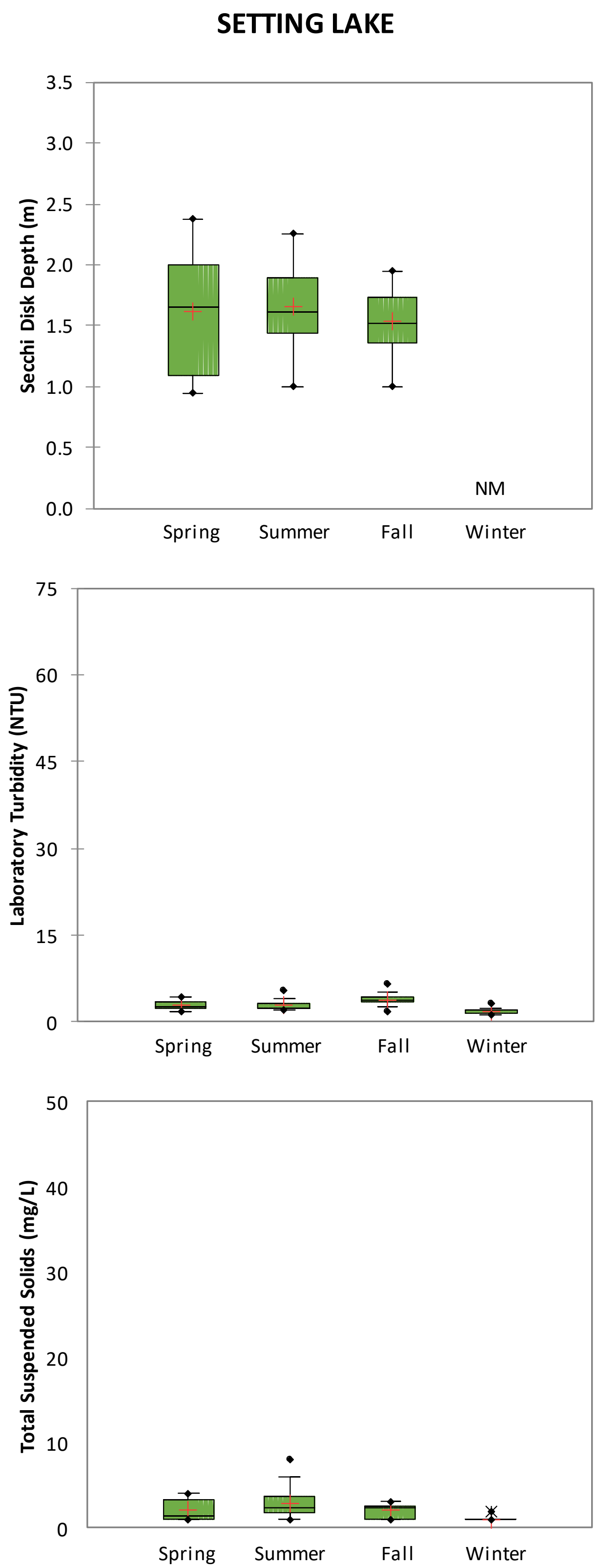


Figure 3.3-6. 2008-2019 Off-system seasonal Secchi disk depth, turbidity, and TSS concentrations.

3.3.2 TURBIDITY

3.3.2.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg Outlet Area

Big Mossy Point

Turbidity in Lake Winnipeg at Big Mossy Point ranged from 0.75 to 20.1 NTU during the open-water season. The mean was 6.80 NTU, the median was 3.78 NTU, and the IQR was 2.69 to 9.99 NTU for the three years of monitoring. Mean annual turbidity in the open-water season ranged from 2.00 to 11.4 NTU and was within the IQR in 2018 but below the IQR in 2019 and above the IQR in 2017 (Table 3.3-1 and Figure 3.3-7).

No data are available for the ice-cover season as this site is not sampled in winter.

Site 22

Turbidity in Lake Winnipeg at Site 22 ranged from 1.17 to 8.66 NTU during the open-water season. The mean was 4.90 NTU, the median was 4.29 NTU, and the IQR was 3.17 to 7.13 NTU for the three years of monitoring. Mean annual turbidity in the open-water season ranged from 2.34 to 7.49 NTU and was within the IQR in 2017 but below the IQR in 2019 and above the IQR in 2018 (Table 3.3-1 and Figure 3.3-7).

No data are available for the ice-cover season as this site is not sampled in winter.

Nelson River near Warren Landing

Turbidity in the Nelson River near Warren Landing ranged from 2.60 to 35.1 NTU during the open-water season. The mean and median turbidity for the eight years of monitoring were 10.9 and 7.00 NTU, respectively. Open-water season mean annual turbidity ranged from 3.49 to 18.3 NTU and was within the IQR (4.55 to 13.2 NTU) in four of the eight years. Mean turbidity was below the IQR in 2014 and above the IQR in 2015, 2017, and 2018 (Table 3.3-1 and Figure 3.3-7).

No data are available for the ice-cover season as this site is not sampled in winter.

Mean turbidity in the Nelson River near Warren Landing was lower in spring and summer (7.99 and 8.23 NTU, respectively) than in fall (15.8 NTU) over the eight years of monitoring. No data are available for winter (Figure 3.3-3).

2-Mile Channel

2-Mile Channel Inlet

Turbidity at the 2-Mile Channel Inlet ranged from 3.40 to 324 NTU during the open-water season. The mean and median turbidity for the seven years of monitoring were 44.9 and 13.3 NTU, respectively. Open-water season mean annual turbidity ranged from 4.99 to 114 NTU and was within the IQR (8.09 to 35.7 NTU) in 2017 and 2019. Mean turbidity was below the IQR in 2014 and above the IQR in 2013, 2015, 2016, and 2018 (Table 3.3-1 and Figure 3.3-7).

No data are available for the ice-cover season as this site is not sampled in winter.

Mean turbidity at the 2-Mile Channel Inlet was lower in spring and summer (15.4 and 24.4 NTU, respectively) than in fall (87.7 NTU) over the seven years of monitoring. No data are available for winter (Figure 3.3-3).

2-Mile Channel Outlet

Turbidity at the 2-Mile Channel Outlet ranged from 4.80 to 148 NTU during the open-water season. The mean and median turbidity for the seven years of monitoring were 28.2 and 16.0 NTU, respectively. Open-water season mean annual turbidity ranged from 7.80 to 54.0 NTU and was within the IQR (8.90 to 23.9 NTU) in 2015, 2017, and 2019. Mean turbidity was below the IQR in 2014 and above the IQR in 2013, 2016, and 2018 (Table 3.3-1 and Figure 3.3-7).

No data are available for the ice-cover season as this site is not sampled in winter.

Mean turbidity at the 2-Mile Channel Outlet was lower in spring and summer (20.3 and 11.9 NTU, respectively) than in fall (49.0 NTU) over the seven years of monitoring. No data are available for winter (Figure 3.3-3).

Cross Lake

Turbidity in Cross Lake ranged from 5.00 to 20.0 NTU during the open-water season. The mean and median turbidity for the 12 years of monitoring were 10.4 and 9.85 NTU, respectively. Open-water season mean annual turbidity ranged from 7.6 to 14.9 NTU and was within the IQR (8.05 to

11.8 NTU) in seven of the 12 years. Mean turbidity was below the IQR in 2009 and 2015 and above the IQR in 2012, 2014, and 2018 (Table 3.3-1 and Figure 3.3-8).

Turbidity in the ice-cover season ranged from 0.80 to 14.0 NTU, with a mean of 7.60 NTU and a median of 7.64 NTU for the 12 years of monitoring. The IQR was 6.79 to 8.52 NTU (Table 3.3-1 and Figure 3.3-8).

No clear seasonality was observed for turbidity in Cross Lake over the 12-year period. However, the lowest mean turbidity occurred in winter (7.60 NTU) and the highest in spring (12.3 NTU; Figure 3.3-3).

ROTATIONAL SITES

Playgreen Lake

Turbidity in Playgreen Lake ranged from 6.14 to 56.3 NTU during the open-water season. The mean was 16.8 NTU, the median was 11.5 NTU, and the IQR was 8.88 to 16.4 NTU for the four years of monitoring. Mean annual turbidity in the open-water season ranged from 9.30 to 25.1 NTU and was within the IQR in 2009 and 2015 but above the IQR in 2012 and 2018 (Table 3.3-1 and Figure 3.3-9).

During the ice-cover season, turbidity was relatively similar in the four years of sampling, ranging from 4.03 to 5.34 NTU, with a mean of 4.70 NTU (Table 3.3-1 and Figure 3.3-9).

Little Playgreen Lake

Turbidity in Little Playgreen Lake ranged from 3.53 to 15.9 NTU during the open-water season. The mean was 9.56 NTU, the median was 10.1 NTU, and the IQR was 7.44 to 12.3 NTU for the four years of monitoring. Mean annual turbidity in the open-water season ranged from 7.20 to 12.1 NTU and was within the IQR in 2013, 2016, and 2019 but below the IQR in 2010 (Table 3.3-1 and Figure 3.3-9).

During the ice-cover season, turbidity ranged from 4.00 to 11.7 NTU, with a mean of 7.28 NTU (Table 3.3-1 and Figure 3.3-9).

Sipiwesk Lake

Turbidity in Sipiwesk Lake ranged from 14.8 to 30.3 NTU during the open-water season. The mean was 20.0 NTU, the median was 18.8 NTU, and the IQR was 17.4 to 21.0 NTU for the three years of monitoring. Mean annual turbidity in the open-water season ranged from 19.5 to 20.8 NTU and was within the IQR in all years sampled (Table 3.3-1 and Figure 3.3-9).

During the ice-cover season, turbidity was relatively similar in the three years of sampling, ranging from 7.56 to 8.28 NTU, with a mean of 8.03 NTU (Table 3.3-1 and Figure 3.3-9).

Upper Nelson River Upstream of the Kelsey GS

Turbidity in the upper Nelson River upstream of the Kelsey GS ranged from 12.7 to 29.3 NTU during the open-water season. The mean was 21.3 NTU, the median was 19.0 NTU, and the IQR was 16.9 to 26.9 NTU for the three years of monitoring. Mean annual turbidity in the open-water season ranged from 18.9 to 24.4 NTU and was within the IQR in all years sampled (Table 3.3-1 and Figure 3.3-9).

During the ice-cover season, turbidity was relatively similar in the three years of sampling, ranging from 6.84 to 8.29 NTU, with a mean of 7.70 NTU (Table 3.3-1 and Figure 3.3-9).

3.3.2.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Turbidity in Setting Lake ranged from 1.82 to 6.58 NTU during the open-water season. The mean and median turbidity for the 12 years of monitoring were 3.25 and 3.20 NTU, respectively. Open-water season mean annual turbidity ranged from 2.06 to 4.21 NTU and was within the IQR (2.38 to 3.85 NTU) in seven of the 12 years. Mean turbidity was below the IQR in 2010 and 2011 and above the IQR in 2009, 2018, and 2019 (Table 3.3-2 and Figure 3.3-10).

Turbidity in the ice-cover season ranged from 1.26 to 3.11 NTU, with a mean of 1.94 NTU and a median of 1.98 NTU for the 12 years of monitoring. The IQR was 1.60 to 2.17 NTU (Table 3.3-2 and Figure 3.3-10).

Mean turbidity in Setting Lake was lower in winter (1.94 NTU) and higher in fall (3.92 NTU) compared to the spring and summer (2.94 and 2.90 NTU, respectively) over the 12-year period (Figure 3.3-6).

ROTATIONAL SITES

Walker Lake

Turbidity in Walker Lake ranged from 1.14 to 3.24 NTU during the open-water season. The mean was 1.91 NTU, the median was 1.86 NTU, and the IQR was 1.53 to 2.18 NTU for the four years of monitoring. Mean annual turbidity in the open-water season ranged from 1.55 to 2.31 NTU and was within the IQR in 2010, 2013, and 2016 but above the IQR in 2019 (Table 3.3-2 and Figure 3.3-10).

During the ice-cover season, turbidity ranged from 0.30 to 1.54 NTU, with a mean of 0.66 NTU (Table 3.3-2 and Figure 3.3-10).

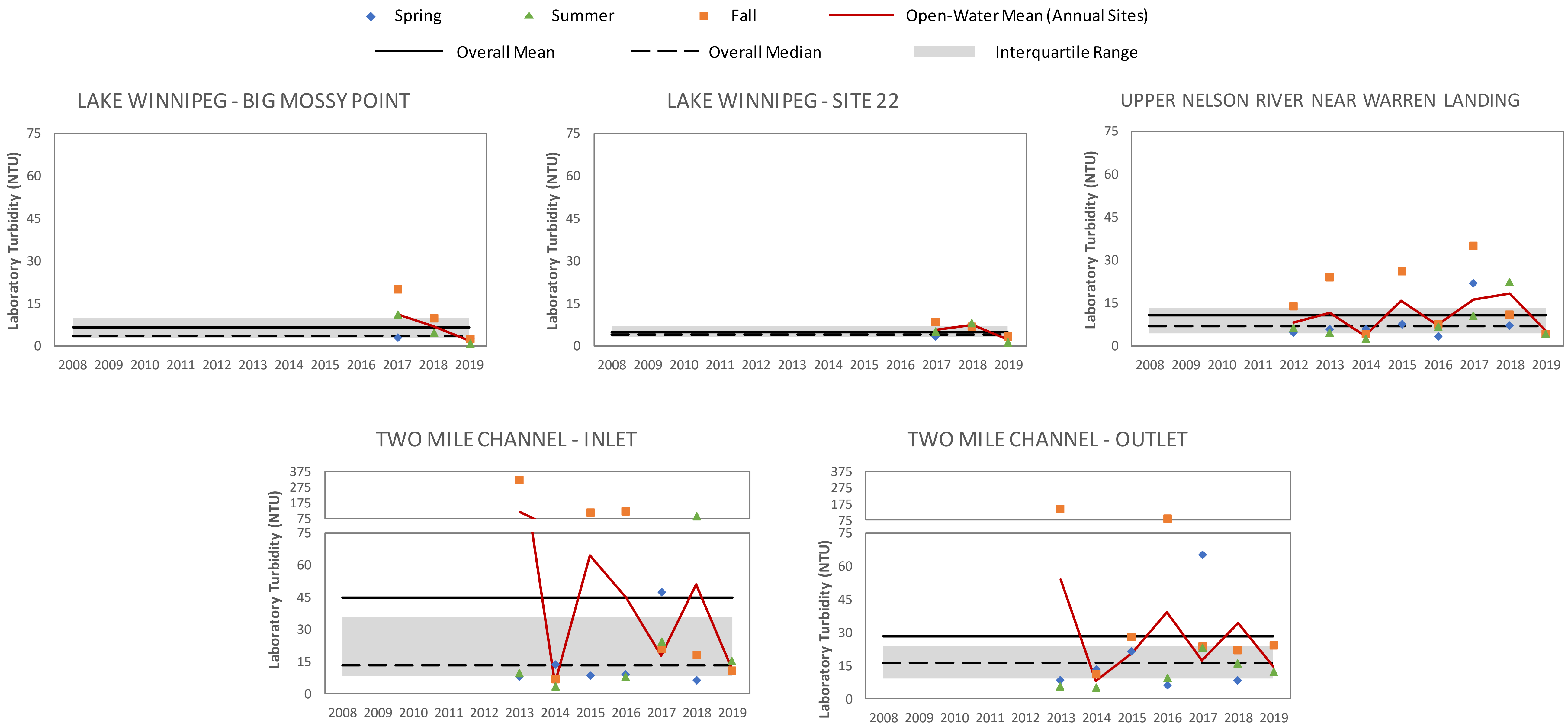
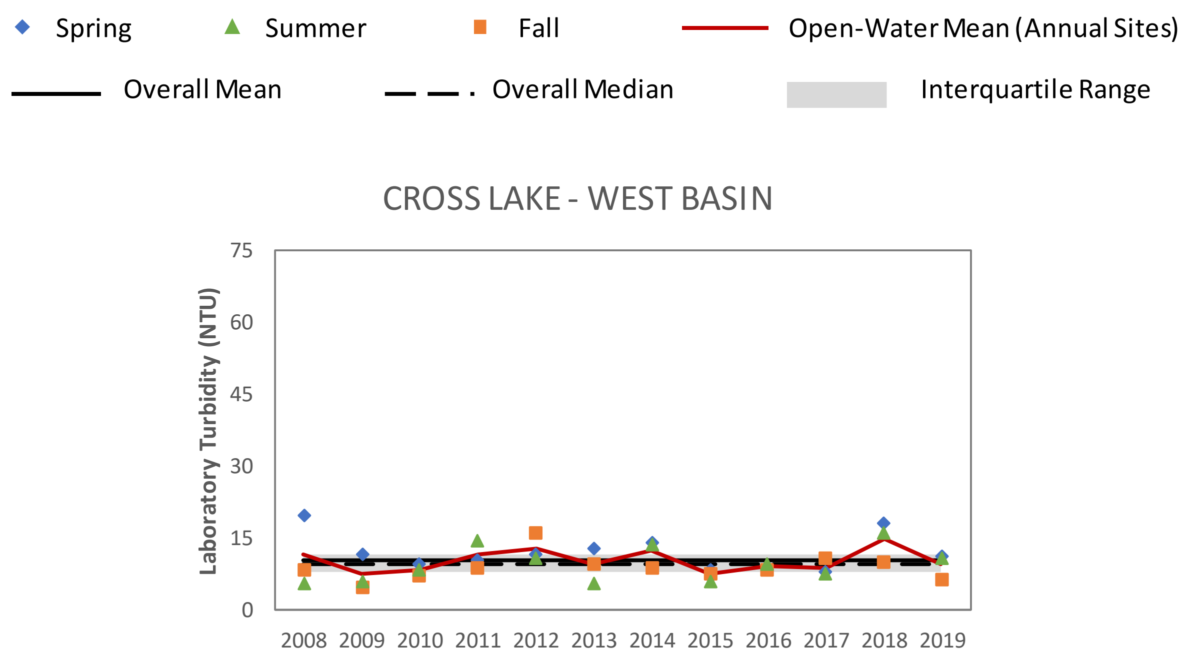


Figure 3.3-7. 2008-2019 Lake Winnipeg outlet area sites open-water season turbidity levels.

OPEN-WATER SEASON



ICE-COVER SEASON

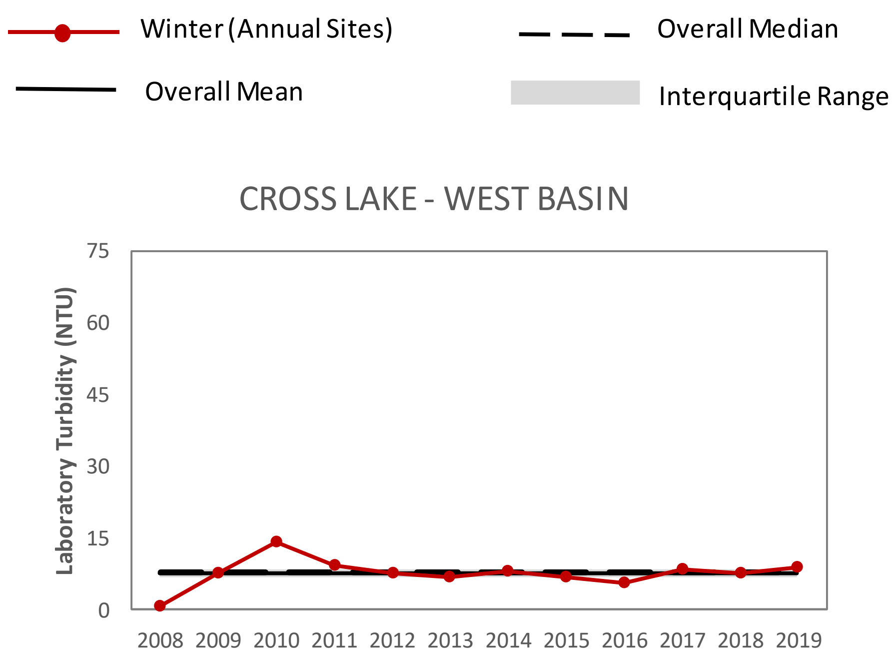


Figure 3.3-8. 2008-2019 Cross Lake – West Basin open-water and ice-cover season turbidity levels.

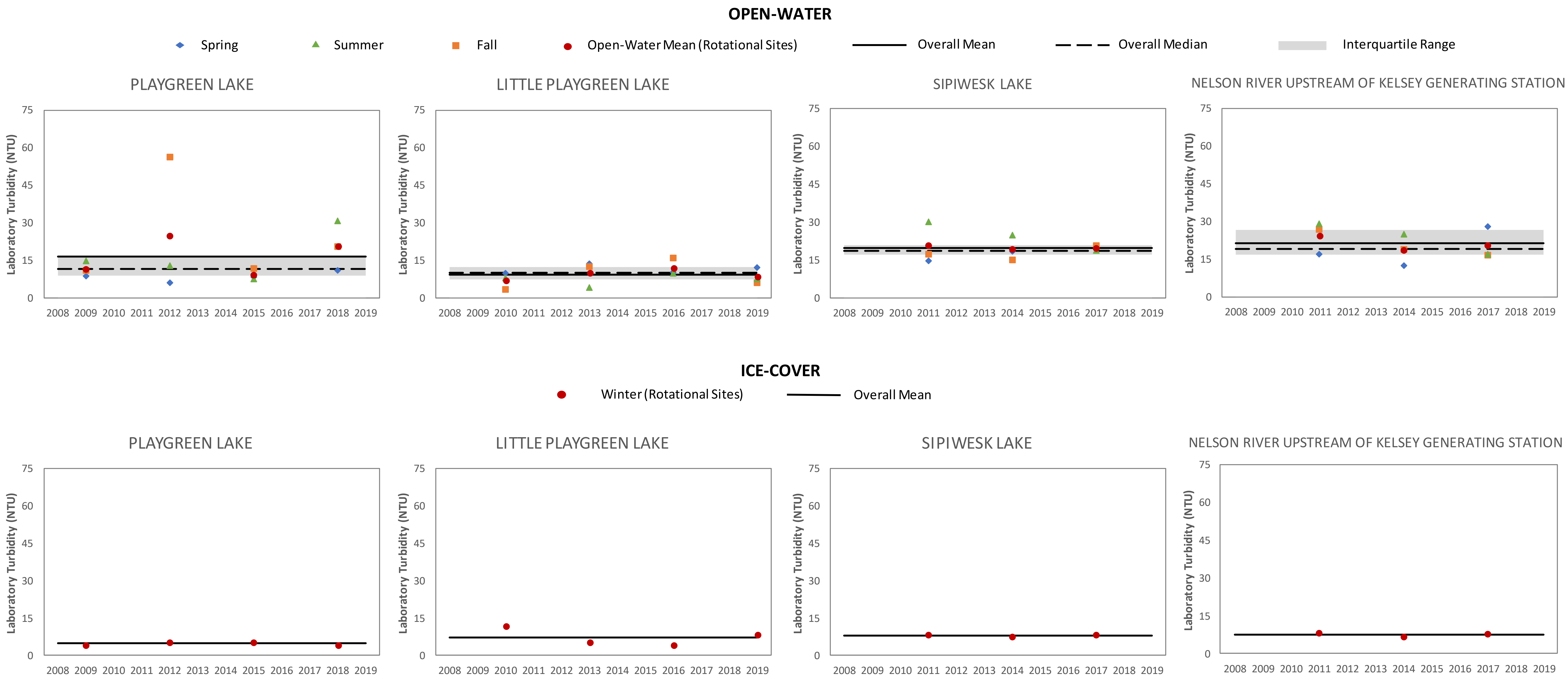


Figure 3.3-9. 2008-2019 On-system rotational sites open-water and ice-cover season turbidity levels.

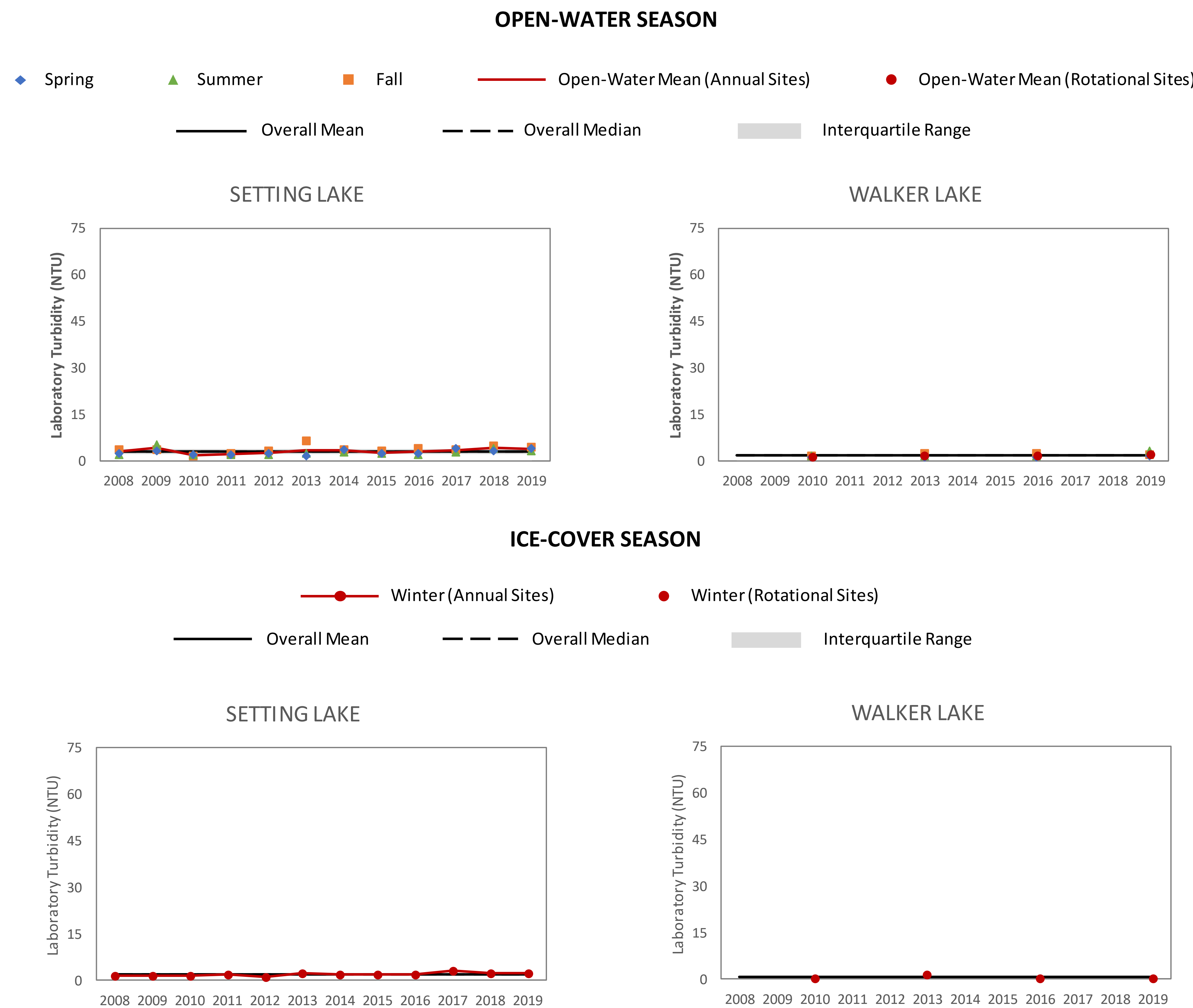


Figure 3.3-10. 2008-2019 Off-system open-water and ice-cover season turbidity levels.

3.3.3 TOTAL SUSPENDED SOLIDS

3.3.3.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg Outlet Area

Big Mossy Point

TSS concentrations in Lake Winnipeg at Big Mossy Point ranged from <2.0 to 11.4 mg/L during the open-water season. The mean was 4.1 mg/L, the median was 2.2 mg/L, and the IQR was <2.0 to 6.7 mg/L for the three years of monitoring. Mean annual TSS concentrations in the open-water season ranged from <2.0 to 6.6 mg/L and were within the IQR in all years. TSS concentrations were typically above the detection limit (DL; 2.0 mg/L) during the open-water season (percent detections = 63; Table 3.3-1 and Figure 3.3-11).

No data are available for the ice-cover season as this site is not sampled in winter.

Site 22

TSS concentrations in Lake Winnipeg at Site 22 ranged from <2.0 to 8.9 mg/L during the open-water season. The mean was 4.1 mg/L, the median was 3.3 mg/L, and the IQR was 2.4 to 5.4 mg/L for the three years of monitoring. Mean annual TSS concentrations in the open-water season ranged from <2.0 to 5.9 mg/L and were within the IQR in 2017 but below the IQR in 2019 and above the IQR in 2018. TSS concentrations were typically above the DL (2.0 mg/L) during the open-water season (percent detections = 75; Table 3.3-1 and Figure 3.3-11).

No data are available for the ice-cover season as this site is not sampled in winter.

Nelson River near Warren Landing

TSS concentrations in the Nelson River near Warren Landing ranged from 2.0 to 31.2 mg/L during the open-water season. The mean and median TSS concentration for the eight years of monitoring were 11.4 and 8.0 mg/L, respectively. Open-water season mean annual TSS concentrations ranged from 4.9 to 18.3 mg/L and were within the IQR (5.0 to 18.0 m/L) in six of the eight years. Mean TSS concentrations were below the IQR in 2019 and above the IQR in 2018. TSS concentrations were consistently above the DL (2.0 mg/L) during the open-water season (percent detections = 100; Table 3.3-1 and Figure 3.3-11).

No data are available for the ice-cover season as this site is not sampled in winter.

Mean TSS concentrations in the Nelson River near Warren Landing were lower in spring and summer (7.1 and 8.8 mg/L, respectively) than in fall (17.4 mg/L) over the eight years of monitoring. No data are available for winter (Figure 3.3-3).

2-Mile Channel

2-Mile Channel Inlet

TSS concentrations at the 2-Mile Channel Inlet ranged from 2.8 to 228 m/L during the open-water season. The mean and median TSS concentration for the seven years of monitoring were 35.2 and 12.6 mg/L, respectively. Open-water season mean annual TSS concentrations ranged from 7.0 to 81.5 mg/L and were within the IQR (8.3 to 27.7 mg/L) in 2017 and 2019. Mean turbidity was below the IQR in 2014 and above the IQR in 2013, 2015, 2016, and 2018. TSS concentrations were consistently above the DL (2.0 mg/L) during the open-water season (percent detections = 100; Table 3.3-1 and Figure 3.3-11).

No data are available for the ice-cover season as this site is not sampled in winter.

Mean TSS concentrations at the 2-Mile Channel Inlet were lower in spring and summer (12.3 and 28.6 mg/L, respectively) than in fall (60.5 mg/L) over the seven years of monitoring. No data are available for winter (Figure 3.3-3).

2-Mile Channel Outlet

TSS concentrations at the 2-Mile Channel Outlet ranged from 4.0 to 147 mg/L during the open-water season. The mean and median TSS concentrations for the seven years of monitoring were 25.0 and 15.8 mg/L, respectively. Open-water season mean annual TSS concentrations ranged from 9.6 to 53.5 mg/L and were within the IQR (9.4 to 19.4 mg/L) in four of seven years. Mean TSS concentrations were above the IQR in 2013, 2016, and 2018. TSS concentrations were consistently above the DL (2.0 mg/L) during the open-water season (percent detections = 100; Table 3.3-1 and Figure 3.3-11).

No data are available for the ice-cover season as this site is not sampled in winter.

Mean TSS concentrations at the 2-Mile Channel Outlet were lower in spring and summer (17.0 and 10.8 mg/L, respectively) than in fall (44.0 mg/L) over the seven years of monitoring. No data are available for winter (Figure 3.3-3).

Cross Lake

TSS concentrations in Cross Lake ranged from 3.7 to 18.0 mg/L during the open-water season. The mean and median concentrations for the 12 years of monitoring were 8.7 and 8.4 mg/L, respectively. Open-water season mean annual TSS concentrations ranged from 5.6 to 11.3 mg/L and were within the IQR (6.3 to 10.8 mg/L) in ten of the 12 years. Mean TSS concentrations were below the IQR in 2015 and above the IQR in 2008. TSS concentrations were consistently above the DL (2.0 mg/L) during the open-water season (percent detections = 100; Table 3.3-1 and Figure 3.3-12).

TSS concentrations in the ice-cover season ranged from <2.0 to 4.4 mg/L. The mean was 2.7 mg/L, the median was 2.9 mg/L, and the IQR was <2.0 to 3.7 mg/L for the 12 years of monitoring. TSS concentrations were below the DL (2.0 mg/L) in three of 12 samples from the ice-cover season (percent detections = 75; Table 3.3-1 and Figure 3.3-12).

TSS concentrations in Cross Lake were lower in winter (mean = 2.7 mg/L) than during the open-water season. No clear seasonality was observed for TSS concentrations in the open-water season over the 12-year period; however, the lowest mean TSS concentration occurred in fall (8.0 mg/L) and the highest in summer (8.2 mg/L; Figure 3.3-3).

ROTATIONAL SITES

Playgreen Lake

TSS concentrations in Playgreen Lake ranged from 4.4 to 95.2 mg/L during the open-water season. The mean was 19.0 mg/L and median was 13.8 mg/L, and the IQR was 6.8 to 17.3 mg/L for the four years of monitoring. Mean annual TSS concentrations in the open-water season ranged from 9.6 to 39.0 mg/L and were within the IQR in 2009, 2015, and 2018, but were above the IQR in 2012. TSS concentrations were consistently above the DL (2.0 mg/L) during the open-water season (percent detections = 100; Table 3.3-1 and Figure 3.3-13).

During the ice-cover season, TSS concentrations ranged from <2.0 to 2.0 mg/L, with a mean of <2.0 mg/L. TSS concentrations were below the DL (2.0 mg/L) in three of four samples collected in winter (percent detections = 25; Table 3.3-1 and Figure 3.3-13).

Little Playgreen Lake

TSS concentrations in Little Playgreen Lake ranged from 4.0 to 14.2 mg/L during the open-water season. The mean was 9.7 mg/L and median was 10.0 mg/L, and the IQR was 7.3 to 12.4 mg/L for the four years of monitoring. Mean annual TSS concentrations in the open-water season ranged from 8.2 to 11.3 mg/L and were within the IQR in all years. TSS concentrations were consistently above the DL (2.0 mg/L) during the open-water season (percent detections = 100; Table 3.3-1 and Figure 3.3-13).

During the ice-cover season, TSS concentrations ranged from <2.0 to 4.8 mg/L, with a mean of 3.0 mg/L. TSS concentrations were below the DL (2.0 mg/L) in one of four samples collected in winter (percent detections = 75; Table 3.3-1 and Figure 3.3-13).

Sipiwesk Lake

TSS concentrations in Sipiwesk Lake ranged from <2.0 to 18.2 mg/L during the open-water season. The mean was 13.1 mg/L and median was 15.0 mg/L, and the IQR was 10.4 to 17.6 mg/L for the three years of monitoring. Mean annual TSS concentrations in the open-water season ranged from 10.6 to 14.3 mg/L and were within the IQR in all years. TSS concentrations were above the DL (2.0 mg/L) in eight of nine samples collected during the open-water season (percent detections = 89; Table 3.3-1 and Figure 3.3-13).

During the ice-cover season, TSS concentrations ranged from <2.0 to 3.6 mg/L, with a mean of 2.7 mg/L. TSS concentrations were below the DL (2.0 mg/L) in one of three samples collected in winter (percent detections = 67; Table 3.3-1 and Figure 3.3-13).

Upper Nelson River Upstream of the Kelsey GS

TSS concentrations in the upper Nelson River upstream of the Kelsey GS ranged from 8.5 to 25.2 mg/L during the open-water season. The mean was 14.9 mg/L and median was 14.4 mg/L, and the IQR was 10.8 to 18.4 mg/L for the three years of monitoring. Mean annual TSS concentrations in the open-water season ranged from 12.0 to 17.7 mg/L and were within the IQR in all years sampled. TSS concentrations were consistently above the DL (2.0 mg/L) during the open-water season (percent detections = 100; Table 3.3-1 and Figure 3.3-13).

During the ice-cover season, TSS concentrations ranged from <2.0 to 2.2 mg/L, with a mean of <2.0 mg/L. TSS concentrations were below the DL (2.0 mg/L) in two of three samples collected in winter (percent detections = 33; Table 3.3-1 and Figure 3.3-13).

3.3.3.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

TSS concentrations in Setting Lake ranged from <2.0 to 8.1 mg/L during the open-water season. The mean and median concentrations for the 12 years of monitoring were both 2.4 mg/L. Open-water season mean annual TSS concentrations ranged from <2.0 to 4.0 mg/L and were within the IQR (<2.0 to 3.1 mg/L) in nine of the 12 years. Mean TSS concentrations were above the IQR in 2009, 2010, and 2018. TSS concentrations were above the DL (2.0 mg/L) in approximately two thirds of the samples during the open-water season (percent detections = 64; Table 3.3-2 and Figure 3.3-14).

TSS concentrations in the ice-cover season ranged from <2.0 to 2.0 mg/L, both the mean and median were <2.0 mg/L, and the IQR was <2.0 to <2.0 mg/L. TSS concentrations were below the DL (2.0 mg/L) in all but one sample over the 12 years of monitoring (percent detections = 8; Table 3.3-2 and Figure 3.3-14).

Although TSS concentrations were more frequently above the DL during the open-water season than in winter, no clear seasonality was observed for TSS concentrations in Setting Lake over the 12 years of monitoring. However, mean TSS concentrations were lowest in winter (<2.0 mg/L) and highest in summer (3.0 mg/L; Figure 3.3-6).

ROTATIONAL SITES

Walker Lake

TSS concentrations in Walker Lake ranged from <2.0 to 6.5 mg/L during the open-water season. The mean was 2.7 mg/L and median was 2.3 mg/L, and the IQR was <2.0 to 3.4 mg/L for the four years of monitoring. Mean annual TSS concentrations in the open-water season ranged from <2.0 to 3.4 mg/L and were within the IQR in all years. TSS concentrations were below the DL (2.0 mg/L) in four of 12 samples during the open-water season (percent detections = 67; Table 3.3-2 and Figure 3.3-14).

During the ice-cover season, TSS concentrations were consistently below the DL (2.0 mg/L; Table 3.3-2 and Figure 3.3-14).

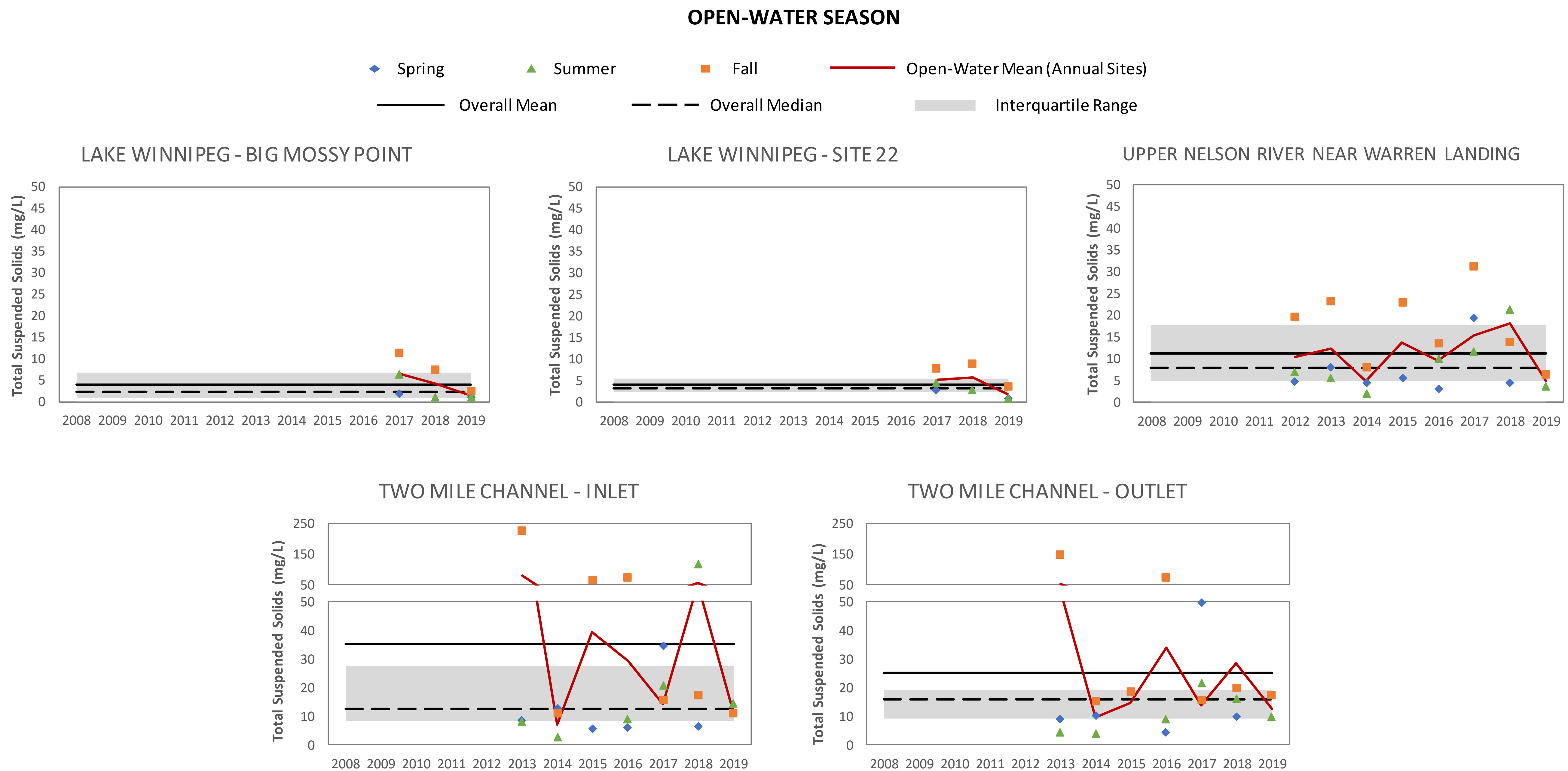
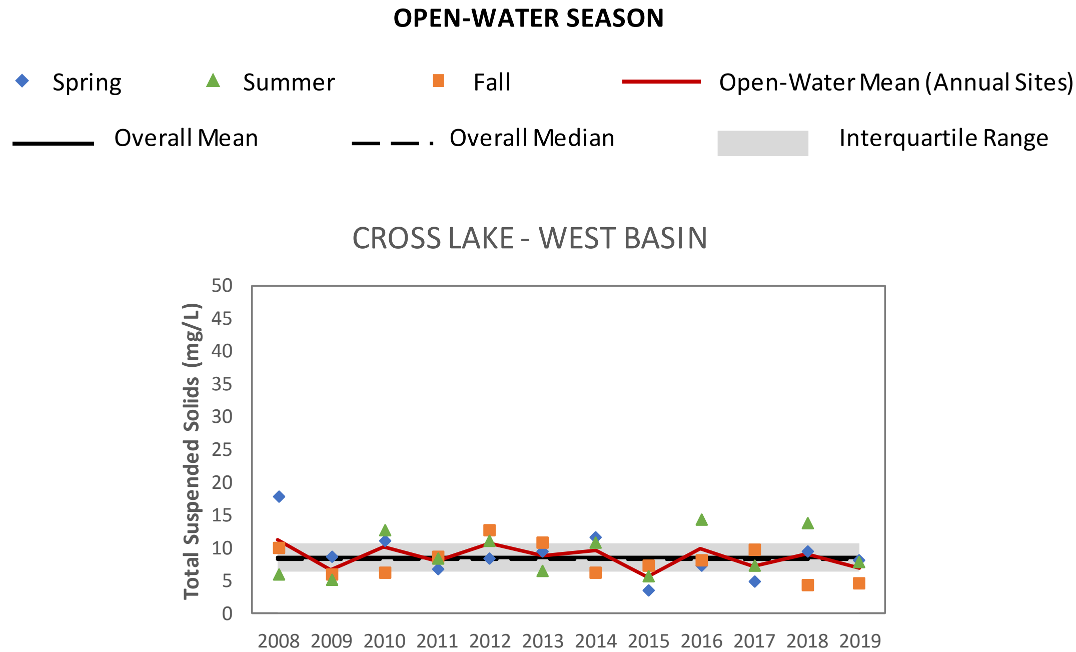


Figure 3.3-11. 2008-2019 Lake Winnipeg outlet area sites open-water season TSS concentrations.



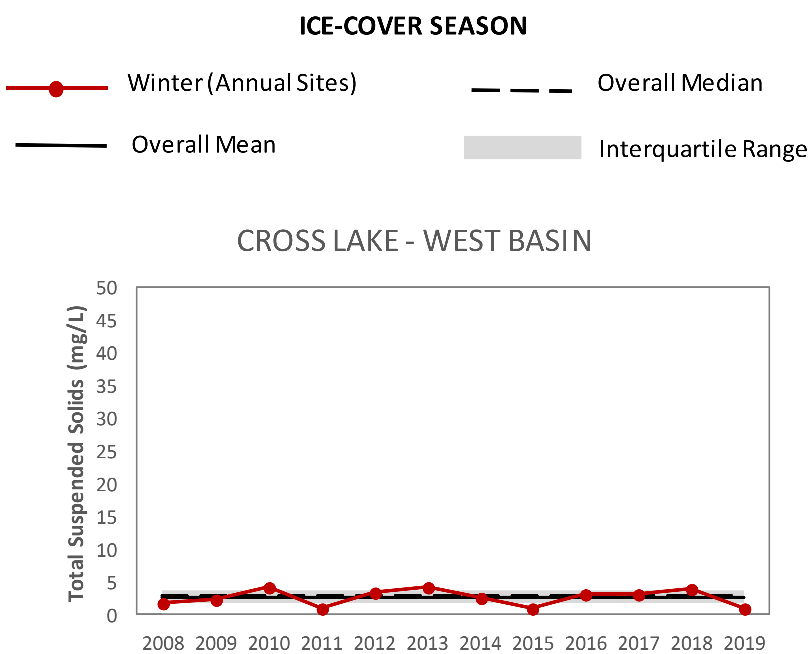


Figure 3.3-12. 2008-2019 Cross Lake – West Basin open-water and ice-cover season TSS concentrations.

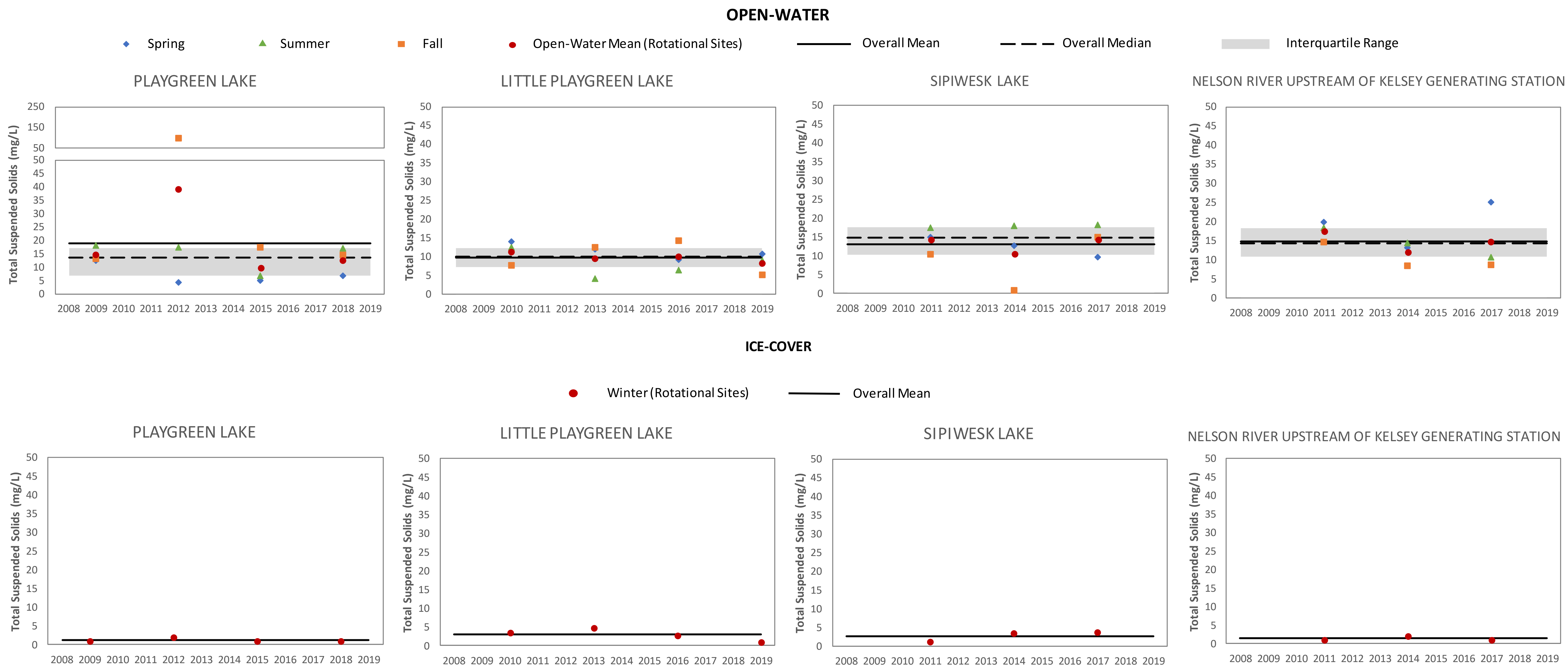


Figure 3.3-13. 2008-2019 On-system rotational sites open-water and ice-cover season TSS concentrations.

Figure 3.3-14. 2008-2019 Off-system open-water and ice-cover season TSS concentrations.

3.4 NUTRIENTS AND TROPHIC STATUS

3.4.1 TOTAL PHOSPHORUS

3.4.1.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg Outlet Area

Big Mossy Point

TP concentrations in Lake Winnipeg at Big Mossy Point ranged from 0.012 to 0.051 mg/L during the open-water season. The mean was 0.026 mg/L, the median was 0.025 mg/L, and the IQR was 0.017 to 0.032 mg/L for the three years of monitoring. Mean annual TP concentrations in the open-water season ranged from 0.017 to 0.033 mg/L and were within the IQR in 2018 and 2019 but above the IQR in 2017 (Table 3.4-1 and Figure 3.4-1).

No data are available for the ice-cover season as this site is not sampled in winter.

Big Mossy Point was meso-eutrophic (0.020 to 0.035 mg/L) based on the mean of the open-water season TP concentrations for the three years of monitoring (0.026 mg/L). Open-water season mean annual TP concentrations (0.017 to 0.033 mg/L) were also within the meso-eutrophic range in 2017 and 2018 but were within the mesotrophic range (0.010 to 0.020 mg/L) in 2019 (Table 3.4-2).

Site 22

TP concentrations in Lake Winnipeg at Site 22 ranged from 0.014 to 0.038 mg/L during the open-water season. The mean and median were both 0.027 mg/L, and the IQR was 0.022 to 0.031 mg/L for the three years of monitoring. Mean annual TP concentrations in the open-water season ranged from 0.021 to 0.030 mg/L and were within the IQR in 2017 and 2018 but below the IQR in 2019 (Table 3.4-1 and Figure 3.4-1).

No data are available for the ice-cover season as this site is not sampled in winter.

Site 22 was meso-eutrophic (0.020 to 0.035 mg/L) based on the mean of the open-water season TP concentrations for the three years of monitoring (0.027 mg/L). Open-water season mean annual TP concentrations (0.021 to 0.030 mg/L) were also within the meso-eutrophic range in each year sampled (Table 3.4-2).

Nelson River near Warren Landing

TP concentrations in Nelson River near Warren Landing ranged from 0.017 to 0.364 mg/L during the open-water season. The mean and median concentrations for the eight years of monitoring were 0.048 and 0.032 mg/L, respectively. Open-water season mean annual TP concentrations ranged from 0.023 to 0.147 mg/L and were within the IQR (0.024 to 0.043 mg/L) in six of the eight years. Mean TP concentrations were below the IQR in 2014 and above the IQR in 2012 (Table 3.4-1 and Figure 3.4-1).

No data are available for the ice-cover season as this site is not sampled in winter.

No clear seasonality was observed for TP in the Nelson River near Warren Landing over the eight years of monitoring. However, the lowest mean TP concentration occurred in spring (0.028 mg/L) and the highest in summer (0.072 mg/L). No data are available for winter (Figure 3.4-2).

The Nelson River near Warren Landing was eutrophic (0.035 to 0.100 mg/L) on the basis of the 2012-2019 mean open-water season TP concentration (0.048 mg/L). Mean annual TP concentrations (0.023 to 0.147 mg/L) in the open-water season were within the meso-eutrophic range (0.020 to 0.035 mg/L) in 2014, 2015, 2017, and 2019, within the eutrophic range (0.035 to 0.100 mg/L) in 2013, 2016, and 2018, and within the hypereutrophic range (>0.100 mg/L) in 2012 (0.010 to 0.020 mg/L; Table 3.4-3).

2-Mile Channel

2-Mile Channel Inlet

TP concentrations at the 2 Mile Channel Inlet ranged from 0.020 to 0.222 mg/L during the open-water season. The mean and median concentrations for the seven years of monitoring were 0.053 and 0.033 mg/L, respectively. Open-water season mean annual TP concentrations ranged from 0.023 to 0.098 mg/L and were within the IQR (0.026 to 0.047 mg/L) in two of the seven years. Mean TP concentrations were below the IQR in 2019 and above the IQR in 2013, 2015, 2016, and 2018 (Table 3.4-1 and Figure 3.4-1).

No data are available for the ice-cover season as this site is not sampled in winter.

No clear seasonality was observed for TP at the 2 Mile Channel Inlet over the seven years of monitoring. However, the lowest mean TP concentration occurred in spring (0.033 mg/L) and the highest in fall (0.084 mg/L). No data are available for winter (Figure 3.4-2).

The 2 Mile Channel Inlet was eutrophic (0.035 to 0.100 mg/L) on the basis of the 2013-2019 mean open-water season TP concentration (0.053 mg/L). Mean annual TP concentrations (0.023 to 0.098 mg/L) in the open-water season were within the eutrophic range (0.035 to 0.100 mg/L) in four of the seven years but were in the meso-eutrophic range (0.020 to 0.035 mg/L) in 2014, 2017, and 2019 (Table 3.4-3).

2-Mile Channel Outlet

TP concentrations at the 2 Mile Channel Outlet ranged from 0.020 to 0.118 mg/L during the open-water season. The mean and median concentrations for the seven years of monitoring were 0.041 and 0.035 mg/L, respectively. Open-water season mean annual TP concentrations ranged from 0.026 to 0.062 mg/L and were within the IQR (0.026 to 0.043 mg/L) in four of the seven years. Mean TP concentrations were above the IQR in 2013, 2016, and 2018 (Table 3.4-1 and Figure 3.4-1).

No data are available for the ice-cover season as this site is not sampled in winter.

No clear seasonality was observed for TP at the 2 Mile Channel Outlet over the seven years of monitoring. However, the lowest mean TP concentration occurred in summer (0.031 mg/L) and the highest in fall (0.057 mg/L). No data are available for winter (Figure 3.4-2).

The 2 Mile Channel Outlet was eutrophic (0.035 to 0.100 mg/L) on the basis of the 2013-2019 mean open-water season TP concentration (0.041 mg/L). Mean annual TP concentrations (0.026 to 0.062 mg/L) in the open-water season were within the eutrophic range (0.035 to 0.100 mg/L) in four of the seven years but were in the meso-eutrophic range (0.020 to 0.035 mg/L) in 2014, 2015, and 2019 (Table 3.4-3).

Cross Lake

TP concentrations in Cross Lake ranged from 0.023 to 0.058 mg/L during the open-water season. The mean and median concentrations for the 12 years of monitoring were both 0.036 mg/L. Open-water season mean annual TP concentrations ranged from 0.030 to 0.041 mg/L and were within the IQR (0.029 to 0.040 mg/L) in ten of the 12 years. Mean TP concentrations were above the IQR in 2011 and 2012 (Table 3.4-1 and Figure 3.4-3).

TP concentrations in the ice-cover season ranged from 0.019 to 0.120 mg/L, with a mean of 0.045 mg/L, and a median of 0.037 mg/L for the 12 years of monitoring. The IQR was 0.031 to 0.048 mg/L. TP concentrations were within or near the IQR except in 2009 and 2011 when they were above the IQR (Table 3.4-1 and Figure 3.4-3).

No clear seasonality was observed for TP in Cross Lake over the 12-year period. However, the lowest mean TP concentration occurred in spring (0.034 mg/L) and the highest in winter (0.045 mg/L; Figure 3.4-2).

Cross Lake was eutrophic (0.035 to 0.100 mg/L) on the basis of the 2008-2019 mean open-water season TP concentration (0.036 mg/L). Mean annual TP concentrations (0.030 to 0.041 mg/L) in the open-water season were also within the eutrophic range in seven of the 12 years of monitoring; however, they were within the meso-eutrophic range (0.020 to 0.035 mg/L) in 2009, 2010, 2014, 2015, and 2019 (Table 3.4-2).

ROTATIONAL SITES

Playgreen Lake

TP concentrations in Playgreen Lake ranged from 0.023 to 0.096 mg/L during the open-water season. The mean was 0.039 mg/L, the median was 0.033 mg/L, and the IQR was 0.027 to 0.045 mg/L for the four years of monitoring. Mean annual TP concentrations in the open-water season ranged from 0.027 to 0.052 mg/L and were within the IQR in 2009, 2015, and 2018 but above the IQR in 2012 (Table 3.4-1 and Figure 3.4-4).

During the ice-cover season, TP concentrations ranged from 0.021 to 0.041 mg/L, with a mean of 0.031 mg/L (Table 3.4-1 and Figure 3.4-4).

Playgreen Lake was eutrophic (0.035 to 0.100 mg/L) based on the mean of the open-water season TP concentrations for the four years of monitoring (0.039 mg/L). Open-water season mean annual TP concentrations (0.027 to 0.052 mg/L) were within the eutrophic range in three of the four years of monitoring; however, the open-water mean TP concentration was within the meso-eutrophic range (0.020 to 0.035 mg/L) in 2015 (Table 3.4-2).

Little Playgreen Lake

TP concentrations in Little Playgreen Lake ranged from 0.021 to 0.048 mg/L during the open-water season. The mean was 0.034 mg/L, the median was 0.035 mg/L, and the IQR was 0.028 to

0.039 mg/L for the four years of monitoring. Mean annual TP concentrations in the open-water season ranged from 0.026 to 0.041 mg/L and were within the IQR in 2013 and 2016 but were below the IQR in 2019 and above the IQR in 2010 (Table 3.4-1 and Figure 3.4-4).

During the ice-cover season, TP concentrations ranged from 0.021 to 0.052 mg/L, with a mean of 0.038 mg/L (Table 3.4-1 and Figure 3.4-4).

Little Playgreen Lake was meso-eutrophic (0.020 to 0.035 mg/L) based on the mean of the open-water season TP concentrations for the four years of monitoring (0.034 mg/L). Open-water season mean annual TP concentrations (0.026 to 0.041 mg/L) were also within the meso-eutrophic range in 2013 and 2019 but were within the eutrophic range (0.035 to 0.100 mg/L) in 2010 and 2016 (Table 3.4-2).

Sipiwesk Lake

TP concentrations in Sipiwesk Lake ranged from 0.029 to 0.066 mg/L during the open-water season. The mean was 0.042 mg/L, the median was 0.040 mg/L, and the IQR was 0.037 to 0.045 mg/L for the three years of monitoring. Mean annual TP concentrations in the open-water season ranged from 0.036 to 0.050 mg/L and were within the IQR in 2017 but were below the IQR in 2014 and above the IQR in 2011 (Table 3.4-1 and Figure 3.4-4).

During the ice-cover season, TP concentrations ranged from 0.028 to 0.055 mg/L, with a mean of 0.038 mg/L (Table 3.4-1 and Figure 3.4-4).

Sipiwesk Lake was eutrophic (0.035 to 0.100 mg/L) based on the mean of the open-water season TP concentrations for the three years of monitoring (0.042 mg/L). Open-water season mean annual TP concentrations (0.036 to 0.050 mg/L) were also within the eutrophic range in each year sampled (Table 3.4-2).

Upper Nelson River Upstream of the Kelsey GS

TP concentrations in the upper Nelson River upstream of the Kelsey GS ranged from 0.036 to 0.052 mg/L during the open-water season. The mean was 0.043 mg/L, the median was 0.042 mg/L, and the IQR was 0.040 to 0.044 mg/L for the three years of monitoring. Mean annual TP concentrations in the open-water season ranged from 0.040 to 0.046 mg/L and were within the IQR in 2014 and 2017 but were above the IQR in 2011 (Table 3.4-1 and Figure 3.4-4).

During the ice-cover season, TP concentrations ranged from 0.027 to 0.050 mg/L, with a mean of 0.038 mg/L (Table 3.4-1 and Figure 3.4-4).

The upper Nelson River upstream of the Kelsey GS was eutrophic (0.035 to 0.100 mg/L) based on the mean of the open-water season TP concentrations for the three years of monitoring (0.043 mg/L). Open-water season mean annual TP concentrations (0.040 to 0.046 mg/L) were also within the eutrophic range in each year sampled (Table 3.4-2).

3.4.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

TP concentrations in Setting Lake ranged from 0.011 to 0.048 mg/L during the open-water season. The mean and median concentrations for the 12 years of monitoring were 0.018 and 0.017 mg/L, respectively. Open-water season mean annual TP concentrations ranged from 0.014 to 0.028 mg/L and were within the IQR (0.014 to 0.020 mg/L) in nine of the 12 years. Mean TP concentrations were above the IQR in 2009, 2010, and 2016 (Table 3.4-4 and Figure 3.4-5).

TP concentrations in the ice-cover season ranged from 0.011 to 0.097 mg/L, with a mean of 0.022 mg/L and a median of 0.014 mg/L for the 12 years of monitoring. The IQR was 0.012 to 0.021 mg/L. TP concentrations were within or near the IQR except in 2009 when it was above the IQR (Table 3.4-4 and Figure 3.4-5).

No clear seasonality was observed for TP in Setting Lake over the 12-year period. However, the lowest mean TP concentration occurred in spring and summer (mean = 0.017 mg/L for both seasons) and the highest occurred in winter (0.022 mg/L; Figure 3.4-6).

Setting Lake was mesotrophic (0.010 to 0.020 mg/L) on the basis of the 2008-2019 mean open-water season TP concentration (0.018 mg/L). Mean annual TP concentrations (0.014 to 0.028 mg/L) in the open-water season were also within the mesotrophic range in nine of the 12 years of monitoring; however, they were within the meso-eutrophic range (0.020 to 0.035 mg/L) in 2009, 2010, and 2016 (Table 3.4-5).

ROTATIONAL SITES

Walker Lake

TP concentrations in Walker Lake ranged from 0.013 to 0.037 mg/L during the open-water season. The mean was 0.024 mg/L, the median was 0.023 mg/L, and the IQR was 0.020 to 0.029 mg/L for the four years of monitoring. Mean annual TP concentrations in the open-water season ranged from 0.021 to 0.029 mg/L and were within the IQR in all years (Table 3.4-4 and Figure 3.4-5).

During the ice-cover season, TP concentrations ranged from 0.010 to 0.015 mg/L, with a mean of 0.012 mg/L (Table 3.4-4 and Figure 3.4-5).

Walker Lake was meso-eutrophic (0.020 to 0.035 mg/L) based on the mean of the open-water season TP concentrations for the four years of monitoring (0.024 mg/L). Open-water season mean annual TP concentrations (0.021 to 0.029 mg/L) were also within the meso-eutrophic range in each year of monitoring (Table 3.4-5).

Table 3.4-1. 2008-2019 On-system sites TP, TN and chlorophyll a summary statistics.

Site	Statistic	TP (mg/L)		TN (mg/L)		Chlorophyll a (µg/L)	
		OW	IC	OW	IC	OW	IC
LW-BMP	Mean	0.026	-	0.48	-	8.15	-
	Median	0.025	-	0.46	-	5.00	-
	Minimum	0.012	-	<0.20	-	1.07	-
	Maximum	0.051	-	1.05	-	24.1	-
	SD	0.0124	-	0.275	-	7.75	-
	SE	0.0044	-	0.097	-	2.74	-
	Lower Quartile	0.017	-	0.36	-	3.45	-
	Upper Quartile	0.032	-	0.54	-	11.1	-
	n	8	-	8	-	8	-
	% Detections	100	-	88	-	100	-
LW-22	Mean	0.027	-	0.53	-	9.42	-
	Median	0.027	-	0.49	-	6.53	-
	Minimum	0.014	-	0.23	-	1.47	-
	Maximum	0.038	-	1.01	-	23.6	-
	SD	0.0077	-	0.233	-	7.97	-
	SE	0.0027	-	0.082	-	2.82	-
	Lower Quartile	0.022	-	0.42	-	3.45	-
	Upper Quartile	0.031	-	0.57	-	15.1	-
	n	8	-	8	-	8	-
	% Detections	100	-	100	-	100	-
NR-WL	Mean	0.048	-	0.48	-	9.44	-
	Median	0.032	-	0.49	-	6.93	-
	Minimum	0.017	-	<0.20	-	1.72	-
	Maximum	0.364	-	0.79	-	25.2	-
	SD	0.0700	-	0.142	-	7.99	-
	SE	0.0146	-	0.030	-	1.70	-
	Lower Quartile	0.024	-	0.39	-	2.59	-
	Upper Quartile	0.043	-	0.58	-	17.2	-
	n	23	-	23	-	22	-
	% Detections	100	-	96	-	100	-
2M-IN	Mean	0.053	-	0.60	-	7.78	-
	Median	0.033	-	0.49	-	7.57	-
	Minimum	0.020	-	<0.20	-	1.26	-
	Maximum	0.222	-	3.10	-	23.5	-
	SD	0.0513	-	0.610	-	6.30	-
	SE	0.0115	-	0.136	-	1.45	-
	Lower Quartile	0.026	-	0.39	-	2.77	-
	Upper Quartile	0.047	-	0.58	-	10.6	-
	n	20	-	20	-	19	-
	% Detections	100	-	95	-	100	-
2M-OUT	Mean	0.041	-	0.50	-	7.03	-
	Median	0.035	-	0.47	-	4.77	-
	Minimum	0.020	-	0.27	-	1.22	-
	Maximum	0.118	-	1.02	-	18.2	-
	SD	0.0243	-	0.165	-	5.34	-
	SE	0.0054	-	0.037	-	1.22	-
	Lower Quartile	0.026	-	0.42	-	2.77	-
	Upper Quartile	0.043	-	0.55	-	11.0	-
	n	20	-	20	-	19	-
	% Detections	100	-	100	-	100	-

Table 3.4-1. continued.

Site	Statistic	TP (mg/L)		TN (mg/L)		Chlorophyll a (µg/L)	
		OW	IC	OW	IC	OW	IC
CROSS	Mean	0.036	0.045	0.57	0.63	7.38	0.92
	Median	0.036	0.037	0.57	0.63	6.08	<0.60
	Minimum	0.023	0.019	0.30	0.44	1.59	<0.60
	Maximum	0.058	0.120	0.98	0.76	31.0	3.18
	SD	0.0082	0.0284	0.143	0.084	5.43	0.911
	SE	0.0014	0.0082	0.024	0.024	0.905	0.263
	Lower Quartile	0.029	0.031	0.47	0.60	4.44	<0.60
	Upper Quartile	0.040	0.048	0.65	0.69	7.78	1.12
	n	36	12	36	12	36	12
	% Detections	100	100	100	100	100	58
PLAYG	Mean	0.039	0.031	0.45	0.58	6.69	0.95
	Median	0.033	-	0.46	-	6.91	-
	Minimum	0.023	0.021	<0.20	0.46	2.30	<0.60
	Maximum	0.096	0.041	0.62	0.78	11.8	1.33
	SD	0.0205	0.0093	0.145	0.140	3.52	0.464
	SE	0.0059	0.0047	0.044	0.070	1.02	0.232
	Lower Quartile	0.027	-	0.42	-	3.47	-
	Upper Quartile	0.045	-	0.55	-	9.56	-
	n	12	4	11	4	12	4
	% Detections	100	100	91	100	100	75
LPLAY	Mean	0.034	0.038	0.57	0.61	5.10	1.71
	Median	0.035	-	0.57	-	4.70	-
	Minimum	0.021	0.021	0.22	0.53	2.09	<0.60
	Maximum	0.048	0.052	1.07	0.75	8.97	4.01
	SD	0.0087	0.0130	0.200	0.095	2.16	1.74
	SE	0.0025	0.0065	0.058	0.048	0.623	0.872
	Lower Quartile	0.028	-	0.49	-	3.77	-
	Upper Quartile	0.039	-	0.61	-	6.38	-
	n	12	4	12	4	12	4
	% Detections	100	100	100	100	100	75
SIP	Mean	0.042	0.038	0.48	0.49	6.35	<0.60
	Median	0.040	-	0.45	-	4.77	-
	Minimum	0.029	0.028	0.36	0.35	3.44	<0.60
	Maximum	0.066	0.055	0.63	0.60	13.0	<0.60
	SD	0.0105	0.0146	0.104	0.128	3.29	-
	SE	0.0035	0.0085	0.035	0.074	1.10	-
	Lower Quartile	0.037	-	0.38	0.44	4.01	-
	Upper Quartile	0.045	-	0.56	0.56	8.82	-
	n	9	3	9	3	9	3
	% Detections	100	100	100	100	100	0
UNR	Mean	0.043	0.038	0.50	0.50	4.01	<0.60
	Median	0.042	-	0.54	-	4.28	-
	Minimum	0.036	0.027	<0.20	0.39	2.48	<0.60
	Maximum	0.052	0.050	0.76	0.68	5.54	<0.60
	SD	0.0047	0.0118	0.197	0.155	0.958	-
	SE	0.0016	0.0068	0.066	0.090	0.319	-
	Lower Quartile	0.040	-	0.49	-	3.25	-
	Upper Quartile	0.044	-	0.61	-	4.39	-
	n	9	3	9	3	9	3
	% Detections	100	100	89	100	100	0

Notes:

1. OW = Open-water season; IC = Ice-cover season.
2. SD = standard deviation; SE = standard error; n = number of samples.
3. TN statistics for PLAYG exclude outlier value of 14.5 mg/L from summer 2012.

Table 3.4-2. 2008-2019 On-system lakes and reservoirs trophic status based on TP, TN, and chlorophyll *a* open-water season mean concentrations.

Trophic Categories	**Total Phosphorus (mg/L)**							**Total Nitrogen (mg/L)**							**Chlorophyll *a* (µg/L)**						
Ultra-oligotrophic	<0.004																				
Oligotrophic	0.004-0.010							<0.350							<2.5						
Mesotrophic	0.010-0.020							0.350-0.650							2.5-8						
Meso-eutrophic	0.020-0.035																				
Eutrophic	0.035-0.100							0.651-1.20							8-25						
Hypereutrophic	> 0.100							>1.20							>25						
References	CCME (1999; updated to 2024)							Nürnberg (1996)							OECD (1982)						
Sampling Year	**LW-BMP**	**LW-22**	**CROSS**	**PLAYG**	**LPLAY**	**SIP**	**UNR**	**LW-BMP**	**LW-22**	**CROSS**	**PLAYG**	**LPLAY**	**SIP**	**UNR**	**LW-BMP**	**LW-22**	**CROSS**	**PLAYG**	**LPLAY**	**SIP**	**UNR**
2008	-	-	0.037	-	-	-	-	-	-	0.67	-	-	-	-	-	-	17.3	-	-	-	-
2009	-	-	0.031	0.041	-	-	-	-	-	0.42	0.42	-	-	-	-	-	5.47	7.33	-	-	-
2010	-	-	0.030	-	0.041	-	-	-	-	0.60	-	0.71	-	-	-	-	4.08	-	4.06	-	-
2011	-	-	0.041	-	-	0.050	0.046	-	-	0.64	-	-	0.48	0.50	-	-	10.4	-	-	8.60	4.26
2012	-	-	0.041	0.052	-	-	-	-	-	0.49	0.50 *	-	-	-	-	-	6.09	6.48	-	-	-
2013	-	-	0.038	-	0.032	-	-	-	-	0.44	-	0.50	-	-	-	-	9.20	-	5.66	-	-
2014	-	-	0.035	-	-	0.036	0.040	-	-	0.57	-	-	0.51	0.40	-	-	7.04	-	-	6.12	3.74
2015	-	-	0.031	0.027	-	-	-	-	-	0.61	0.47	-	-	-	-	-	6.51	6.37	-	-	-
2016	-	-	0.039	-	0.037	-	-	-	-	0.55	-	0.61	-	-	-	-	4.67	-	6.43	-	-
2017	0.033	0.030	0.036	-	-	0.040	0.043	0.51	0.55	0.53	-	-	0.45	0.61	6.86	7.39	4.54	-	-	4.33	4.01
2018	0.030	0.030	0.038	0.036	-	-	-	0.47	0.61	0.68	0.44	-	-	-	14.8	19.7	8.85	6.58	-	-	-
2019	0.017	0.021	0.033	-	0.026	-	-	0.46	0.46	0.62	-	0.46	-	-	5.04	4.61	4.36	-	4.24	-	-
Overall (2008-2019)	0.026	0.027	0.036	0.039	0.034	0.042	0.043	0.48	0.53	0.57	0.45 *	0.57	0.48	0.50	8.15	9.42	7.38	6.69	5.10	6.35	4.01

Notes:

1. CCME = Canadian Council of Ministers of the Environment.
2. OECD = Organization for Economic Cooperation and Development.
3. TN values for PLAYG exclude outlier value of 14.5 mg/L from summer 2012.

Table 3.4-3. 2008-2019 On-system riverine sites trophic status based on TP, TN, and chlorophyll *a* open-water season mean concentrations.

Trophic Categories	Total Phosphorus (mg/L)			Total Nitrogen (mg/L)			Chlorophyll *a* (µg/L)		
Ultra-oligotrophic	<0.004								
Oligotrophic	0.004-0.010			<0.7			<10		
Mesotrophic	0.010-0.020			0.7-1.5			10-30		
Meso-eutrophic	0.020-0.035								
Eutrophic	0.035-0.100			>1.5			>30		
Hypereutrophic	> 0.100								
References	CCME (1999; updated to 2024)			Dodds et al. (1998)			Dodds et al. (1998)		
Sampling Year	**NR-WL**	**2M-IN**	**2M-OUT**	**NR-WL**	**2M-IN**	**2M-OUT**	**NR-WL**	**2M-IN**	**2M-OUT**
2008	-	-	-	-	-	-	-	-	-
2009	-	-	-	-	-	-	-	-	-
2010	-	-	-	-	-	-	-	-	-
2011	-	-	-	-	-	-	-	-	-
2012	0.147	-	-	0.48	-	-	5.87	-	-
2013	0.043	0.098	0.062	0.49	1.24	0.50	7.50	6.62	4.77
2014	0.023	0.027	0.029	0.48	0.47	0.47	10.9	12.4	9.85
2015	0.029	0.047	0.031	0.48	0.50	0.50	11.4	5.59	9.45
2016	0.037	0.071	0.053	0.58	0.58	0.52	12.2	5.50	7.14
2017	0.032	0.034	0.040	0.43	0.45	0.60	6.17	6.17	6.36
2018	0.037	0.063	0.044	0.53	0.50	0.45	18.9	14.5	9.28
2019	0.024	0.023	0.026	0.41	0.43	0.46	3.88	4.44	4.14
Overall (2008-2019)	0.048	0.053	0.041	0.48	0.60	0.50	9.44	7.78	7.03

Notes:

1. CCME = Canadian Council of Ministers of the Environment.

Table 3.4-4. 2008-2019 Off-system sites TP, TN and chlorophyll *a* summary statistics.

Site	Statistic	TP (mg/L)		TN (mg/L)		Chlorophyll a (µg/L)	
		OW	IC	OW	IC	OW	IC
SET	Mean	0.018	0.022	0.51	0.61	4.48	0.89
	Median	0.017	0.014	0.51	0.62	4.34	0.95
	Minimum	0.011	0.011	0.33	0.46	1.90	<0.60
	Maximum	0.048	0.097	0.82	0.81	9.55	1.43
	SD	0.0065	0.0240	0.101	0.099	1.53	0.402
	SE	0.0011	0.0069	0.017	0.029	0.255	0.116
	Lower Quartile	0.014	0.012	0.44	0.56	3.33	0.65
	Upper Quartile	0.020	0.021	0.56	0.65	5.04	1.17
	n	36	12	36	12	36	12
	% Detections	100	100	100	100	100	83
WLKR	Mean	0.024	0.012	0.52	0.53	6.37	1.52
	Median	0.023	-	0.55	-	5.29	-
	Minimum	0.013	0.010	<0.20	0.39	2.10	0.95
	Maximum	0.037	0.015	0.85	0.63	14.0	2.86
	SD	0.0070	0.0020	0.175	0.111	3.94	0.899
	SE	0.0020	0.0010	0.051	0.055	1.14	0.450
	Lower Quartile	0.020	-	0.49	-	3.30	-
	Upper Quartile	0.029	-	0.58	-	8.59	-
	n	12	4	12	4	12	4
	% Detections	100	100	92	100	100	100

Notes:

1. OW = Open-water season; IC = Ice-cover season.
2. SD = standard deviation; SE = standard error; n = number of samples.

Table 3.4-5. 2008-2019 Off-system lakes and reservoirs trophic status based on TP, TN, and chlorophyll *a* open-water season mean concentrations.

Trophic Categories	Total Phosphorus (mg/L)		Total Nitrogen (mg/L)		Chlorophyll *a* (µg/L)	
Ultra-oligotrophic	<0.004					
Oligotrophic	0.004-0.010		<0.350		<2.5	
Mesotrophic	0.010-0.020		0.350-0.650		2.5-8	
Meso-eutrophic	0.020-0.035					
Eutrophic	0.035-0.100		0.651-1.20		8-25	
Hypereutrophic	> 0.100		>1.20		>25	
References	CCME (1999; updated to 2024)		Nürnberg (1996)		OECD (1982)	
Sampling Year	**SET**	**WLKR**	**SET**	**WLKR**	**SET**	**WLKR**
2008	0.017	-	0.53	-	4.67	-
2009	0.021	-	0.46	-	4.47	-
2010	0.028	0.029	0.52	0.57	3.32	4.73
2011	0.017	-	0.56	-	4.98	-
2012	0.015	-	0.52	-	6.11	-
2013	0.014	0.021	0.42	0.50	4.77	6.06
2014	0.018	-	0.52	-	4.47	-
2015	0.015	-	0.50	-	3.44	-
2016	0.021	0.027	0.62	0.42	4.45	4.22
2017	0.017	-	0.52	-	3.32	-
2018	0.020	-	0.48	-	4.42	-
2019	0.015	0.021	0.49	0.59	5.35	10.5
Overall (2008-2019)	0.018	0.024	0.51	0.52	4.48	6.37

Notes:

1. CCME = Canadian Council of Ministers of the Environment.
2. OECD = Organization for Economic Cooperation and Development.

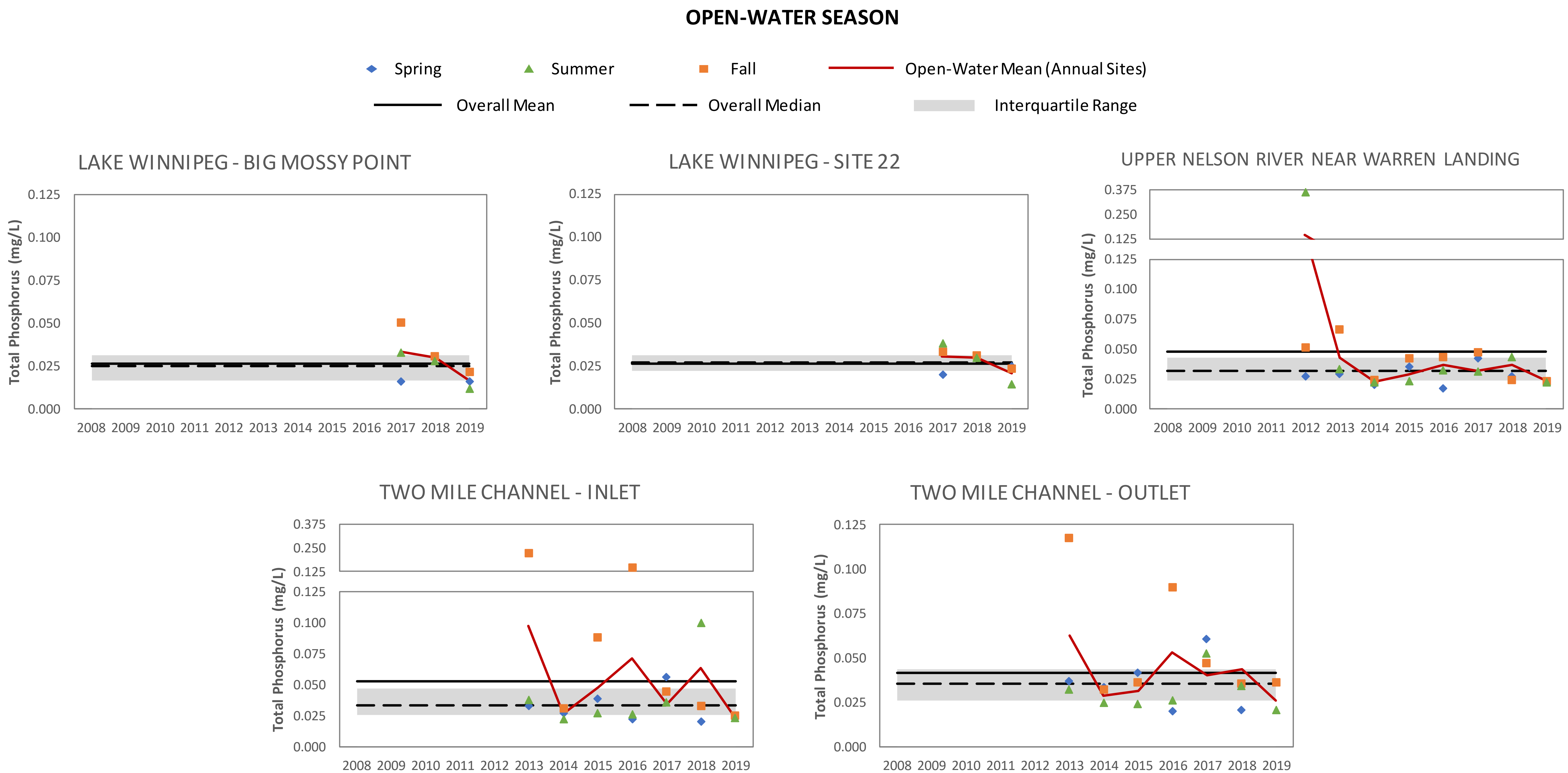


Figure 3.4-1. 2008-2019 Lake Winnipeg outlet area sites open-water season TP concentrations.

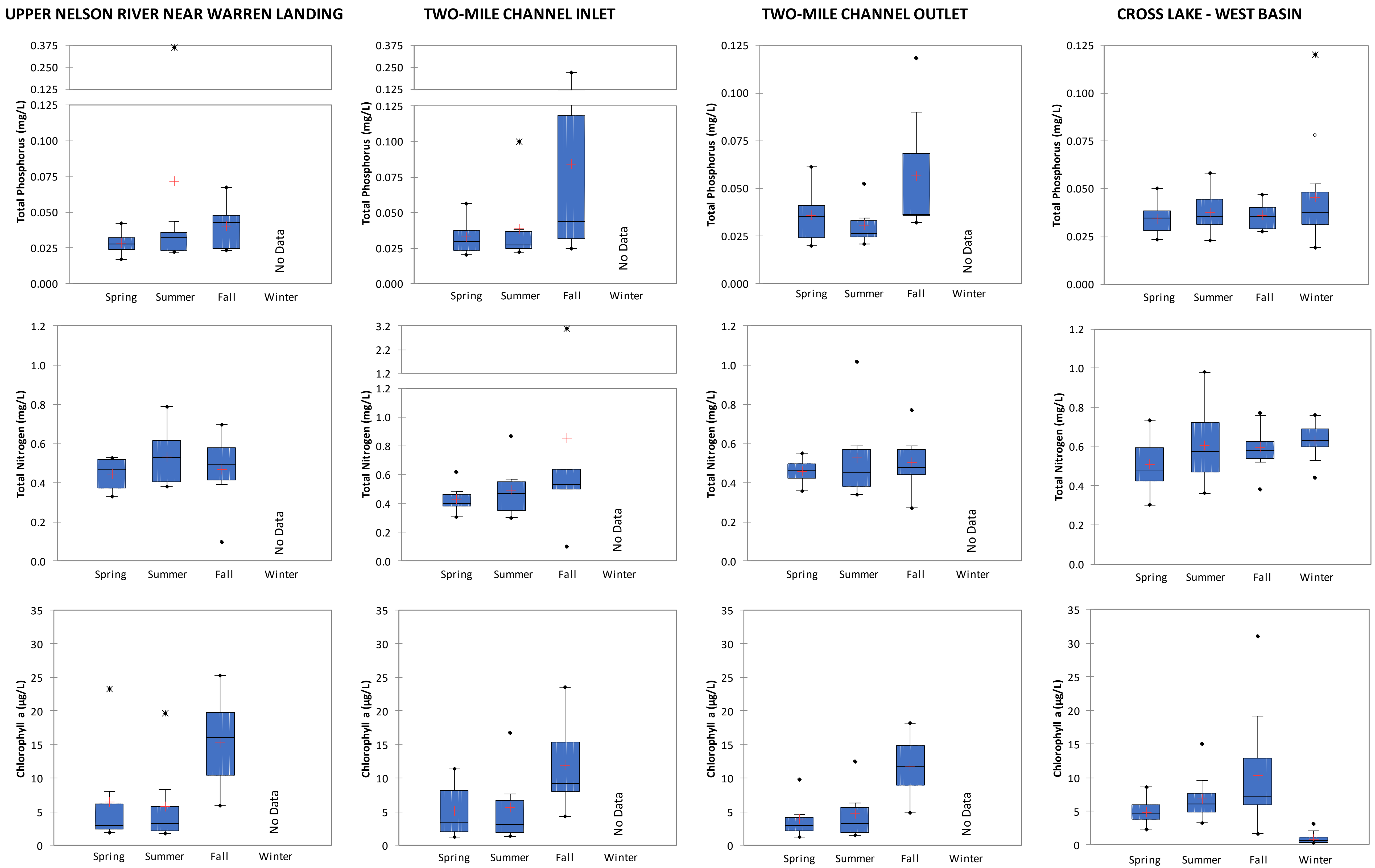
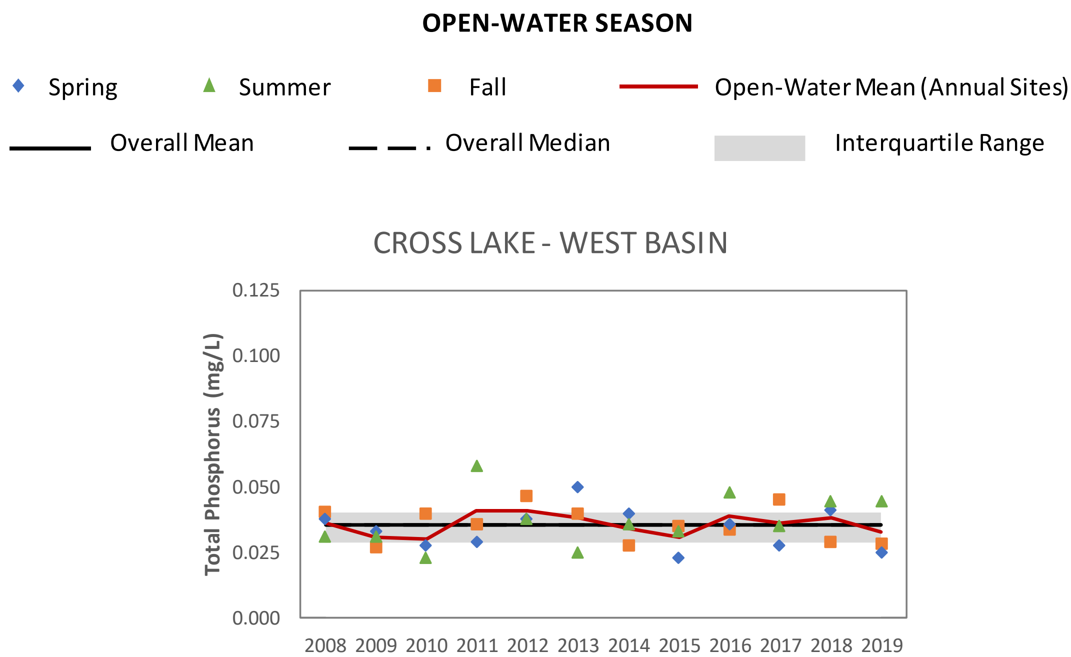


Figure 3.4-2. 2008-2019 On-system seasonal total phosphorus, total nitrogen, and chlorophyll a concentrations.

CAMP



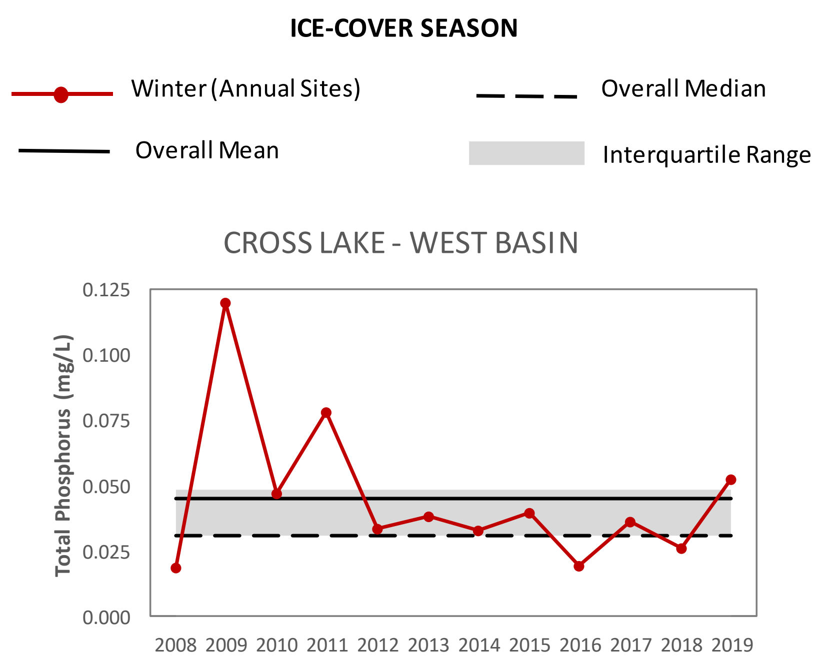


Figure 3.4-3. 2008-2019 Cross Lake – West Basin open-water and ice-cover season TP concentrations.

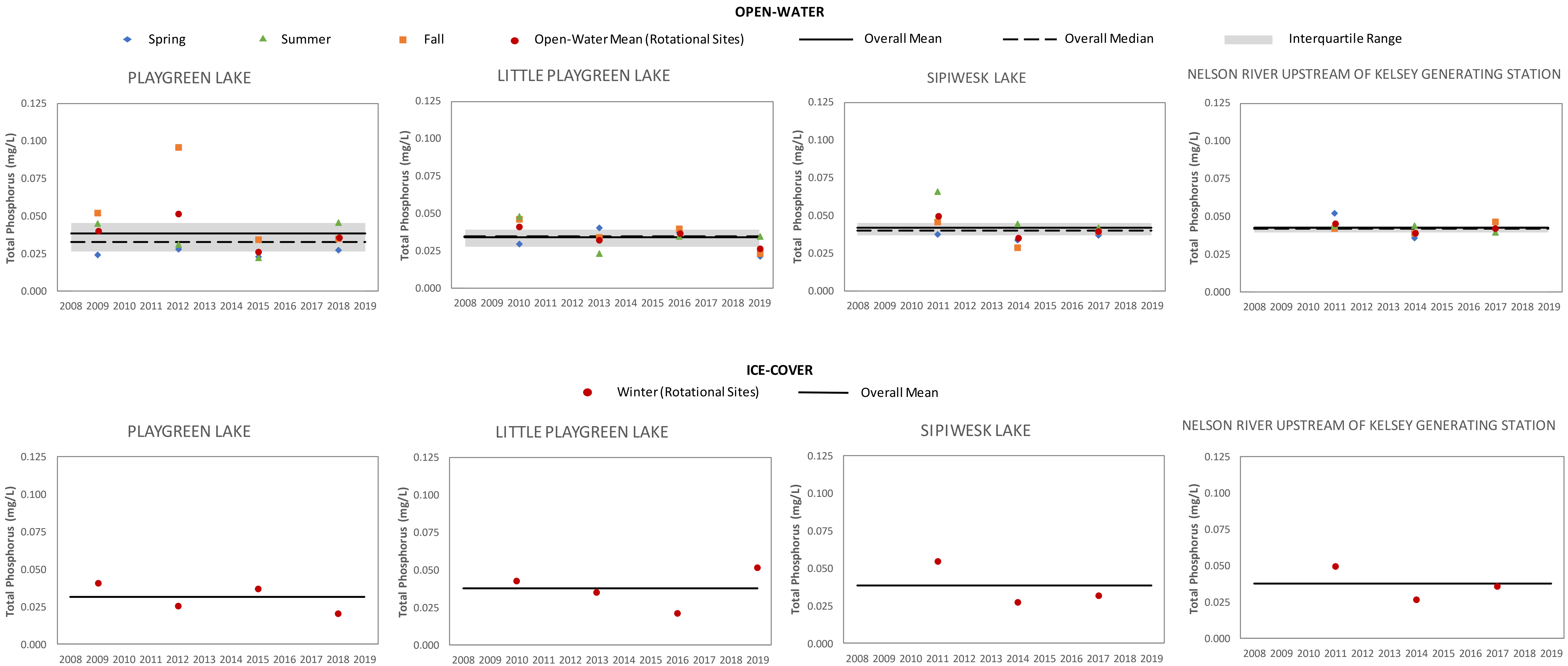


Figure 3.4-4. 2008-2019 On-system rotational sites open-water and ice-cover season TP concentrations.

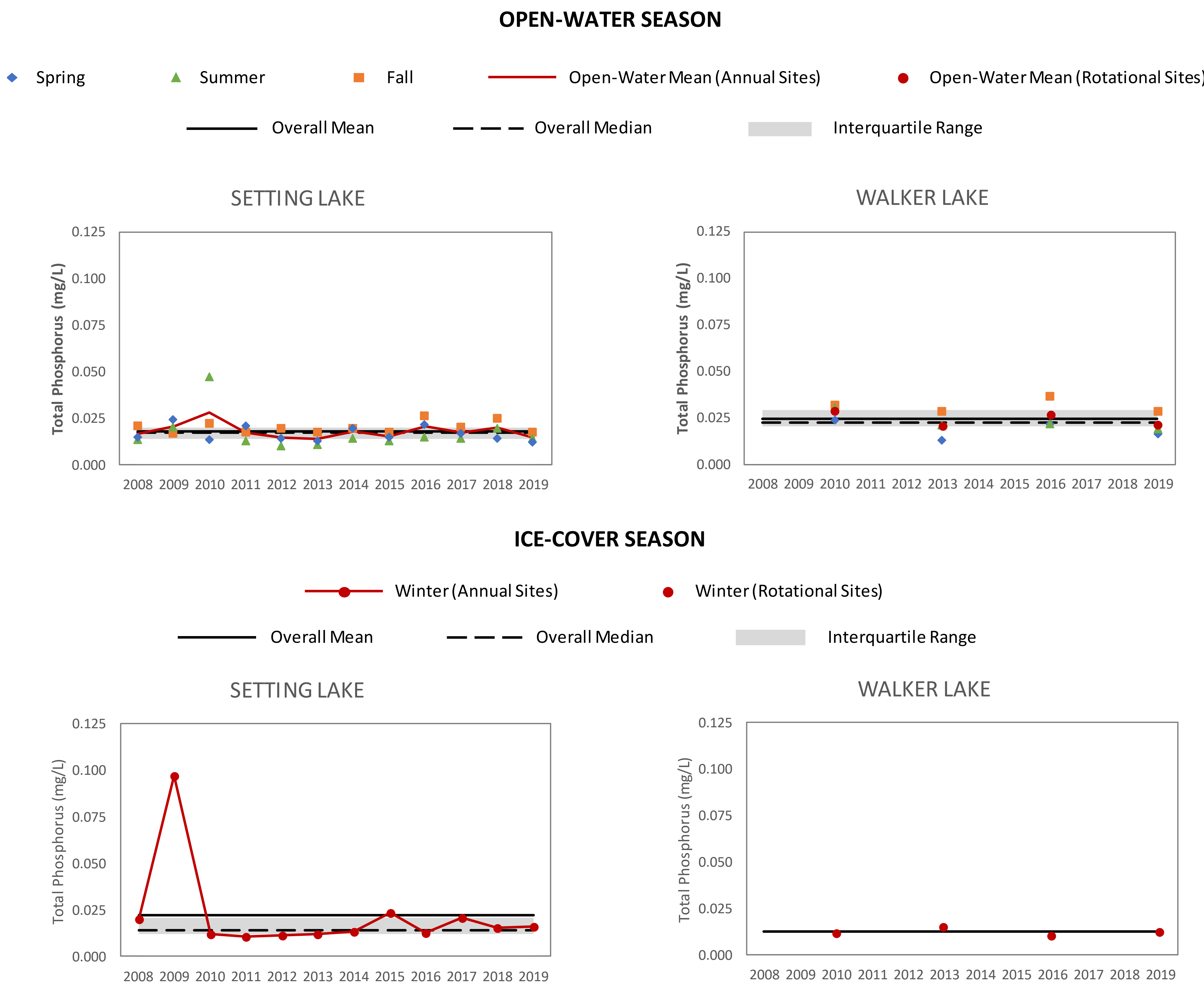


Figure 3.4-5. 2008-2019 Off-system open-water and ice-cover season TP concentrations.

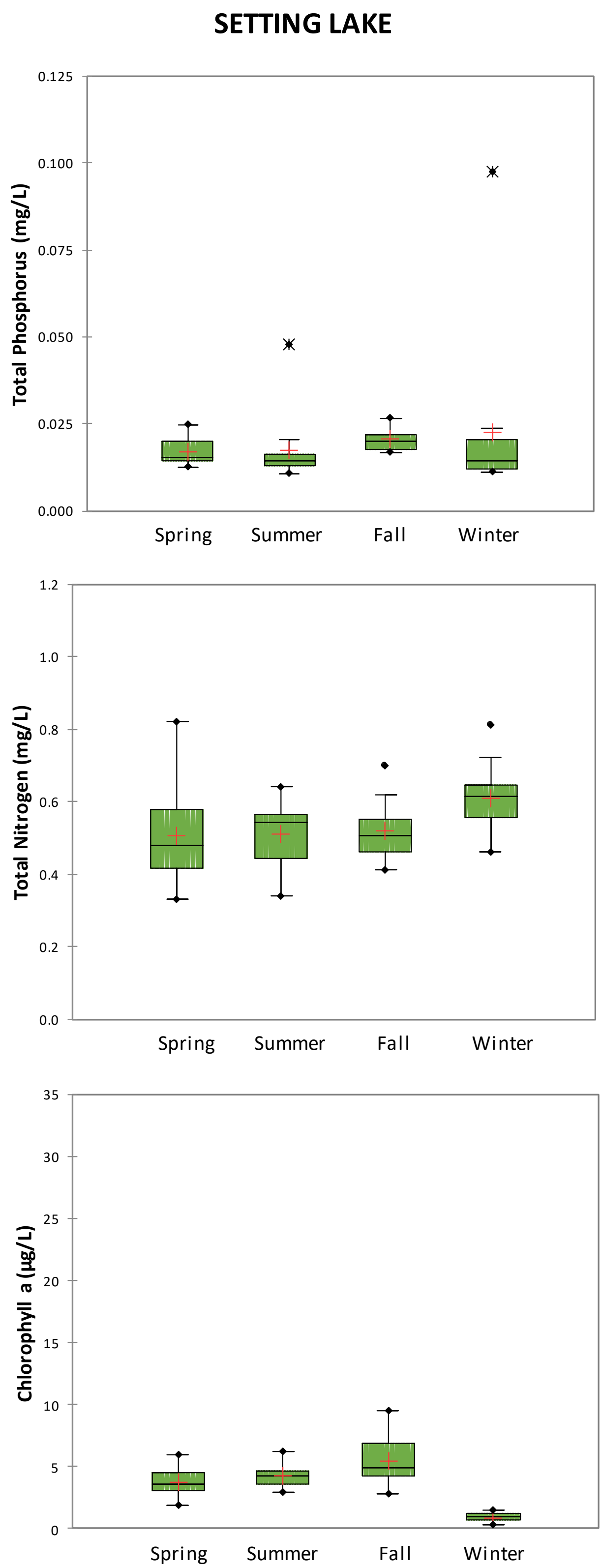


Figure 3.4-6. 2008-2019 Off-system seasonal total phosphorus, total nitrogen, and chlorophyll *a* concentrations

3.4.2 TOTAL NITROGEN

3.4.2.1 ON-SYSTEM SITES

ANNUAL SITES

<u>**Lake Winnipeg Outlet Area**</u>

Big Mossy Point

TN concentrations in Lake Winnipeg at Big Mossy Point ranged from <0.20 to 1.05 mg/L during the open-water season. The mean was 0.48 mg/L, the median was 0.46 mg/L, and the IQR was 0.36 to 0.54 mg/L for the three years of monitoring. Mean annual TN concentrations in the open-water season ranged from 0.46 to 0.51 mg/L and were within the IQR in all years (Table 3.4-1 and Figure 3.4-7).

No data are available for the ice-cover season as this site is not sampled in winter.

Big Mossy Point was mesotrophic (0.350 to 0.650 mg/L) based on the mean of the open-water season TN concentrations for the three years of monitoring (0.48 mg/L). Open-water season mean annual TN concentrations (0.46 to 0.51 mg/L) were also within the mesotrophic range in each year sampled (Table 3.4-2).

Site 22

TN concentrations in Lake Winnipeg at Site 22 ranged from 0.23 to 1.01 mg/L during the open-water season. The mean was 0.53 mg/L, the median was 0.49 mg/L, and the IQR was 0.42 to 0.57 mg/L for the three years of monitoring. Mean annual TN concentrations in the open-water season ranged from 0.46 to 0.61 mg/L and were within the IQR in 2017 and 2019 but above the IQR in 2018 (Table 3.4-1 and Figure 3.4-7).

No data are available for the ice-cover season as this site is not sampled in winter.

Site 22 was mesotrophic (0.350 to 0.650 mg/L) based on the mean of the open-water season TN concentrations for the three years of monitoring (0.53 mg/L). Open-water season mean annual TN concentrations (0.46 to 0.61 mg/L) were also within the mesotrophic range in each year sampled (Table 3.4-2).

Nelson River near Warren Landing

TN concentrations in Nelson River near Warren Landing ranged from <0.20 to 0.79 mg/L during the open-water season. The mean and median concentrations for the eight years of monitoring were 0.48 and 0.49 mg/L, respectively. Open-water season mean annual TN concentrations ranged from 0.41 to 0.58 mg/L and were within the IQR (0.39 to 0.58 mg/L) in all years (Table 3.4-1 and Figure 3.4-7).

No data are available for the ice-cover season as this site is not sampled in winter.

No clear seasonality was observed for TN in the Nelson River near Warren Landing over the eight years of monitoring. However, the lowest mean TN concentration occurred in spring (0.45 mg/L) and the highest in summer (0.53 mg/L). No data are available for winter (Figure 3.4-2).

The Nelson River near Warren Landing was oligotrophic (<0.7 mg/L) on the basis of the 2012-2019 mean open-water season TN concentration (0.48 mg/L). Mean annual TN concentrations (0.41 to 0.58 mg/L) in the open-water season were within the oligotrophic range in all years (Table 3.4-3).

2-Mile Channel

2-Mile Channel Inlet

TN concentrations at the 2 Mile Channel Inlet ranged from <0.20 to 3.10 mg/L during the open-water season. The mean and median concentrations for the seven years of monitoring were 0.60 and 0.49 mg/L, respectively. Open-water season mean annual TN concentrations ranged from 0.43 to 1.24 mg/L and were within the IQR (0.39 to 0.58 mg/L) in six of seven years. Mean TN concentrations were above the IQR in 2013 (Table 3.4-1 and Figure 3.4-7).

No data are available for the ice-cover season as this site is not sampled in winter.

No clear seasonality was observed for TN at the 2 Mile Channel Inlet over the seven years of monitoring. However, the lowest mean TN concentration occurred in spring (0.43 mg/L) and the highest in fall (0.86 mg/L). No data are available for winter (Figure 3.4-2).

The 2 Mile Channel Inlet was oligotrophic (<0.7 mg/L) on the basis of the 2013-2019 mean open-water season TN concentration (0.60 mg/L). Mean annual TN concentrations (0.43 to 1.24 mg/L) in the open-water season were within the oligotrophic range (<0.7 mg/L) in all years except for 2013 when the mean (1.24 mg/L) was within the mesotrophic range (0.7 to 1.5 mg/L; Table 3.4-3).

2-Mile Channel Outlet

TN concentrations at the 2 Mile Channel Outlet ranged from 0.27 to 1.02 mg/L during the open-water season. The mean and median concentrations for the seven years of monitoring were 0.50 and 0.47 mg/L, respectively. Open-water season mean annual TN concentrations ranged from 0.45 to 0.60 mg/L and were within the IQR (0.42 to 0.55 mg/L) in six of the seven years. Mean TN concentrations were above the IQR in 2017 (Table 3.4-1 and Figure 3.4-7).

No data are available for the ice-cover season as this site is not sampled in winter.

No clear seasonality was observed for TN at the 2 Mile Channel Outlet over the seven years of monitoring. However, the lowest mean TN concentration occurred in spring (0.46 mg/L) and the highest in summer (0.53 mg/L). No data are available for winter (Figure 3.4-2).

The 2 Mile Channel Outlet was oligotrophic (<0.7 mg/L) on the basis of the 2013-2019 mean open-water season TN concentration (0.50 mg/L). Mean annual TN concentrations (0.45 to 0.60 mg/L) in the open-water season were within the oligotrophic range in all years (Table 3.4-3).

Cross Lake

TN concentrations in Cross Lake ranged from 0.30 to 0.98 mg/L during the open-water season. The mean and median concentrations for the 12 years of monitoring were both 0.57 mg/L. Open-water season mean annual TN concentrations ranged from 0.42 to 0.68 mg/L and were within the IQR (0.47 to 0.65 mg/L) in eight of the 12 years. Mean TN concentrations were below the IQR in 2009 and 2013 and above the IQR in 2008 and 2018 (Table 3.4-1 and Figure 3.4-8).

TN concentrations in the ice-cover season ranged from 0.44 to 0.76 mg/L, with both a mean and median of 0.63 mg/L for the 12 years of monitoring. The IQR was 0.60 to 0.69 mg/L (Table 3.4-1 and Figure 3.4-8).

No clear seasonality was observed for TN in Cross Lake over the 12-year period. However, the lowest mean TN concentration occurred in spring (0.51 mg/L) and the highest in winter (0.63 mg/L; Figure 3.4-2).

Cross Lake was mesotrophic (0.350 to 0.650 mg/L) on the basis of the 2008-2019 mean open-water season TN concentration (0.57 mg/L). Mean annual TN concentrations (0.42 to 0.68 mg/L) in the open-water season were also within the eutrophic range in ten of the 12 years of monitoring; however, they were within the eutrophic range (0.651 to 1.20 mg/L) in 2008 and 2018 (Table 3.4-2).

ROTATIONAL SITES

Playgreen Lake

TN concentrations in Playgreen Lake ranged from <0.20 to 0.62 mg/L during the open-water season. The mean was 0.45 mg/L, the median was 0.46 mg/L, and the IQR was 0.42 to 0.55 mg/L for the four years of monitoring. Mean annual TN concentrations in the open-water season ranged from 0.42 to 0.50 mg/L and were within the IQR in all years (Table 3.4-1 and Figure 3.4-9). An outlier value of 14.5 mg/L from summer 2012 has been excluded from the data reported for the open-water season.

During the ice-cover season, TN concentrations ranged from 0.46 to 0.78 mg/L, with a mean of 0.58 mg/L (Table 3.4-1 and Figure 3.4-9).

Playgreen Lake was mesotrophic (0.350 to 0.650 mg/L) based on the mean of the open-water season TN concentrations for the four years of monitoring (0.45 mg/L). Open-water season mean annual TN concentrations (0.42 to 0.50 mg/L) were within the mesotrophic range in each year of monitoring (Table 3.4-2).

Little Playgreen Lake

TN concentrations in Little Playgreen Lake ranged from 0.22 to 1.07 mg/L during the open-water season. The mean and median were both 0.57 mg/L and the IQR was 0.49 to 0.61 mg/L for the four years of monitoring. Mean annual TN concentrations in the open-water season ranged from 0.46 to 0.71 mg/L and were within the IQR in 2013 and 2016, but were below the IQR in 2019, and above the IQR in 2010 (Table 3.4-1 and Figure 3.4-9).

During the ice-cover season, TN concentrations ranged from 0.53 to 0.75 mg/L, with a mean of 0.61 mg/L (Table 3.4-1 and Figure 3.4-9).

Little Playgreen Lake was mesotrophic (0.350 to 0.650 mg/L) based on the mean of the open-water season TN concentrations for the four years of monitoring (0.57 mg/L). Open-water season mean annual TN concentrations (0.46 to 0.71 mg/L) were also within the mesotrophic range in three of the four years sampled but were within the eutrophic range (0.651 to 1.20 mg/L) in 2010 (Table 3.4-2).

Sipiwesk Lake

TN concentrations in Sipiwesk Lake ranged from 0.36 to 0.63 mg/L during the open-water season. The mean was 0.48 mg/L, the median was 0.45 mg/L, and the IQR was 0.38 to 0.56 mg/L for the three years of monitoring. Mean annual TN concentrations in the open-water season ranged from 0.45 to 0.51 mg/L and were within the IQR in all years (Table 3.4-1 and Figure 3.4-9).

During the ice-cover season, TN concentrations ranged from 0.35 to 0.60 mg/L, with a mean of 0.49 mg/L (Table 3.4-1 and Figure 3.4-9).

Sipiwesk Lake was mesotrophic (0.350 to 0.650 mg/L) based on the mean of the open-water season TN concentrations for the three years of monitoring (0.48 mg/L). Open-water season mean annual TN concentrations (0.45 to 0.51 mg/L) were also within the mesotrophic range in each year sampled (Table 3.4-2).

Upper Nelson River Upstream of the Kelsey GS

TN concentrations in the upper Nelson River upstream of the Kelsey GS ranged from <0.20 to 0.76 mg/L during the open-water season. The mean was 0.50 mg/L, the median was 0.54 mg/L, and the IQR was 0.49 to 0.61 mg/L for the three years of monitoring. Mean annual TN concentrations in the open-water season ranged from 0.40 to 0.61 mg/L and were within the IQR in 2011 and 2017 but were below the IQR in 2014 (Table 3.4-1 and Figure 3.4-9).

During the ice-cover season, TN concentrations ranged from 0.39 to 0.68 mg/L, with a mean of 0.50 mg/L (Table 3.4-1 and Figure 3.4-9).

The upper Nelson River upstream of the Kelsey GS was mesotrophic (0.350 to 0.650 mg/L) based on the mean of the open-water season TN concentrations for the three years of monitoring (0.50 mg/L). Open-water season mean annual TN concentrations (0.40 to 0.61 mg/L) were also within the mesotrophic range in each year sampled (Table 3.4-2).

3.4.2.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

TN concentrations in Setting Lake ranged from 0.33 to 0.82 mg/L during the open-water season. Both the mean and median concentrations the 12 years of monitoring were 0.051 mg/L. Open-water season mean annual TN concentrations ranged from 0.42 to 0.62 mg/L and were within the IQR (0.44 to 0.56 mg/L) in ten of the 12 years. Mean TN concentrations were below the IQR in 2013 and above the IQR 2016 (Table 3.4-4 and Figure 3.4-10).

TN concentrations in the ice-cover season ranged from 0.46 to 0.81 mg/L, with a mean of 0.61 mg/L and a median of 0.62 mg/L for the 12 years of monitoring. The IQR was 0.56 to 0.65 mg/L (Table 3.4-4 and Figure 3.4-10).

No clear seasonality was observed for TN in Setting Lake over the 12-year period. However, mean TN concentrations were lowest in spring and summer (0.51 mg/L for both seasons) and highest in winter (0.61 mg/L; Figure 3.4-6).

Setting Lake was mesotrophic (0.350 to 0.650 mg/L) on the basis of the 2008-2019 mean open-water season TN concentration (0.51 mg/L). Mean annual TN concentrations (0.42 to 0.62 mg/L) in the open-water season were also within the mesotrophic range in all years (Table 3.4-5).

ROTATIONAL SITES

Walker Lake

TN concentrations in Walker Lake ranged from <0.20 to 0.85 mg/L during the open-water season. The mean was 0.52 mg/L, the median was 0.55 mg/L, and the IQR was 0.49 to 0.58 mg/L for the four years of monitoring. Mean annual TN concentrations in the open-water season ranged from 0.42 to 0.59 mg/L and were within the IQR in 2010 and 2013 but were below the IQR in 2016 and above the IQR in 2019 (Table 3.4-4 and Figure 3.4-10).

During the ice-cover season, TN concentrations ranged from 0.39 to 0.63 mg/L, with a mean of 0.53 mg/L (Table 3.4-4 and Figure 3.4-10).

Walker Lake was mesotrophic (0.350 to 0.650 mg/L) based on the mean of the open-water season TN concentrations for the four years of monitoring (0.52 mg/L). Open-water season mean annual TN concentrations (0.42 to 0.59 mg/L) were also within the mesotrophic range in all years sampled (Table 3.4-5).

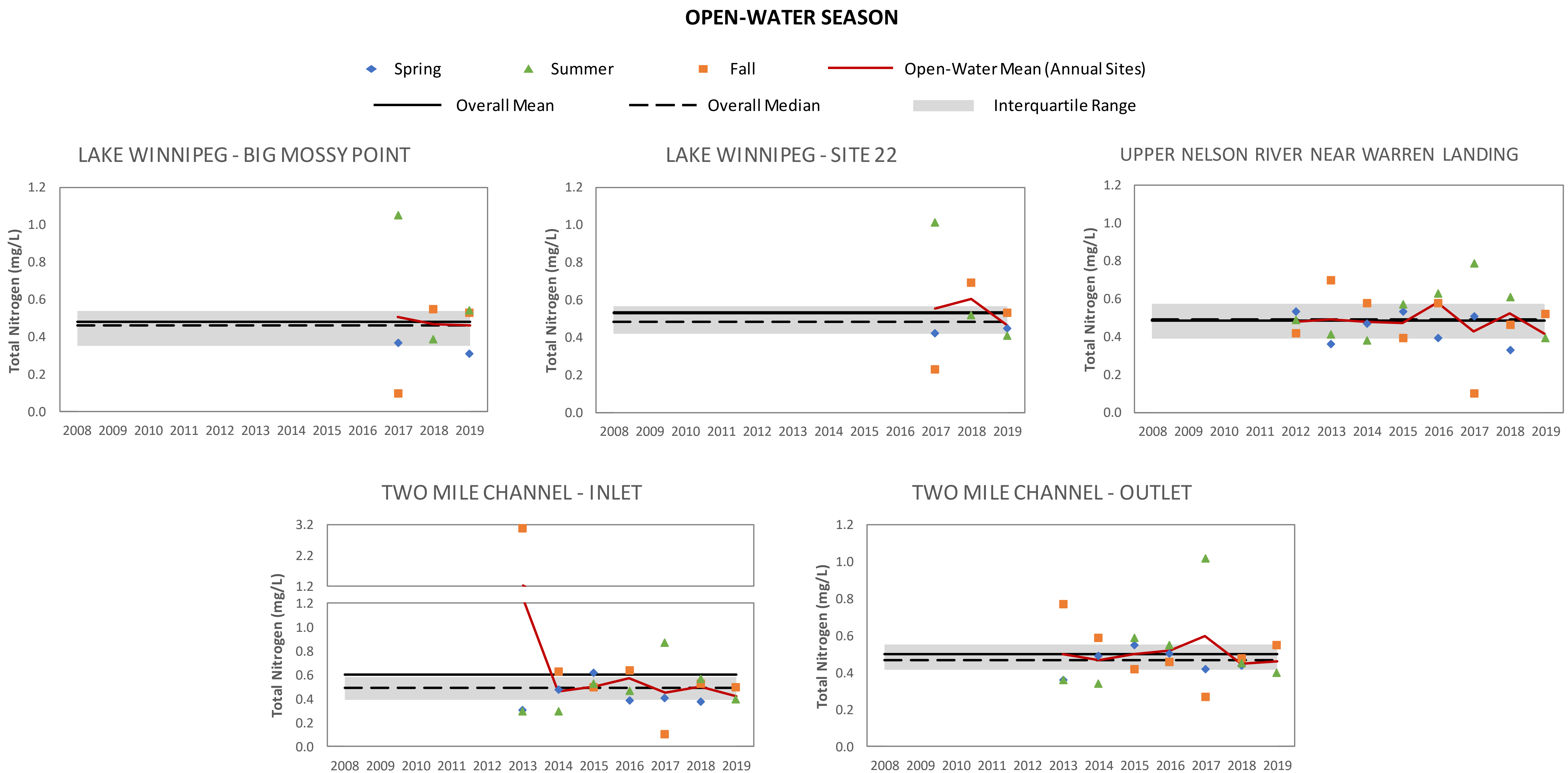
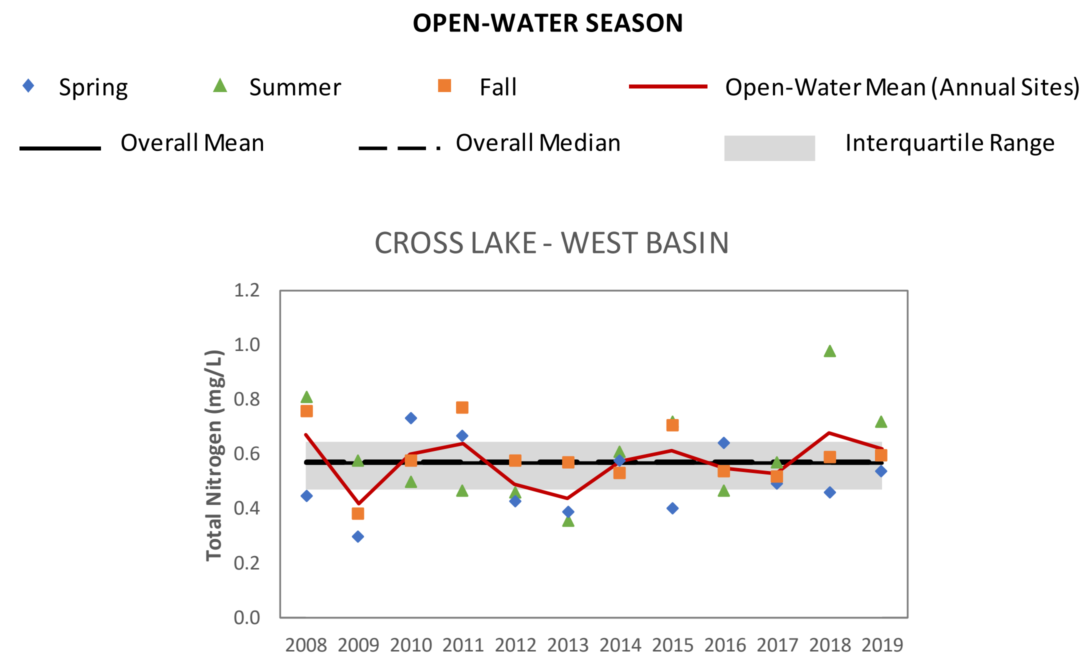


Figure 3.4-7. 2008-2019 Lake Winnipeg outlet area sites open-water season TN concentrations.



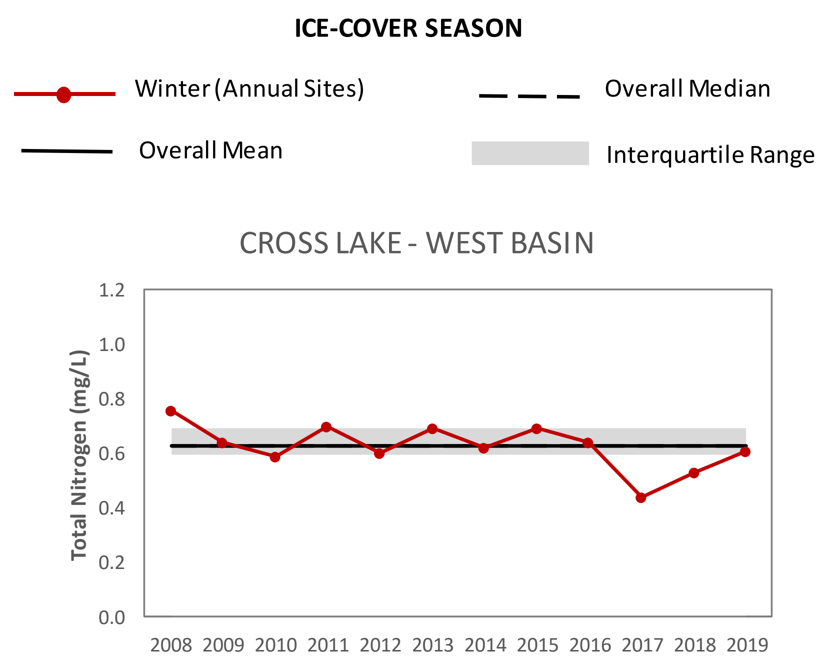
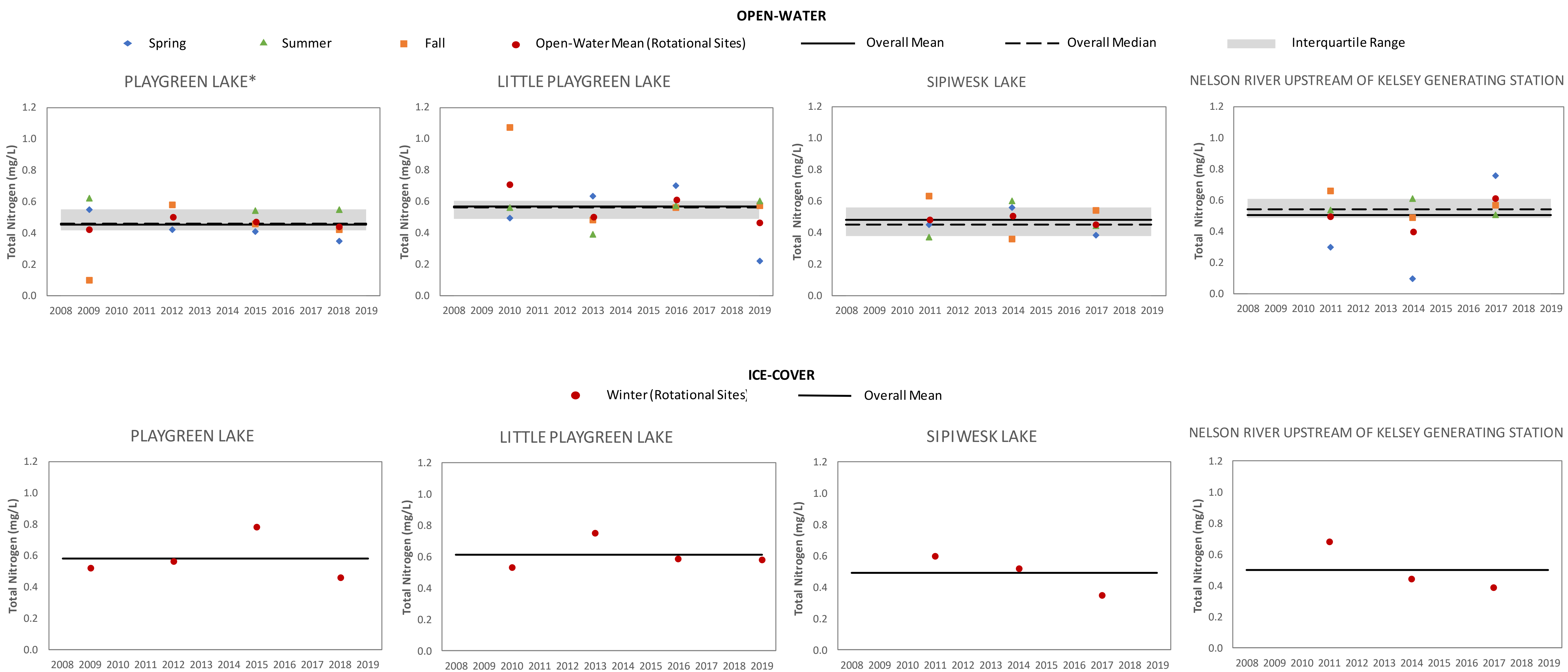


Figure 3.4-8. 2008-2019 Cross Lake – West Basin open-water and ice-cover season TN concentrations.



*Excludes outlier value of 14.5 mg/L at PLAYG from summer 2012.

Figure 3.4-9. 2008-2019 On-system rotational open-water and ice-cover season TN concentrations.

Figure 3.4-10. 2008-2019 Off-system open-water and ice-cover season TN concentrations.

3.4.3 CHLOROPHYLL *A*

3.4.3.1 ON-SYSTEM SITES

ANNUAL SITES

<u>**Lake Winnipeg Outlet Area**</u>

Big Mossy Point

Chlorophyll *a* concentrations in Lake Winnipeg at Big Mossy Point ranged from 1.07 to 24.1 µg/L during the open-water season. The mean was 8.15 µg/L, the median was 5.00 µg/L, and the IQR was 3.45 to 11.1 µg/L for the three years of monitoring. Mean annual chlorophyll *a* concentrations in the open-water season ranged from 5.04 to 14.8 µg/L and were within the IQR in 2017 and 2019 but above the IQR in 2018 (Table 3.4-1 and Figure 3.4-11).

No data are available for the ice-cover season as this site is not sampled in winter.

Big Mossy Point was eutrophic (8 to 25 µg/L) based on the mean of the open-water season chlorophyll *a* concentrations for the three years of monitoring (8.15 µg/L). Open-water season mean annual chlorophyll *a* concentrations (5.04 to 14.8 µg/L) were also within the eutrophic range in 2018 but were within the meso-eutrophic range (2.5 to 8 µg/L) in 2017 and 2019 (Table 3.4-2).

Site 22

Chlorophyll *a* concentrations in Lake Winnipeg at Site 22 ranged from 1.47 to 23.6 µg/L during the open-water season. The mean was 9.42 µg/L, the median was 6.53 µg/L, and the IQR was 3.45 to 15.1 µg/L for the three years of monitoring. Mean annual chlorophyll *a* concentrations in the open-water season ranged from 4.61 to 19.7 µg/L and were within the IQR in 2017 and 2019 but above the IQR in 2018 (Table 3.4-1 and Figure 3.4-11).

No data are available for the ice-cover season as this site is not sampled in winter.

Site 22 was eutrophic (8 to 25 µg/L) based on the mean of the open-water season chlorophyll *a* concentrations for the three years of monitoring (9.42 µg/L). Open-water season mean annual chlorophyll *a* concentrations (4.61 to 19.7 µg/L) were also within the eutrophic range in 2018 but were within the meso-eutrophic range (2.5 to 8 µg/L) in 2017 and 2019 (Table 3.4-2).

Nelson River near Warren Landing

Chlorophyll *a* concentrations in Nelson River near Warren Landing ranged from 1.72 to 25.2 µg/L during the open-water season. The mean and median concentrations for the eight years of monitoring were 9.44 and 6.93 µg/L, respectively. Open-water season mean annual chlorophyll *a* concentrations ranged from 3.88 to 18.9 µg/L and were within the IQR (2.59 to 17.2 µg/L) in seven of the eight years. Mean chlorophyll *a* concentrations were above the IQR in 2018 (Table 3.4-1 and Figure 3.4-11).

No data are available for the ice-cover season as this site is not sampled in winter.

Mean chlorophyll *a* concentrations in the Nelson River near Warren Landing were lower in spring and summer (6.45 and 5.79 µg/L, respectively) than in fall (15.3 µg/L) over the eight years of monitoring. No data are available for winter (Figure 3.4-2).

The Nelson River near Warren Landing was oligotrophic (<10 µg/L) on the basis of the 2012-2019 mean open-water season chlorophyll *a* concentration (9.44 µg/L). Mean annual chlorophyll a concentrations (3.88 to 18.9 µg/L) in the open-water season were within the oligotrophic range in 2012, 2013, 2017, and 2019; and within the mesotrophic range (10 to 30 µg/L) in 2014, 2015, 2016, and 2018 (Table 3.4-3).

2-Mile Channel

2-Mile Channel Inlet

Chlorophyll *a* concentrations at the 2 Mile Channel Inlet ranged from 1.26 to 23.5 µg/L during the open-water season. The mean and median concentrations for the seven years of monitoring were 7.78 and 7.57 µg/L, respectively. Open-water season mean annual chlorophyll *a* concentrations ranged from 4.44 to 14.5 µg/L and were within the IQR (2.77 to 10.6 µg/L) in five of seven years. Mean chlorophyll *a* concentrations were above the IQR in 2014 and 2018 (Table 3.4-1 and Figure 3.4-11).

No data are available for the ice-cover season as this site is not sampled in winter.

Mean chlorophyll *a* concentrations at the 2 Mile Channel Inlet were lower in spring and summer (5.13 and 5.57 µg/L, respectively) than in fall (11.9 µg/L) over the seven years of monitoring. No data are available for winter (Figure 3.4-2).

The 2 Mile Channel Inlet was oligotrophic (<10 µg/L) on the basis of the 2013-2019 mean open-water season chlorophyll *a* concentration (7.78 µg/L). Mean annual chlorophyll *a* concentrations

(4.44 to 14.5 µg/L) in the open-water season were within the oligotrophic range in most years except for 2014 and 2018 when the mean chlorophyll *a* concentrations were within the mesotrophic range (10 to 30 µg/L; Table 3.4-3).

2-Mile Channel Outlet

Chlorophyll *a* concentrations at the 2 Mile Channel Outlet ranged from 1.22 to 18.2 µg/L during the open-water season. The mean and median concentrations for the seven years of monitoring were 7.03 and 4.77 µg/L, respectively. Open-water season mean annual chlorophyll *a* concentrations ranged from 4.14 to 9.85 µg/L and were within the IQR (2.77 to 11.0 µg/L) in all years (Table 3.4-1 and Figure 3.4-11).

No data are available for the ice-cover season as this site is not sampled in winter.

Mean chlorophyll *a* concentrations at the 2 Mile Channel Outlet were lower in spring and summer (3.88 and 4.68 µg/L, respectively) than in fall (11.8 µg/L) over the seven years of monitoring. No data are available for winter (Figure 3.4-2).

The 2 Mile Channel Outlet was oligotrophic (<10 µg/L) on the basis of the 2013-2019 mean open-water season chlorophyll *a* concentration (7.03 µg/L). Mean annual chlorophyll *a* concentrations (4.14 to 9.85 µg/L) in the open-water season were within the oligotrophic range in all years (Table 3.4-3).

Cross Lake

Chlorophyll *a* concentrations in Cross Lake ranged from 1.59 to 31.0 µg/L during the open-water season. The mean and median for the 12 years of monitoring were 7.38 µg/L and 6.08 µg/L, respectively. Open-water season mean annual chlorophyll *a* concentrations ranged from 4.08 to 17.3 µg/L and were within the IQR (4.44 to 7.78 µg/L) in six of the 12 years. Mean chlorophyll *a* concentrations were below the IQR in 2010 and 2019 and above the IQR in 2008, 2011, 2013, and 2018 (Table 3.4-1 and Figure 3.4-12).

Chlorophyll *a* concentrations in the ice-cover season ranged from <0.60 to 3.18 µg/L, with a mean of 0.92 µg/L and a median of <0.60 µg/L for the 12 years of monitoring. The IQR was <0.60 to 1.12 µg/L (Table 3.4-1 and Figure 3.4-12).

Chlorophyll *a* concentrations were lower in the winter, often less than the DL (0.10-1.0 µg/L; percent detection = 58), compared the open-water season (Table 3.4-1). On average, chlorophyll *a* concentrations during the open-water season were lowest in spring (4.92 µg/L) and highest in fall (10.4 µg/L; Figure 3.4-2).

Cross Lake was mesotrophic (2.5 to 8 µg/L) on the basis of the 2008-2019 mean open-water season chlorophyll *a* concentration (7.38 µg/L). Mean annual chlorophyll *a* concentrations (4.08 to 17.3 µg/L) in the open-water season were also within the mesotrophic range in eight of the 12 years. The exceptions were 2008, 2011, 2013, and 2018 when the mean chlorophyll *a* concentrations were within the eutrophic range (8 to 25 µg/L; Table 3.4-2).

ROTATIONAL SITES

Playgreen Lake

Chlorophyll *a* concentrations in Playgreen Lake ranged from 2.30 to 11.8 µg/L during the open-water season. The mean and median concentrations for the four years of monitoring were 6.69 µg/L and 6.91 µg/L, respectively. Open-water season mean annual chlorophyll *a* concentrations ranged from 6.37 to 7.33 µg/L and were within the IQR (3.47 to 9.56 µg/L) in all years (Table 3.4-1 and Figure 3.4-13).

During the ice-cover season, chlorophyll *a* concentrations ranged from <0.60 to 1.33 µg/L, with a mean of 0.95 µg/L (Table 3.4-1 and Figure 3.4-13).

Playgreen Lake was mesotrophic (2.5 to 8 µg/L) based on the mean of the open-water season chlorophyll *a* concentrations for the four years of monitoring (6.69 µg/L). Open-water season mean annual chlorophyll *a* concentrations (6.37 to 7.33 µg/L) were also within the mesotrophic range in each year of monitoring (Table 3.4-2).

Little Playgreen Lake

Chlorophyll *a* concentrations in Little Playgreen Lake ranged from 2.09 to 8.97 µg/L during the open-water season. The mean and median concentrations for the four years of monitoring were 5.10 µg/L and 4.70 µg/L, respectively. Open-water season mean annual chlorophyll *a* concentrations ranged from 4.06 to 6.43 µg/L and were within the IQR (3.77 to 6.38 µg/L) in 2010, 2013, and 2019 but were above the IQR in 2016 (Table 3.4-1 and Figure 3.4-13).

During the ice-cover season, chlorophyll *a* concentrations ranged from <0.60 to 4.01 µg/L, with a mean of 1.71 µg/L (Table 3.4-1 and Figure 3.4-13).

Little Playgreen Lake was mesotrophic (2.5 to 8 µg/L) based on the mean of the open-water season chlorophyll *a* concentrations for the four years of monitoring (5.10 µg/L). Open-water season mean annual chlorophyll *a* concentrations (4.06 to 6.43 µg/L) were also within the mesotrophic range in each year of monitoring (Table 3.4-2).

Sipiwesk Lake

Chlorophyll *a* concentrations in Sipiwesk Lake ranged from 3.44 to 13.0 µg/L during the open-water season. The mean and median concentrations for the three years of monitoring were 6.35 µg/L and 4.77 µg/L, respectively. Open-water season mean annual chlorophyll *a* concentrations ranged from 4.33 to 8.60 µg/L and were within the IQR (4.01 to 8.82 µg/L) in all years (Table 3.4-1 and Figure 3.4-13).

During the ice-cover season, chlorophyll *a* concentrations were consistently below the DL (0.60 µg/L; Table 3.4-1 and Figure 3.4-13).

Sipiwesk Lake was mesotrophic (2.5 to 8 µg/L) based on the mean of the open-water season chlorophyll *a* concentrations for the three years of monitoring (6.35 µg/L). Open-water season mean annual chlorophyll *a* concentrations (4.33 to 8.60 µg/L) were also within the mesotrophic range in 2014 and 2017 but were within the eutrophic range (8 to 25 µg/L) in 2011 (Table 3.4-2).

Upper Nelson River Upstream of the Kelsey GS

Chlorophyll *a* concentrations in the upper Nelson River upstream of Kelsey GS ranged from 2.48 to 5.54 µg/L during the open-water season. The mean and median concentrations for the three years of monitoring were 4.01 µg/L and 4.28 µg/L, respectively. Open-water season mean annual chlorophyll *a* concentrations ranged from 3.74 to 4.26 µg/L and were within the IQR (3.25 to 4.39 µg/L) in all years (Table 3.4-1 and Figure 3.4-13).

During the ice-cover season, chlorophyll *a* concentrations were consistently below the DL (0.60 µg/L; Table 3.4-1 and Figure 3.4-13).

The upper Nelson River upstream of Kelsey GS was mesotrophic (2.5 to 8 µg/L) based on the mean of the open-water season chlorophyll *a* concentrations for the three years of monitoring (4.01 µg/L). Open-water season mean annual chlorophyll *a* concentrations (3.74 to 4.26 µg/L) were also within the mesotrophic range in all years sampled (Table 3.4-2).

3.4.3.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Chlorophyll a concentrations in Setting Lake ranged from 1.90 to 9.55 µg/L during the open-water season. The mean and median concentrations for the 12 years of monitoring were 4.48 µg/L and 4.34 µg/L, respectively. Open-water season mean annual chlorophyll *a* concentrations ranged from 3.32 to 6.11 µg/L and were within the IQR (3.33 to 5.04 µg/L) in eight of the 12 years. Mean chlorophyll *a* concentrations were below the IQR in 2010 and 2017 and above the IQR in 2012 and 2019 (Table 3.4-4 and Figure 3.4-14).

Chlorophyll *a* concentrations in the ice-cover season ranged from <0.60 to 1.43 µg/L, with a mean of 0.89 µg/L and a median of 0.95 µg/L for the 12 years of monitoring. The IQR was 0.65 to 1.17 µg/L (Table 3.4-4 and Figure 3.4-14).

Chlorophyll *a* concentrations were lower in the winter (mean = 0.89 µg/L), sometimes less than the DL (percent detections = 83), compared to the open-water season (mean = 4.48 µg/L). On average, chlorophyll *a* concentrations during the open-water season were lowest in spring (3.76 µg/L) and highest in fall (5.40 µg/L; Figure 3.4-6).

Setting Lake was mesotrophic (2.5 to 8 µg/L) on the basis of the 2008-2019 mean open-water season chlorophyll *a* concentration (4.48 µg/L). Mean annual chlorophyll *a* concentrations (3.32 to 6.11 µg/L) in the open-water season were also within the mesotrophic range in all years (Table 3.4-5).

ROTATIONAL SITES

Walker Lake

Chlorophyll *a* concentrations in Walker Lake ranged from 2.10 to 14.0 µg/L during the open-water season. The mean and median concentrations for the four years of monitoring were 6.37 µg/L and 5.29 µg/L, respectively. Open-water season mean annual chlorophyll *a* concentrations ranged from 4.22 to 10.5 µg/L and were within the IQR (3.30 to 8.59 µg/L) in 2010, 2013, and 2016 but were above the IQR in 2019 (Table 3.4-4 and Figure 3.4-14).

During the ice-cover season, chlorophyll *a* concentrations ranged from 0.95 to 2.86 µg/L, with a mean of 1.52 µg/L (Table 3.4-4 and Figure 3.4-14).

Walker Lake was mesotrophic (2.5 to 8 µg/L) based on the mean of the open-water season chlorophyll *a* concentrations for the four years of monitoring (6.37 µg/L). Open-water season mean annual chlorophyll *a* concentrations (4.22 to 10.5 µg/L) were also within the mesotrophic range in 2010, 2013, and 2016 but were within the eutrophic range (8 to 25 µg/L) in 2019 (Table 3.4-5).

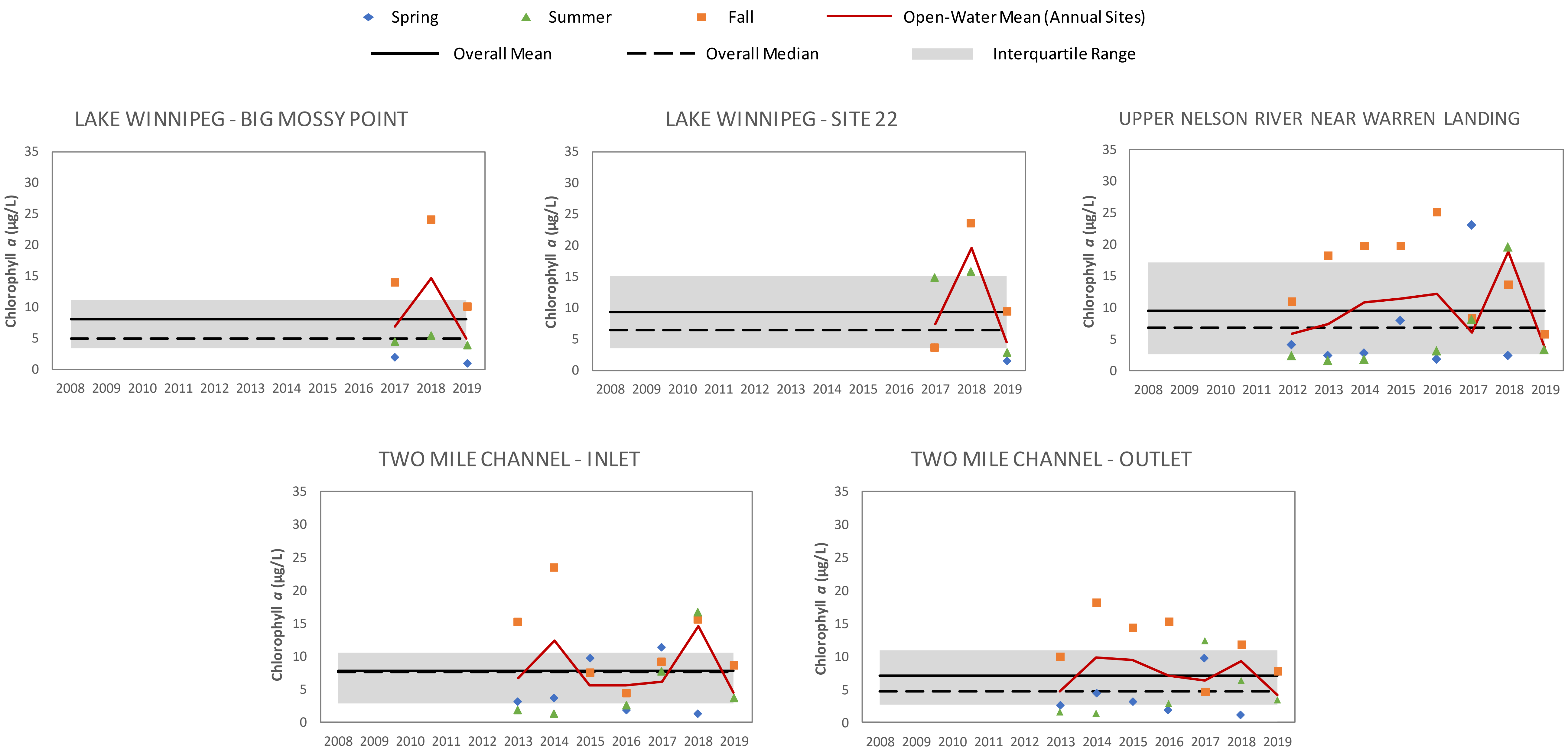
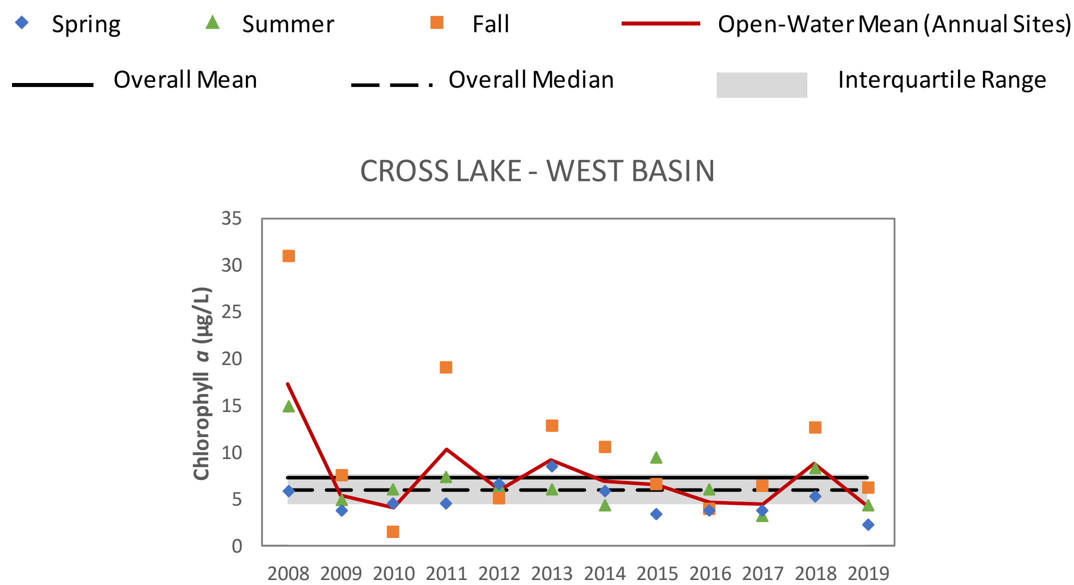


Figure 3.4-11. 2008-2019 Lake Winnipeg outlet area sites open-water season chlorophyll *a* concentrations.

OPEN-WATER SEASON



ICE-COVER SEASON

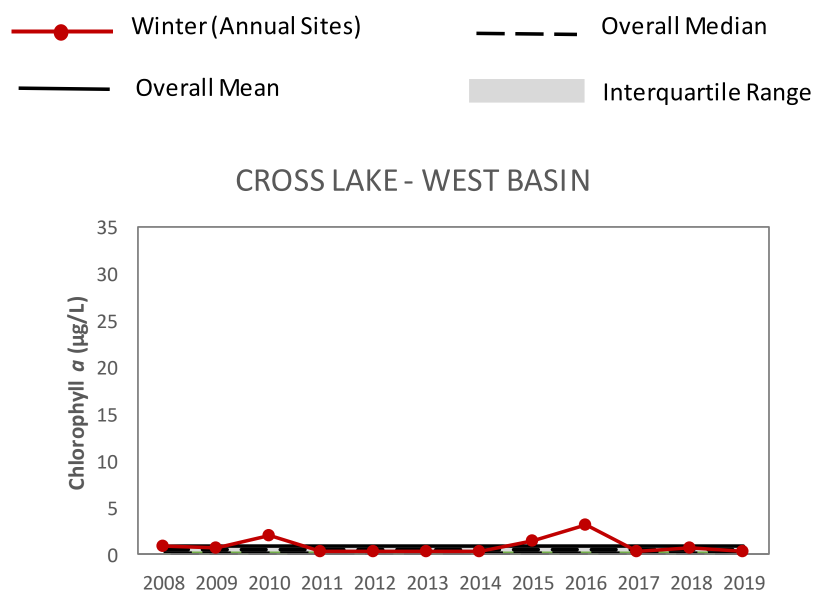


Figure 3.4-12. 2008-2019 Cross Lake – West Basin open-water and ice-cover season chlorophyll *a* concentrations

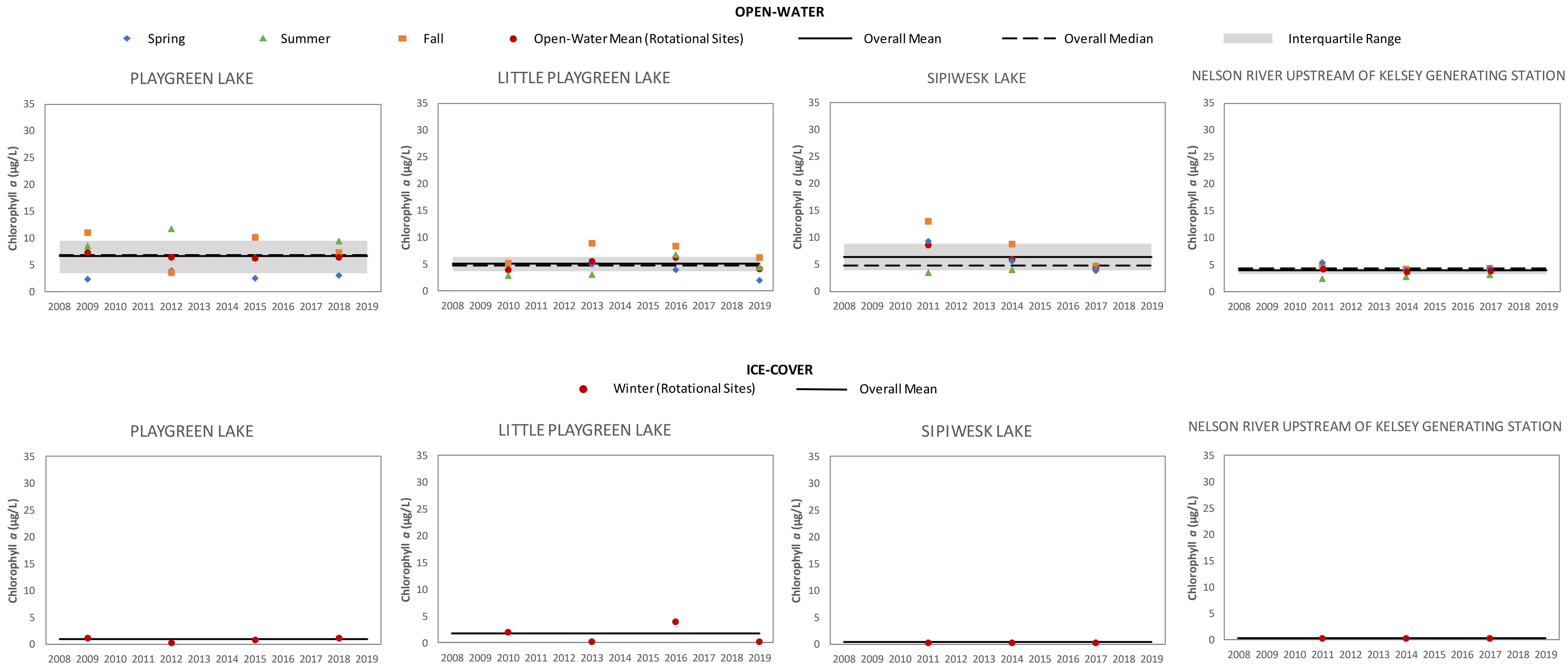


Figure 3.4-13. 2008-2019 On-system rotational sites open-water season chlorophyll *a* concentrations.

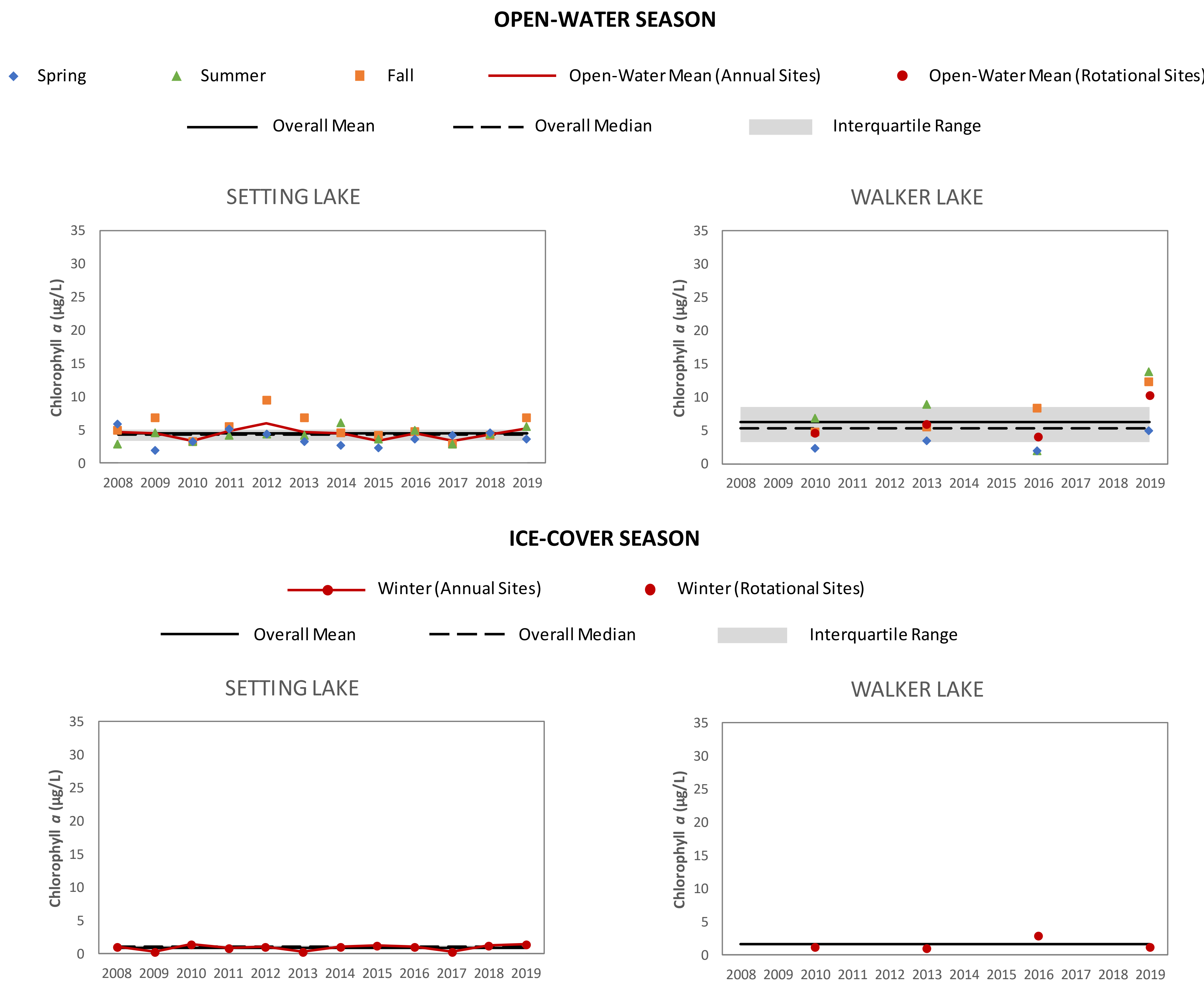


Figure 3.4-14. 2008-2019 Off-system open-water and ice-cover season chlorophyll *a* concentrations.

APPENDIX 3-1. WATER QUALITY SAMPLING SITES: 2008-2019

Figure A3-1-1. Spring water quality sampling locations: Lake Winnipeg – Big Mossy Point.

Figure A3-1-2. Summer water quality sampling locations: Lake Winnipeg – Big Mossy Point.

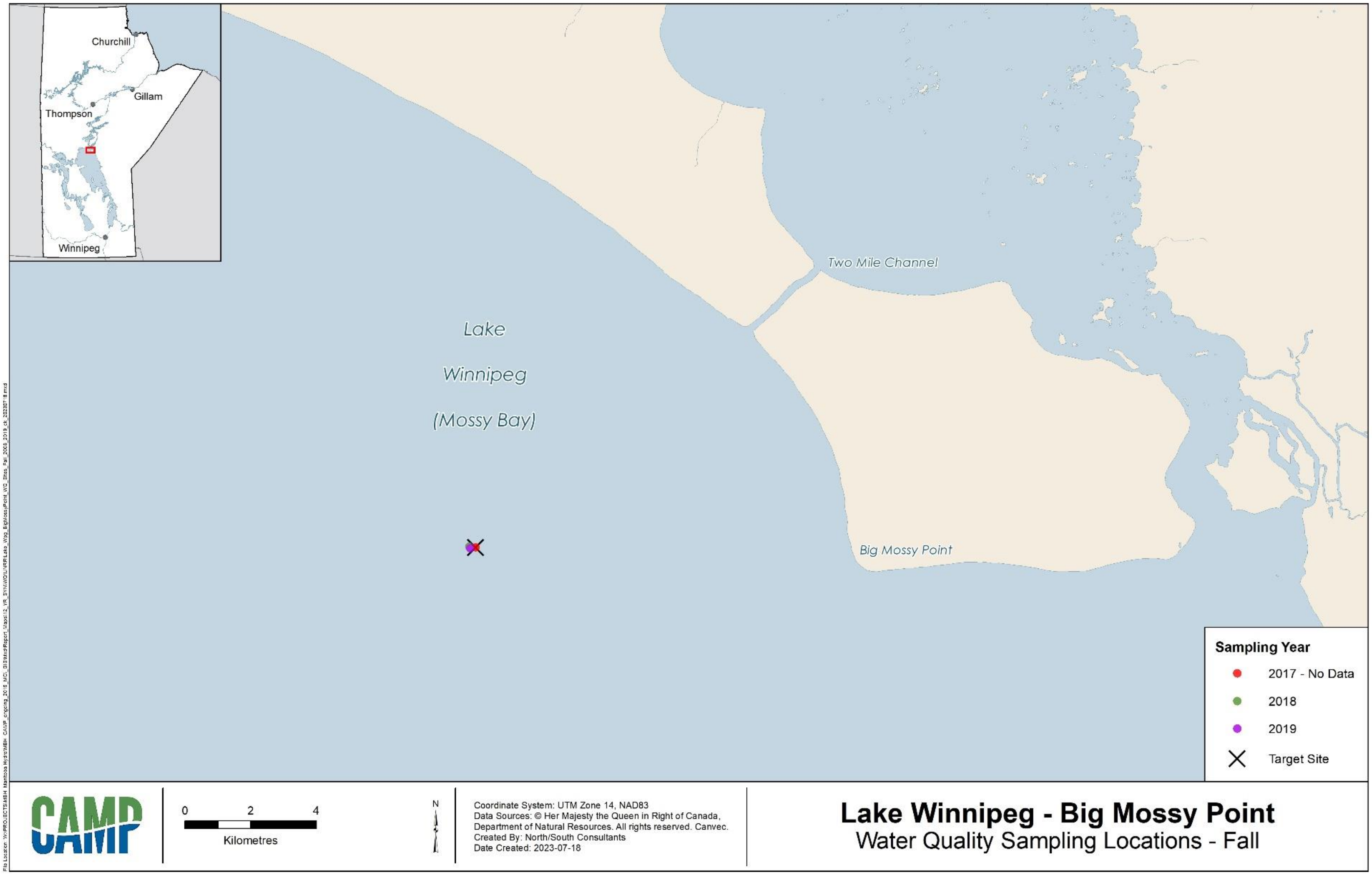


Figure A3-1-3. Fall water quality sampling locations: Lake Winnipeg – Big Mossy Point.

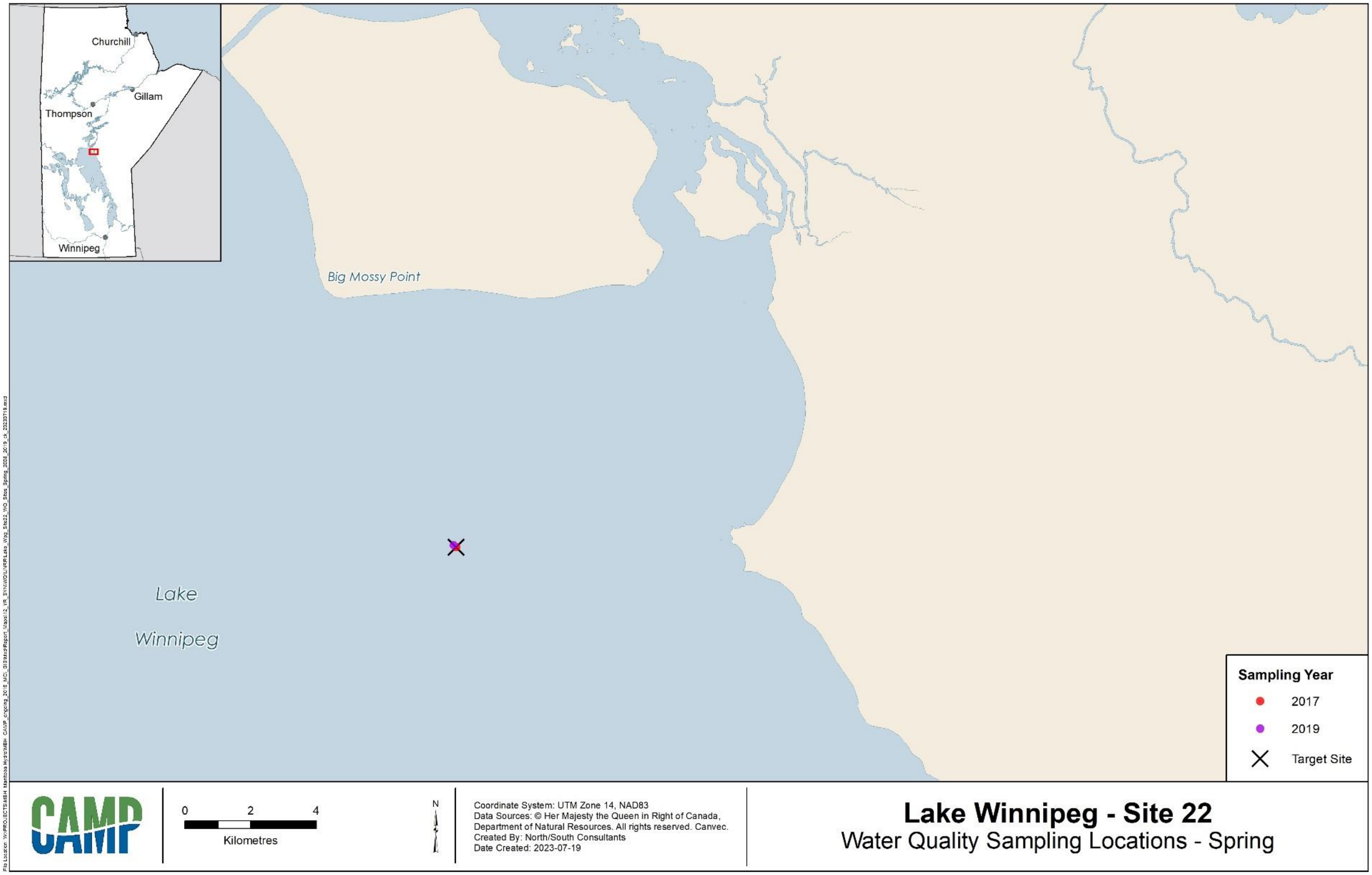


Figure A3-1-4. Spring water quality sampling locations: Lake Winnipeg – Site 22.

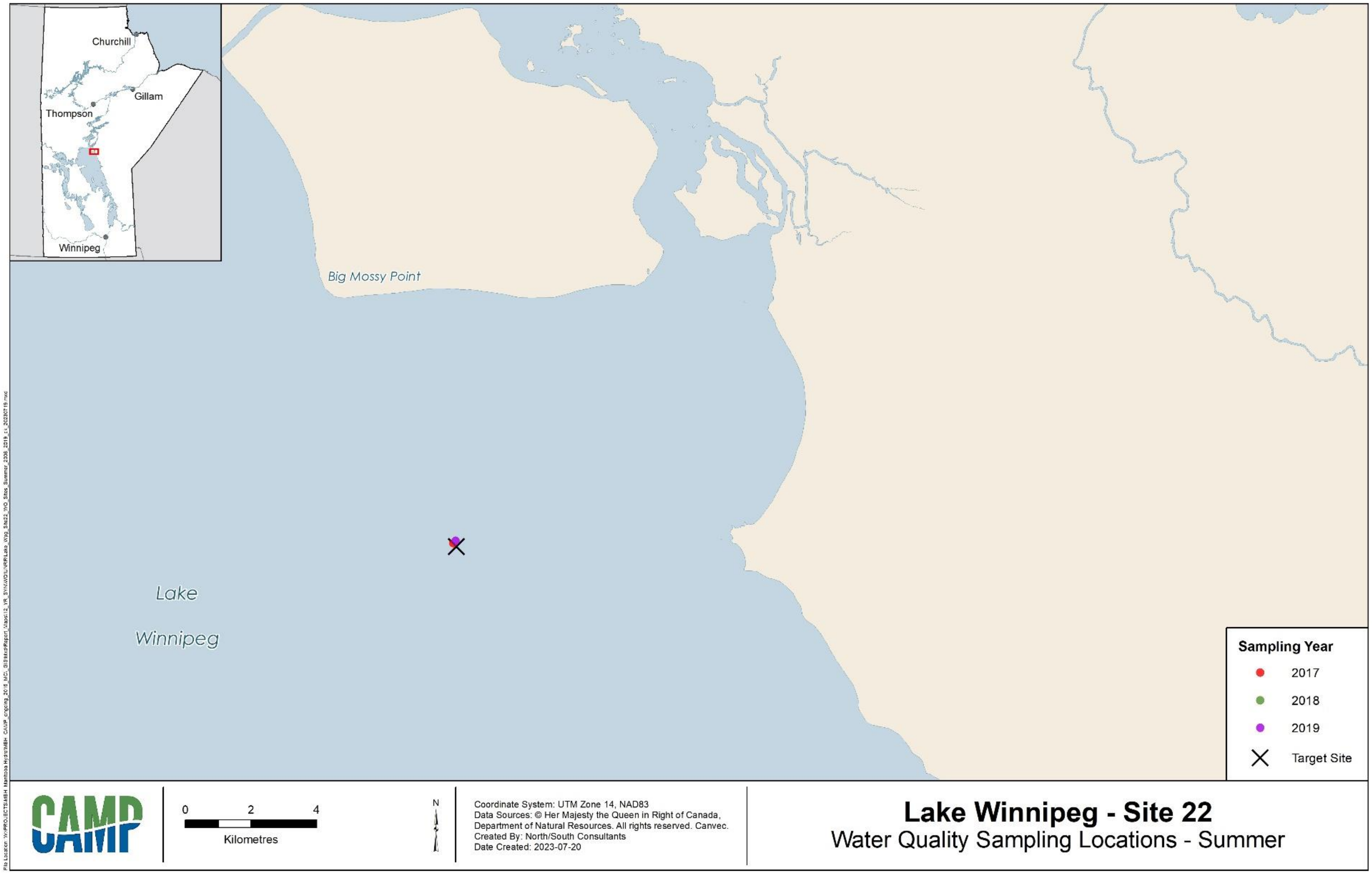


Figure A3-1-5. Summer water quality sampling locations: Lake Winnipeg – Site 22.

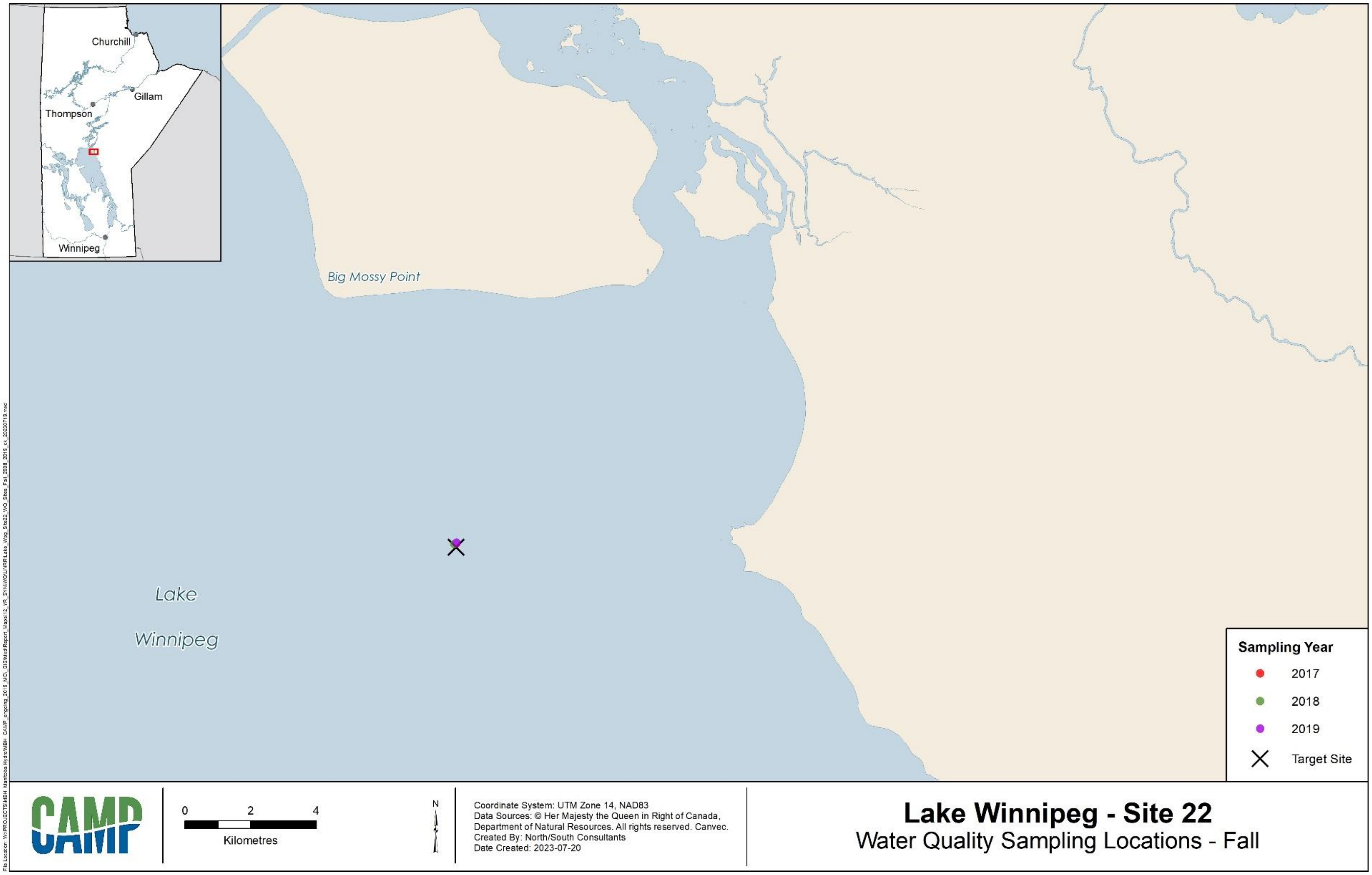


Figure A3-1-6. Fall water quality sampling locations: : Lake Winnipeg – Site 22.

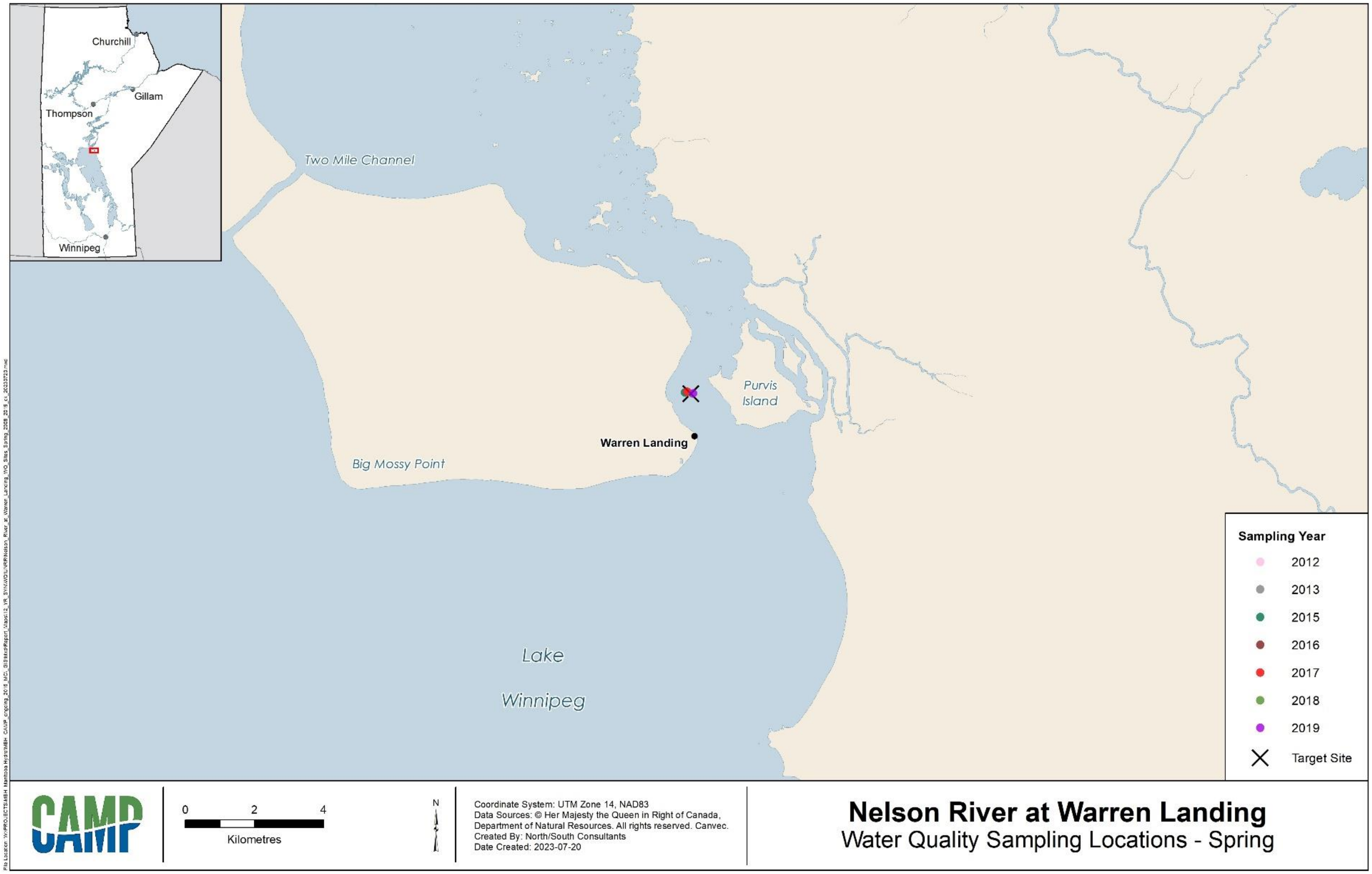


Figure A3-1-7. Spring water quality sampling locations: the Nelson River near Warren Landing.

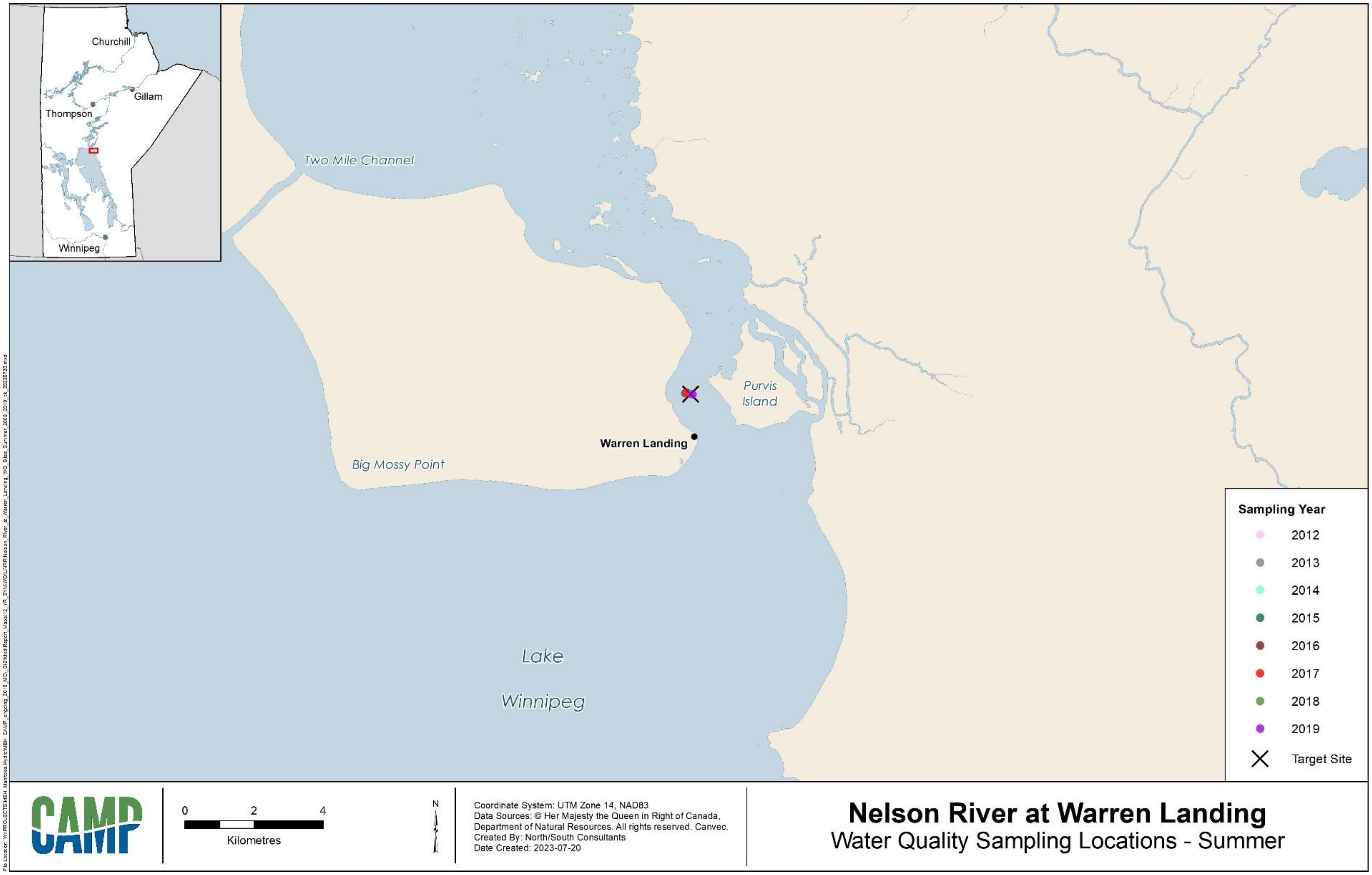


Figure A3-1-8. Summer water quality sampling locations: the Nelson River near Warren Landing.

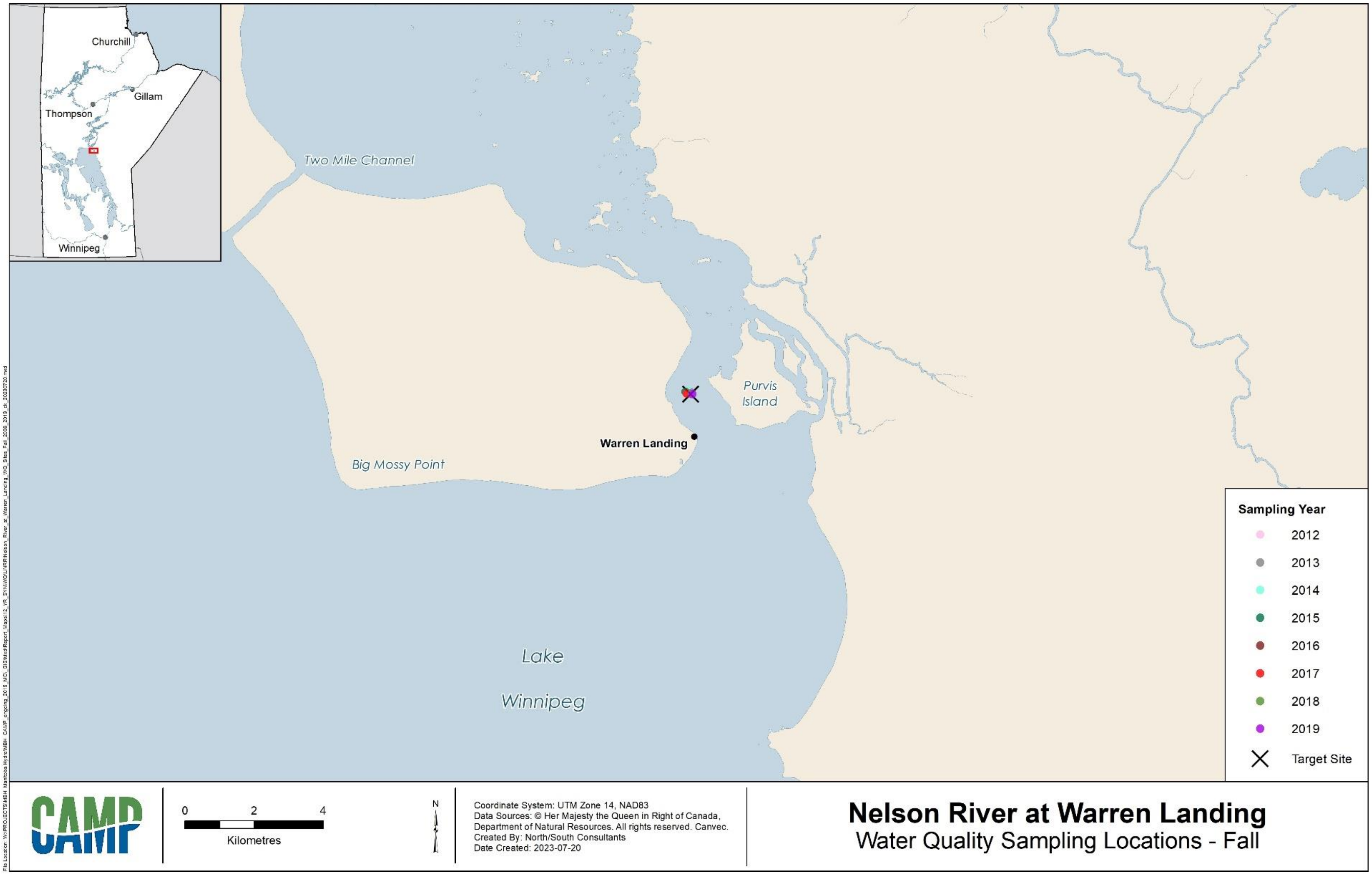


Figure A3-1-9. Fall water quality sampling locations: the Nelson River near Warren Landing.

Figure A3-1-10. Spring water quality sampling locations: Two-Mile Channel Inlet.

Figure A3-1-11. Summer water quality sampling locations: Two-Mile Channel Inlet.

Figure A3-1-12. Fall water quality sampling locations: Two-Mile Channel Inlet.

Figure A3-1-13. Spring water quality sampling locations: Two-Mile Channel Outlet.

Figure A3-1-14. Summer water quality sampling locations: Two-Mile Channel Outlet.

Figure A3-1-15. Fall water quality sampling locations: Two-Mile Channel Outlet.

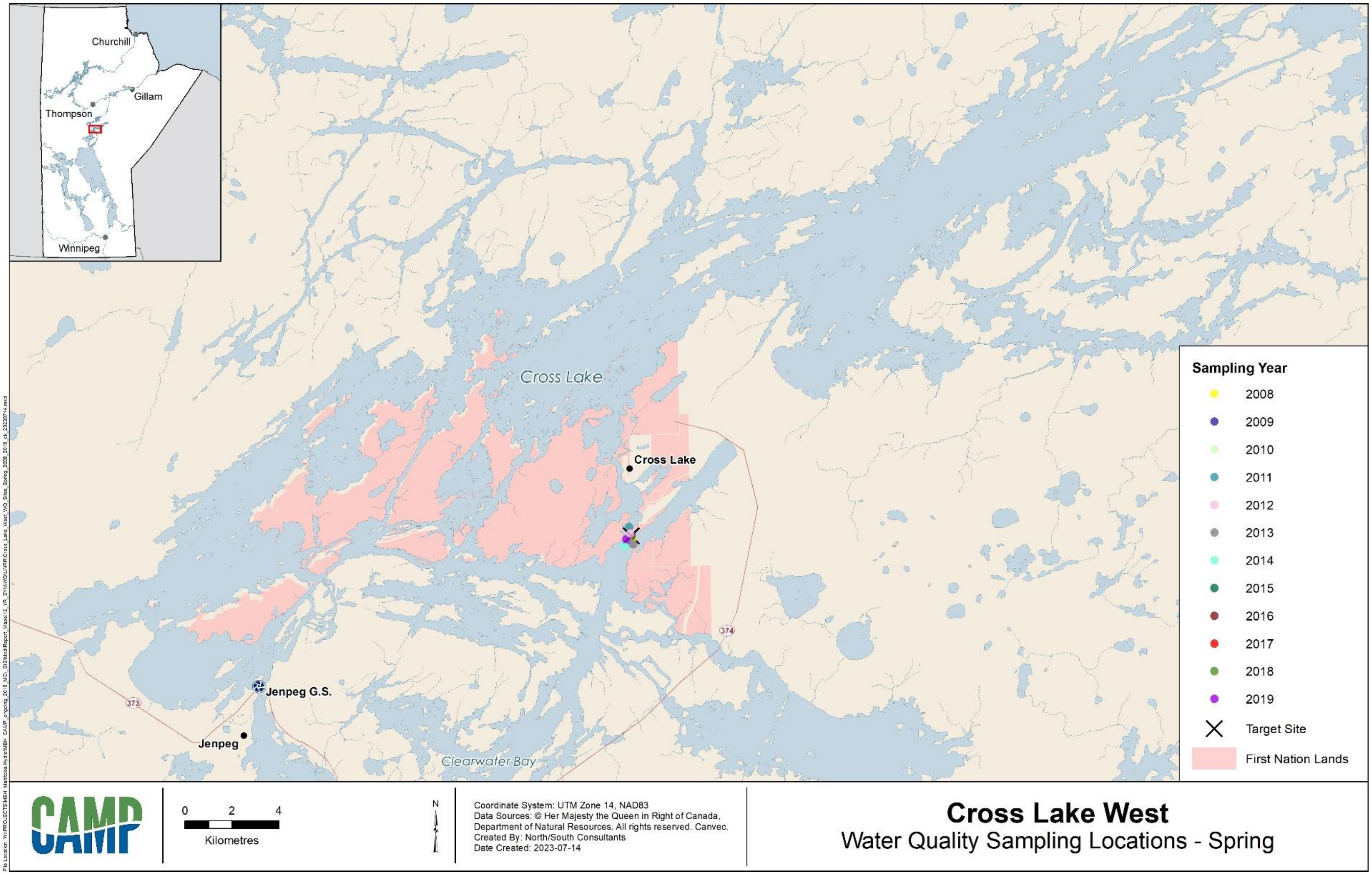


Figure A3-1-16. Spring water quality sampling locations: Cross Lake – West Basin.

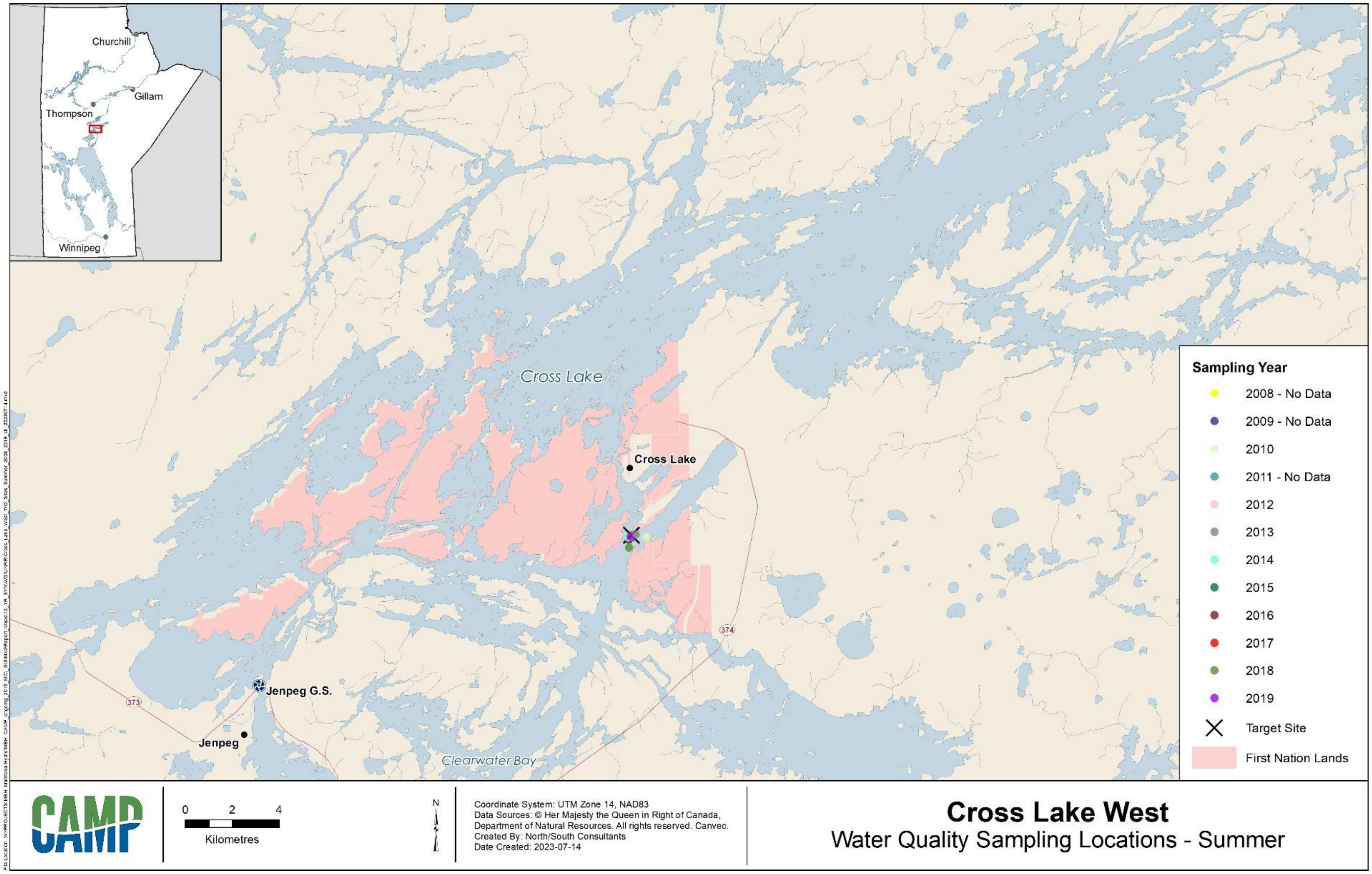


Figure A3-1-17. Summer water quality sampling locations: Cross Lake – West Basin.

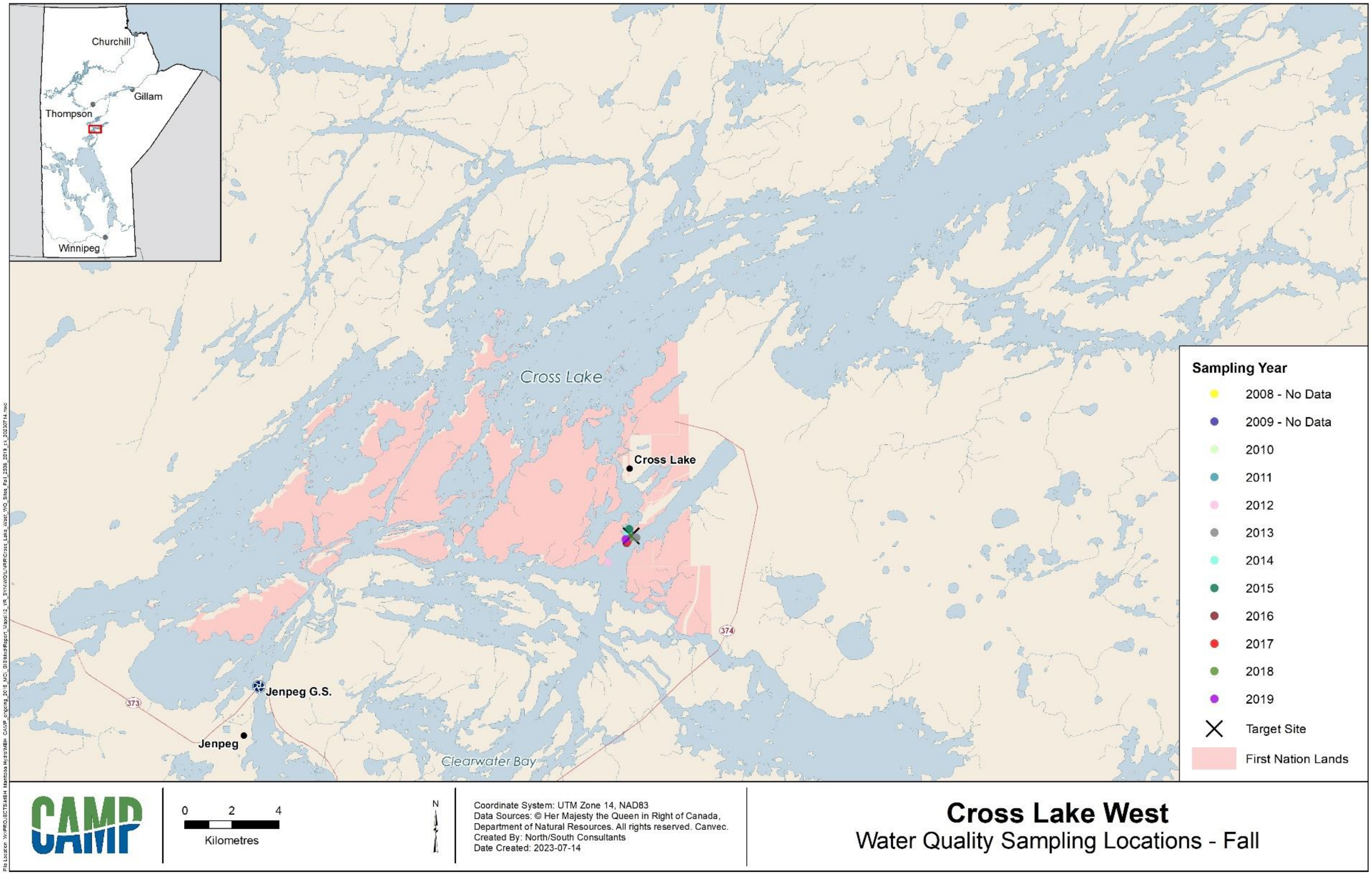


Figure A3-1-18. Fall water quality sampling locations: Cross Lake – West Basin.

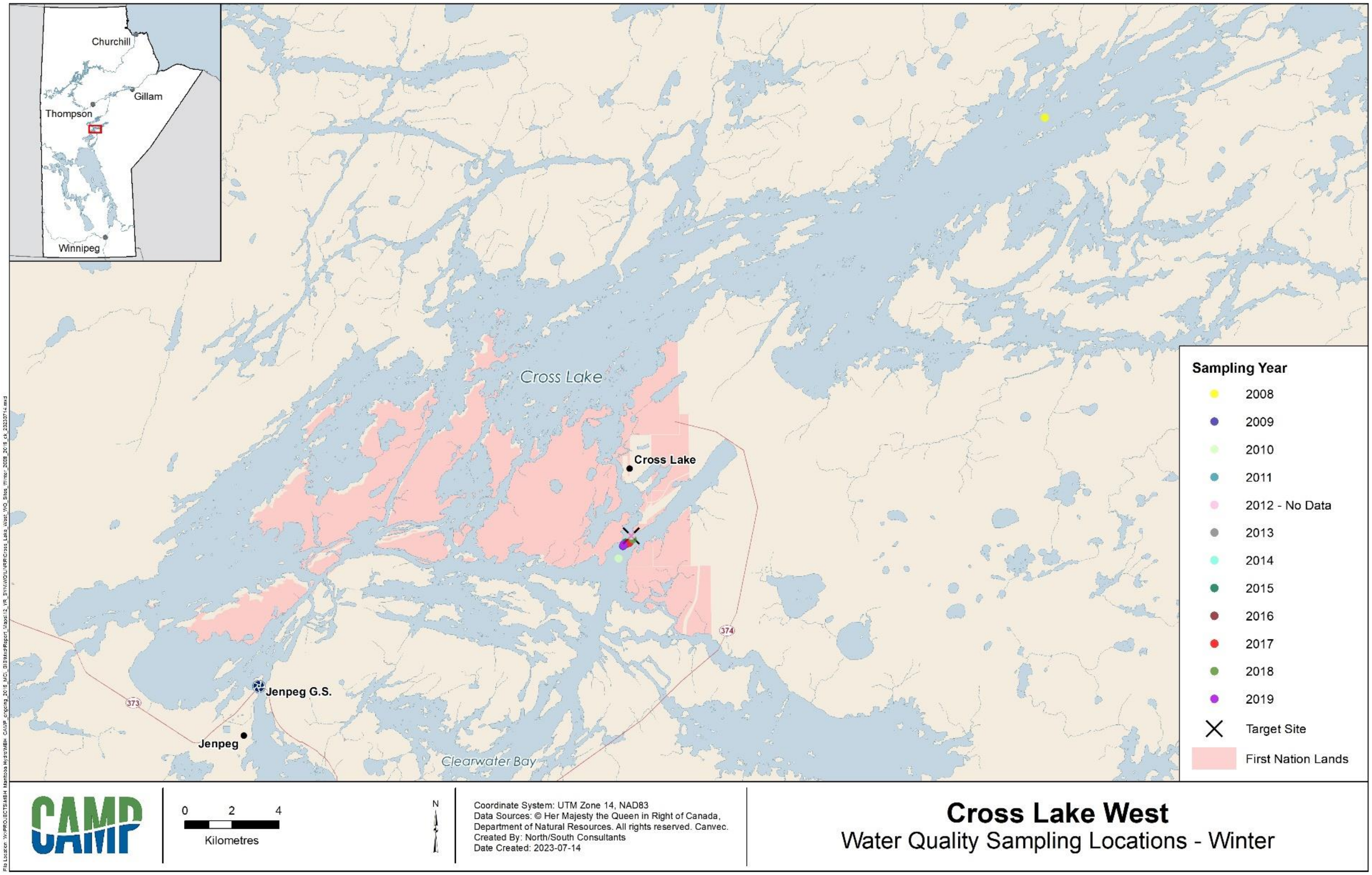


Figure A3-1-19. Winter quality sampling locations: Cross Lake – West Basin.

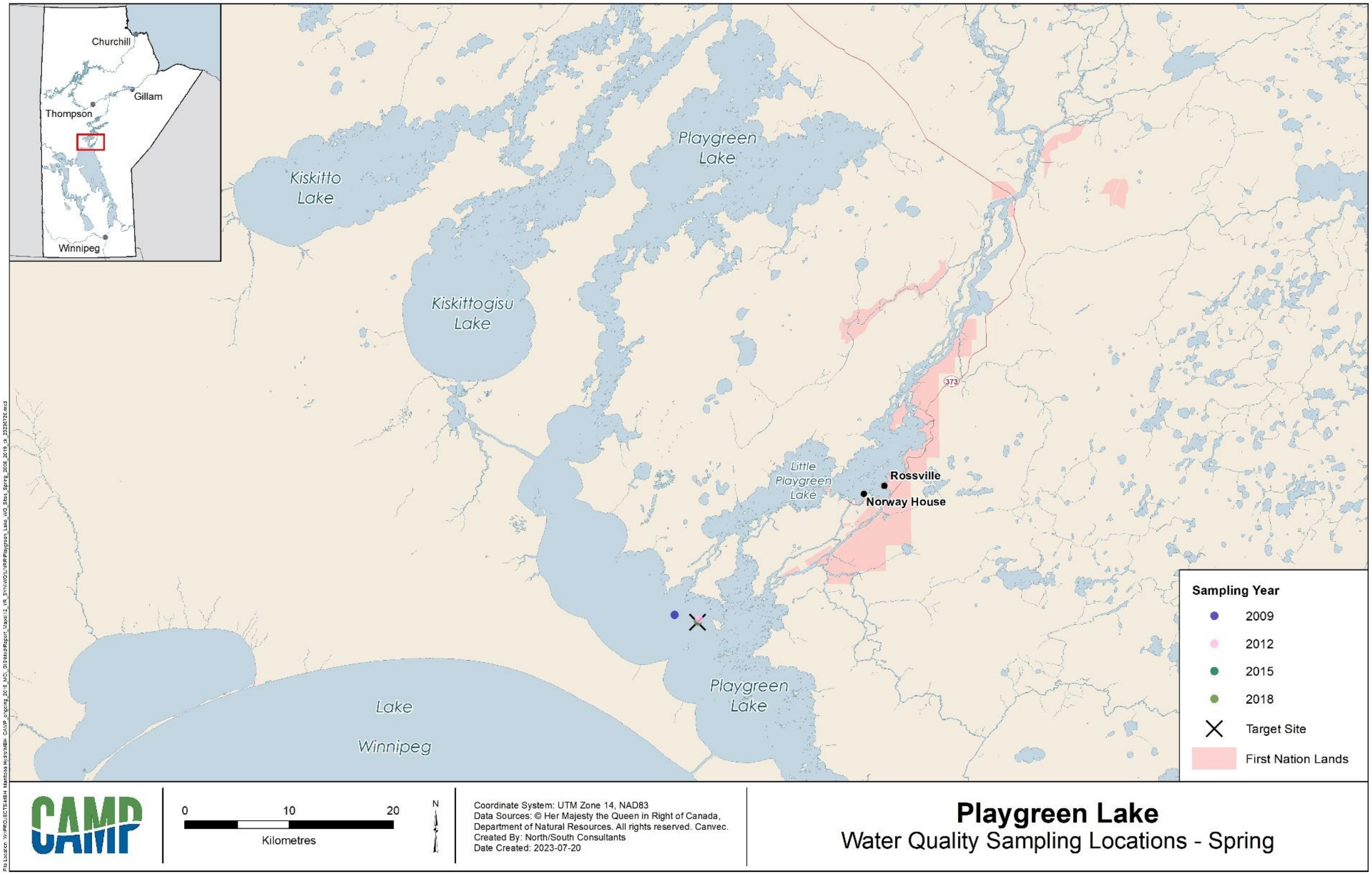


Figure A3-1-20. Spring water quality sampling locations: Playgreen Lake.

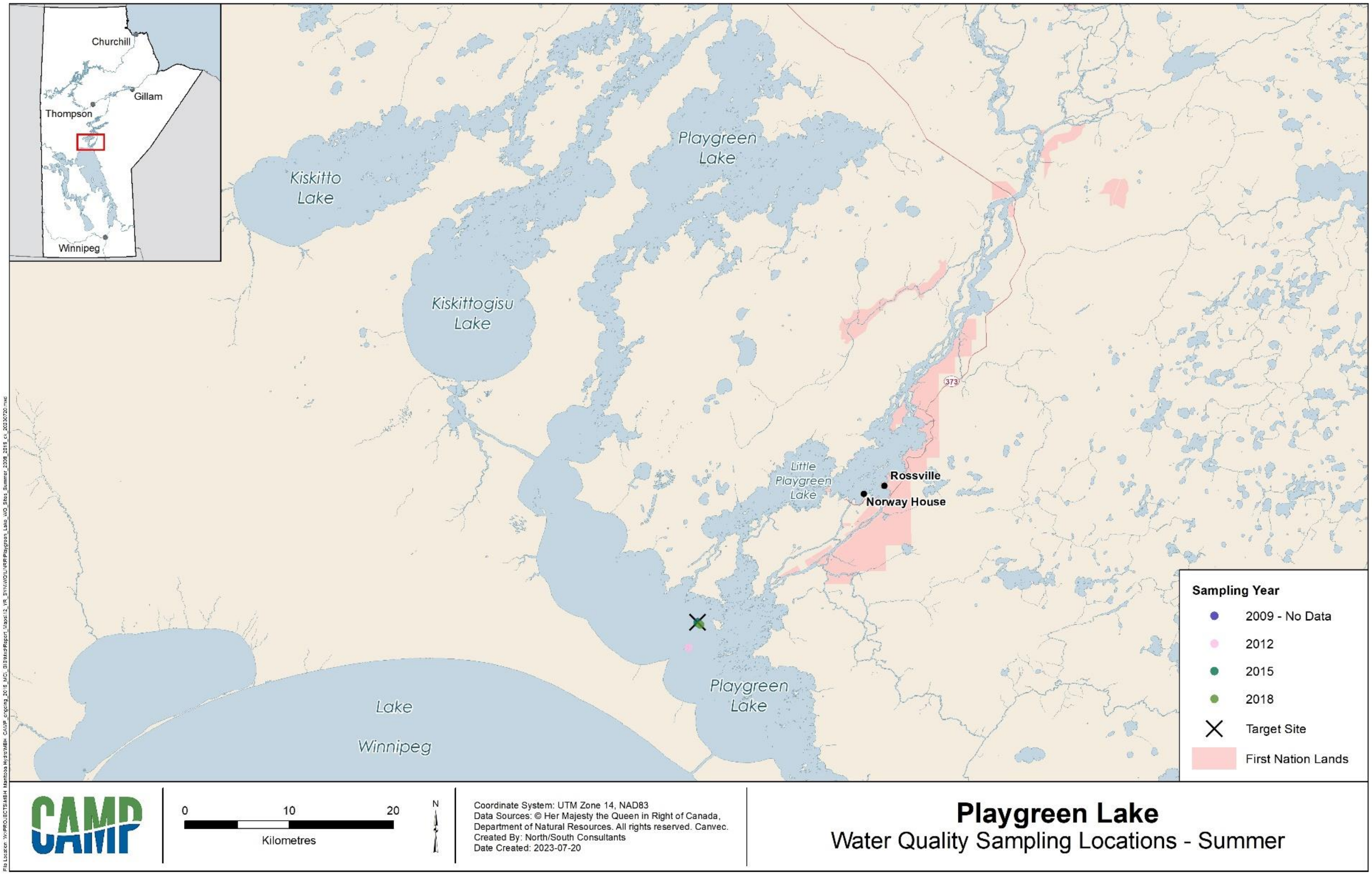


Figure A3-1-21. Summer water quality sampling locations: Playgreen Lake.

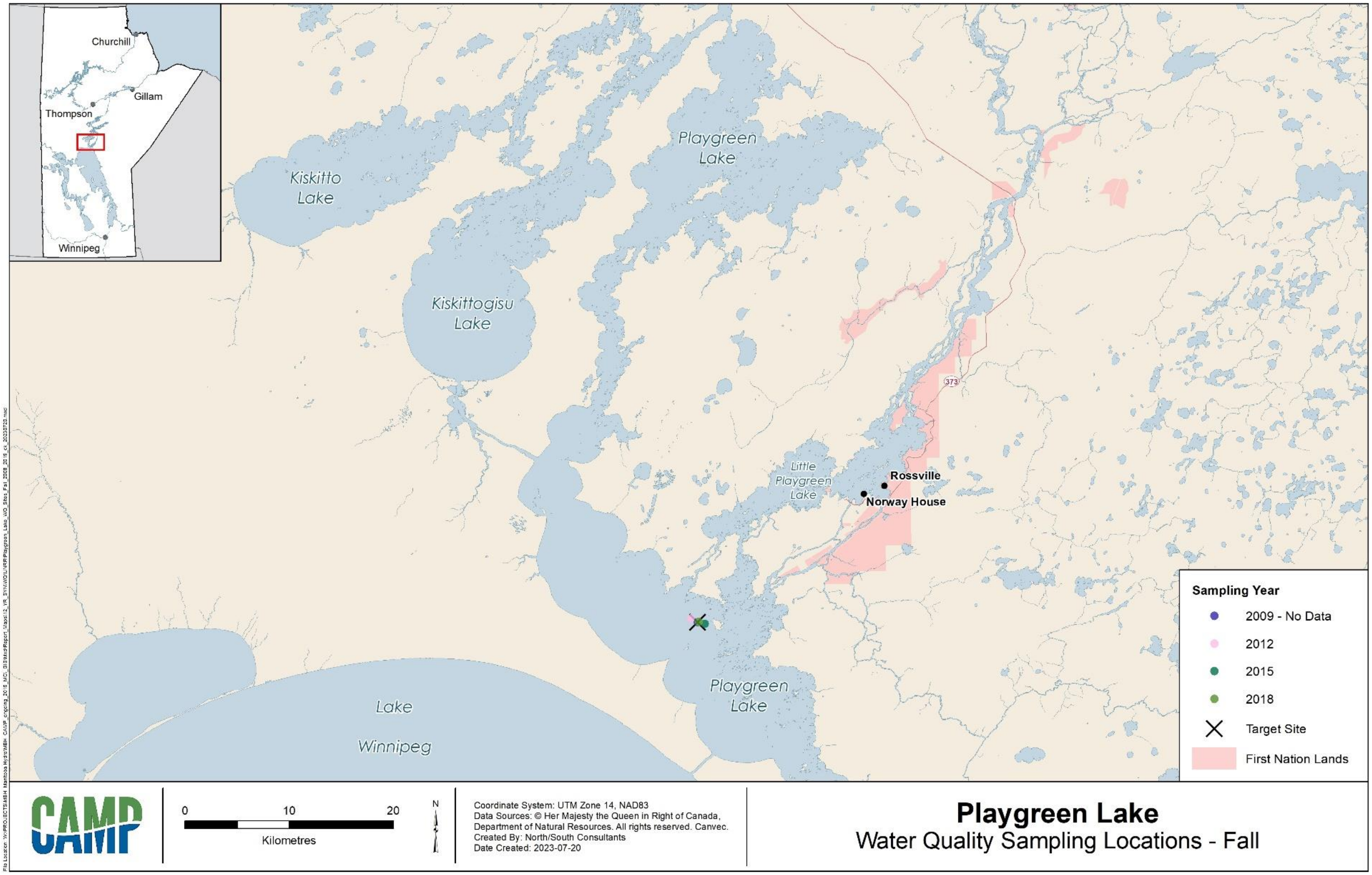


Figure A3-1-22. Fall water quality sampling locations: Playgreen Lake.

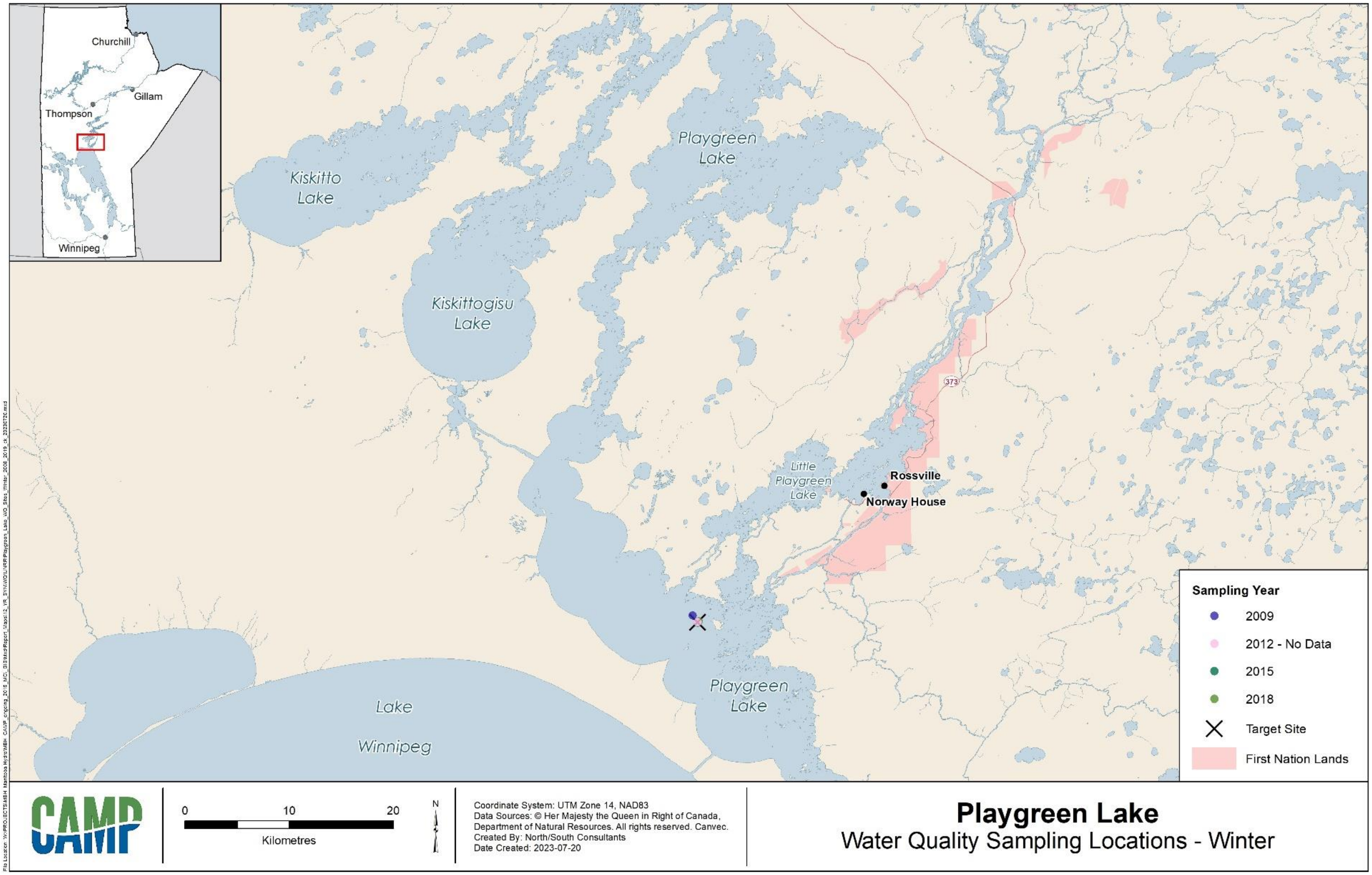


Figure A3-1-23. Winter water quality sampling locations: Playgreen Lake.

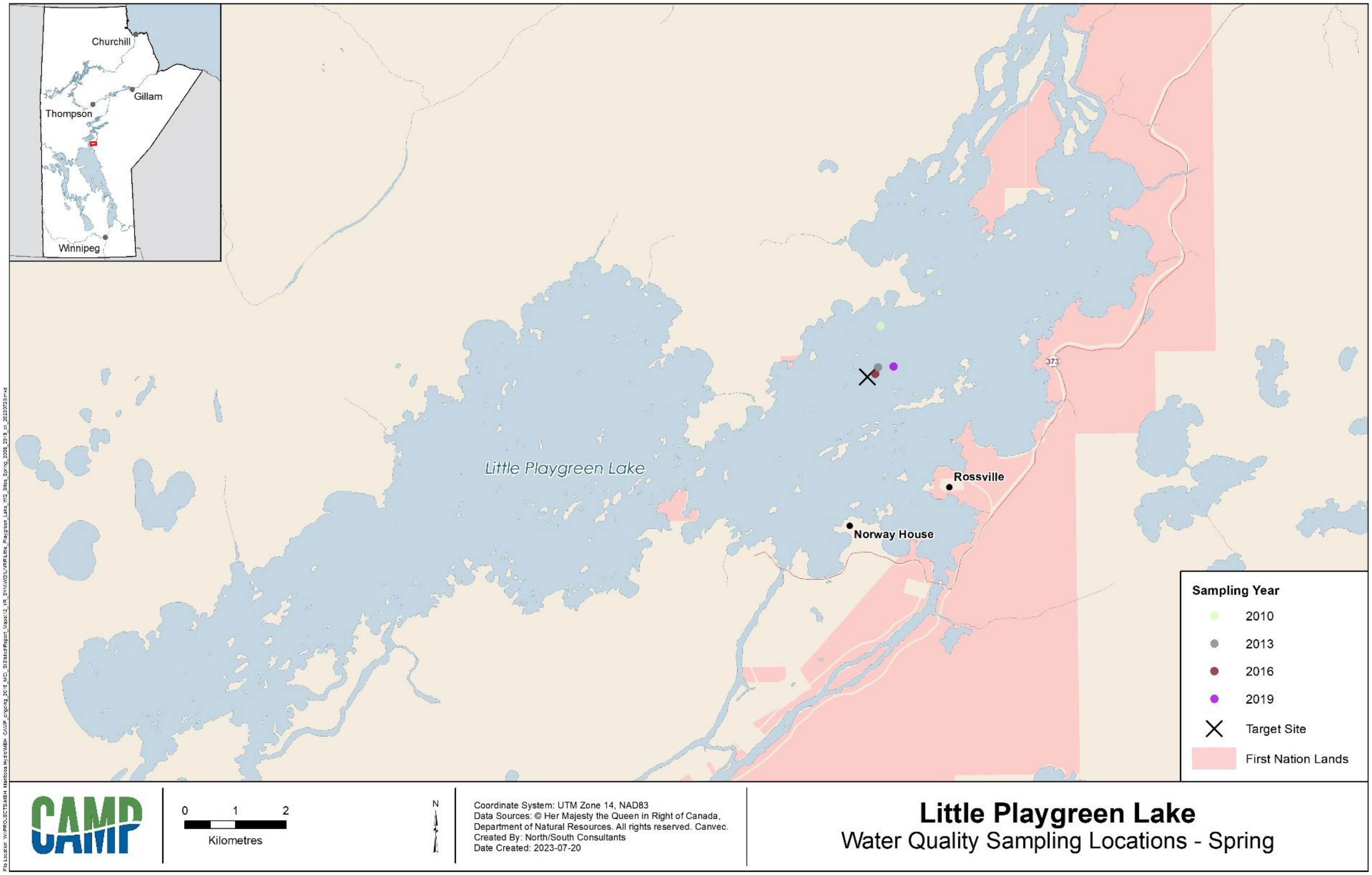


Figure A3-1-24. Spring water quality sampling locations: Little Playgreen Lake.

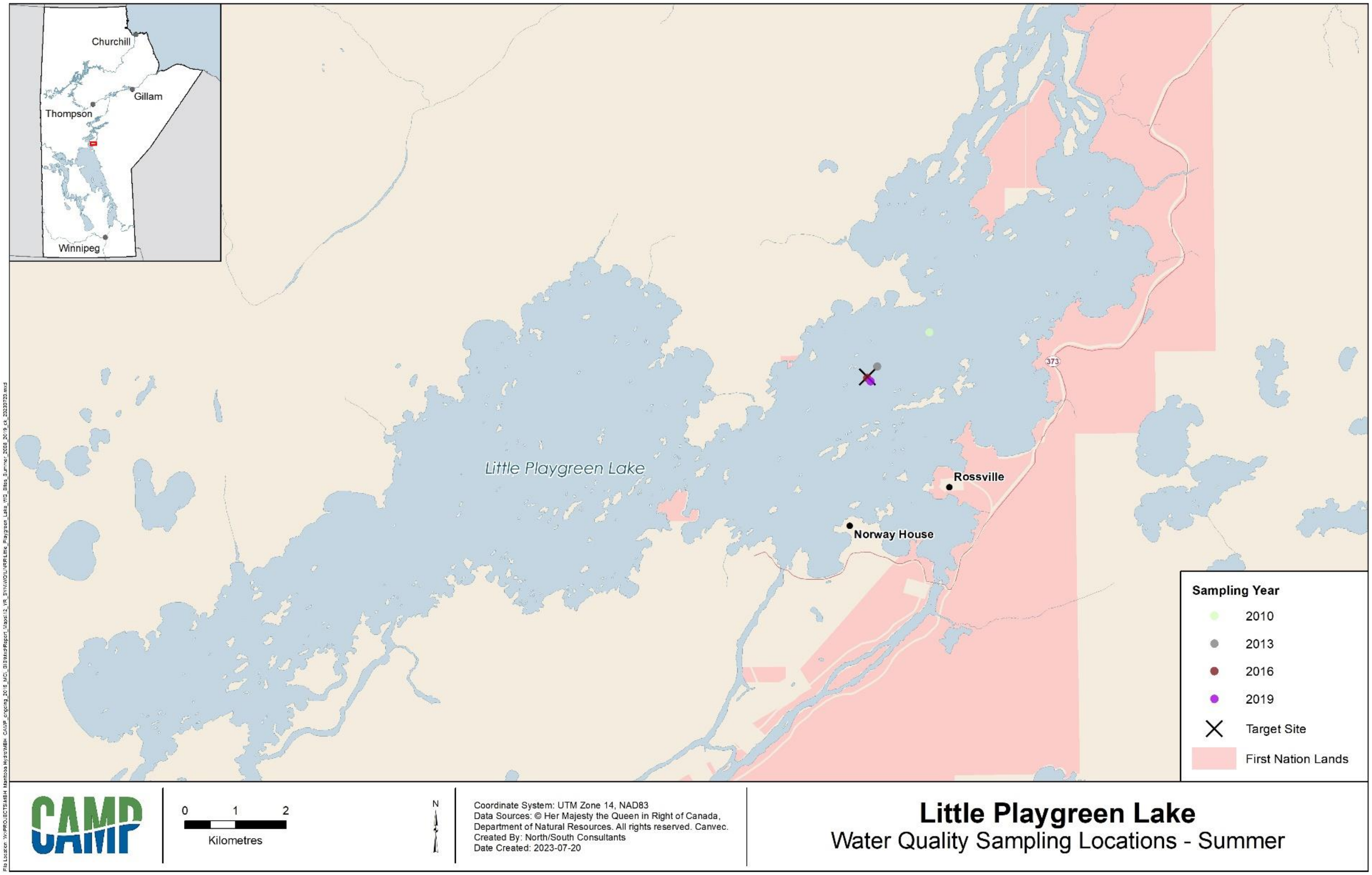


Figure A3-1-25. Summer water quality sampling locations: Little Playgreen Lake.

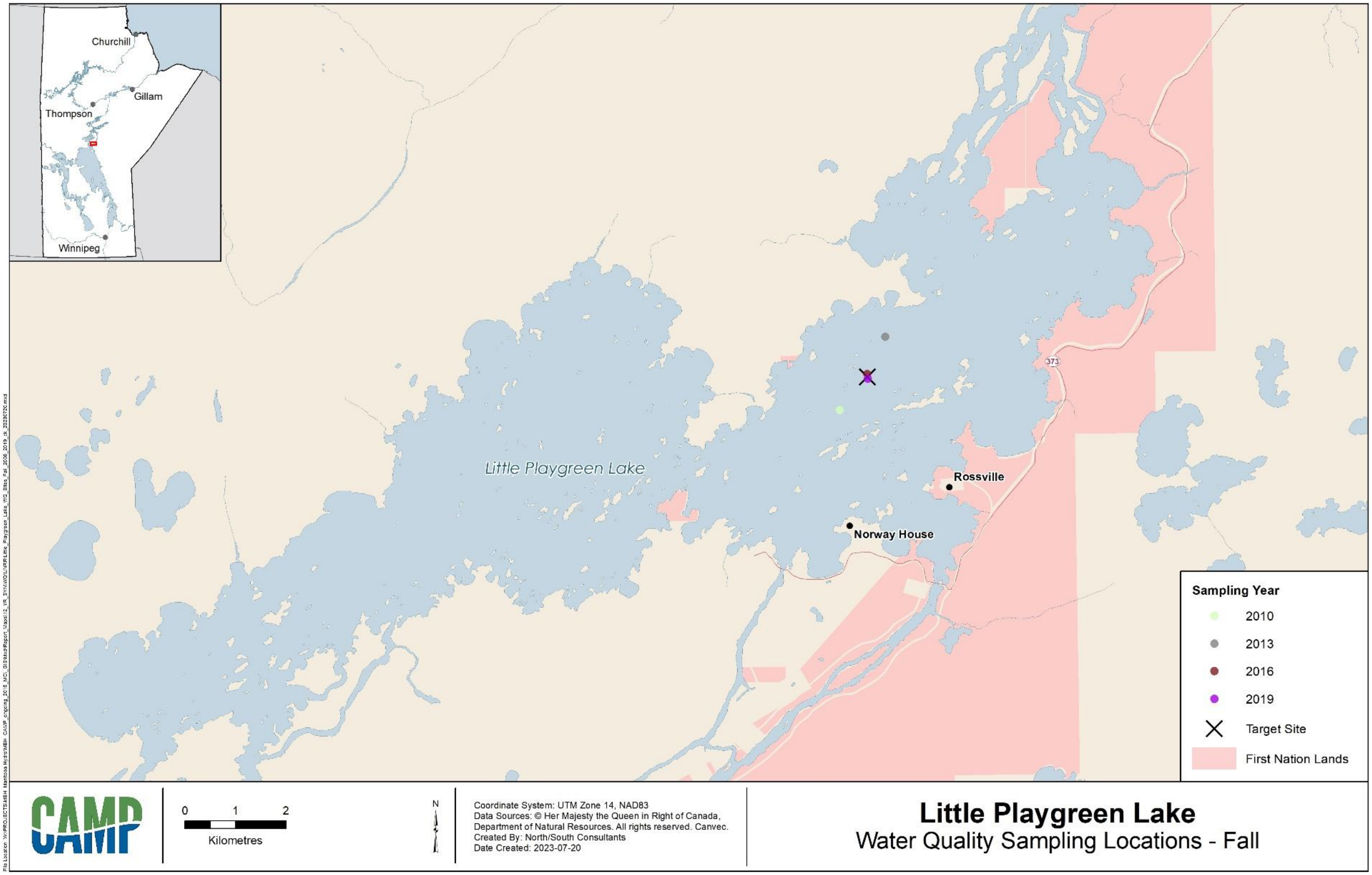


Figure A3-1-26. Fall water quality sampling locations: Little Playgreen Lake.

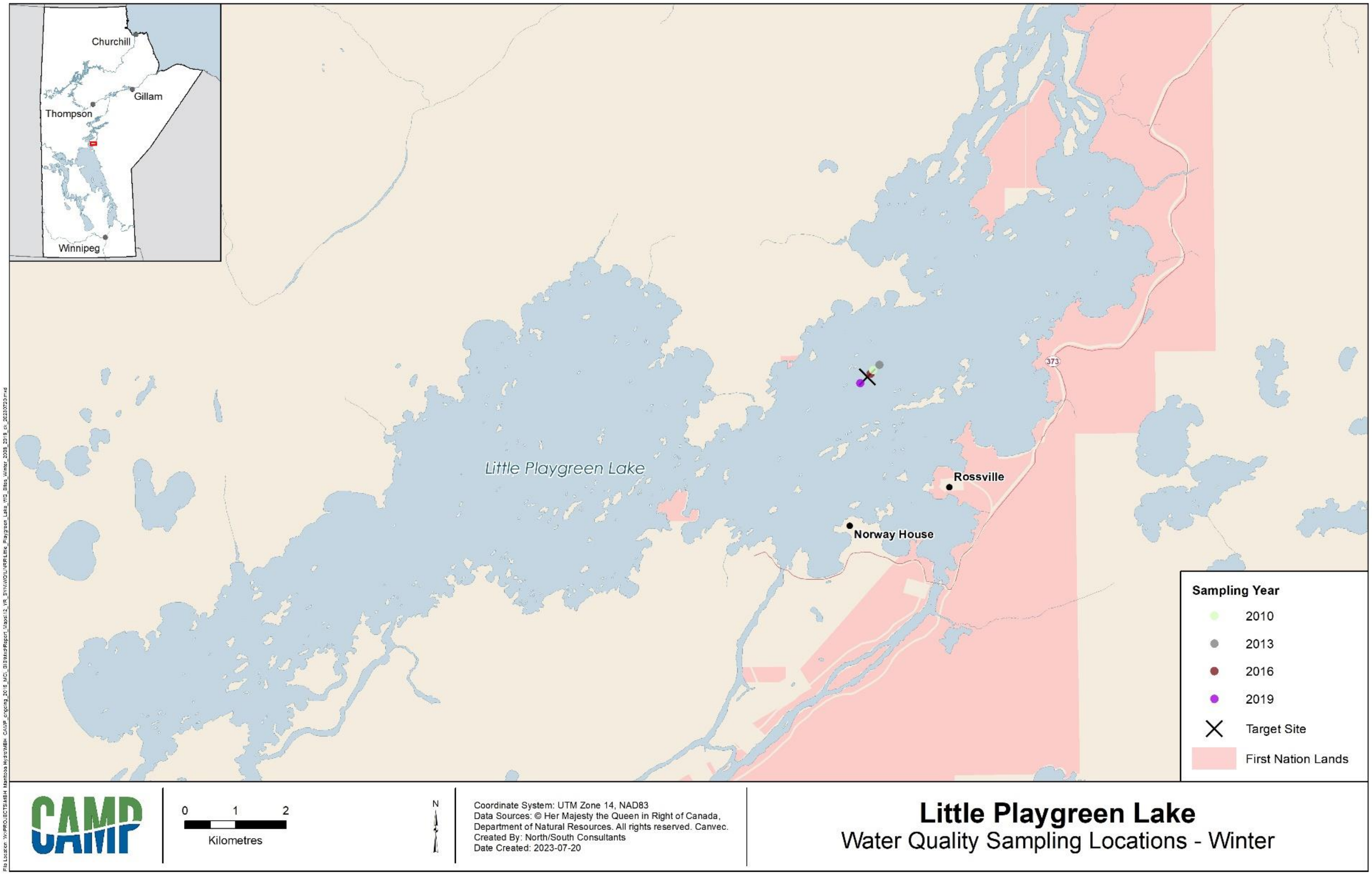


Figure A3-1-27. Winter water quality sampling locations: Little Playgreen Lake.

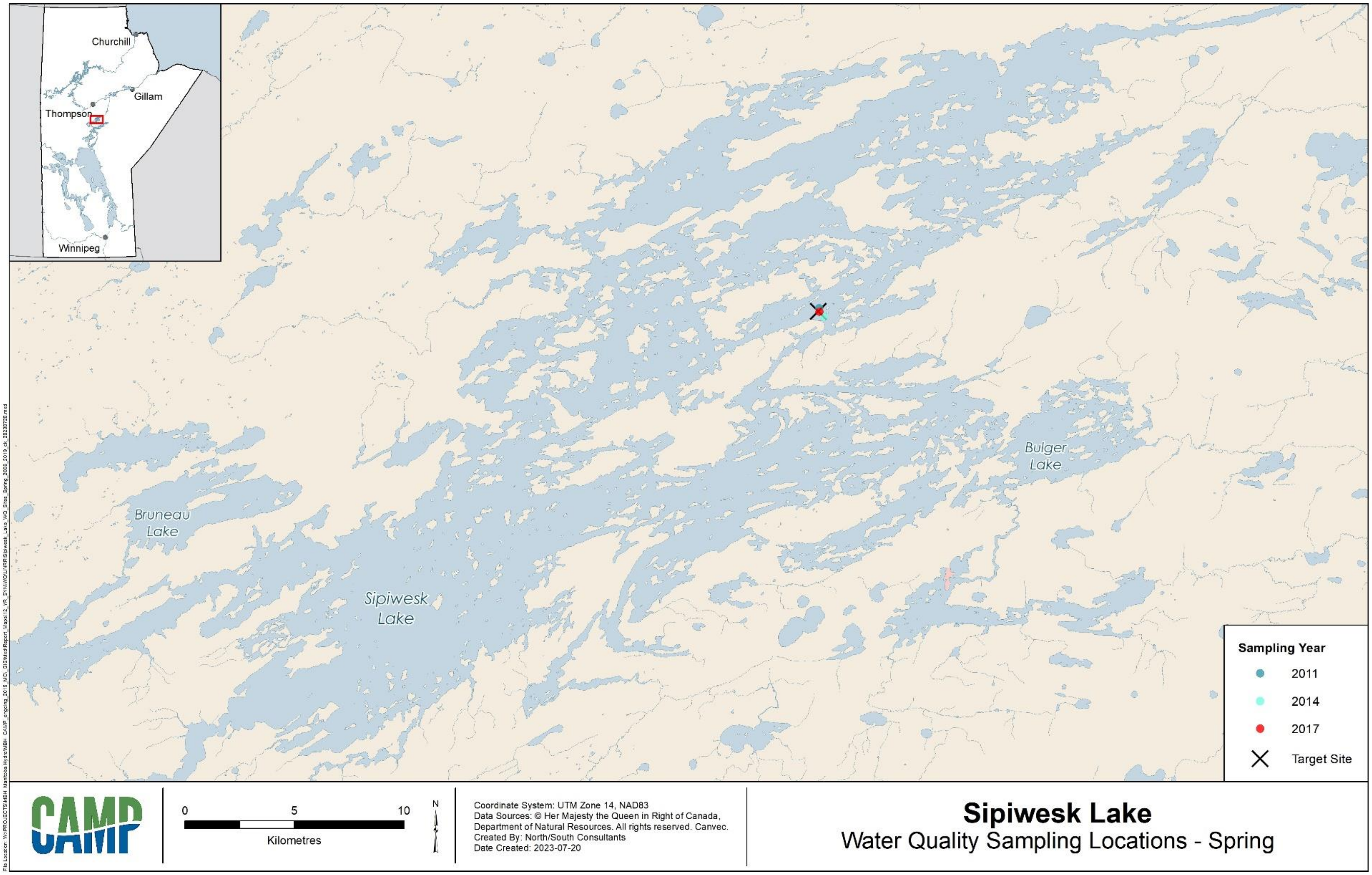


Figure A3-1-28. Spring water quality sampling locations: Sipiwesk Lake.

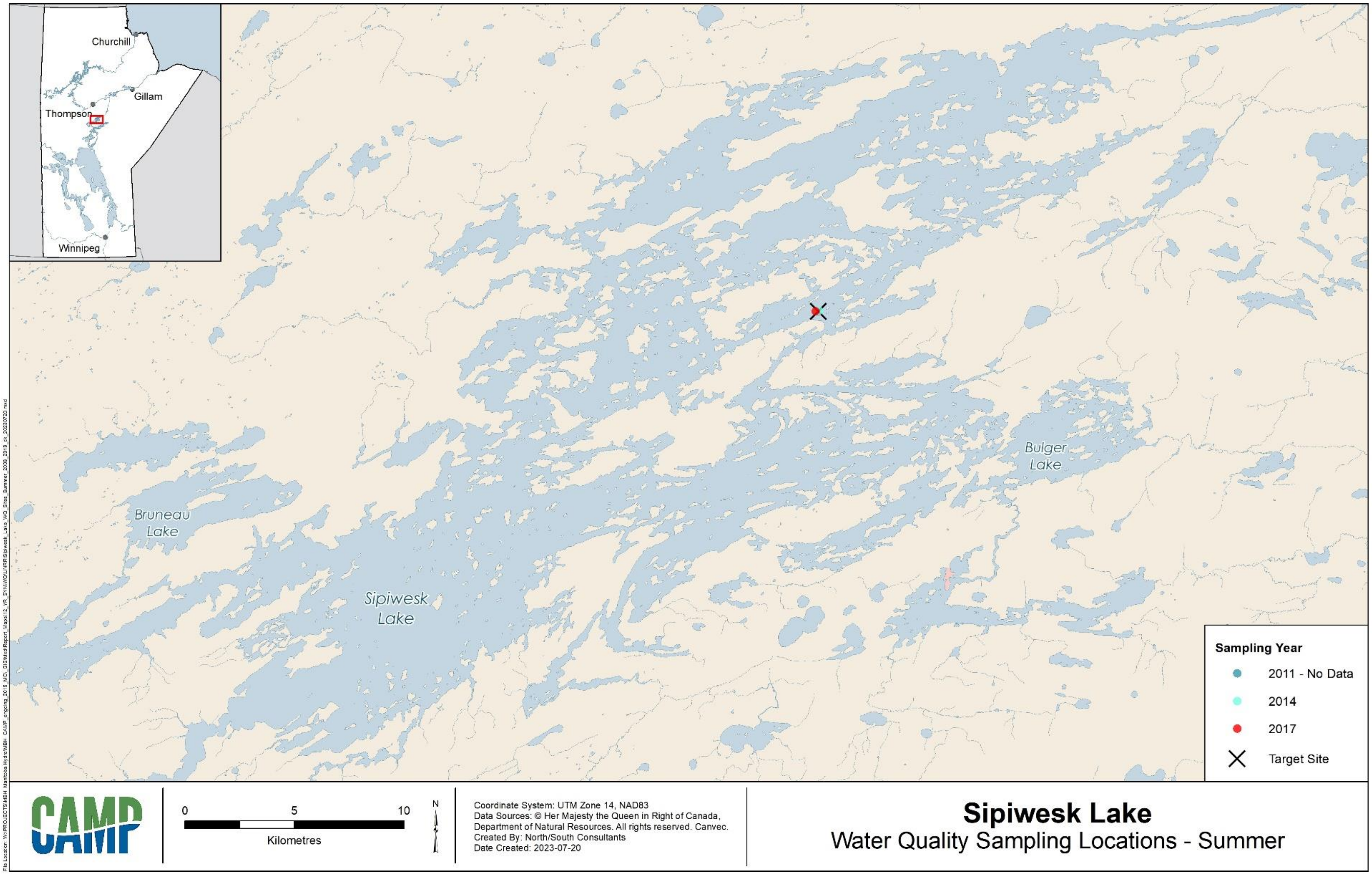


Figure A3-1-29. Summer water quality sampling locations: Sipiwesk Lake.

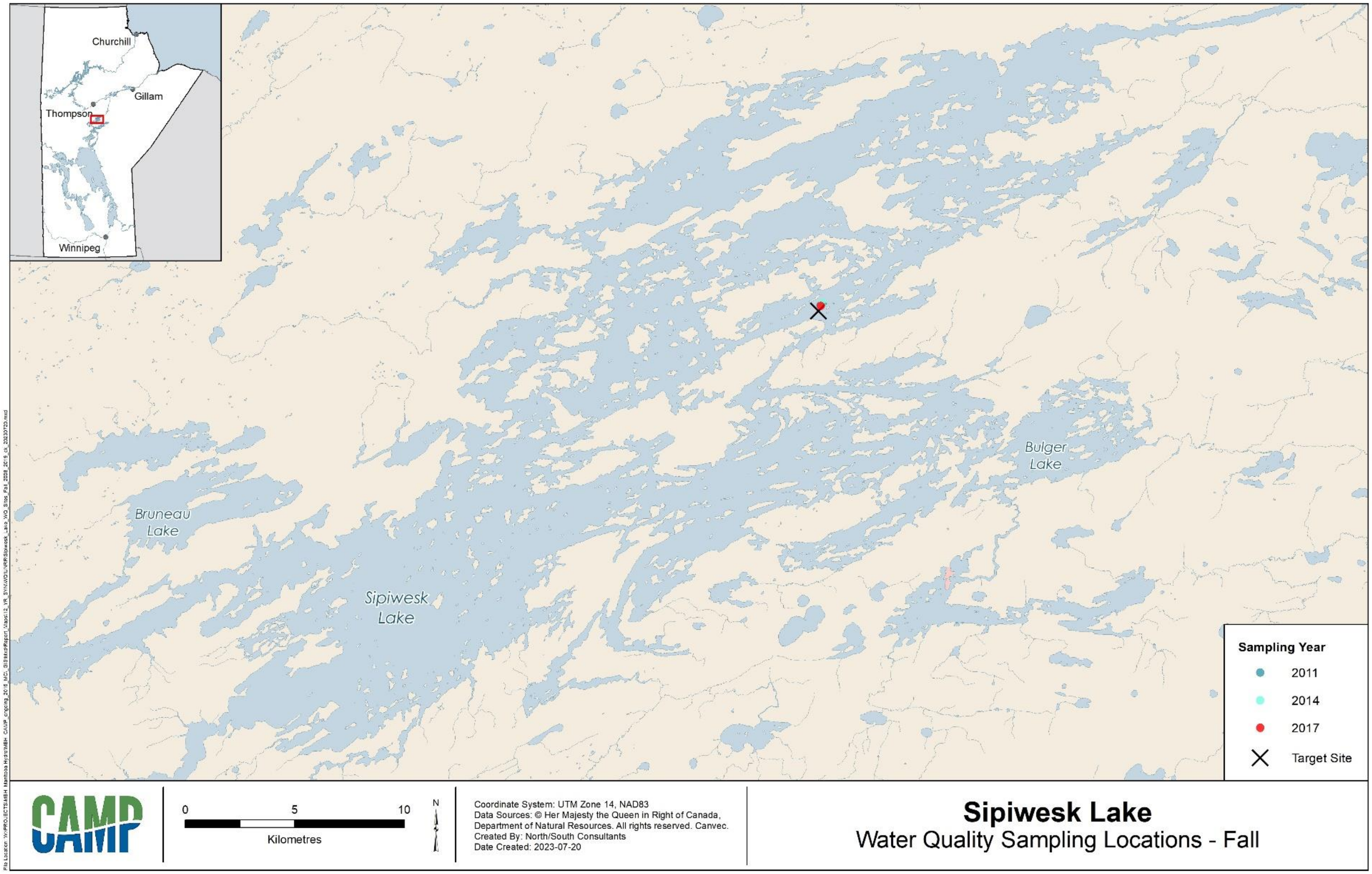


Figure A3-1-30. Fall water quality sampling locations: Sipiwesk Lake.

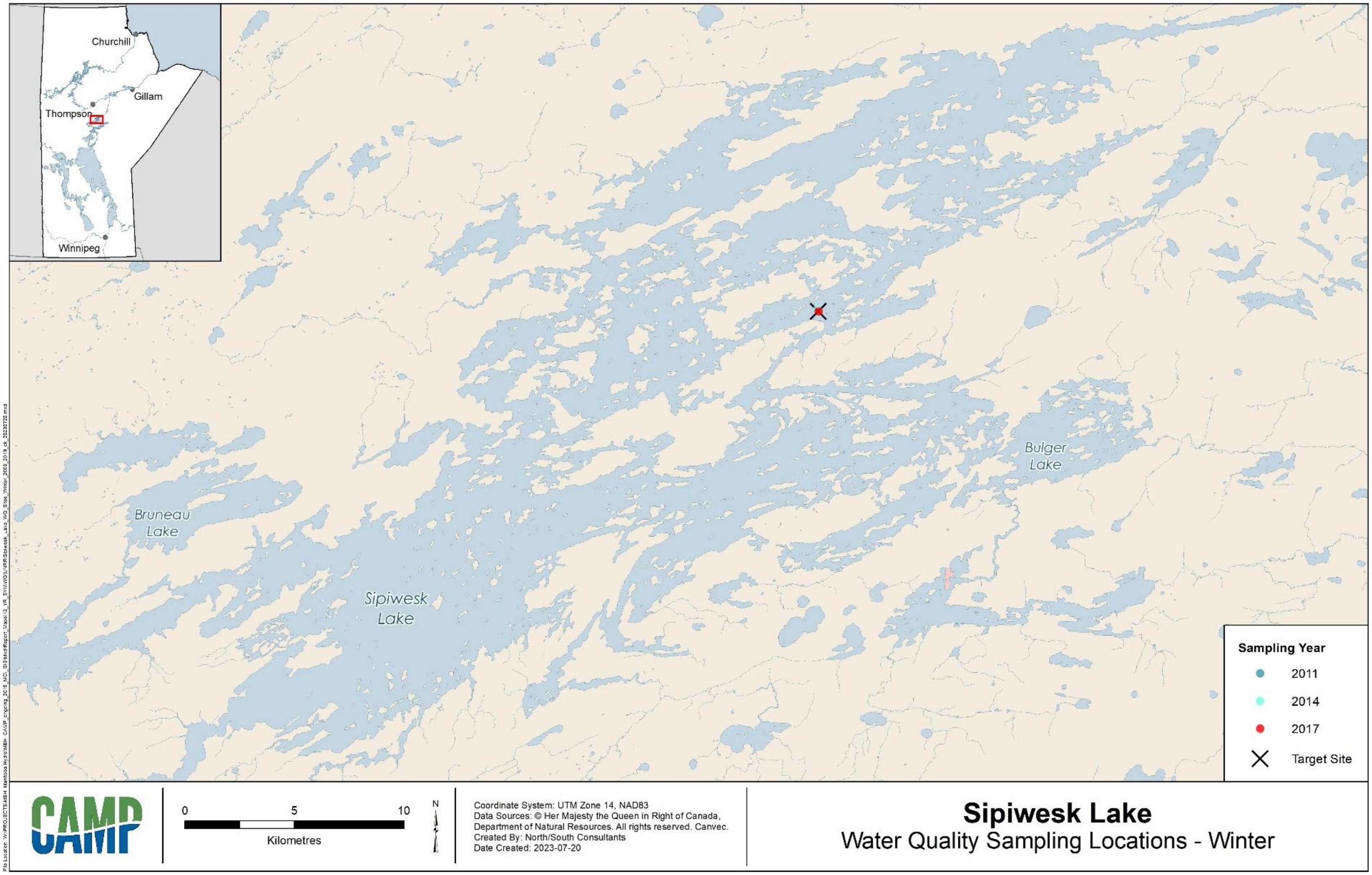


Figure A3-1-31. Winter water quality sampling locations: Sipiwesk Lake.

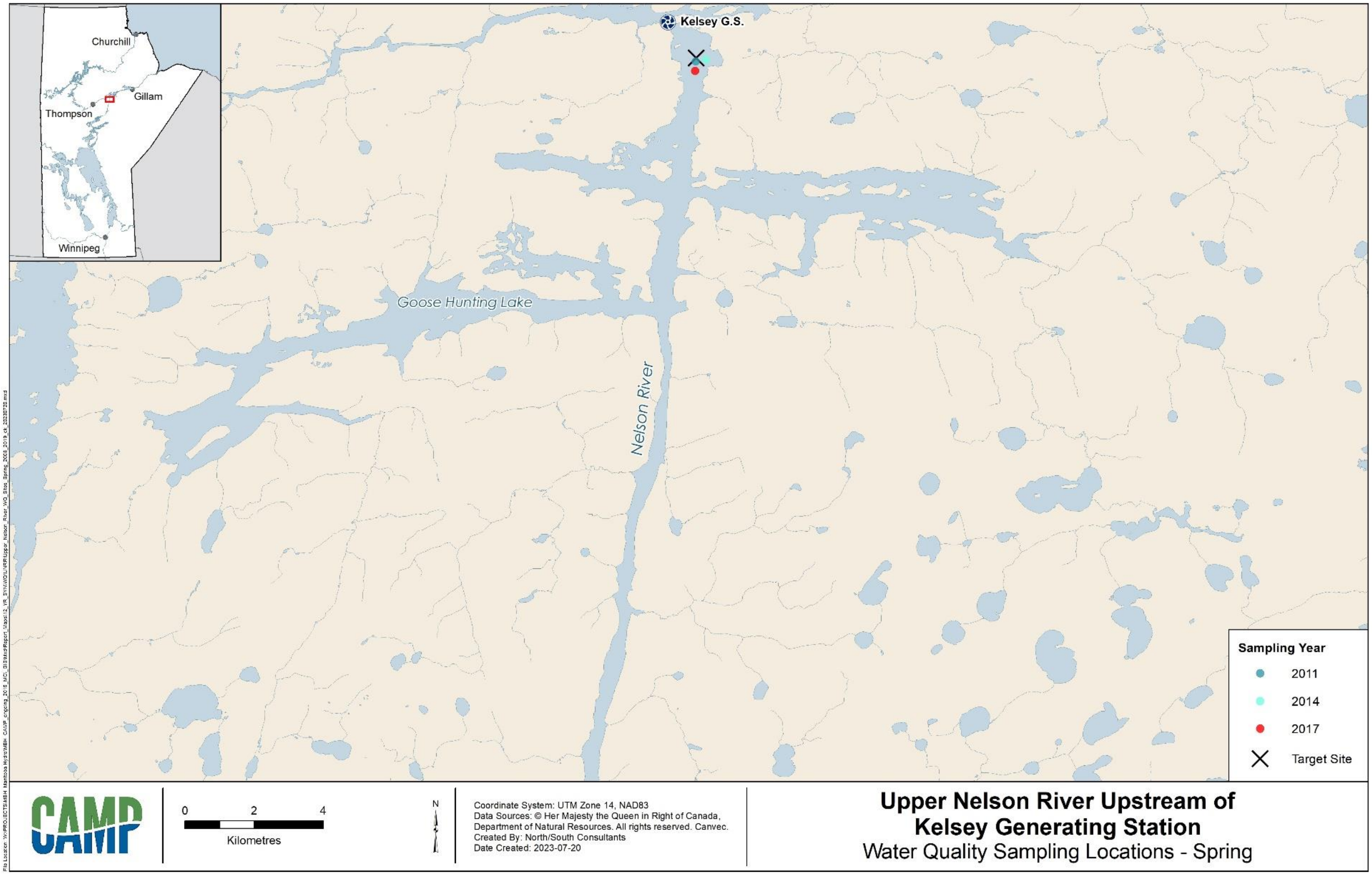


Figure A3-1-32. Spring water quality sampling locations: Upper Nelson River upstream of the Kelsey GS.

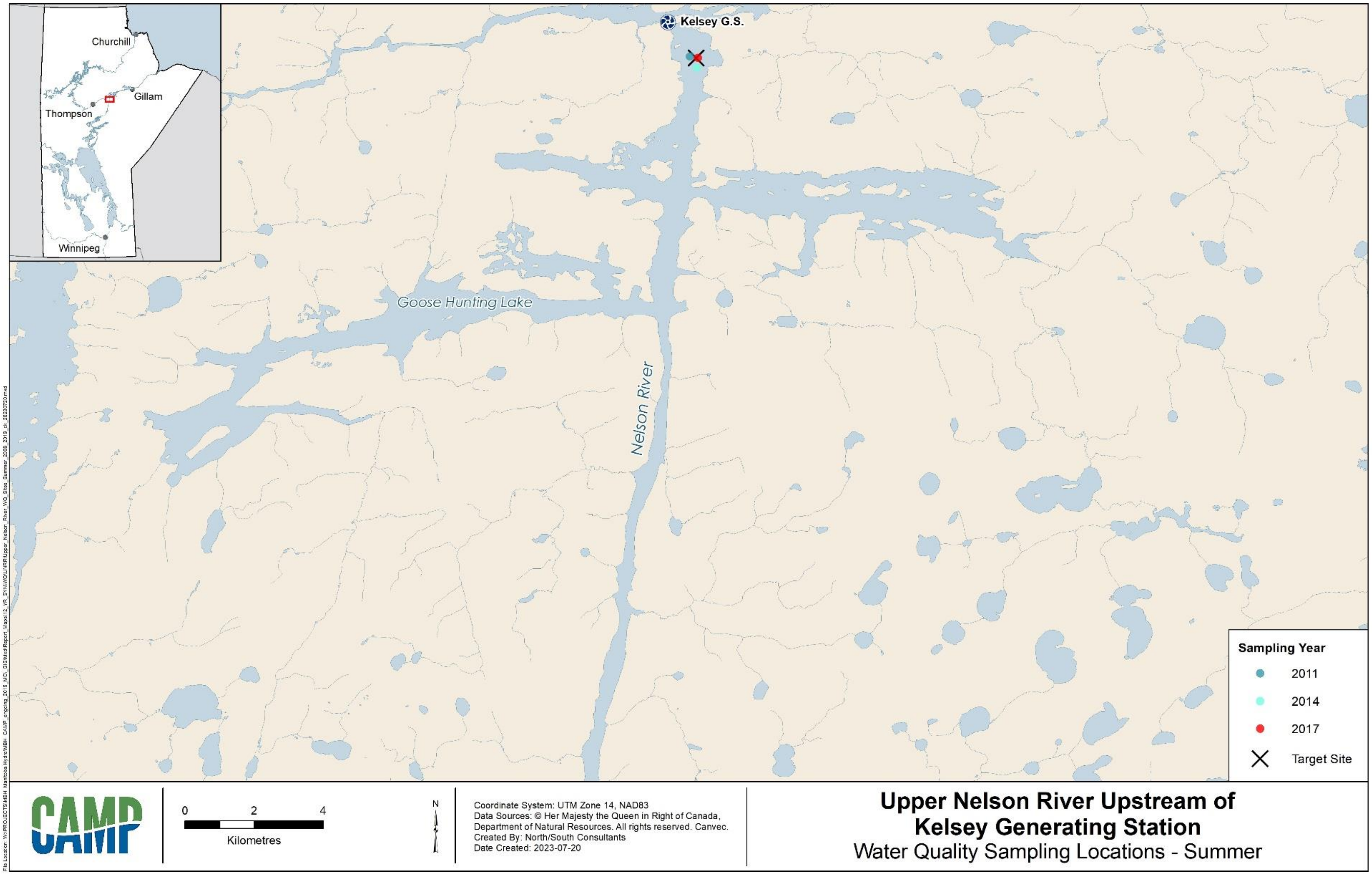


Figure A3-1-33. Summer water quality sampling locations: Upper Nelson River upstream of the Kelsey GS.

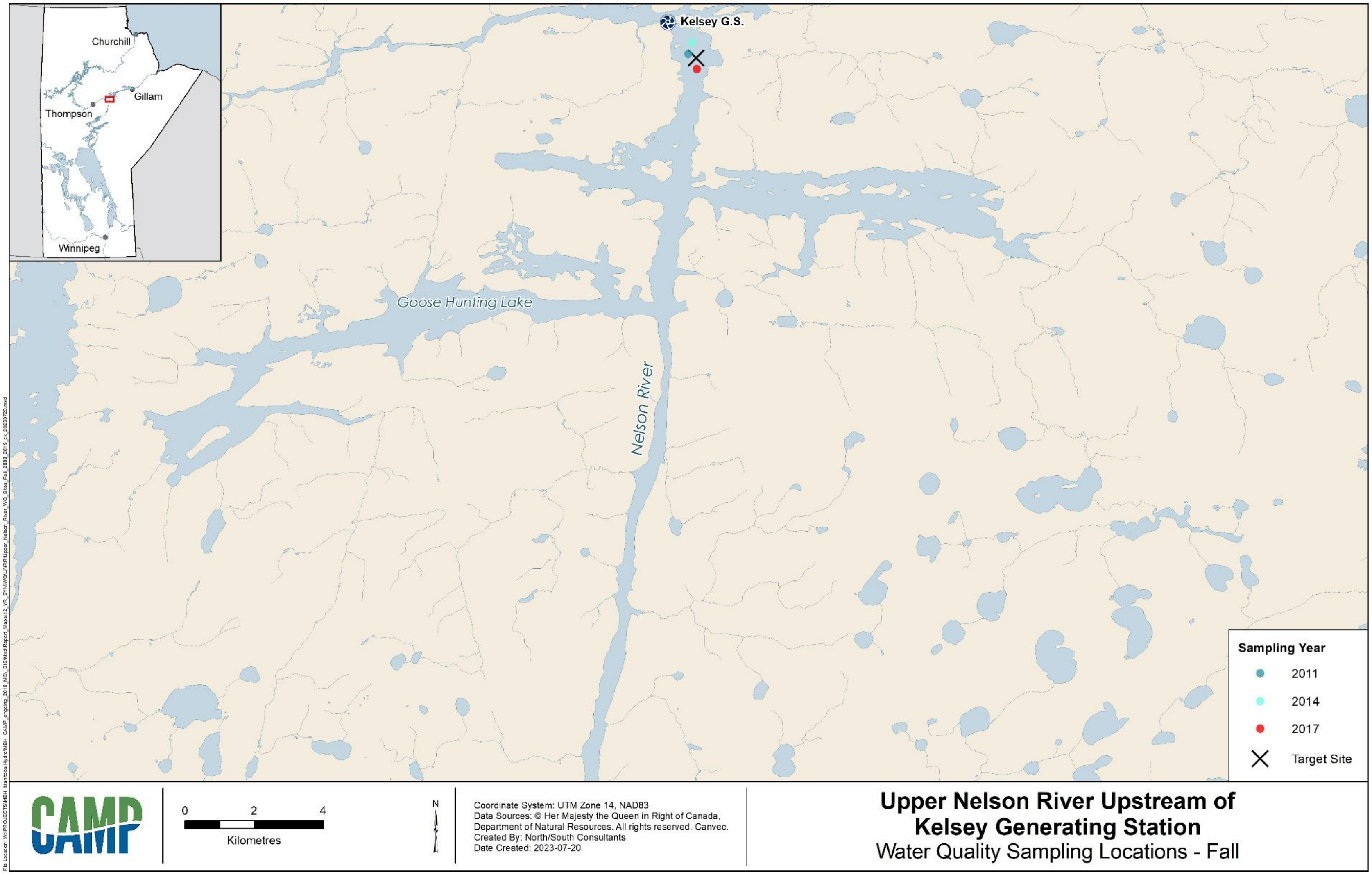


Figure A3-1-34. Fall water quality sampling locations: Upper Nelson River upstream of the Kelsey GS.

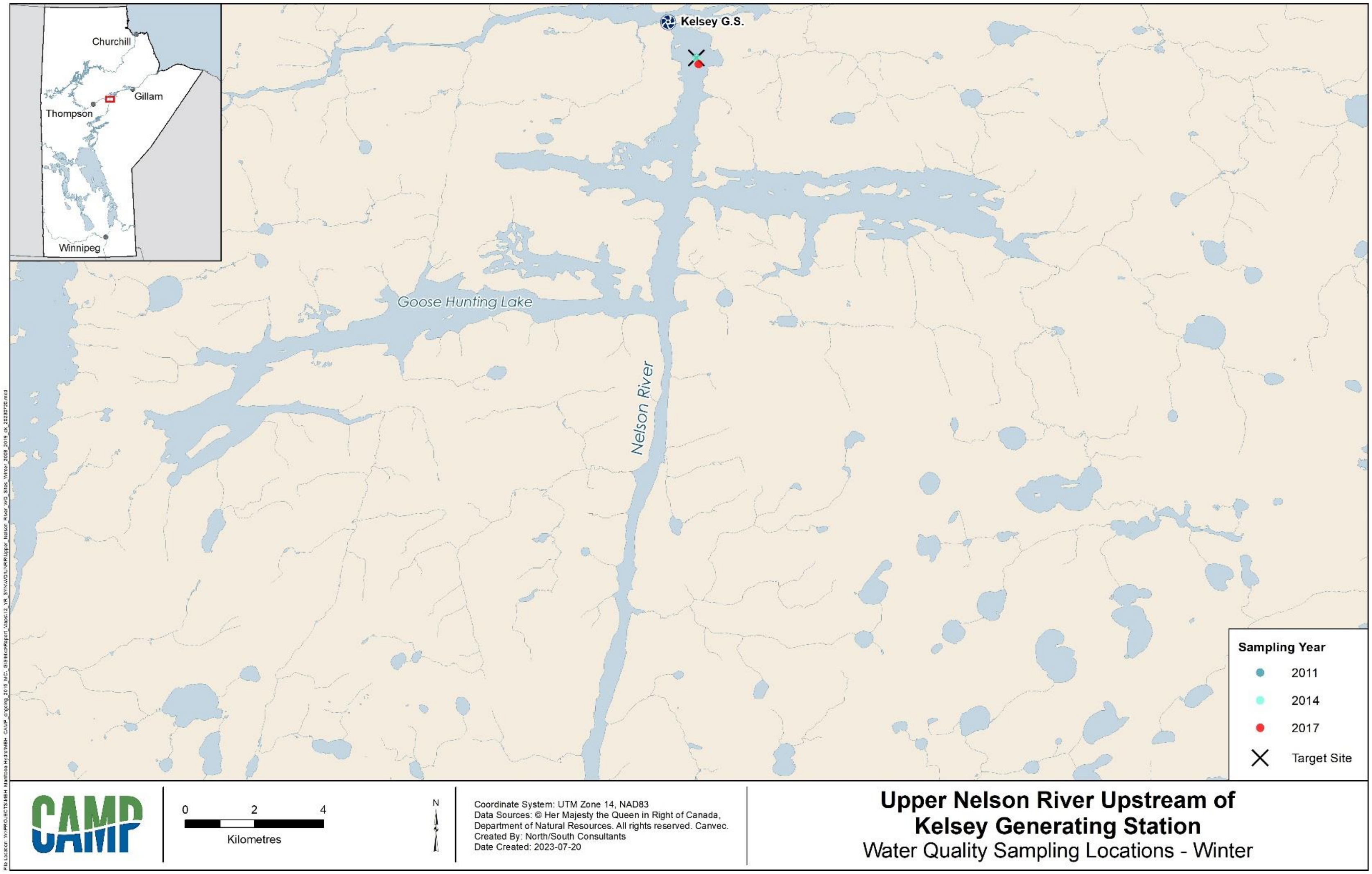


Figure A3-1-35. Winter water quality sampling locations: Upper Nelson River upstream of the Kelsey GS.

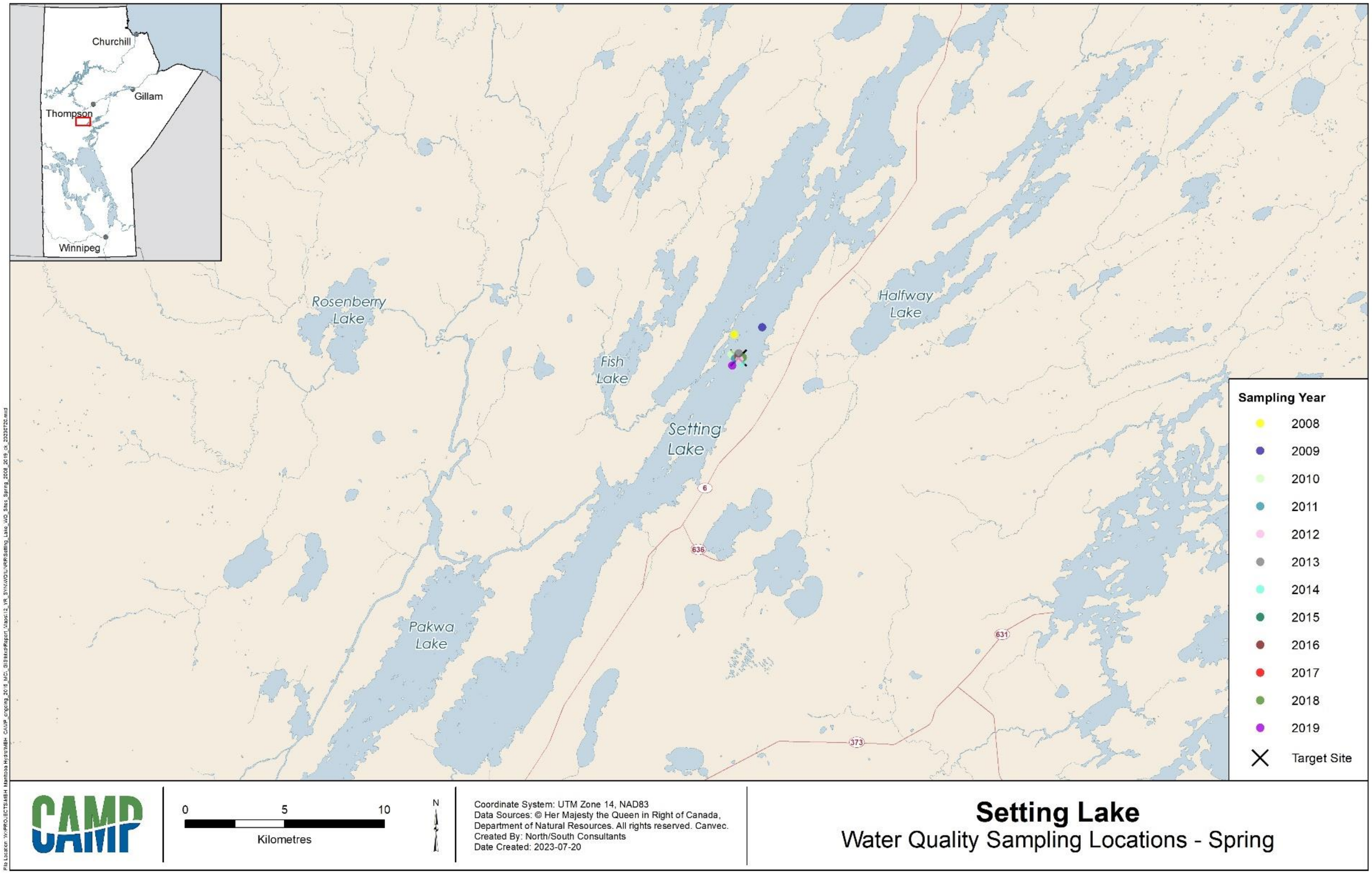


Figure A3-1-36. Spring water quality sampling locations: Setting Lake.

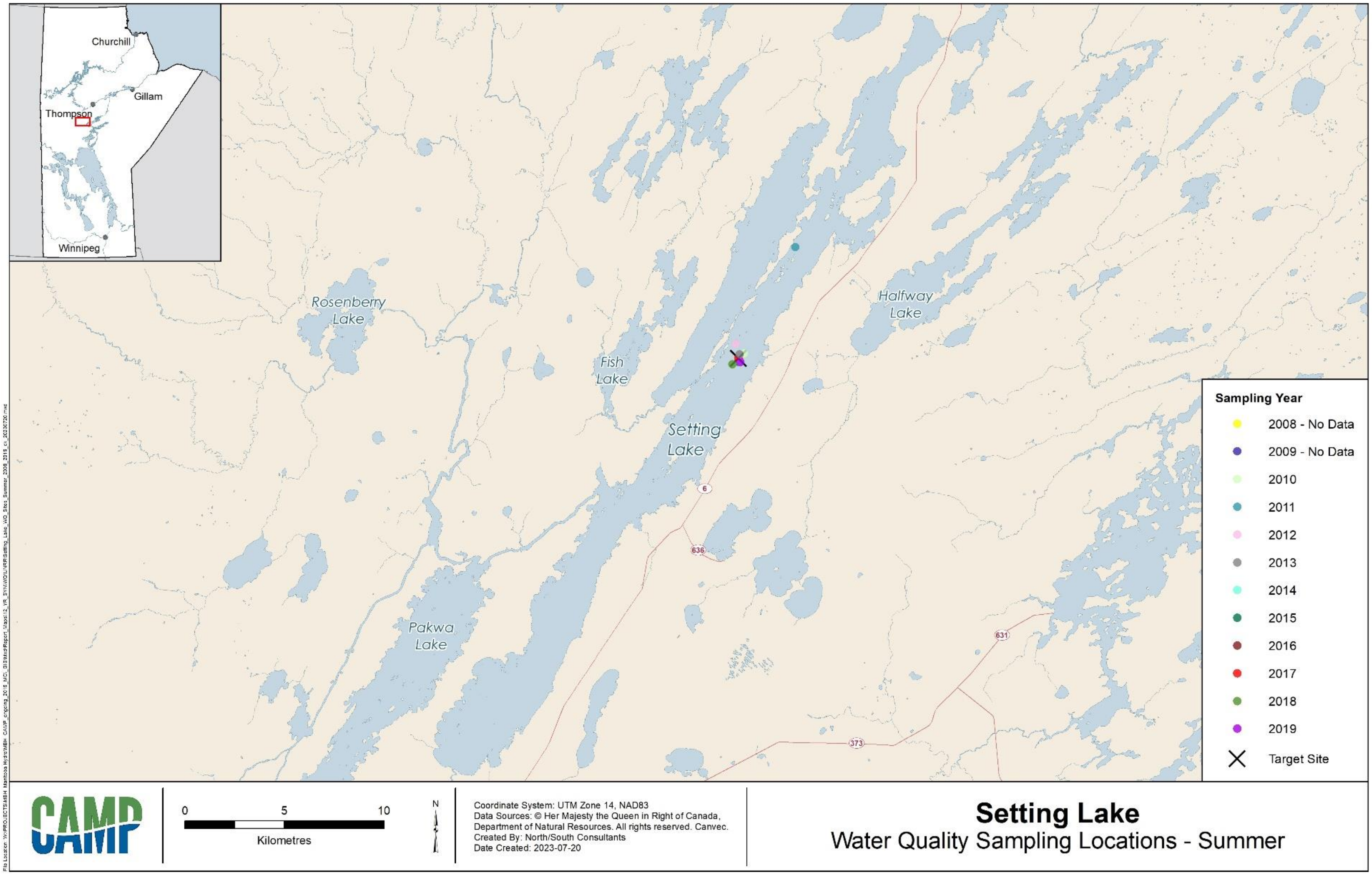


Figure A3-1-37. Summer water quality sampling locations: Setting Lake.

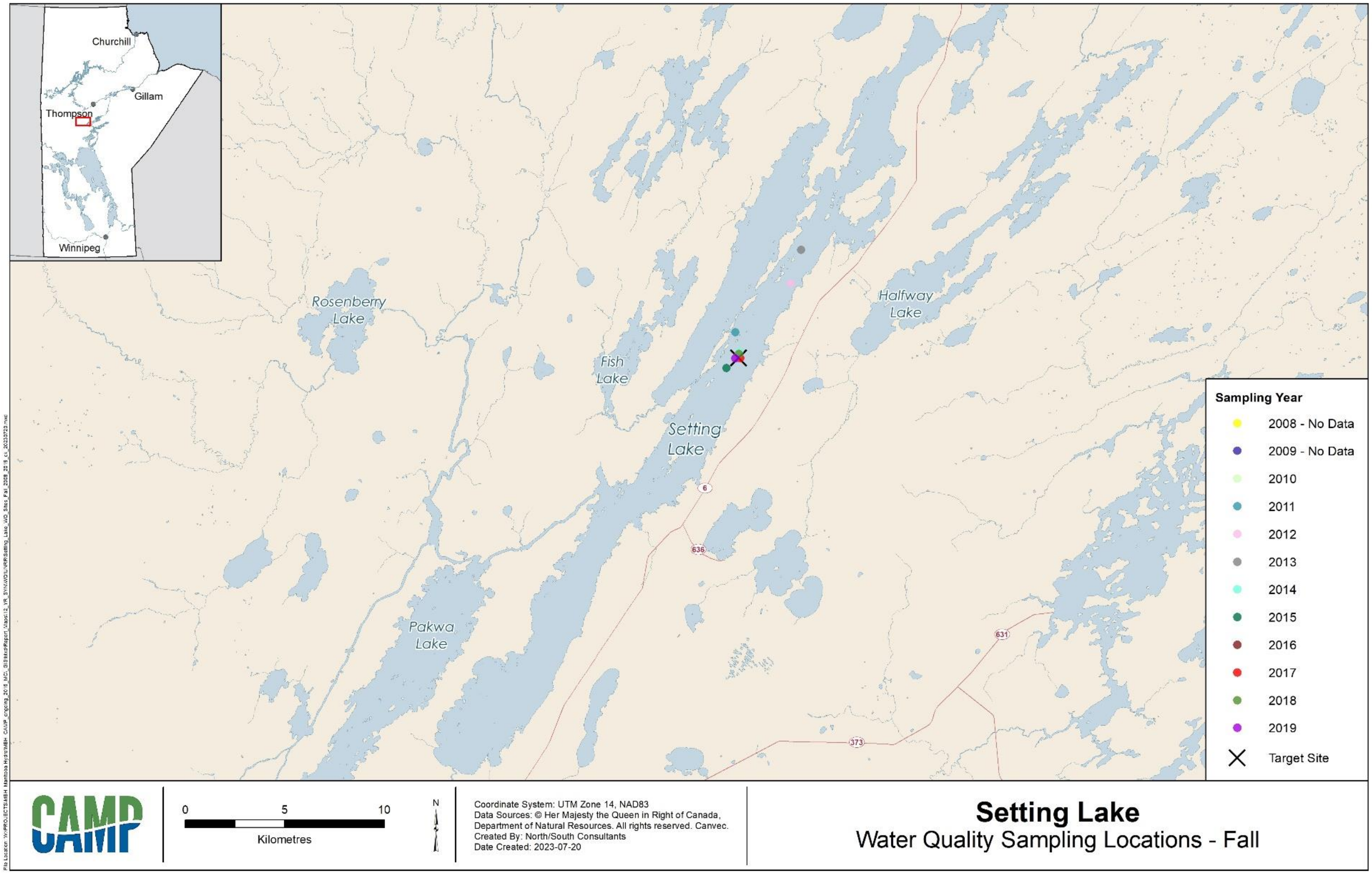


Figure A3-1-38. Fall water quality sampling locations: Setting Lake.

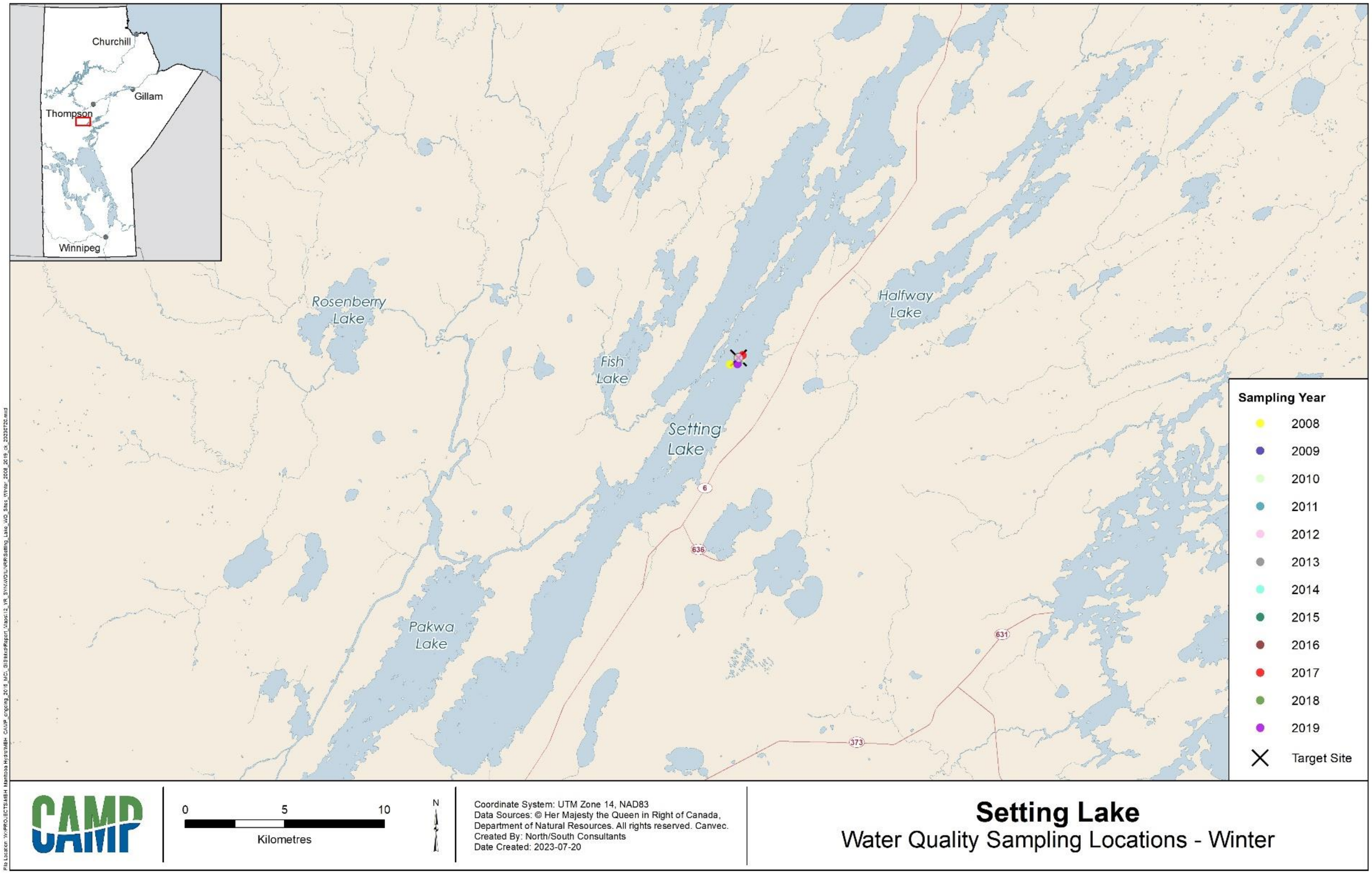


Figure A3-1-39. Winter water quality sampling locations: Setting Lake.

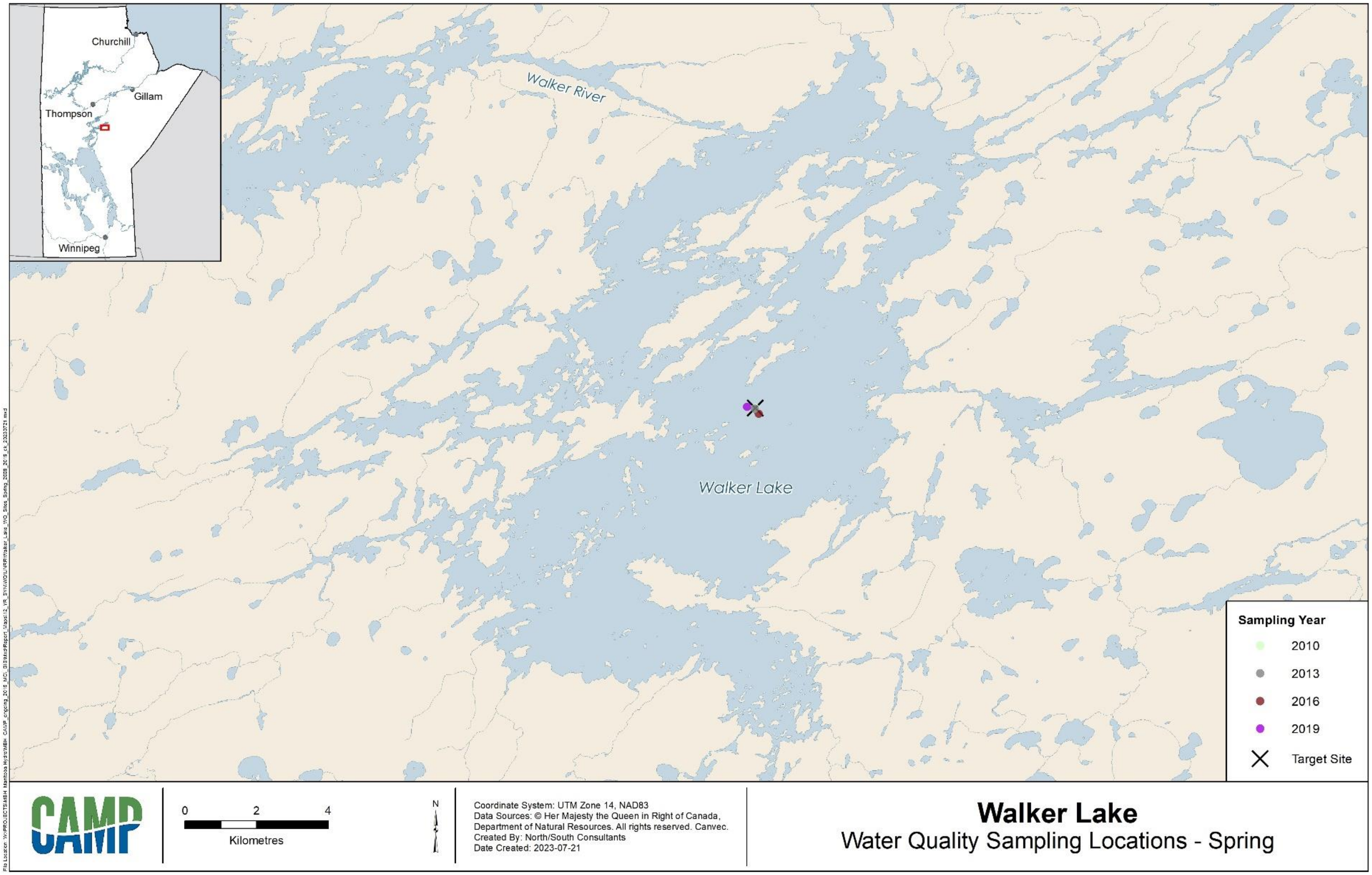


Figure A3-1-40. Spring water quality sampling locations: Walker Lake.

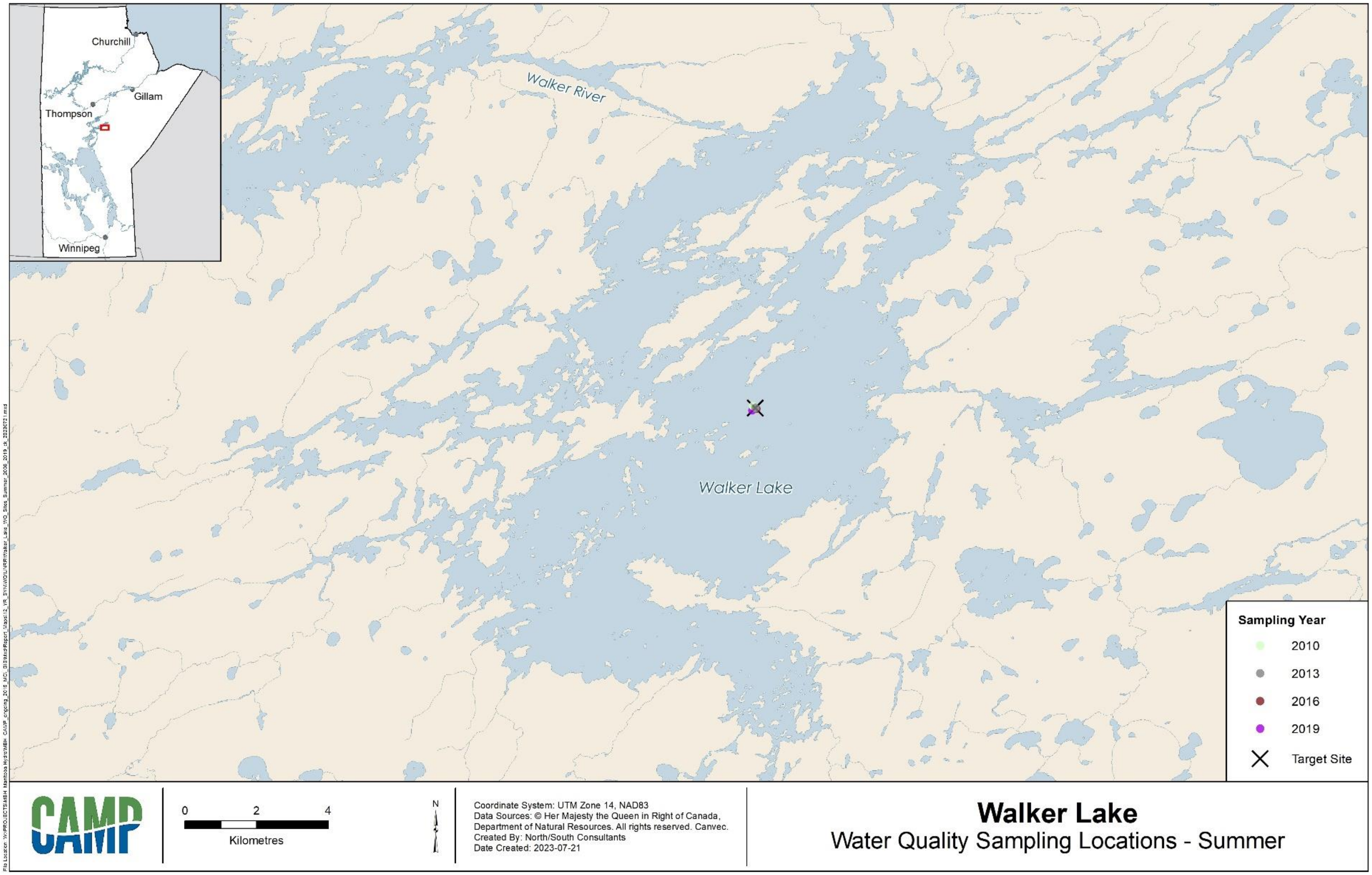


Figure A3-1-41. Summer water quality sampling locations: Walker Lake.

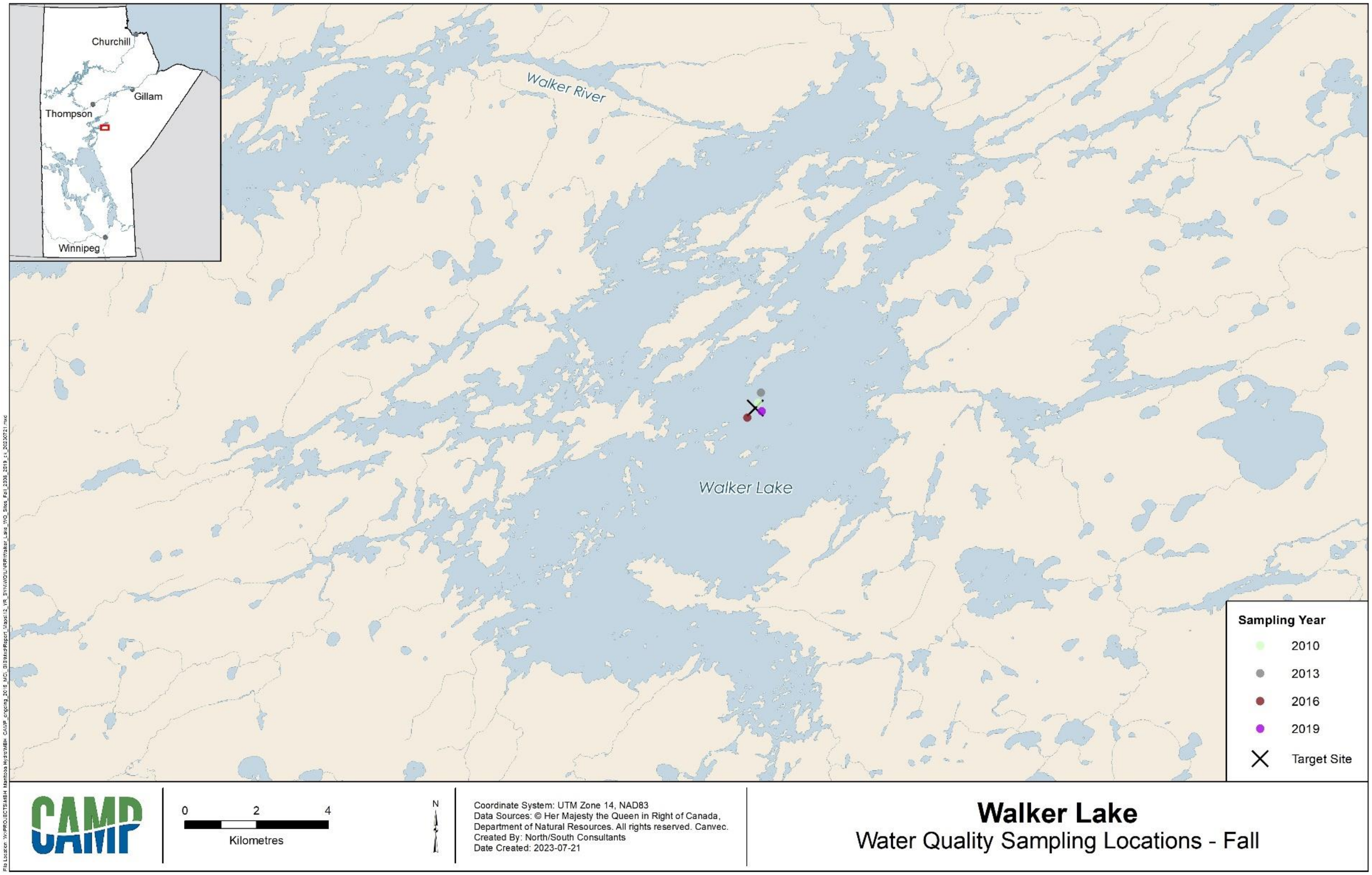


Figure A3-1-42. Fall water quality sampling locations: Walker Lake.

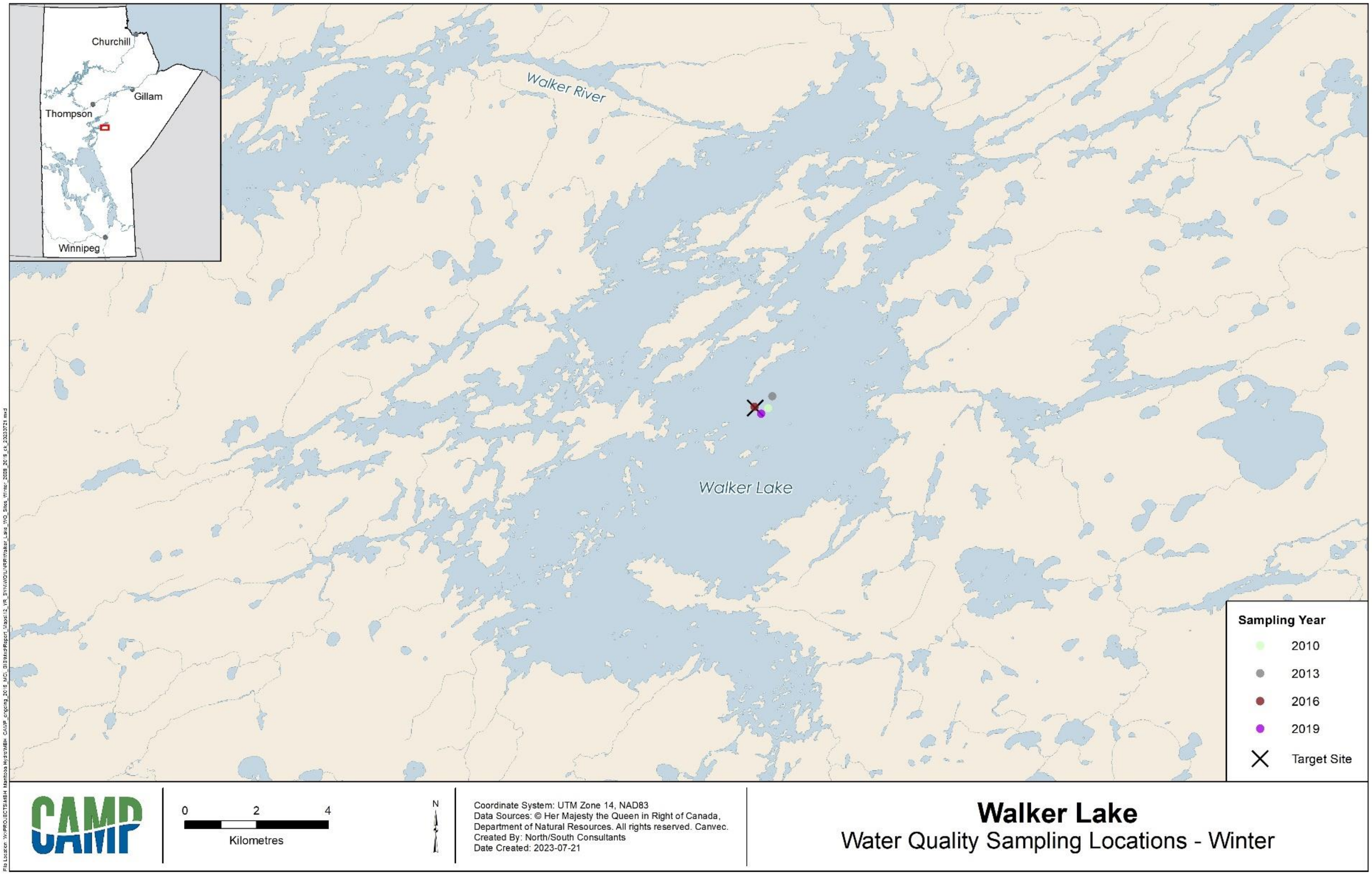


Figure A3-1-43. Winter water quality sampling locations: Walker Lake.

4.0 BENTHIC INVERTEBRATES

4.1 INTRODUCTION

The following presents the results of the benthic invertebrate community monitoring conducted from 2010-2019 in the Upper Nelson River Region. The 2008 and 2009 benthic invertebrate datasets were excluded due to a significant change in the sampling design in 2010.

Eight waterbodies were monitored in the Upper Nelson River Region: two on-system annual sites (Lake Winnipeg – Mossy Bay and Cross Lake) and four on-system rotational sites (Playgreen Lake, Little Playgreen Lake, Sipiwesk Lake, and the Nelson River upstream of the Kelsey GS); and, one off-system annual site (Setting Lake) and one off-system rotational site (Walker Lake; Table 4.1-1 and Figure 4.1-1). Annual sampling at the on-system Lake Winnipeg – Mossy Bay site began in 2013 and is described based on seven years of monitoring data.

Two sampling polygons (nearshore [NS] and offshore [OS]) defined by water depth, flow, and substrate composition were sampled in each waterbody in late summer/fall per year (Appendix 4-1). Five benthic invertebrate samples were collected in each polygon for a total of ten invertebrate samples per waterbody per year. Five sediment samples were also collected in each polygon (where possible) to provide supporting information on substrate composition, total organic carbon (TOC), and texture. Dominant benthic substrate and sediment composition results are presented in Appendix 4-2. Sampling was completed at all sites as planned over the period of 2010-2019.

Four benthic invertebrate indicators (abundance, community composition, taxonomic richness, and diversity) were selected for detailed reporting (Table 4.1-2). Metrics for these indicators that are presented herein include: total invertebrate abundance or total invertebrate density; the Ephemeroptera, Plecoptera, and Trichoptera (EPT) Index; the Oligochaeta and Chironomidae (O+C) Index; total taxa richness; EPT taxa richness; and Hill's effective richness (Hill's Index). A detailed description of these indicators is provided in CAMP (2024).

A detailed description of the program design and sampling methods are provided in Technical Document 1, Section 2.4.

Table 4.1-1. 2010 to 2019 Benthic invertebrate sampling inventory.

Site	Sampling Year											
	2008[1]	2009[1]	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
LW-MB[2]						●	●	●	●	●	●	●
CROSS	-	-	●	●	●	●	●	●	●	●	●	●
PLAYG		-			●			●			●	
LPLAY			●			●			●			●
SIP				●			●			●		
UNR				●			●			●		
SET	-	-	●	●	●	●	●	●	●	●	●	●
WLKR			●			●			●			●

Notes:

1. Dataset excluded from analysis and reporting due to change in sampling design in 2010.
2. Annual sampling at LW-MB began in 2013.

Table 4.1-2. Benthic invertebrate indicators and metrics.

Indicators	Metrics	Units
Abundance	• Total Invertebrate Abundance	Number (no.) per sample
	• Total Invertebrate Density	no. per square metre (m^2)
Community Composition	• Relative Proportions of Major Invertebrate Groups	%
	• EPT Index	%
	• O+C Index	%
Taxonomic Richness	• Total Taxa Richness	no. of families
	• EPT Taxa Richness	no. of families
Diversity	• Hill's Effective Richness (Hill's Index)	value

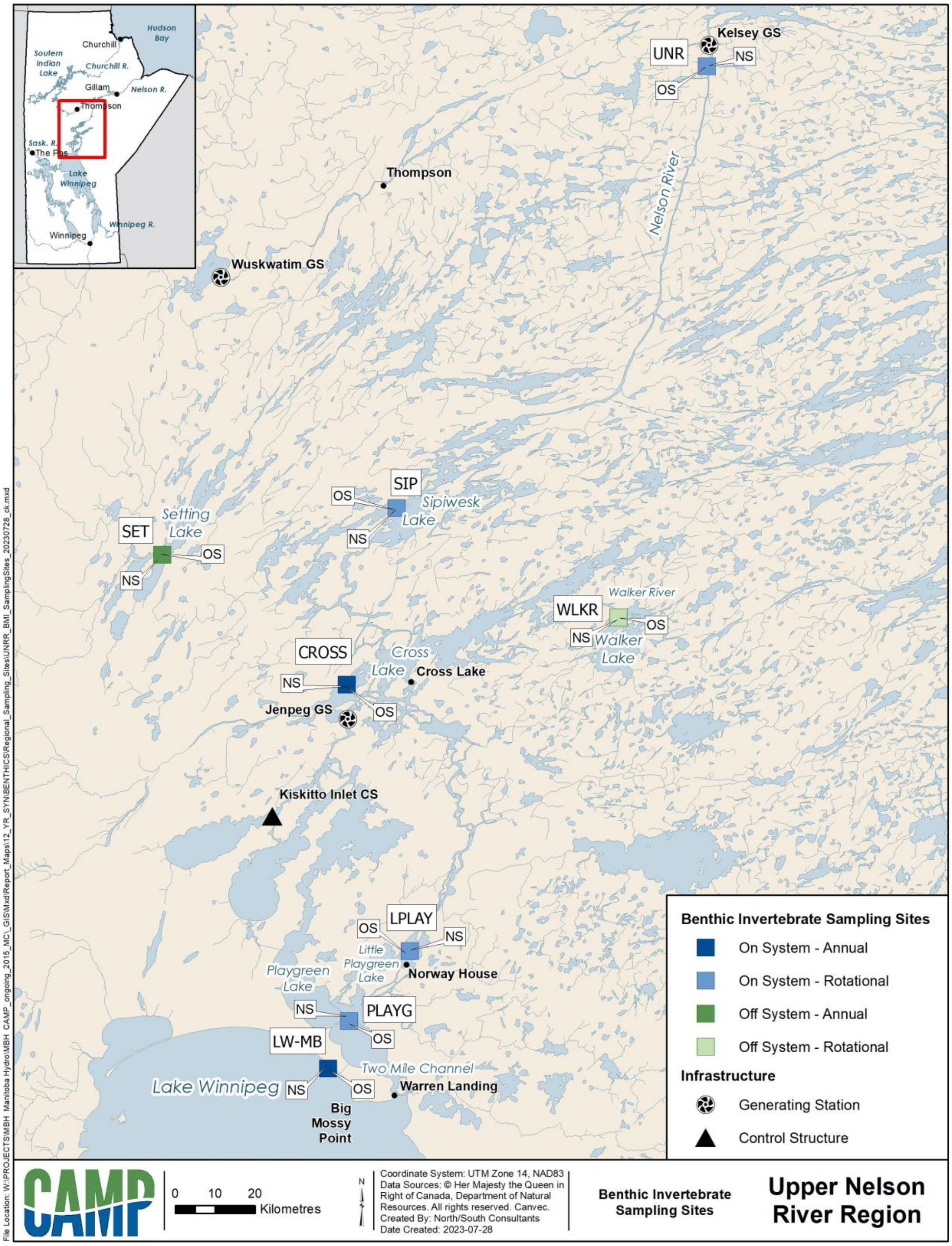


Figure 4.1-1. 2010-2019 Benthic invertebrate nearshore (NS) and offshore (OS) sampling sites

4.2 ABUNDANCE

4.2.1 TOTAL INVERTEBRATE ABUNDANCE

4.2.1.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg – Mossy Bay

Nearshore Habitat

Annual mean abundance over the seven years of monitoring ranged from zero invertebrates per sample (2014 and 2018) to 12 invertebrates per sample (2016; Figure 4.2-1). The overall mean abundance was five invertebrates per sample, the overall median abundance was three invertebrates per sample, and the interquartile range was 0 to 7 invertebrates per sample. Annual means were within the IQR, except for 2016 (above). No benthic invertebrates were collected in nearshore samples in 2014 and 2018.

Offshore Habitat

Annual mean abundance (density) over the seven years of monitoring ranged from 110 invertebrates per m^2 (2013) to 1,013 invertebrates per m^2 (2016; Figure 4.2-2). The overall mean abundance was 495 invertebrates per m^2, the overall median abundance was 361 invertebrates per m^2, and the interquartile range was 159 to 664 invertebrates per m^2. Annual means were below the IQR in 2013, and above the IQR in 2015 and 2016

Cross Lake - West

Nearshore Habitat

Annual mean abundance over the ten years of monitoring ranged from 208 invertebrates per sample (2018) to 1,102 invertebrates per sample (2016; Figure 4.2-1). The overall mean abundance was 631 invertebrates per sample, the overall median abundance was 496 invertebrates per sample, and the interquartile range was 258 to 747 invertebrates per sample. Annual means were below the IQR in 2018, and above the IQR in 2012, 2016, and 2017.

Offshore Habitat

Annual mean abundance (density) over the ten years of monitoring ranged from 929 invertebrates per m^2 (2019) to 5,967 invertebrates per m^2 (2014; Figure 4.2-2). The overall mean abundance was 2,752 invertebrates per m^2, the overall median abundance was 1,904 invertebrates per m^2, and the interquartile range was 1,461 to 3,629 invertebrates per m^2. Annual means were below the IQR in 2010, 2018, and 2019, and above the IQR in 2014 and 2016.

ROTATIONAL SITES

Playgreen Lake

Nearshore Habitat

Annual mean abundance over the three years of monitoring ranged from 382 invertebrates per sample (2018) to 1,787 invertebrates per sample (2012; Figure 4.2-1). The overall mean abundance was 1,313 invertebrates per sample, the overall median abundance was 1,079 invertebrates per sample, and the interquartile range was 623 to 1,884 invertebrates per sample. Annual means were within the IQR, except for 2018 (below).

Offshore Habitat

Annual mean abundance (density) over the three years of monitoring ranged from 2,381 invertebrates per m^2 (2012) to 7,055 invertebrates per m^2 (2015; Figure 4.2-2). The overall mean abundance was 4,657 invertebrates per m^2, the overall median abundance was 4,617 invertebrates per m^2, and the interquartile range was 3,109 to 5,418 invertebrates per m^2. Annual means were below the IQR in 2012, and above the IQR in 2015.

Little Playgreen Lake

Nearshore Habitat

Annual mean abundance over the four years of monitoring ranged from 1,933 invertebrates per sample (2019) to 25,131 invertebrates per sample (2016; Figure 4.2-1). The overall mean abundance was 17,771 invertebrates per sample, the overall median abundance was 19,387 invertebrates per sample, and the interquartile range was 3,456 to 27,807 invertebrates per sample. Annual means were within the IQR, except for 2019 (below).

Offshore Habitat

Annual mean abundance (density) over the four years of monitoring ranged from 1,997 invertebrates per m^2 (2019) to 3,916 invertebrates per m^2 (2010; Figure 4.2-2). The overall mean abundance was 2,787 invertebrates per m^2, the overall median abundance was 2,590 invertebrates per m^2, and the interquartile range was 1,749 to 3,791 invertebrates per m^2. Annual means were within the IQR, except for 2010 (above).

Sipiwesk Lake

Nearshore Habitat

Annual mean abundance over the three years of monitoring ranged from 163 invertebrates per sample (2011) to 1,726 invertebrates per sample (2017; Figure 4.2-1). The overall mean abundance was 699 invertebrates per sample, the overall median abundance was 229 invertebrates per sample, and the interquartile range was 96 to 482 invertebrates per sample. Annual means were within the IQR, except for 2017 (above).

Offshore Habitat

Annual mean abundance (density) over the three years of monitoring ranged from 2,453 invertebrates per m^2 (2017) to 3,347 invertebrates per m^2 (2011; Figure 4.2-2). The overall mean abundance was 2,864 invertebrates per m^2, the overall median abundance was 2,669 invertebrates per m^2, and the interquartile range was 2,215 to 3,571 invertebrates per m^2. Annual means for all years fell within the interquartile range.

Upper Nelson River

Nearshore Habitat

Annual mean abundance over the three years of monitoring ranged from 352 invertebrates per sample (2014) to 1,146 invertebrates per sample (2017; Figure 4.2-1). The overall mean abundance was 733 invertebrates per sample, the overall median abundance was 565 invertebrates per sample, and the interquartile range was 410 to 955 invertebrates per sample. Annual means were below the IQR in 2014, and above the IQR in 2017.

Offshore Habitat

Annual mean abundance (density) over the three years of monitoring ranged from 744 invertebrates per m^2 (2017) to 2,793 invertebrates per m^2 (2014; Figure 4.2-2). The overall mean abundance was 1,849 invertebrates per m^2, the overall median abundance was 2,020 invertebrates per m^2, and the interquartile range was 1,003 to 2,460 invertebrates per m^2. Annual means were below the IQR in 2017, and above the IQR in 2014.

4.2.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Nearshore Habitat

Annual mean abundance over the ten years of monitoring ranged from 401 invertebrates per sample (2015) to 3,808 invertebrates per sample (2019; Figure 4.2-1). The overall mean abundance was 1,590 invertebrates per sample, the overall median abundance was 1,073 invertebrates per sample, and the interquartile range was 457 to 1,940 invertebrates per sample. Annual means were below the IQR in 2015, and above the IQR in 2016 and 2019.

Offshore Habitat

Annual mean abundance (density) over the ten years of monitoring ranged from 707 invertebrates per m^2 (2016) to 3,757 invertebrates per m^2 (2013; Figure 4.2-2). The overall mean abundance was 1,835 invertebrates per m^2, the overall median abundance was 1,652 invertebrates per m^2, and the interquartile range was 974 to 2,485 invertebrates m^2. Annual means were below the IQR in 2016, and above the IQR in 2010 and 2013.

ROTATIONAL SITES

Walker Lake

Nearshore Habitat

Annual mean abundance over the four years of monitoring ranged from 636 invertebrates per sample (2013) to 8,243 invertebrates per sample (2019; Figure 4.2-1). The overall mean abundance was 2,815 invertebrates per sample, the overall median abundance was 1,010 invertebrates per sample, and the interquartile range was 434 to 4,190 invertebrates per sample. Annual means were within the IQR, except for 2019 (above).

Offshore Habitat

Annual mean abundance (density) over the four years of monitoring ranged from 395 invertebrates per m^2 (2013) to 1,105 invertebrates per m^2 (2010; Figure 4.2-2). The overall mean abundance was 623 invertebrates per m^2, the overall median abundance was 505 invertebrates per m^2, and the interquartile range was 339 to 848 invertebrates per m^2. Annual means were within the IQR, except for 2010 (above).

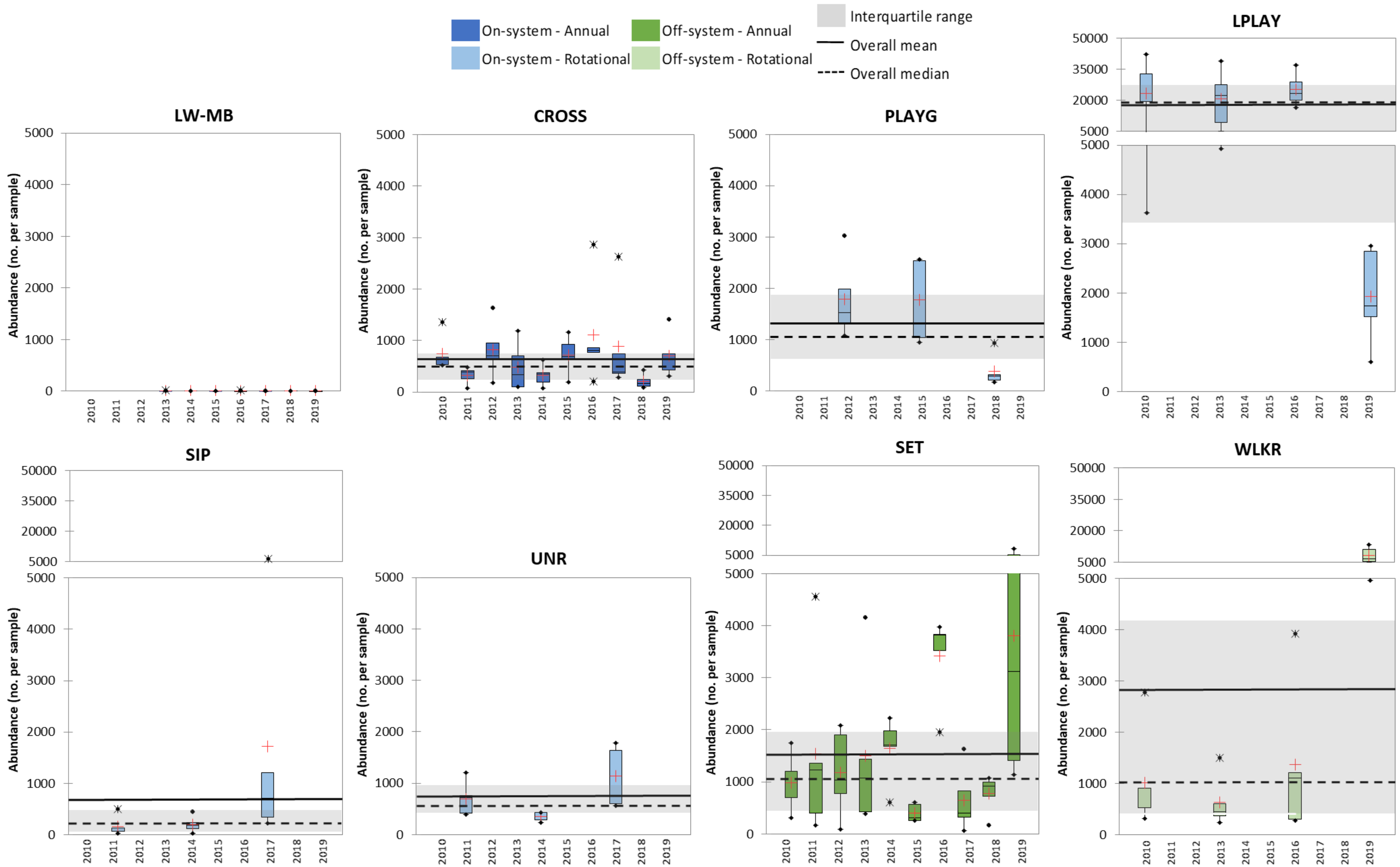


Figure 4.2-1. 2010 to 2019 Nearshore benthic invertebrate abundance (total no. per sample).

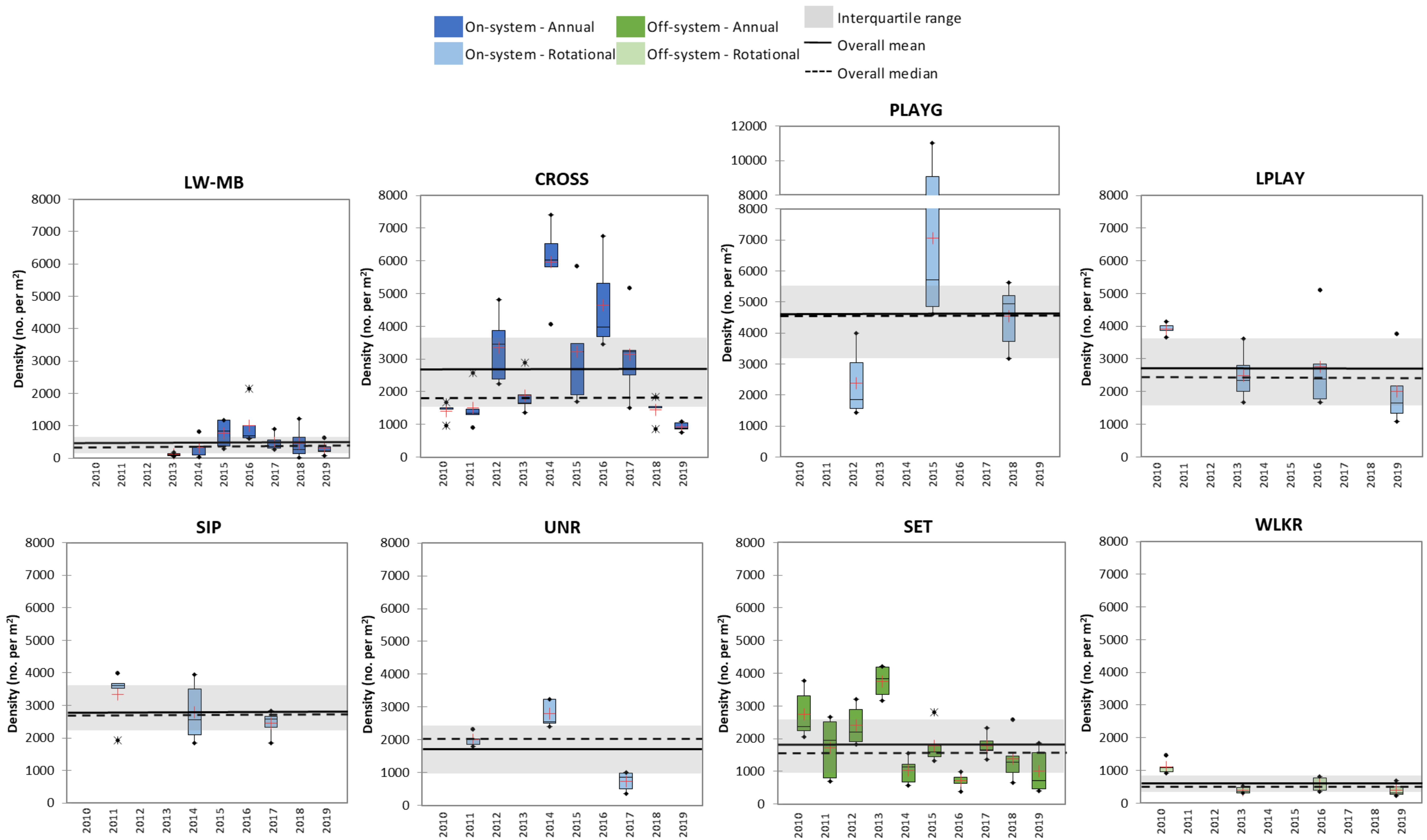


Figure 4.2-2. 2010 to 2019 Offshore benthic invertebrate abundance (density; total no. per m^2).

4.3 COMMUNITY COMPOSITION

4.3.1 RELATIVE ABUNDANCE

4.3.1.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg – Mossy Bay

Nearshore Habitat

Trichoptera (caddisflies, mainly Hydropsychidae) dominated the benthic invertebrate community in four of the seven years of monitoring (2013, 2015, 2016, and 2019; Table 4.3-1). Among those years, mean annual relative abundances of Trichoptera ranged from 61% (2019) to 77% (2016). Amphipoda (freshwater shrimps, mainly Pontoporeiidae) was the most abundant taxon in 2017 (27%). No benthic invertebrates were collected in nearshore samples in 2014 and 2018.

Offshore Habitat

Amphipoda (freshwater shrimps, mainly Pontoporeiidae) dominated the benthic invertebrate community in six of the seven years of monitoring (2014 to 2019; Table 4.3-2). Among those years, mean annual relative abundances of Amphipoda ranged from 32% (2017) to 71% (2018). The benthic invertebrate community sampled in 2013 was mainly comprised of Gastropoda (snails, 45%, mainly Hydrobiidae) and Amphipoda (32%).

Cross Lake - West

Nearshore Habitat

Chironomidae (non-biting midges) dominated the benthic invertebrate community in seven of the ten years of monitoring (2011 to 2013, 2015 to 2017, and 2019; Table 4.3-3). Among those years, mean annual relative abundances of Chironomidae ranged from 34% (2015) to 64% (2012). Chironomidae (36%) and Corixidae (water boatmen, 43%) were the dominant groups in 2010. Corixidae comprised 75% of the benthic invertebrate community in 2014. Ephemeroptera (mayflies, 33%, mainly Ephemeridae and Heptageniidae) and Corixidae (32%) were the dominant taxa in 2018.

Offshore Habitat

Bivalvia (clams, mainly Sphaeriidae) dominated the benthic invertebrate community in seven of the ten years of monitoring (2011 to 2017; Table 4.3-4). Among those years, mean annual relative abundances of Bivalvia ranged from 54% (2011) to 83% (2016). Bivalvia (32%), Chironomidae (non-biting midges, 28%), and Ephemeroptera (mayflies, Ephemeridae, 32%) were the dominant taxa in 2010. Bivalvia (Sphaeriidae, 40%) and Ephemeroptera (Ephemeridae, 46%) dominated the benthic invertebrate community in 2018. Chironomidae (34%) and Ephemeroptera (Ephemeridae, 43%) dominated in 2019.

ROTATIONAL SITES

Playgreen Lake

Nearshore Habitat

Benthic invertebrate community composition varied over the three years of monitoring (2012, 2015, and 2018; Table 4.3-5). Chironomidae (non-biting midges) was the dominant taxon in 2012 (79%), Oligochaeta (aquatic segmented worms) was the dominant group in 2015 (71%). Bivalvia (clams, Sphaeriidae, 35%) and Chironomidae (41%) were most dominant taxa in 2018.

Offshore Habitat

Benthic invertebrate community composition varied over the three years of monitoring (2012, 2015, and 2018; Table 4.3-6). Bivalvia (clams, Sphaeriidae) was the dominant taxon in 2012 (45%). Bivalvia (35%, mainly Sphaeriidae) and Chironomidae (non-biting midges, 32%) dominated in 2015, and Amphipoda (freshwater shrimps, 45%, mainly Pontoporeiidae) dominated in 2018.

Little Playgreen Lake

Nearshore Habitat

Benthic invertebrate community composition varied over the four years of monitoring (2010, 2013, 2016, and 2019; Table 4.3-7). Amphipoda (freshwater shrimps, 36%, mainly Hyalellidae) and Chironomidae (non-biting midges, 27%) were dominant in 2010. Chironomidae were more relatively abundant in 2013 (44%) and 2016 (35%). Gastropoda (snails, 30%, manly Planorbidae) and Chironomidae (26%) dominated the invertebrate community in 2019.

Offshore Habitat

Bivalvia (clams, Sphaeriidae) dominated the benthic invertebrate community in three of the four monitoring years (2010, 2016, and 2019; Table 4.3-8). Among those years, mean annual relative abundances of Bivalvia ranged from 46% (2016) to 65% (2010). Chironomidae (non-biting midges) dominated in 2013 (62%).

Sipiwesk Lake

Nearshore Habitat

Benthic invertebrate community composition varied over the three years of monitoring (2011, 2014, 2017; Table 4.3-9). Corixidae (water boatmen) was the most relatively abundant group in 2011 (64%) and 2014 (68%; Table 4.3-9). Chironomidae (28%) and Ephemeroptera (mayflies, 26%, mainly Caenidae) were nearly co-dominant in 2017.

Offshore Habitat

Amphipoda (freshwater shrimps, mainly Pontoporeiidae) and Ephemeroptera (mayflies, Ephemeridae) dominated the benthic invertebrate community over the three years of monitoring (2011, 2014, 2017; Table 4.3-10). Among those years, mean relative abundances of Amphipoda ranged from 43% (2014) to 63% (2011), and Ephemeroptera ranged between 27% (2011) and 37% (2017).

Upper Nelson River

Nearshore Habitat

Benthic invertebrate community composition varied over the three years of monitoring (2011, 2014, and 2017; Table 4.3-11). Amphipoda (freshwater shrimps, 37%, mainly Hyalellidae) and Chironomidae (non-biting midges, 29%) were the dominant taxa in 2011. Amphipoda (mainly Hyalellidae) dominated in 2014 (55%). Amphipoda (42%, mainly Hyalellidae) and Corixidae (water boatmen, 34%) dominated in 2017.

Offshore Habitat

Benthic invertebrate community composition varied over the three years of monitoring (2011, 2014, and 2017; Table 4.3-12). Amphipoda (freshwater shrimps, Pontoporeiidae, 52%) and Ephemeroptera (mayflies, Ephemeridae, 36%) dominated the benthic invertebrate community in 2011. Ephemeroptera (Ephemeridae) dominated in 2014 (60%) and 2017 (67%).

4.3.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Nearshore Habitat

Amphipoda (freshwater shrimps, mainly Hyalellidae) dominated the benthic invertebrate community in six of the ten years of monitoring (2011, 2012, 2014, 2015, 2017, and 2019; Table 4.3-13). Among those years, mean annual relative abundances of Amphipoda ranged from 27% (2012 and 2016) to 45% (2019). Chironomidae (non-biting midges) was the dominant taxon in 2010, 2013, 2016, and 2018 where mean annual relative abundances ranged from 30% (2010) to 59% (2013).

Offshore Habitat

Amphipoda (freshwater shrimps, mainly Pontoporeiidae) dominated the benthic invertebrate community in all ten years of monitoring (2010 to 2019; Table 4.3-14). Among those years, mean annual relative abundances of Amphipoda ranged from 43% (2019) to 78% (2015).

ROTATIONAL SITES

Walker Lake

Nearshore Habitat

Benthic invertebrate community composition varied over the four years of monitoring (2010, 2013, 2016, and 2019; Table 4.3-15). Amphipoda (freshwater shrimps, mainly Hyalellidae) dominated in 2010 (45%). The Other category (mainly, Hydrachnidae, water mites) comprised 61% of the community in 2013. Gastropoda (snails, 25%, mainly Lymnaeidae and Planorbidae), Trichoptera (caddisflies, 20%, mainly Leptoceridae), Chironomidae (non-biting midges, 18%), and Oligochaeta (aquatic segmented worms, 16%) were most relatively abundant in 2016. Oligochaeta (29%), Gastropoda (24%, mainly Lymnaeidae and Planorbidae), and Chironomidae (19%) dominated the 2019 benthic invertebrate community.

Offshore Habitat

Chironomidae (non-biting midges) dominated the benthic invertebrate community in all four years of monitoring (2010, 2013, 2016, and 2019; Table 4.3-16). Among those years, mean annual relative abundances of Chironomidae ranged from 40% (2016) to 68% (2010).

Table 4.3-1. 2010 to 2019 Lake Winnipeg – Mossy Bay nearshore benthic invertebrate relative abundance.

0% <1% to 15% >15% to 25% >25% to 50% >50%

Invertebrate Taxa	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Oligochaeta	--	--	--	0%	0%	3%	2%	7%	0%	0%
Amphipoda	--	--	--	0%	0%	0%	15%	27%	0%	18%
Bivalvia	--	--	--	0%	0%	0%	0%	0%	0%	0%
Gastropoda	--	--	--	0%	0%	0%	0%	7%	0%	0%
Ceratopogonidae	--	--	--	0%	0%	0%	0%	0%	0%	0%
Chironomidae	--	--	--	15%	0%	23%	3%	20%	0%	9%
Other Diptera	--	--	--	0%	0%	0%	0%	13%	0%	0%
Ephemeroptera	--	--	--	4%	0%	0%	2%	0%	0%	12%
Plecoptera	--	--	--	0%	0%	0%	0%	0%	0%	0%
Trichoptera	--	--	--	69%	0%	73%	77%	20%	0%	61%
Corixidae	--	--	--	4%	0%	0%	0%	7%	0%	0%
Coleoptera	--	--	--	0%	0%	0%	0%	0%	0%	0%
All other taxa	--	--	--	8%	0%	0%	2%	0%	0%	0%

Table 4.3-2. 2010 to 2019 Lake Winnipeg – Mossy Bay offshore benthic invertebrate relative abundance.

0% <1% to 15% >15% to 25% >25% to 50% >50%

Invertebrate Taxa	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Oligochaeta	--	--	--	3%	3%	2%	7%	3%	4%	7%
Amphipoda	--	--	--	32%	59%	41%	44%	32%	71%	43%
Bivalvia	--	--	--	5%	1%	0%	2%	4%	1%	2%
Gastropoda	--	--	--	45%	19%	8%	12%	13%	2%	6%
Ceratopogonidae	--	--	--	0%	0%	0%	0%	0%	0%	0%
Chironomidae	--	--	--	5%	15%	40%	28%	32%	15%	22%
Other Diptera	--	--	--	0%	0%	0%	0%	0%	0%	0%
Ephemeroptera	--	--	--	3%	1%	1%	0%	2%	1%	2%
Plecoptera	--	--	--	0%	0%	0%	0%	0%	0%	0%
Trichoptera	--	--	--	5%	3%	2%	3%	5%	3%	8%
Corixidae	--	--	--	0%	0%	0%	0%	0%	0%	0%
Coleoptera	--	--	--	0%	0%	0%	0%	0%	0%	0%
All other taxa	--	--	--	3%	0%	5%	5%	11%	4%	11%

Table 4.3-3. 2010 to 2019 Cross Lake nearshore benthic invertebrate relative abundance.

0% | <1% to 15% | >15% to 25% | >25% to 50% | >50%

Invertebrate Taxa	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Oligochaeta	3%	9%	2%	4%	1%	25%	4%	4%	4%	30%
Amphipoda	2%	27%	15%	7%	7%	3%	5%	4%	2%	1%
Bivalvia	0%	<1%	1%	1%	<1%	1%	1%	2%	3%	2%
Gastropoda	1%	<1%	1%	<1%	<1%	1%	<1%	1%	<1%	<1%
Ceratopogonidae	0%	0%	0%	0%	0%	0%	0%	<1%	<1%	<1%
Chironomidae	36%	45%	64%	50%	13%	34%	50%	45%	20%	43%
Other Diptera	0%	0%	0%	0%	1%	0%	0%	<1%	0%	0%
Ephemeroptera	15%	14%	7%	27%	2%	19%	14%	26%	33%	11%
Plecoptera	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Trichoptera	<1%	1%	<1%	<1%	0%	<1%	1%	<1%	1%	<1%
Corixidae	43%	2%	8%	8%	75%	15%	25%	14%	32%	11%
Coleoptera	0%	0%	0%	0%	<1%	0%	0%	<1%	0%	0%
All other taxa	<1%	1%	2%	1%	1%	1%	1%	3%	5%	1%

Table 4.3-4. 2010 to 2019 Cross Lake offshore benthic invertebrate relative abundance.

0% | <1% to 15% | >15% to 25% | >25% to 50% | >50%

Invertebrate Taxa	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Oligochaeta	<1%	2%	<1%	<1%	<1%	2%	<1%	2%	<1%	5%
Amphipoda	5%	8%	1%	<1%	<1%	<1%	0%	<1%	<1%	<1%
Bivalvia	32%	54%	62%	80%	60%	81%	83%	68%	40%	15%
Gastropoda	0%	<1%	0%	0%	<1%	<1%	<1%	0%	0%	<1%
Ceratopogonidae	<1%	0%	<1%	<1%	0%	0%	<1%	0%	<1%	<1%
Chironomidae	28%	9%	8%	5%	18%	3%	10%	16%	10%	34%
Other Diptera	0%	0%	0%	0%	0%	0%	0%	<1%	0%	<1%
Ephemeroptera	32%	25%	28%	13%	21%	10%	4%	11%	46%	43%
Plecoptera	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Trichoptera	0%	1%	0%	0%	<1%	0%	<1%	<1%	0%	0%
Corixidae	0%	0%	0%	0%	0%	0%	<1%	0%	0%	<1%
Coleoptera	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
All other taxa	1%	1%	1%	1%	1%	4%	2%	2%	4%	2%

Table 4.3-5. 2010 to 2019 Playgreen Lake nearshore benthic invertebrate relative abundance.

0% <1% to 15% >15% to 25% >25% to 50% >50%

Invertebrate Taxa	2012	2015	2018
Oligochaeta	5%	71%	9%
Amphipoda	5%	2%	4%
Bivalvia	4%	<1%	35%
Gastropoda	2%	1%	4%
Ceratopogonidae	0%	0%	<1%
Chironomidae	79%	20%	41%
Other Diptera	<1%	<1%	1%
Ephemeroptera	2%	2%	1%
Plecoptera	0%	0%	0%
Trichoptera	1%	1%	<1%
Corixidae	1%	3%	6%
Coleoptera	<1%	<1%	<1%
All other taxa	<1%	<1%	<1%

Table 4.3-6. 2010 to 2019 Playgreen Lake offshore benthic invertebrate relative abundance.

0% <1% to 15% >15% to 25% >25% to 50% >50%

Invertebrate Taxa	2012	2015	2018
Oligochaeta	4%	1%	2%
Amphipoda	13%	20%	45%
Bivalvia	45%	35%	17%
Gastropoda	6%	4%	21%
Ceratopogonidae	1%	1%	<1%
Chironomidae	11%	32%	4%
Other Diptera	0%	0%	<1%
Ephemeroptera	13%	3%	5%
Plecoptera	0%	0%	0%
Trichoptera	3%	3%	2%
Corixidae	<1%	<1%	0%
Coleoptera	0%	0%	0%
All other taxa	2%	<1%	4%

Table 4.3-7. 2010 to 2019 Little Playgreen Lake nearshore benthic invertebrate relative abundance.

0% | <1% to 15% | >15% to 25% | >25% to 50% | >50%

Invertebrate Taxa	2010	2013	2016	2019
Oligochaeta	21%	2%	1%	8%
Amphipoda	36%	20%	24%	12%
Bivalvia	<1%	<1%	<1%	<1%
Gastropoda	6%	23%	22%	30%
Ceratopogonidae	0%	<1%	<1%	<1%
Chironomidae	27%	44%	35%	26%
Other Diptera	0%	0%	0%	0%
Ephemeroptera	7%	10%	16%	17%
Plecoptera	0%	0%	0%	0%
Trichoptera	<1%	<1%	<1%	1%
Corixidae	3%	1%	2%	4%
Coleoptera	<1%	<1%	<1%	<1%
All other taxa	<1%	<1%	<1%	1%

Table 4.3-8. 2010 to 2019 Little Playgreen Lake offshore benthic invertebrate relative abundance.

0% | <1% to 15% | >15% to 25% | >25% to 50% | >50%

Invertebrate Taxa	2010	2013	2016	2019
Oligochaeta	0%	2%	<1%	<1%
Amphipoda	3%	1%	1%	8%
Bivalvia	65%	25%	46%	59%
Gastropoda	4%	<1%	8%	<1%
Ceratopogonidae	<1%	<1%	<1%	<1%
Chironomidae	17%	62%	22%	17%
Other Diptera	0%	0%	0%	0%
Ephemeroptera	4%	7%	20%	13%
Plecoptera	0%	0%	0%	0%
Trichoptera	1%	2%	1%	1%
Corixidae	<1%	0%	1%	0%
Coleoptera	0%	0%	0%	0%
All other taxa	6%	1%	1%	1%

Table 4.3-9. 2010 to 2019 Sipiwesk Lake nearshore benthic invertebrate relative abundance.

0% | <1% to 15% | >15% to 25% | >25% to 50% | >50%

Invertebrate Taxa	2011	2014	2017
Oligochaeta	5%	8%	5%
Amphipoda	10%	3%	19%
Bivalvia	0%	<1%	0%
Gastropoda	1%	3%	1%
Ceratopogonidae	0%	0%	0%
Chironomidae	14%	14%	28%
Other Diptera	<1%	<1%	<1%
Ephemeroptera	3%	3%	26%
Plecoptera	0%	0%	0%
Trichoptera	1%	0%	<1%
Corixidae	64%	68%	19%
Coleoptera	0%	<1%	0%
All other taxa	1%	<1%	1%

Table 4.3-10. 2010 to 2019 Sipiwesk Lake offshore benthic invertebrate relative abundance.

0% | <1% to 15% | >15% to 25% | >25% to 50% | >50%

Invertebrate Taxa	2011	2014	2017
Oligochaeta	1%	<1%	<1%
Amphipoda	63%	43%	45%
Bivalvia	3%	5%	6%
Gastropoda	1%	15%	<1%
Ceratopogonidae	0%	<1%	<1%
Chironomidae	4%	4%	10%
Other Diptera	0%	0%	0%
Ephemeroptera	27%	31%	37%
Plecoptera	0%	0%	0%
Trichoptera	1%	<1%	1%
Corixidae	0%	<1%	0%
Coleoptera	0%	0%	0%
All other taxa	0%	0%	<1%

Table 4.3-11. 2010 to 2019 Upper Nelson River upstream of Kelsey GS nearshore benthic invertebrate relative abundance.

0% <1% to 15% >15% to 25% >25% to 50% >50%

Invertebrate Taxa	2011	2014	2017
Oligochaeta	6%	6%	8%
Amphipoda	37%	55%	42%
Bivalvia	<1%	<1%	0%
Gastropoda	1%	<1%	<1%
Ceratopogonidae	<1%	<1%	<1%
Chironomidae	29%	16%	12%
Other Diptera	<1%	0%	<1%
Ephemeroptera	1%	1%	3%
Plecoptera	0%	0%	0%
Trichoptera	<1%	<1%	<1%
Corixidae	24%	15%	34%
Coleoptera	<1%	<1%	0%
All other taxa	1%	5%	1%

Table 4.3-12. 2010 to 2019 Upper Nelson River upstream of Kelsey GS offshore benthic invertebrate relative abundance.

0% <1% to 15% >15% to 25% >25% to 50% >50%

Invertebrate Taxa	2011	2014	2017
Oligochaeta	4%	22%	3%
Amphipoda	52%	1%	10%
Bivalvia	0%	0%	0%
Gastropoda	0%	0%	0%
Ceratopogonidae	<1%	<1%	0%
Chironomidae	8%	16%	19%
Other Diptera	0%	1%	0%
Ephemeroptera	36%	60%	67%
Plecoptera	0%	0%	0%
Trichoptera	<1%	0%	0%
Corixidae	0%	0%	0%
Coleoptera	0%	0%	0%
All other taxa	<1%	<1%	1%

Table 4.3-13. 2010 to 2019 Setting Lake nearshore benthic invertebrate relative abundance.

0% | <1% to 15% | >15% to 25% | >25% to 50% | >50%

Invertebrate Taxa	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Oligochaeta	16%	4%	12%	4%	7%	10%	10%	29%	10%	16%
Amphipoda	12%	42%	27%	10%	44%	34%	27%	42%	23%	45%
Bivalvia	5%	6%	1%	1%	1%	2%	1%	1%	<1%	6%
Gastropoda	7%	8%	3%	5%	3%	19%	5%	1%	8%	10%
Ceratopogonidae	1%	0%	<1%	<1%	<1%	<1%	<1%	<1%	0%	<1%
Chironomidae	30%	10%	26%	59%	34%	19%	35%	4%	49%	14%
Other Diptera	<1%	<1%	0%	0%	0%	<1%	0%	1%	<1%	<1%
Ephemeroptera	17%	16%	25%	15%	7%	6%	12%	12%	4%	4%
Plecoptera	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Trichoptera	9%	9%	7%	5%	2%	6%	5%	2%	2%	2%
Corixidae	1%	3%	<1%	<1%	<1%	3%	1%	1%	1%	1%
Coleoptera	2%	1%	<1%	<1%	1%	1%	2%	5%	1%	1%
All other taxa	2%	2%	<1%	1%	1%	1%	1%	1%	1%	1%

Table 4.3-14. 2010 to 2019 Setting Lake offshore benthic invertebrate relative abundance.

0% | <1% to 15% | >15% to 25% | >25% to 50% | >50%

Invertebrate Taxa	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Oligochaeta	<1%	<1%	<1%	2%	1%	<1%	0%	2%	2%	2%
Amphipoda	51%	62%	47%	52%	51%	78%	51%	56%	69%	43%
Bivalvia	11%	21%	19%	15%	16%	9%	10%	7%	9%	18%
Gastropoda	<1%	1%	1%	1%	0%	<1%	0%	<1%	<1%	1%
Ceratopogonidae	1%	0%	<1%	<1%	1%	<1%	0%	1%	<1%	<1%
Chironomidae	25%	6%	5%	9%	9%	4%	4%	13%	5%	15%
Other Diptera	2%	0%	<1%	<1%	0%	<1%	0%	<1%	0%	1%
Ephemeroptera	7%	9%	26%	17%	20%	6%	31%	16%	8%	14%
Plecoptera	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Trichoptera	1%	<1%	1%	2%	1%	<1%	2%	1%	1%	1%
Corixidae	<1%	0%	0%	<1%	1%	<1%	0%	0%	0%	1%
Coleoptera	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
All other taxa	<1%	1%	1%	<1%	2%	1%	2%	4%	6%	5%

Table 4.3-15. 2010 to 2019 Walker Lake nearshore benthic invertebrate relative abundance.

0% | <1% to 15% | >15% to 25% | >25% to 50% | >50%

Invertebrate Taxa	2010	2013	2016	2019
Oligochaeta	19%	13%	16%	29%
Amphipoda	45%	9%	11%	5%
Bivalvia	1%	0%	<1%	1%
Gastropoda	1%	4%	25%	24%
Ceratopogonidae	<1%	0%	0%	<1%
Chironomidae	20%	8%	18%	19%
Other Diptera	0%	<1%	0%	0%
Ephemeroptera	9%	<1%	3%	9%
Plecoptera	0%	0%	0%	0%
Trichoptera	4%	4%	20%	8%
Corixidae	<1%	<1%	0%	<1%
Coleoptera	<1%	<1%	<1%	<1%
All other taxa	1%	61%	6%	5%

Table 4.3-16. 2010 to 2019 Walker Lake offshore benthic invertebrate relative abundance.

0% | <1% to 15% | >15% to 25% | >25% to 50% | >50%

Invertebrate Taxa	2010	2013	2016	2019
Oligochaeta	7%	9%	13%	6%
Amphipoda	<1%	0%	0%	0%
Bivalvia	8%	20%	9%	9%
Gastropoda	0%	0%	0%	1%
Ceratopogonidae	1%	8%	6%	11%
Chironomidae	68%	57%	40%	62%
Other Diptera	13%	5%	29%	11%
Ephemeroptera	1%	1%	3%	0%
Plecoptera	0%	0%	0%	0%
Trichoptera	0%	0%	0%	0%
Corixidae	0%	0%	0%	0%
Coleoptera	0%	0%	0%	0%
All other taxa	1%	0%	0%	1%

4.3.2 EPT INDEX

4.3.2.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg – Mossy Bay

Nearshore Habitat

Annual mean EPT Index over the seven years of monitoring ranged from 0% (2014 and 2018) to 76% (2019; Figure 4.3-1). The overall mean was 49%, the overall median was 58%, and the interquartile range was 0% to 80%. Annual means for all years fell within the interquartile range. No benthic invertebrates were collected in nearshore samples in 2014 and 2018.

Offshore Habitat

Annual mean EPT Index over the seven years of monitoring ranged from 2% (2014) to 23% (2018; Figure 4.3-2). The overall mean was 9%, the overall median was 3%, and the interquartile range was 0% to 13%. Annual means were within the IQR, except for 2018 and 2019 (above).

Cross Lake - West

Nearshore Habitat

Annual mean EPT Index over the ten years of monitoring ranged from 5% (2014) to 47% (2013; Figure 4.3-1). The overall mean was 23%, the overall median was 16%, and the interquartile range was 6% to 28%. Annual means were below the IQR in 2014, and above the IQR in 2013, 2017, and 2018.

Offshore Habitat

Annual mean EPT Index over the ten years of monitoring ranged from 4% (2016) to 46% (2018; Figure 4.3-2). The overall mean was 24%, the overall median was 20%, and the interquartile range was 11% to 35%. Annual means were below the IQR in 2016, and above the IQR in 2018 and 2019.

ROTATIONAL SITES

Playgreen Lake

Nearshore Habitat

Annual mean EPT Index over the three years of monitoring ranged from 2% (2018) to 3% (2012 and 2015; Figure 4.3-1). The overall mean was 2%, the overall median was 3%, and the interquartile range was 2% to 3%. Annual means for all years fell within the interquartile range.

Offshore Habitat

Annual mean EPT Index over the three years of monitoring ranged from 6% (2015 and 2018) to 19% (2012; Figure 4.3-2). The overall mean was 11%, the overall median was 6%, and the interquartile range was 5% to 13%. Annual means were within the IQR, except for 2012 (above).

Little Playgreen Lake

Nearshore Habitat

Annual mean EPT Index over the four years of monitoring ranged from 10% (2010 and 2013) to 18% (2019; Figure 4.3-1). The overall mean was 14%, the overall median was 11%, and the interquartile range was 8% to 19%. Annual means for all years fell within the interquartile range.

Offshore Habitat

Annual mean EPT Index over the four years of monitoring ranged from 5% (2010) to 22% (2016; Figure 4.3-2). The overall mean was 12%, the overall median was 10%, and the interquartile range was 7% to 19%. Annual means were below the IQR in 2010, and above the IQR in 2016.

Sipiwesk Lake

Nearshore Habitat

Annual mean EPT Index over the three years of monitoring ranged from 4% (2014) to 20% (2017; Figure 4.3-1). The overall mean was 10%, the overall median was 5%, and the interquartile range was 3% to 14%. Annual means were within the IQR, except for 2017 (above).

Offshore Habitat

Annual mean EPT Index over the three years of monitoring ranged from 28% (2011) to 40% (2017; Figure 4.3-2). The overall mean was 34%, the overall median was 31%, and the interquartile range was 26% to 37%. Annual means were within the IQR, except for 2017 (above).

Upper Nelson River

Nearshore Habitat

Annual mean EPT Index over the three years of monitoring ranged from 2% (2011 and 2014) to 4% (2017; Figure 4.3-1). The overall mean and median were 2%, and the interquartile range was 1% to 3%. Annual means were within the IQR, except for 2017 (above).

Offshore Habitat

Annual mean EPT Index over the three years of monitoring ranged from 36% (2011) to 66% (2017; Figure 4.3-2). The overall mean was 54%, the overall median was 57%, and the interquartile range was 39% to 65%. Annual means were below the IQR in 2011, and above the IQR in 2017.

4.3.2.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Nearshore Habitat

Annual mean EPT Index over the ten years of monitoring ranged from 6% (2018) to 35% (2012; Figure 4.3-1). The overall mean was 18%, the overall median was 14%, and the interquartile range was 9% to 23%. Annual means were below the IQR in 2018 and 2019, and above the IQR from 2010 to 2013.

Offshore Habitat

Annual mean EPT Index over the ten years of monitoring ranged from 7% (2015) to 31% (2016; Figure 4.3-2). The overall mean was 17%, the overall median was 16%, and the interquartile range was 9% to 22%. Annual means were below the IQR in 2010 and 2015, and above the IQR in 2012 and 2016.

ROTATIONAL SITES

Walker Lake

Nearshore Habitat

Annual mean EPT Index over the four years of monitoring ranged from 5% (2013) to 25% (2016; Figure 4.3-1). The overall mean and median were 14%, and the interquartile range was 7% to 15%. Annual means were below the IQR in 2013, and above the IQR in 2016.

Offshore Habitat

Annual mean EPT Index over the four years of monitoring ranged from 0% (2019) to 4% (2016; Figure 4.3-2). The overall mean was 2%, the overall median was 0%, and the interquartile range was 0% to 3%. Annual means were within the IQR, except for 2016 (above).

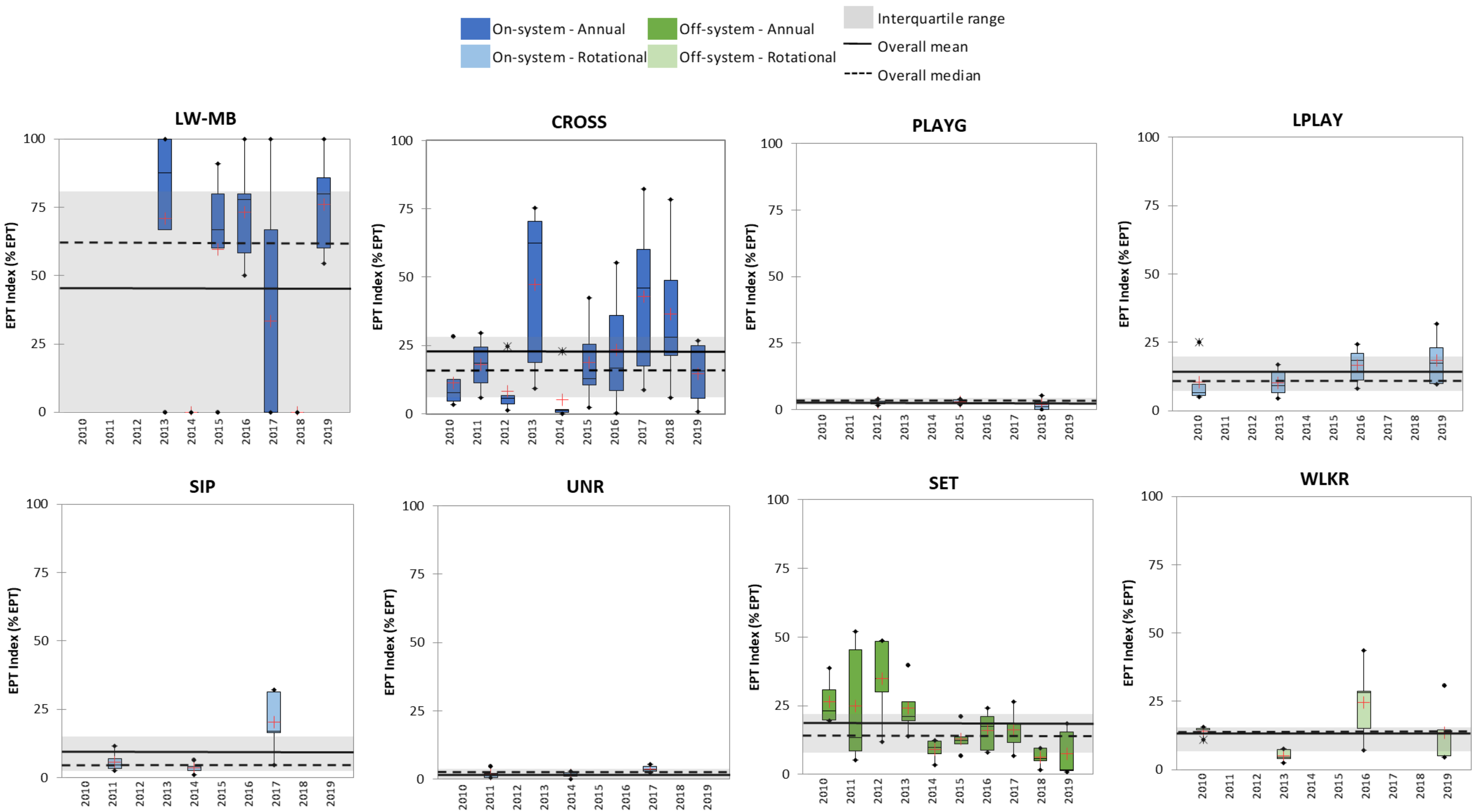


Figure 4.3-1. 2010 to 2019 Nearshore benthic invertebrate EPT Index.

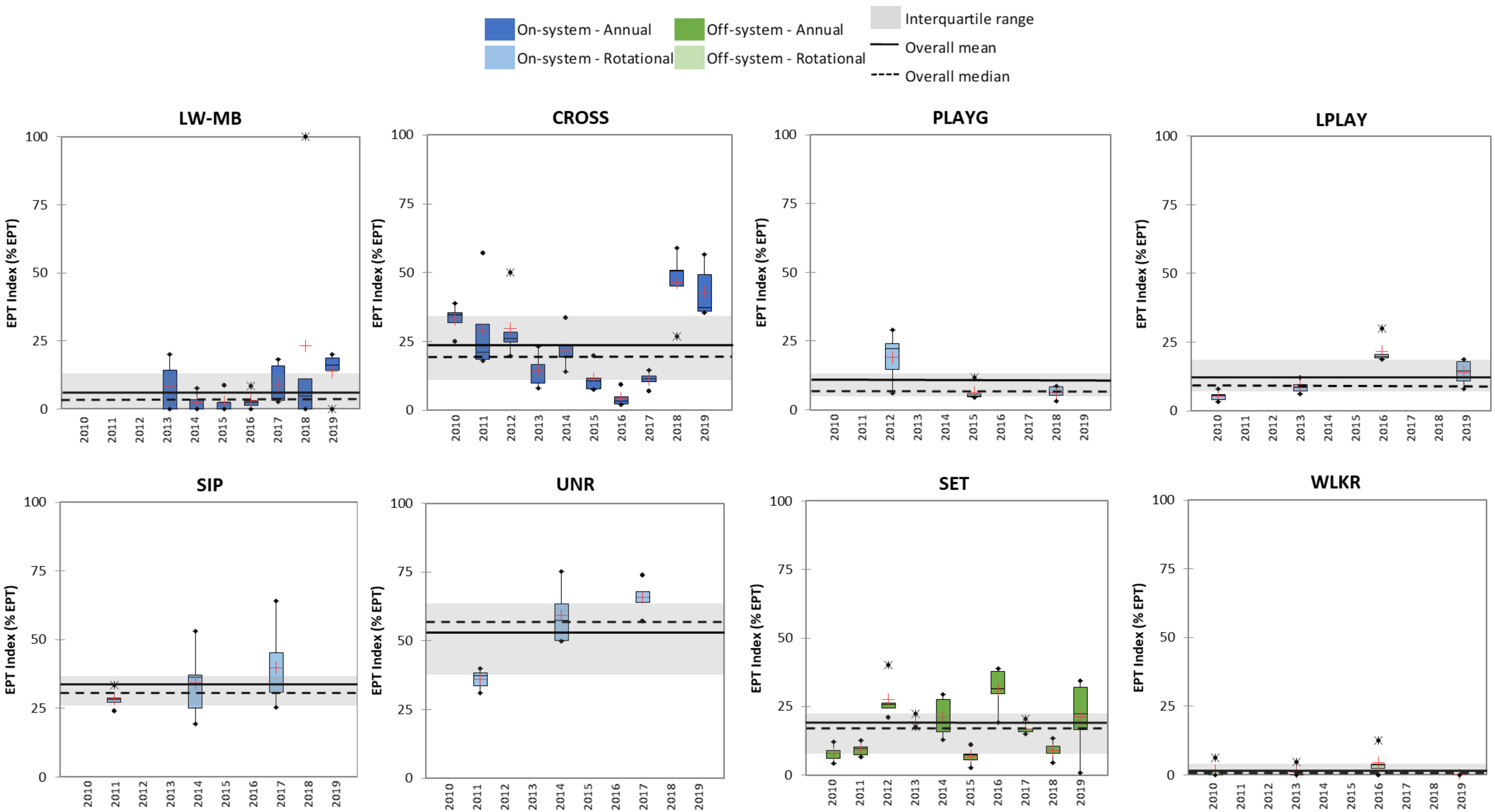


Figure 4.3-2. 2010 to 2019 Offshore benthic invertebrate EPT Index.

4.3.3 O+C INDEX

4.3.3.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg – Mossy Bay

Nearshore Habitat

Annual mean O+C Index (relative percent of Oligochaeta plus Chironomidae) over the seven years of monitoring ranged from 0% (2014 and 2018) to 40% (2015; Figure 4.3-3). The overall mean was 14%, the overall median was 0%, and the interquartile range was 0% to 18%. Annual means were above the IQR in 2015 and 2017. No benthic invertebrates were collected in nearshore samples in 2014 and 2018.

Offshore Habitat

Annual mean O+C Index over the seven years of monitoring ranged from 10% (2013) to 36% (2016 and 2017; Figure 4.3-4). The overall mean and median were 27%, and the interquartile range was 15% to 38%. Annual means were within the IQR, except for 2013 (below).

Cross Lake - West

Nearshore Habitat

Annual mean O+C Index over the ten years of monitoring ranged from 17% (2014) to 67% (2019; Figure 4.3-3). The overall mean was 42%, the overall median was 38%, and the interquartile range was 20% to 63%. Annual means were below the IQR in 2014, and above the IQR in 2019.

Offshore Habitat

Annual mean O+C Index over the ten years of monitoring ranged from 6% (2013 and 2015) to 39% (2019; Figure 4.3-4). The overall mean was 16%, the overall median was 13%, and the interquartile range was 7% to 20%. Annual means were below the IQR in 2013 and 2015, and above the IQR in 2010 and 2019.

ROTATIONAL SITES

Playgreen Lake

Nearshore Habitat

Annual mean O+C Index over the three years of monitoring ranged from 56% (2018) to 90% (2015; Figure 4.3-3). The overall mean was 76%, the overall median was 85%, and the interquartile range was 77% to 89%. Annual means were below the IQR in 2018, and above the IQR in 2015.

Offshore Habitat

Annual mean O+C Index over the three years of monitoring ranged from 6% (2018) to 36% (2015; Figure 4.3-4). The overall mean was 20%, the overall median was 16%, and the interquartile range was 8% to 26%. Annual means were below the IQR in 2018, and above the IQR in 2015.

Little Playgreen Lake

Nearshore Habitat

Annual mean O+C Index over the four years of monitoring ranged from 33% (2019) to 54% (2013; Figure 4.3-3). The overall mean was 42%, the overall median was 39%, and the interquartile range was 32% to 49%. Annual means were within the IQR, except for 2013 (above).

Offshore Habitat

Annual mean O+C Index over the four years of monitoring ranged from 17% (2010) to 63% (2013; Figure 4.3-4). The overall mean was 31%, the overall median was 23%, and the interquartile range was 17% to 37%. Annual means were within the IQR, except for 2013 (above).

Sipiwesk Lake

Nearshore Habitat

Annual mean O+C Index over the three years of monitoring ranged from 20% (2014) to 30% (2011; Figure 4.3-3). The overall mean was 25%, the overall median was 28%, and the interquartile range was 14% to 32%. Annual means for all years fell within the interquartile range.

Offshore Habitat

Annual mean O+C Index over the three years of monitoring ranged from 5% (2011 and 2014) to 11% (2017; Figure 4.3-4). The overall mean was 7%, the overall median was 6%, and the interquartile range was 4% to 8%. Annual means were within the IQR, except for 2017 (above).

Upper Nelson River

Nearshore Habitat

Annual mean O+C Index over the three years of monitoring ranged from 23% (2017) to 36% (2011; Figure 4.3-3). The overall mean and median were 28%, and the interquartile range was 19% to 35%. Annual means were within the IQR, except for 2011 (above).

Offshore Habitat

Annual mean O+C Index over the three years of monitoring ranged from 12% (2011) to 39% (2014; Figure 4.3-4). The overall mean was 25%, the overall median was 20%, and the interquartile range was 16% to 36%. Annual means were below the IQR in 2011, and above the IQR in 2014.

4.3.3.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Nearshore Habitat

Annual mean O+C Index over the ten years of monitoring ranged from 19% (2011) to 54% (2018; Figure 4.3-3). The overall mean was 39%, the overall median was 41%, and the interquartile range was 23% to 51%. Annual means were below the IQR in 2011, and above the IQR in 2018.

Offshore Habitat

Annual mean O+C Index over the ten years of monitoring ranged from 4% (2015 and 2016) to 25% (2010; Figure 4.3-4). The overall mean was 11%, the overall median was 7%, and the interquartile range was 4% to 15%. Annual means were above the IQR in 2010 and 2019.

ROTATIONAL SITES

Walker Lake

Nearshore Habitat

Annual mean O+C Index over the four years of monitoring ranged from 19% (2013) to 52% (2019; Figure 4.3-3). The overall mean was 39%, the overall median was 31%, and the interquartile range was 26% to 56%. Annual means were within the IQR, except for 2013 (below).

Offshore Habitat

Annual mean O+C Index over the four years of monitoring ranged from 55% (2016) to 76% (2010; Figure 4.3-4). The overall mean and median were 66%, and the interquartile range was 58% to 75%. Annual means were below the IQR in 2016, and above the IQR in 2010.

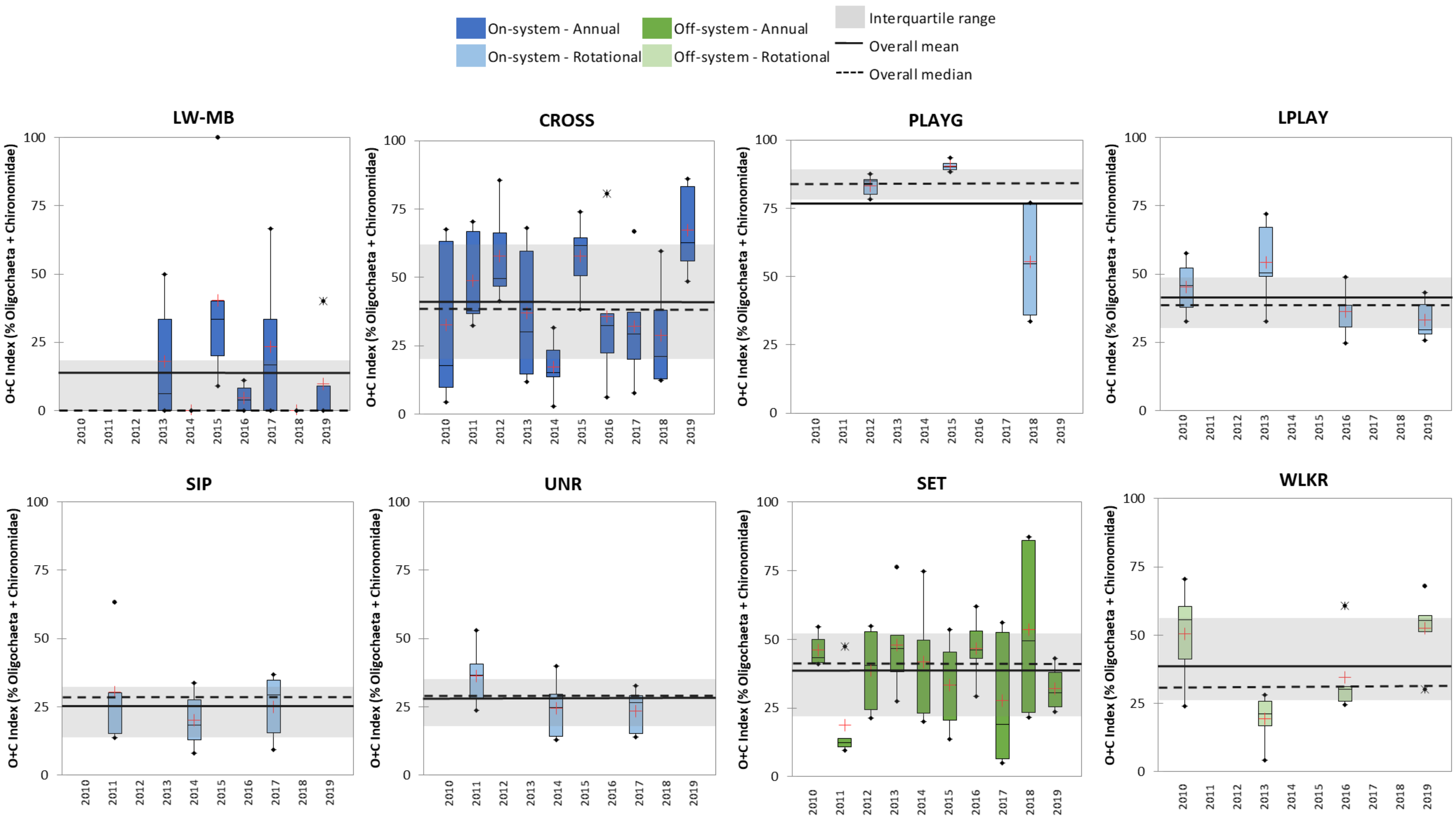


Figure 4.3-3. 2010 to 2019 Nearshore benthic invertebrate O+C Index.

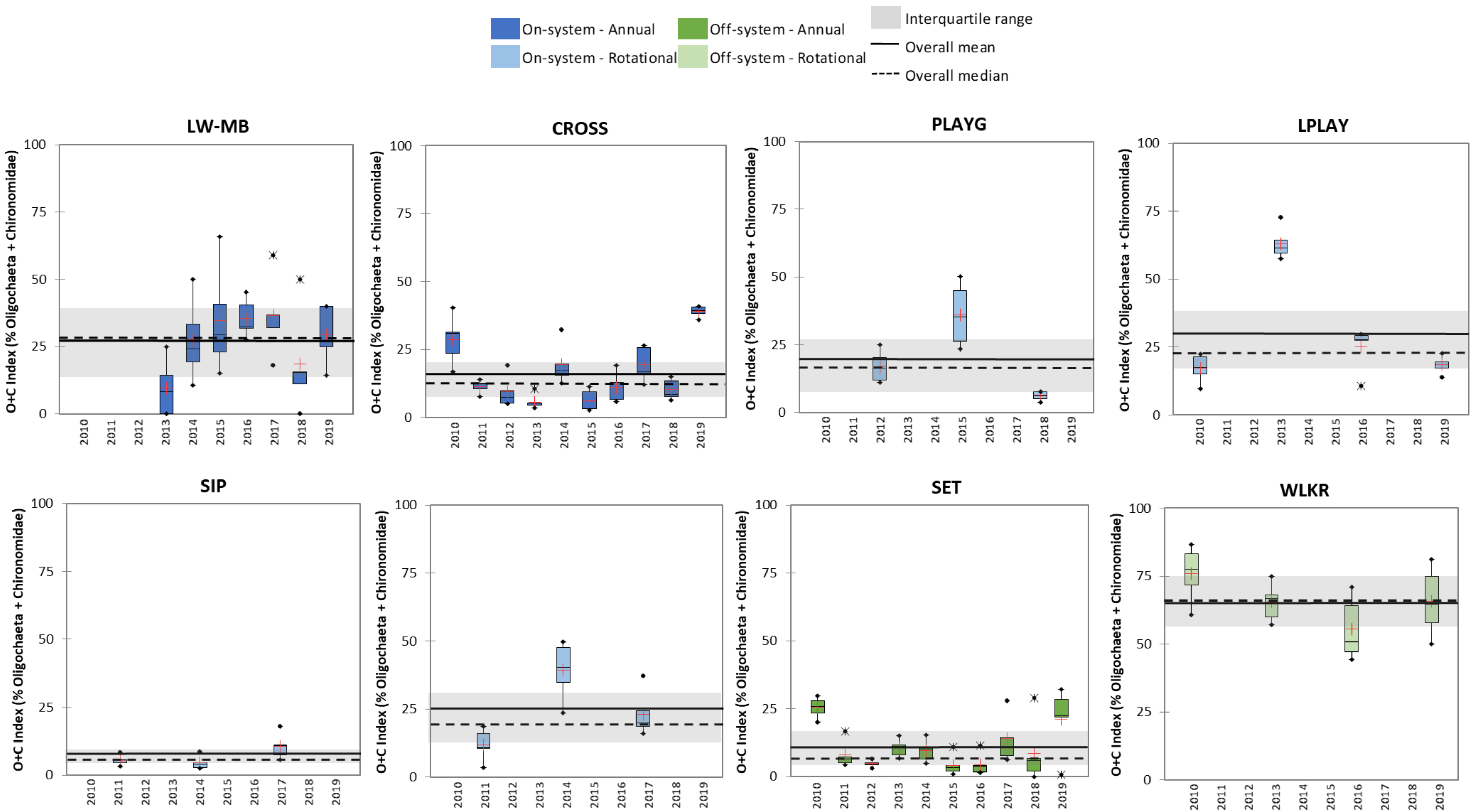


Figure 4.3-4.	2010 to 2019 Offshore benthic invertebrate O+C Index.

4.4 RICHNESS

4.4.1 TOTAL TAXA RICHNESS

4.4.1.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg – Mossy Bay

Nearshore Habitat

Annual mean total taxa richness over the seven years of monitoring ranged from zero families (2014 and 2018) to three families (2016 and 2019; Figure 4.4-1). The overall mean and median were two families, and the interquartile range was 0 to 3 families. Annual means were within the IQR, except in 2019 (above). No benthic invertebrates were collected in nearshore samples in 2014 and 2018.

Offshore Habitat

Annual mean total taxa richness over the seven years of monitoring ranged from four families (2013, 2014, and 2018) to seven families (2016 and 2017; Figure 4.4-2). The overall mean was five families, the overall median was six families, and the interquartile range was 4 to 7 families. Annual means were below the IQR in 2013 and above the IQR in 2017.

Cross Lake - West

Nearshore Habitat

Annual mean total taxa richness over the ten years of monitoring ranged from nine families (2014) to 15 families (2017; Figure 4.4-1). The overall mean was 11 families, the overall median was 12 families, and the interquartile range was 9 to 13 families. Annual means were below the IQR in 2014 and above the IQR in 2017.

Offshore Habitat

Annual mean total taxa richness over the ten years of monitoring ranged from five families (2010, 2013, 2016, and 2018) to eight families (2014; Figure 4.4-2). The overall mean and median were six families, and the interquartile range was 5 to 6 families. Annual means were below the IQR in 2013 and 2018 and above the IQR in 2011, 2014, and 2017.

ROTATIONAL SITES

Playgreen Lake

Nearshore Habitat

Annual mean total taxa richness over the three years of monitoring ranged from 11 families (2018) to 14 families (2015; Figure 4.4-1). The overall mean and median were 13 families, and the interquartile range was 11 to 14 families. Annual means for all years fell within the interquartile range.

Offshore Habitat

Annual mean total taxa richness over the three years of monitoring ranged from ten families (2012) to 12 families (2015 and 2018; Figure 4.4-2). The overall mean was 11 families, the overall median was 12 families, and the interquartile range was 10 to 12 families. Annual means were within the IQR, except in 2018 (above).

Little Playgreen Lake

Nearshore Habitat

Annual mean total taxa richness over the four years of monitoring ranged from 13 families (2019) to 15 families (2010; Figure 4.4-1). The overall mean was 14 families, the overall median was 15 families, and the interquartile range was 13 to 15 families. Annual means for all years fell within the interquartile range.

Offshore Habitat

Annual mean total taxa richness over the four years of monitoring ranged from seven families (2013, 2016, and 2019) to nine families (2010; Figure 4.4-2). The overall mean was seven families, the overall median was eight families, and the interquartile range was 7 to 8 families. Annual means were below the IQR in 2016 and 2019, and above the IQR in 2010.

Sipiwesk Lake

Nearshore Habitat

Annual mean total taxa richness over the three years of monitoring ranged from eight families (2011 and 2014) to 14 families (2017; Figure 4.4-1). The overall mean and median were ten families, and the interquartile range was 9 to 12 families. Annual means were below the IQR in 2011 and 2014, and above the IQR in 2017.

Offshore Habitat

Annual mean total taxa richness over the three years of monitoring ranged from six families (2014) to seven families (2011 and 2017; Figure 4.4-2). The overall mean was seven families, the overall median was six families, and the interquartile range was 6 to 7 families. Annual means for all years fell within the interquartile range.

Upper Nelson River

Nearshore Habitat

Annual mean total taxa richness over the three years of monitoring ranged from ten families (2014 and 2017) to 14 families (2011; Figure 4.4-1). The overall mean and median were 11 families, and the interquartile range was 9 to 13 families. Annual means were within the IQR, except in 2011 (above).

Offshore Habitat

Annual mean total taxa richness over the three years of monitoring was five families (2011, 2014, and 2017; Figure 4.4-2). The overall mean and median were five families, and the interquartile range was 4 to 5 families. Annual means for all years fell within the interquartile range.

4.4.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Nearshore Habitat

Annual mean total taxa richness over the ten years of monitoring ranged from 16 families (2014) to 21 families (2010; Figure 4.4-1). The overall mean and median were 18 families, and the interquartile range was 15 to 21 families. Annual means were within the IQR, except in 2010 (above).

Offshore Habitat

Annual mean total taxa richness over the ten years of monitoring ranged from five families (2011 and 2016) to ten families (2013; Figure 4.4-2). The overall mean and median were seven families, and the interquartile range was 6 to 9 families. Annual means were below the IQR in 2011 and 2016, and above the IQR in 2013.

ROTATIONAL SITES

Walker Lake

Nearshore Habitat

Annual mean total taxa richness over the four years of monitoring ranged from 12 families (2013) to 19 families (2010; Figure 4.4-1). The overall mean and median were 16 families, and the interquartile range was 14 to 19 families. Annual means were below the IQR in 2013 and above the IQR in 2010.

Offshore Habitat

Annual mean total taxa richness over the four years of monitoring ranged from five families (2013, 2016, and 2019) to six families (2010; Figure 4.4-2). The overall mean and median were five families, and the interquartile range was 5 to 6 families. Annual means were below the IQR in 2013 and 2019.

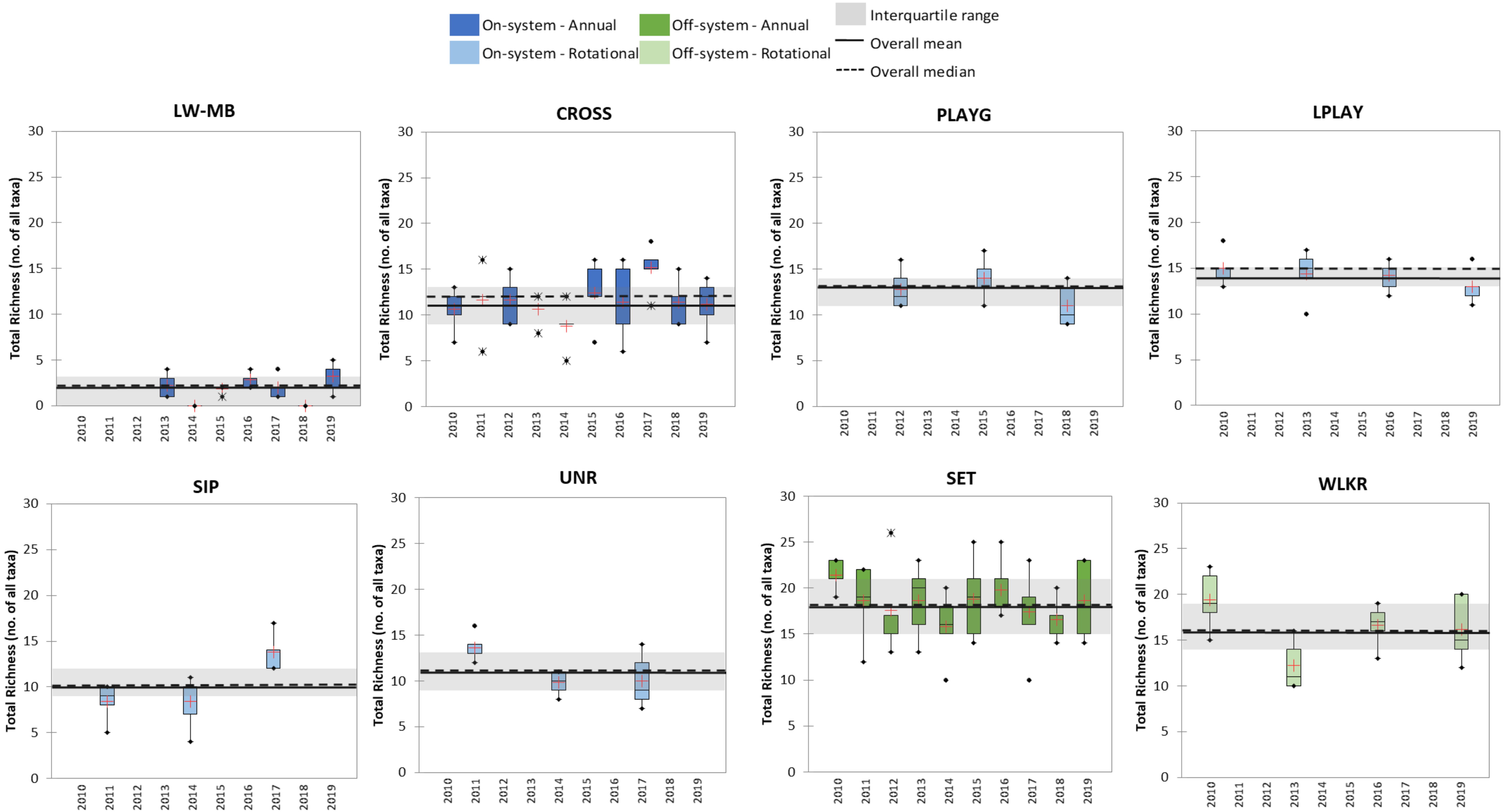


Figure 4.4-1. 2010 to 2019 Nearshore benthic invertebrate total richness (family-level).

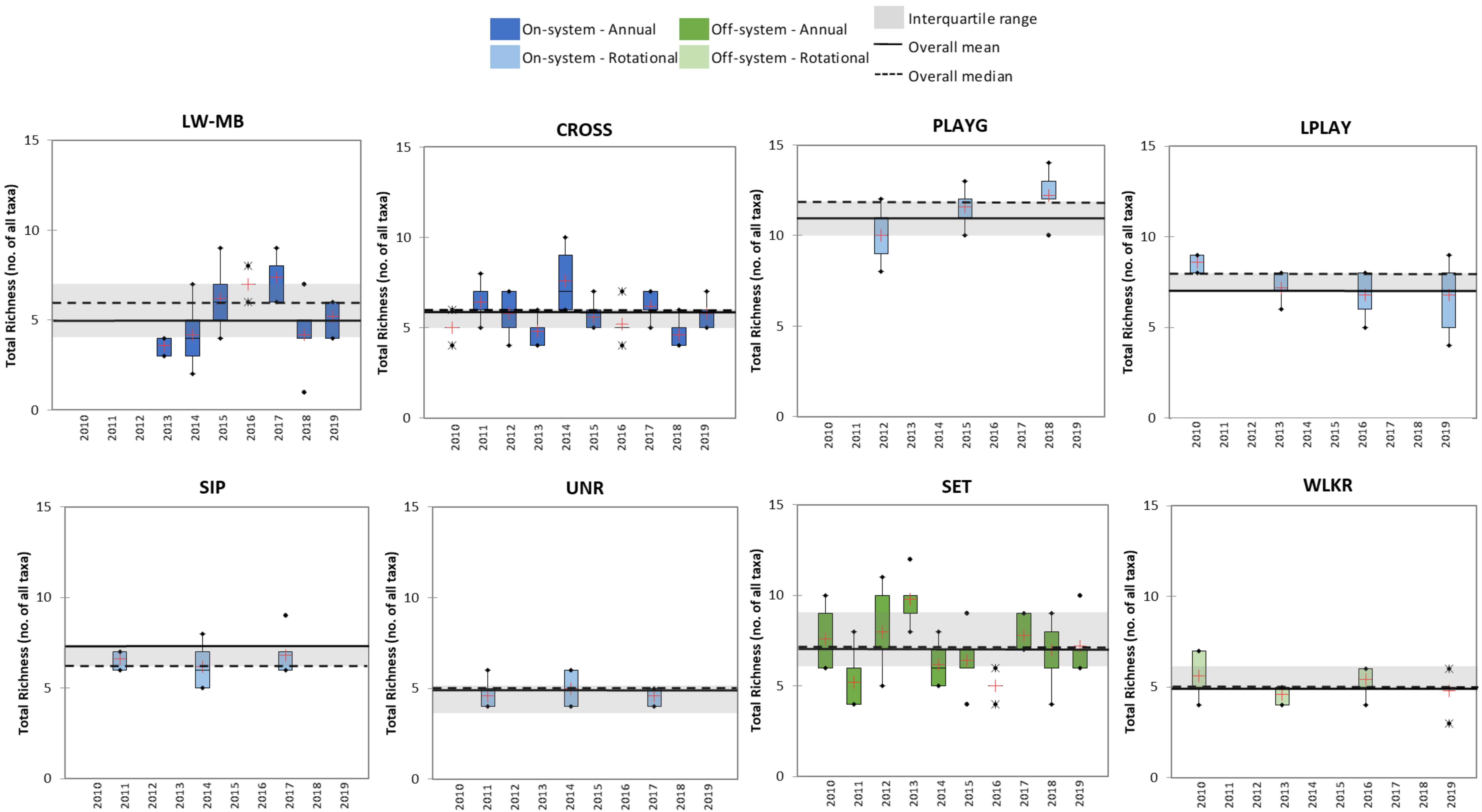


Figure 4.4-2. 2010 to 2019 Offshore benthic invertebrate total richness (family-level).

4.4.2 EPT TAXA RICHNESS

4.4.2.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg – Mossy Bay

Nearshore Habitat

Annual mean EPT taxa richness over the seven years of monitoring ranged from zero families (2014, 2017, and 2018) to two families (2019; Figure 4.4-3). The overall mean was slightly less than one family (0.8), the median was one family, and the interquartile range was 0 to 1 family. Annual means were within the IQR, except in 2019 (above). No benthic invertebrates were collected in nearshore samples in 2014 and 2018.

Offshore Habitat

Annual mean EPT taxa richness over the seven years of monitoring ranged from one family (2013 to 2016 and 2018 to 2019) to two families (2017; Figure 4.4-4). The overall mean was slightly more than one family (1.1), the median was one family, and the interquartile range was 0 to 2 families. Annual means for all years fell within the interquartile range.

Cross Lake - West

Nearshore Habitat

Annual mean EPT taxa richness over the ten years of monitoring ranged from three families (2014) to five families (2011 to 2013, and 2017; Figure 4.4-3). The overall mean was four families, the overall median was five families, and the interquartile range was 3 to 6 families. Annual means were within the IQR, except in 2014 (below).

Offshore Habitat

Annual mean EPT taxa richness over the ten years of monitoring ranged from one family (2010, 2012, 2013, and 2015 to 2019) to two families (2011 and 2014; Figure 4.4-4). The overall mean was slightly more than one family (1.2), the median was one family, and the interquartile range was within one family. Annual means were above the IQR in 2011, 2014, 2016, and 2017.

ROTATIONAL SITES

Playgreen Lake

Nearshore Habitat

Annual mean EPT taxa richness over the three years of monitoring ranged from one family (2018) to five families (2015; Figure 4.4-3). The overall mean and median were three families, and the interquartile range was 2 to 4 families. Annual means were below the IQR in 2018, and above the IQR in 2015.

Offshore Habitat

Annual mean EPT taxa richness over the three years of monitoring ranged from two families (2012 and 2018) to three families (2015; Figure 4.4-4). The overall mean was more than two families (2.5), the median was two families, and the interquartile range was 2 to 3 families. Annual means for all years fell within the interquartile range.

Little Playgreen Lake

Nearshore Habitat

Annual mean EPT taxa richness over the four years of monitoring ranged from three families (2016) to five families (2010; Figure 4.4-3). The overall mean and median were four families, and the interquartile range was 3 to 5 families. Annual means for all years fell within the interquartile range.

Offshore Habitat

Annual mean EPT taxa richness over the four years of monitoring was two families (2010, 2013, 2016, and 2019; Figure 4.4-4). The overall mean was slightly more than two families (2.1), the median was two families, and the interquartile range was 2 to more than 2 families (2.3). Annual means were below the IQR in 2016 and 2019, and above the IQR in 2010.

Sipiwesk Lake

Nearshore Habitat

Annual mean EPT taxa richness over the three years of monitoring ranged from two families (2011 and 2014) to five families (2017; Figure 4.4-3). The overall mean was more than three families (3.3), the median was three families, and the interquartile range was 2 to more than 4 families (4.5). Annual means were within the IQR, except in 2017 (above).

Offshore Habitat

Annual mean EPT taxa richness over the three years of monitoring ranged from one family (2014) to two families (2011 and 2017; Figure 4.4-4). The overall mean was slightly less than two families (1.8), median was two families, and the interquartile range was less than two (1.5) to two families. Annual means were below the IQR in 2014, and above the IQR in 2017.

Upper Nelson River

Nearshore Habitat

Annual mean EPT taxa richness over the three years of monitoring ranged from two families (2014 and 2017) to three families (2011; Figure 4.4-3). The overall mean was more than two families (2.3), the median was two families, and the interquartile range was 2 to 3 families. Annual means for all years fell within the interquartile range.

Offshore Habitat

Annual mean EPT taxa richness over the three years of monitoring was one family (2011, 2014, and 2017; Figure 4.4-4). The overall mean was slightly more than one family (1.2), the median was one family, and the interquartile range was within one family. Annual means were within the IQR, except in 2011 (above).

4.4.2.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Nearshore Habitat

Annual mean EPT taxa richness over the ten years of monitoring ranged from six families (2014, 2018, and 2019) to nine families (2016; Figure 4.4-3). The overall mean and median were seven families, and the interquartile range was 6 to 9 families. Annual means were below the IQR in 2014, and above the IQR in 2016.

Offshore Habitat

Annual mean EPT taxa richness over the ten years of monitoring ranged from one family (2011, 2012, and 2014 to 2017) to two families (2010, 2013, 2018, and 2019; Figure 4.4-4). The overall mean was more than one family (1.5), the overall median was one family, and the interquartile range was 1 to 2 families. Annual means were within the IQR, except in 2013 (above).

ROTATIONAL SITES

Walker Lake

Nearshore Habitat

Annual mean EPT taxa richness over the four years of monitoring ranged from four families (2013) to ten families (2010; Figure 4.4-3). The overall mean was more than six families (6.4), the median was six families, and the interquartile range was 4 to 8 families. Annual means were within the IQR, except in 2010 (above).

Offshore Habitat

Annual mean EPT taxa richness over the four years of monitoring ranged from zero families (2010, 2013, and 2019) to one family (2016; Figure 4.4-4). The overall mean less than one family (0.4), the overall median value was zero, and the interquartile range was 0 to 1 family. Annual means for all years fell within the interquartile range.

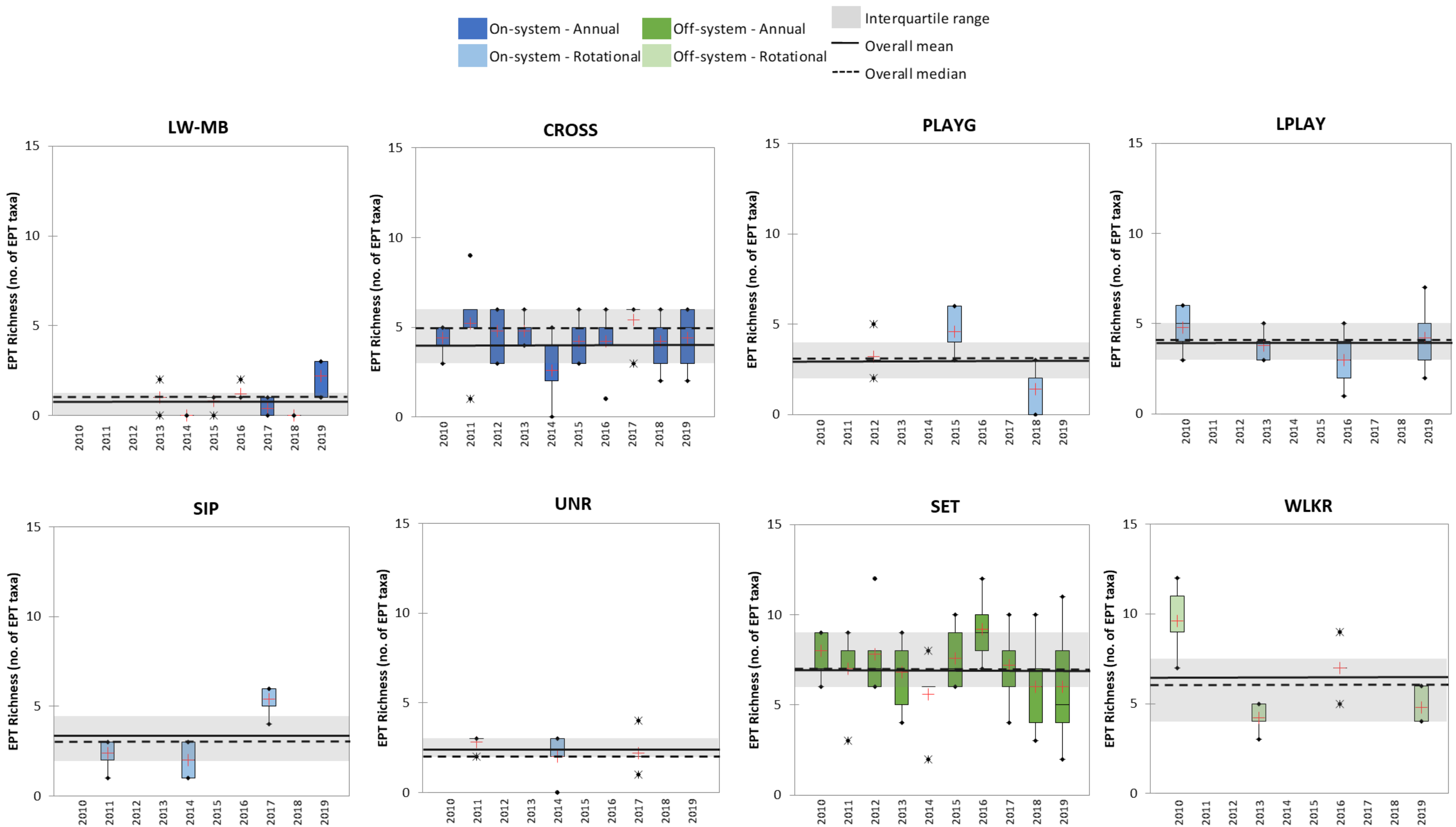


Figure 4.4-3. 2010 to 2019 Nearshore benthic invertebrate EPT richness (family level).

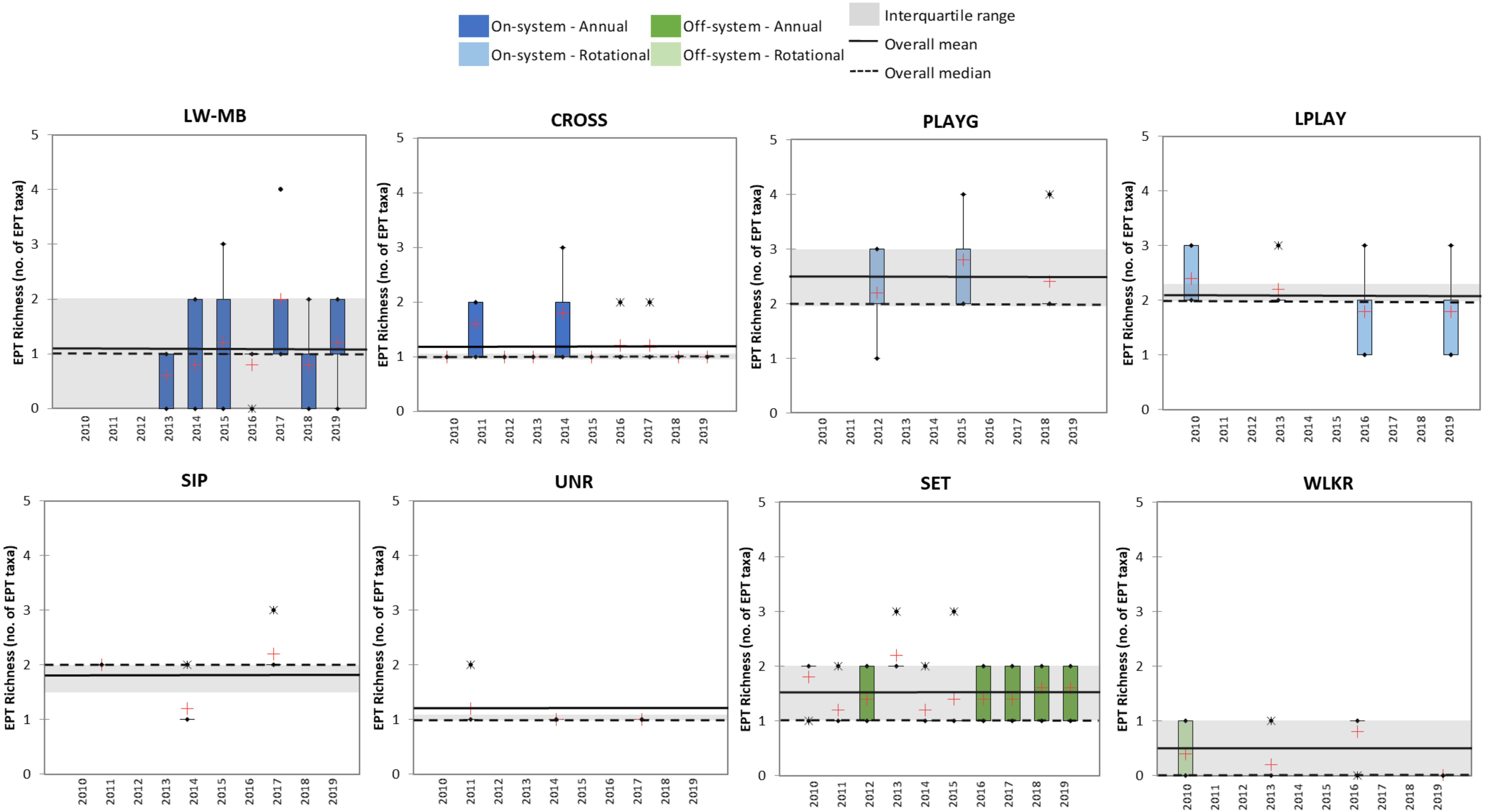


Figure 4.4-4. 2010 to 2019 Offshore benthic invertebrate EPT richness (family level).

4.5 DIVERSITY

4.5.1 HILL'S EFFECTIVE RICHNESS

4.5.1.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg – Mossy Bay

Nearshore Habitat

Annual mean Hill's effective richness (Hill's index) over the seven years of monitoring ranged from zero (2014 and 2018) to three (2019; Figure 4.5-1). The overall mean and median were more than one (1.4), and the interquartile range was 0 to 2. Annual means were within the IQR, except in 2019 (above). No benthic invertebrates were collected in nearshore samples in 2014 and 2018.

Offshore Habitat

Annual mean Hill's index over the seven years of monitoring ranged from two (2018) to five (2016 and 2017; Figure 4.5-2). The overall mean was more than three (3.6), the overall median was three, and the interquartile range was 3 to slightly above 4. Annual means were below the IQR in 2018, and above the IQR in 2016 and 2017.

Cross Lake - West

Nearshore Habitat

Annual mean Hill's index over the ten years of monitoring ranged from three (2010 and 2014) to six (2017; Figure 4.5-1). The overall mean was more than four (4.5), the median was four, and the interquartile range was 3 to 6. Annual means were below the IQR in 2010 and 2014.

Offshore Habitat

Annual mean Hill's index over the ten years of monitoring ranged from two (2013, 2015, and 2016) to four (2010 and 2019; Figure 4.5-2). The overall mean and median were three, and the interquartile range was slightly more than 2 to 3. Annual means were below the IQR in 2013 and 2016, and above the IQR in 2010, 2011, and 2019.

ROTATIONAL SITES

Playgreen Lake

Nearshore Habitat

Annual mean Hill's index over the three years of monitoring ranged from three (2012 and 2015) to four (2018; Figure 4.5-1). The overall mean and median were three, and the interquartile range was slightly less than and more than three. Annual means were within the IQR, except in 2018 (above).

Offshore Habitat

Annual mean Hill's index over the three years of monitoring ranged from four (2015) to six (2018; Figure 4.5-2). The overall mean and median were five, and the interquartile range was 4 to more than 5 (5.4). Annual means were within the IQR, except in 2018 (above).

Little Playgreen Lake

Nearshore Habitat

Annual mean Hill's index over the four years of monitoring ranged from four (2013) to seven (2019; Figure 4.5-1). The overall mean and median were five, and the interquartile range was from 4 to 6. Annual means were below the IQR in 2013, and above the IQR in 2019.

Offshore Habitat

Annual mean Hill's index over the four years of monitoring ranged from three (2010, 2013, and 2019) to four (2016; Figure 4.5-2). The overall mean and median were slightly more than three, and the interquartile range was 3 to slightly above 3. Annual means were within the IQR, except in 2013 (below).

Sipiwesk Lake

Nearshore Habitat

Annual mean Hill's index over the three years of monitoring ranged from three (2014) to five (2017; Figure 4.5-1). The overall mean was less than four (3.7), the median was four, and the interquartile range was 3 to 5. Annual means were below the IQR in 2014, and above the IQR in 2017.

Offshore Habitat

Annual mean Hill's index over the three years of monitoring ranged from three (2011 and 2017) to four (2014; Figure 4.5-2). The overall mean and median were three, and the interquartile range was 3 to slightly more than 3. Annual means were below the IQR in 2011, and above the IQR in 2014.

Upper Nelson River

Nearshore Habitat

Annual mean Hill's index over the three years of monitoring was four (2011, 2014, and 2017; Figure 4.5-1). The overall mean and median were four, and the interquartile range was 4 to less than 5 (4.7). Annual means for all years were within the interquartile range.

Offshore Habitat

Annual mean Hill's index over the three years of monitoring was three (2011, 2014, and 2017; Figure 4.5-2). The overall mean and median were slightly less than three, and the interquartile range was slightly below 3 to 3. Annual means for all years were within the interquartile range.

4.5.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Nearshore Habitat

Annual mean Hill's index over the ten years of monitoring ranged from four (2014, 2017, and 2018) to eight (2010; Figure 4.5-1). The overall mean and median were six, and the interquartile range was 4 to 8. Annual means were within the IQR, except in 2010 (above).

Offshore Habitat

Annual mean Hill's index over the ten years of monitoring ranged from two (2015) to five (2019; Figure 4.5-2). The overall mean and median were three, and the interquartile range was 3 to 4. Annual means were below the IQR in 2011 and 2015, and above the IQR in 2019.

ROTATIONAL SITES

Walker Lake

Nearshore Habitat

Annual mean Hill's index over the four years of monitoring ranged from four (2013) to eight (2016; Figure 4.5-1). The overall mean and median were more than six, and the interquartile range was 5 to 7. Annual means were below the IQR in 2013, and above the IQR in 2016.

Offshore Habitat

Annual mean Hill's index over the four years of monitoring ranged from three (2010, 2013, and 2019) to four (2016; Figure 4.5-2). The overall mean and median were slightly more than three, and the interquartile range was less than 3 (2.6) to less than 4 (3.6). Annual means were within the IQR, except in 2016 (above).

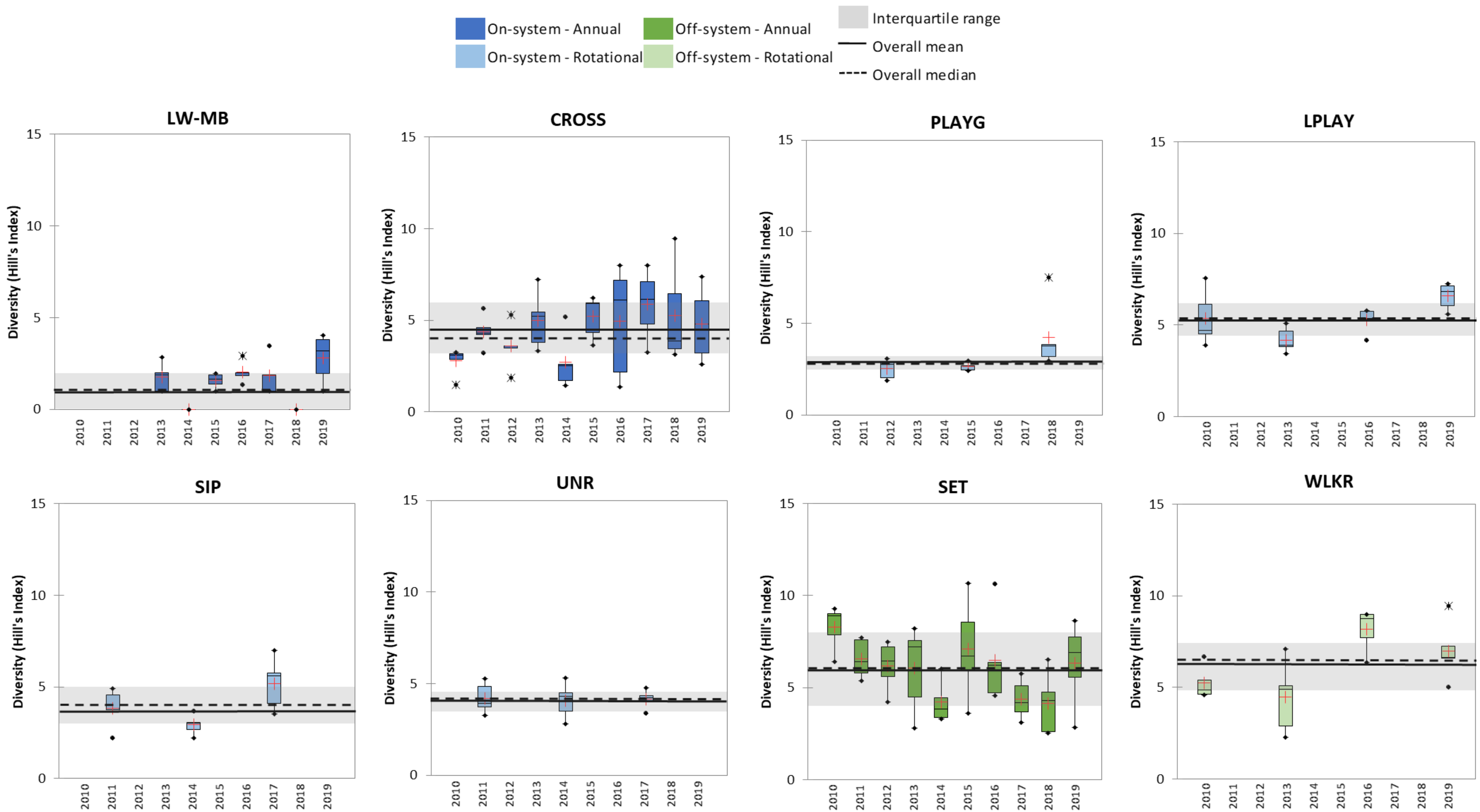


Figure 4.5-1. 2010 to 2019 Nearshore benthic invertebrate diversity (family level).

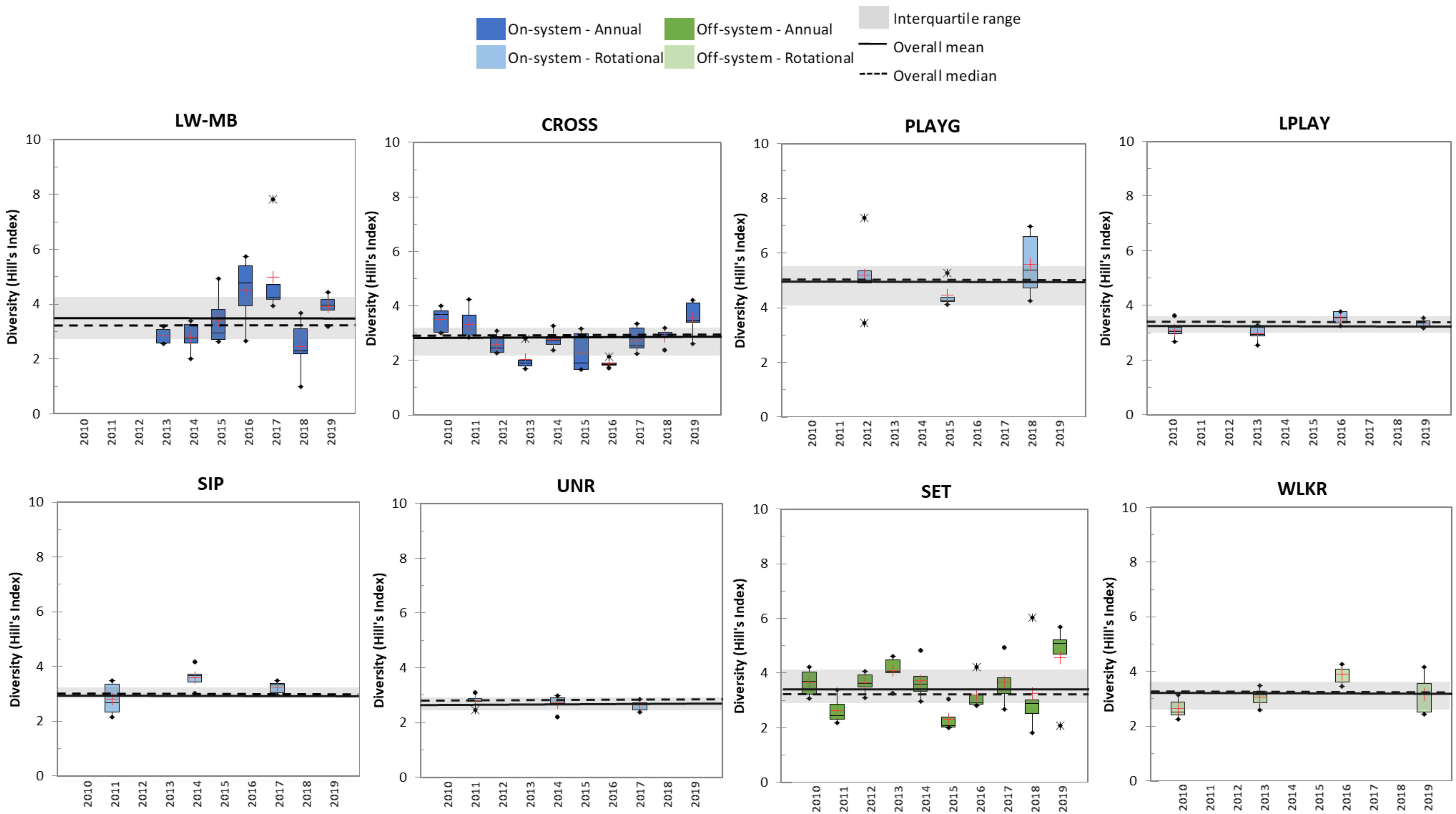


Figure 4.5-2. 2010 to 2019 Offshore benthic invertebrate diversity (family level).

APPENDIX 4-1. BENTHIC INVERTEBRATE NEARSHORE AND OFFSHORE SAMPLING SITES: 2008-2019

Figure A4-1-1. 2010 to 2019 Lake Winnipeg – Mossy Bay nearshore (NS) and offshore (OS) benthic invertebrate sampling sites.

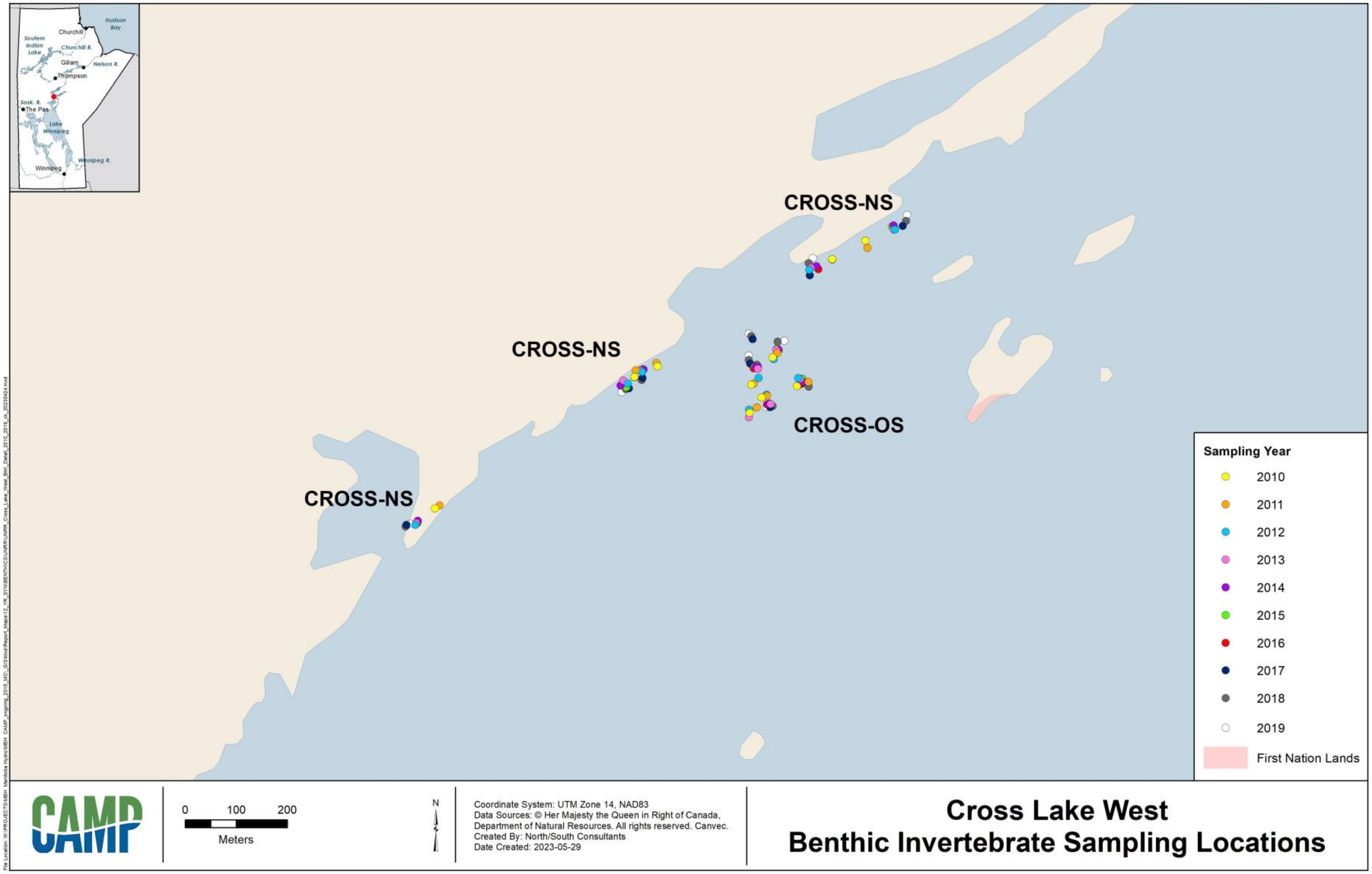


Figure A4-1-2. 2010 to 2019 Cross Lake nearshore (NS) and offshore (OS) benthic invertebrate sampling sites.

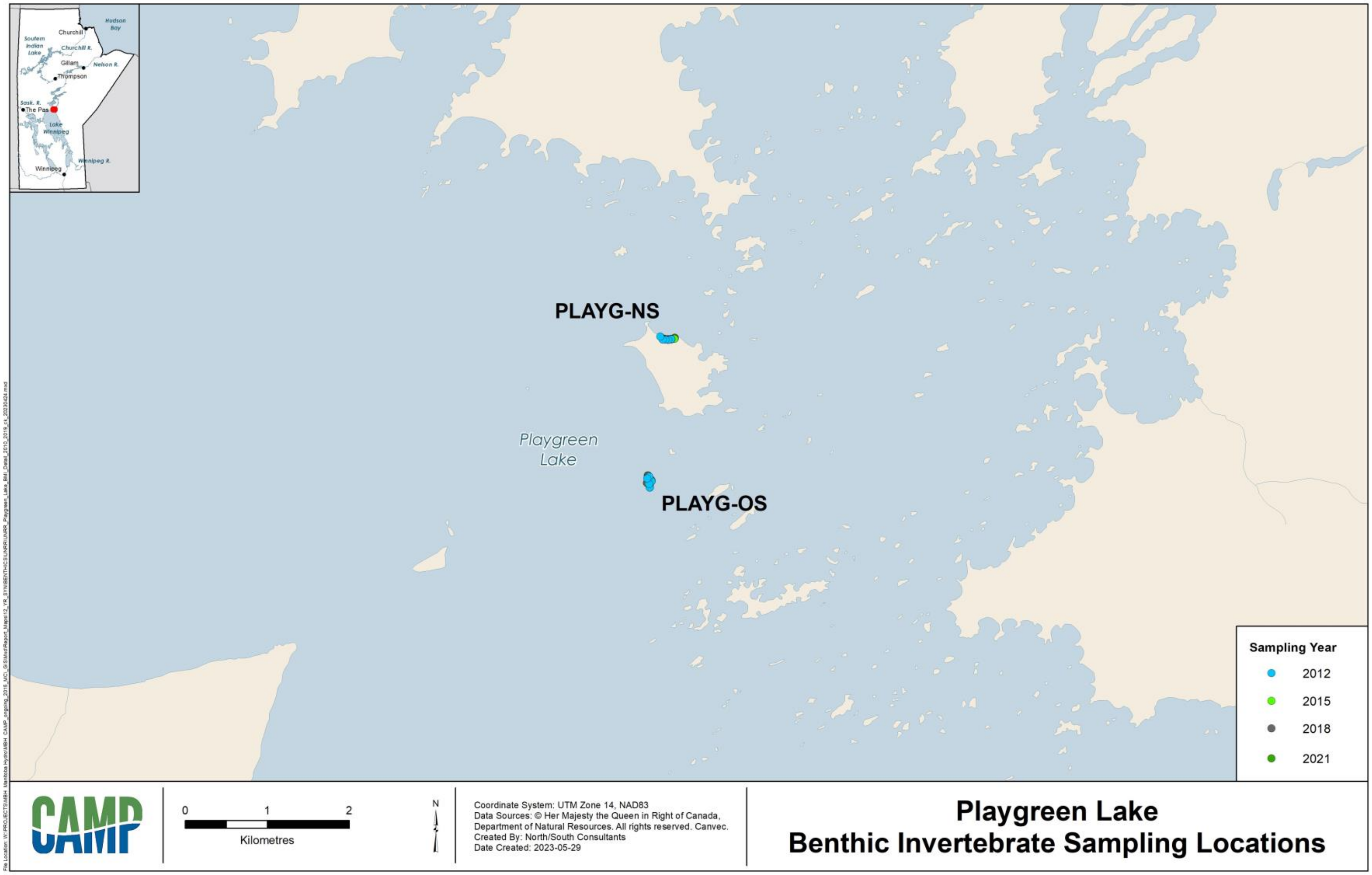


Figure A4-1-3. 2010 to 2019 Playgreen Lake nearshore (NS) and offshore (OS) benthic invertebrate sampling sites.

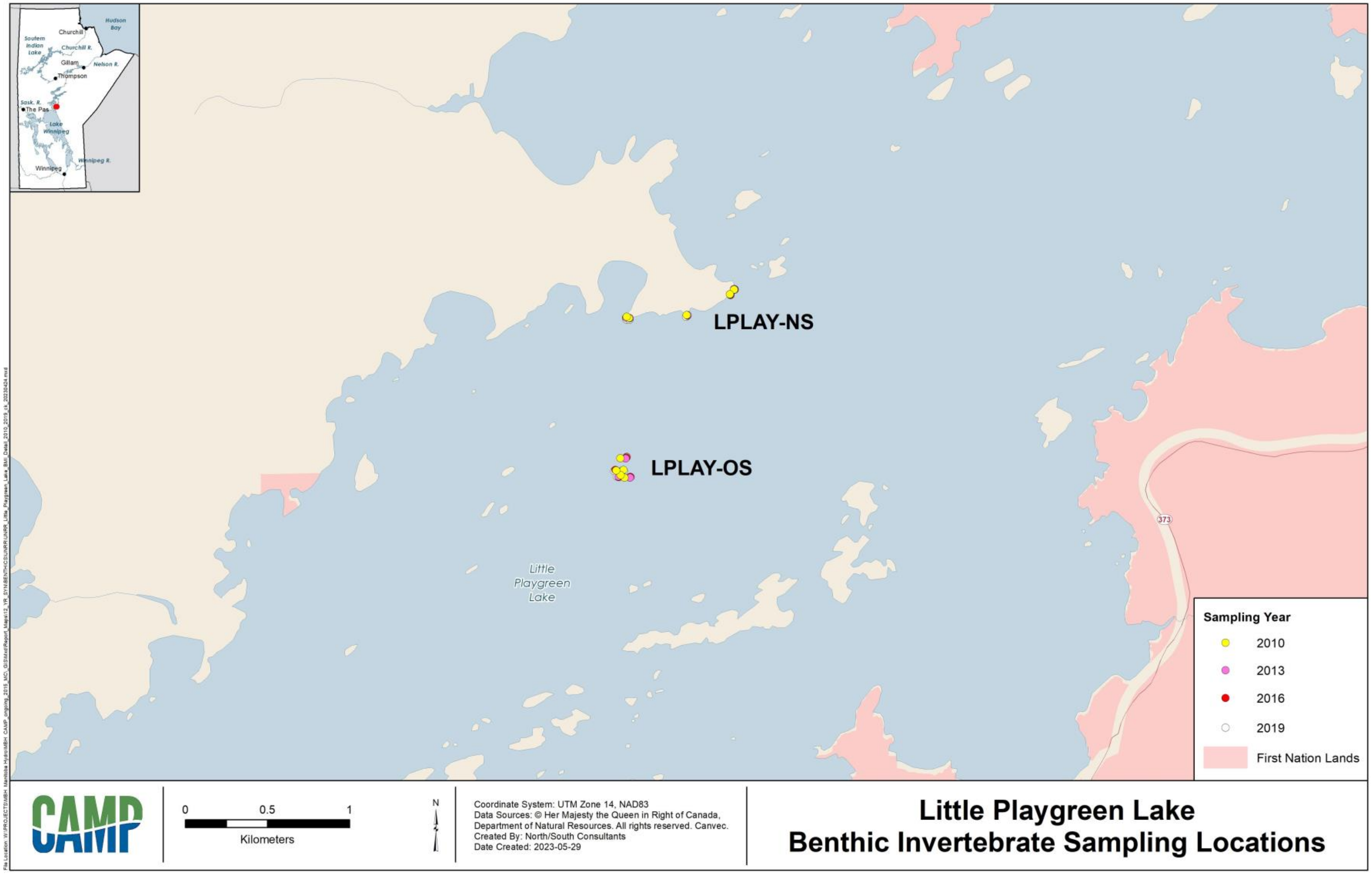


Figure A4-1-4. 2010 to 2019 Little Playgreen Lake nearshore (NS) and offshore (OS) benthic invertebrate sampling sites.

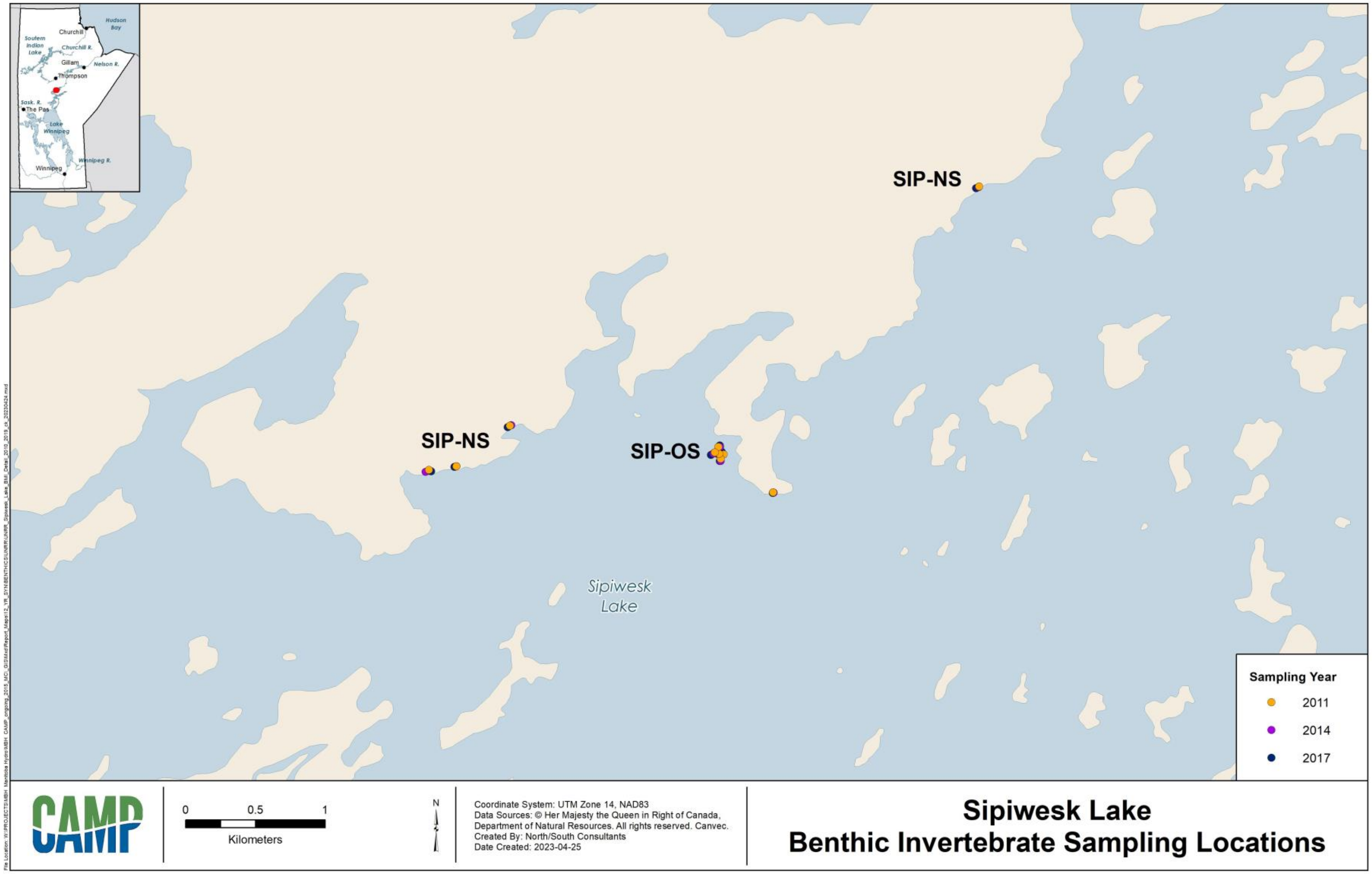


Figure A4-1-5. 2010 to 2019 Sipiwesk Lake nearshore (NS) and offshore (OS) benthic invertebrate sampling sites.

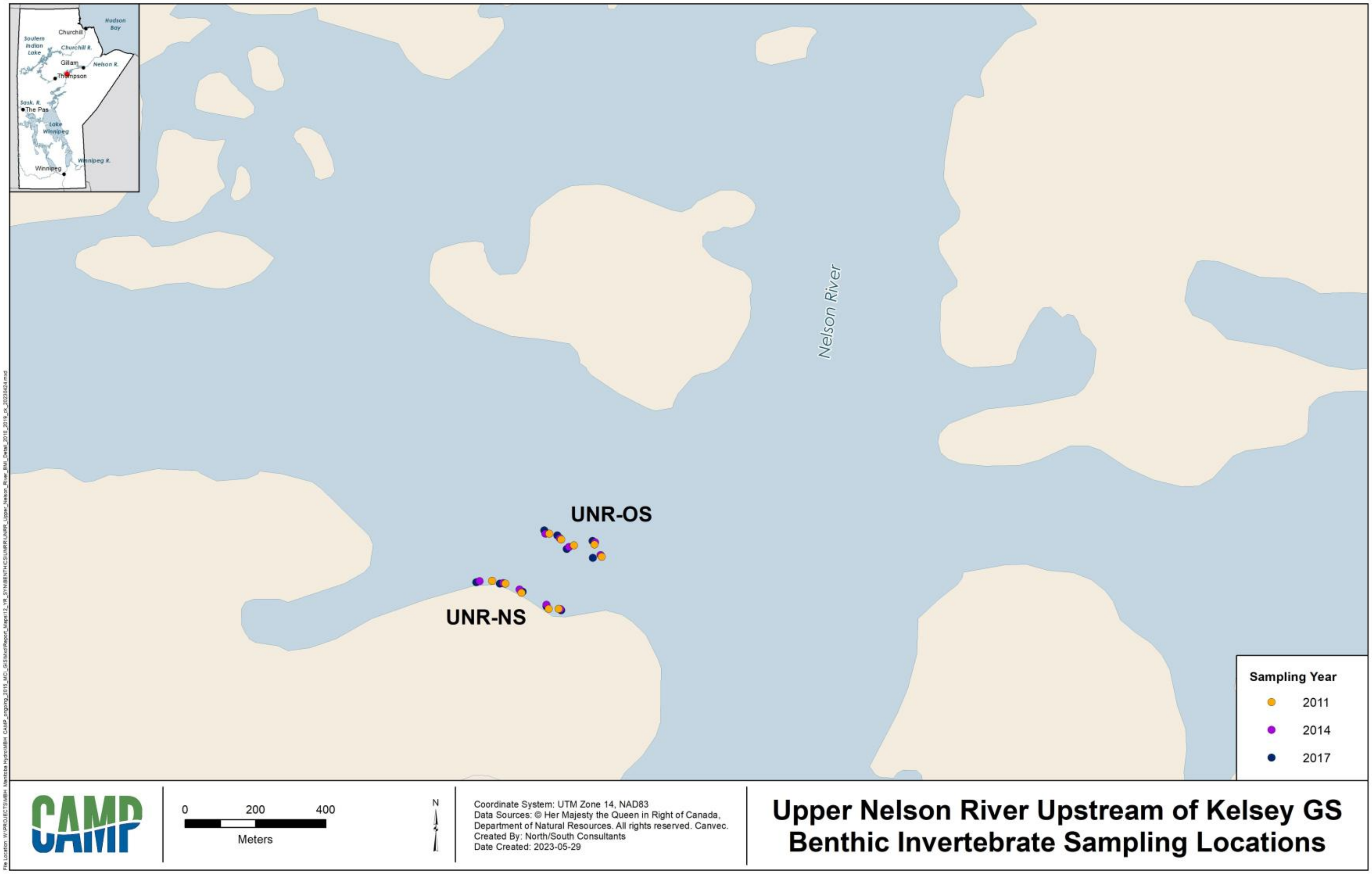


Figure A4-1-6. 2010 to 2019 Upper Nelson River upstream of Kelsey GS nearshore (NS) and offshore (OS) benthic invertebrate sampling sites.

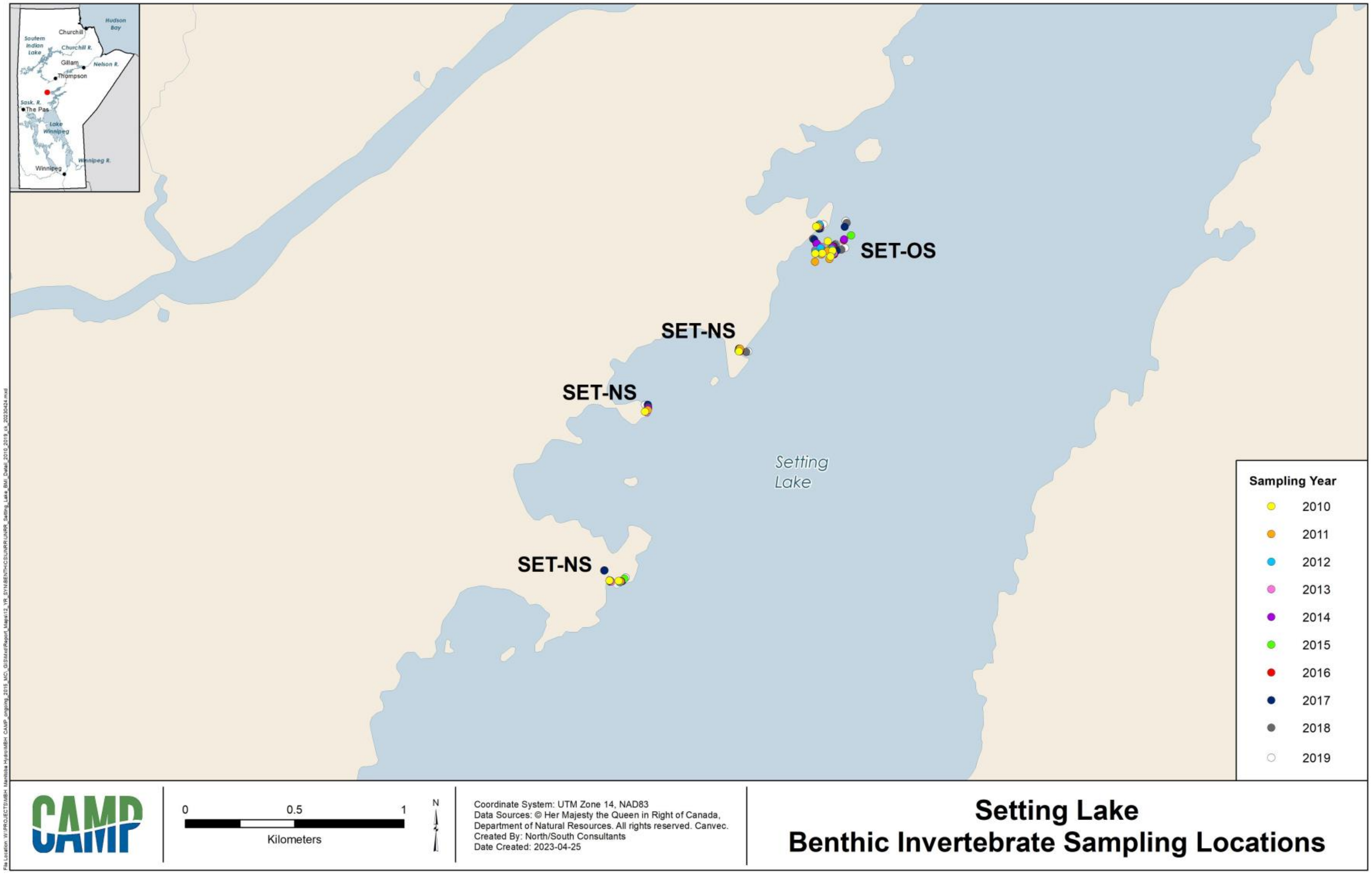


Figure A4-1-7. 2010 to 2019 Setting Lake nearshore (NS) and offshore (OS) benthic invertebrate sampling sites.

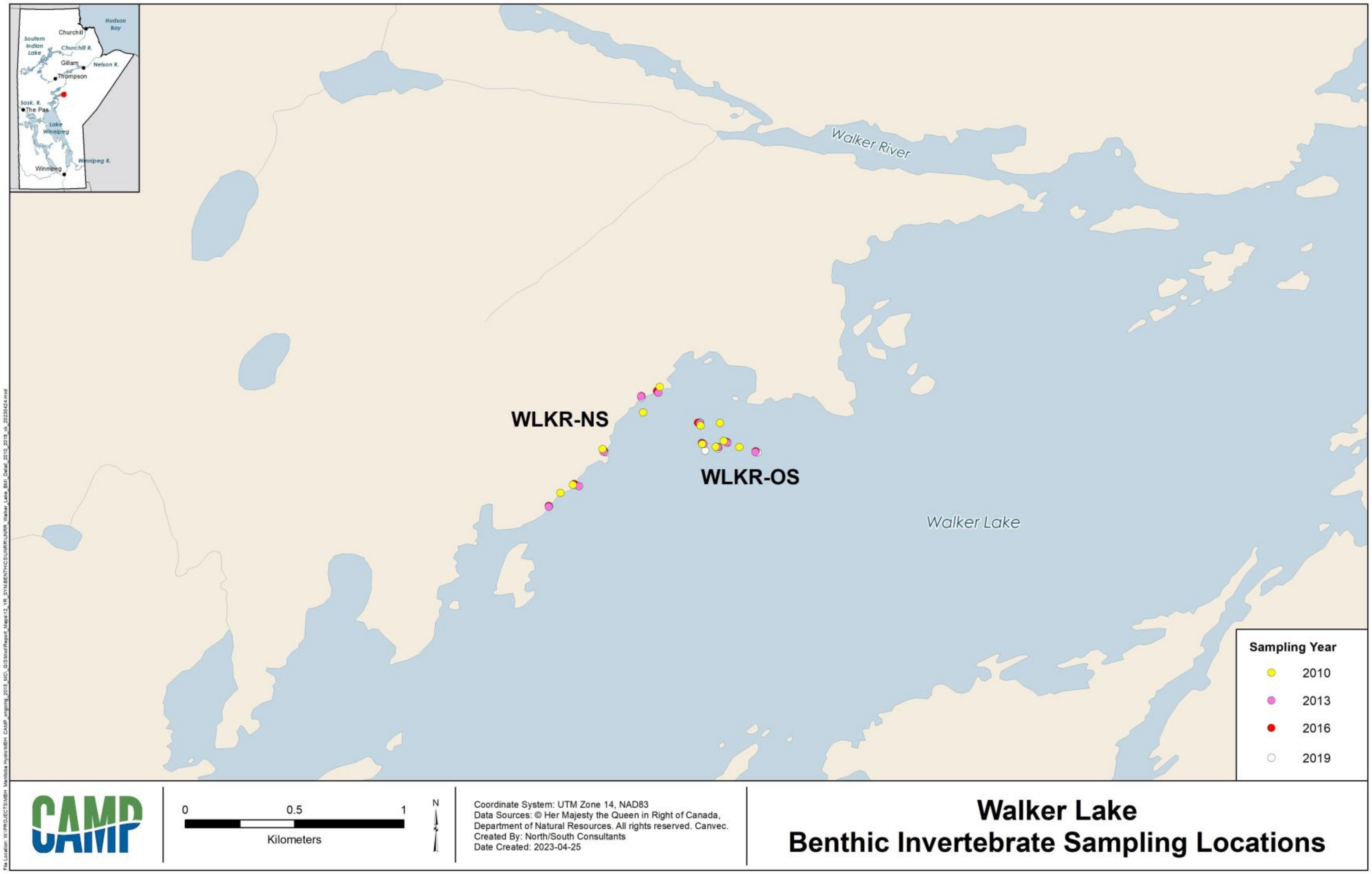


Figure A4-1-8. 2010 to 2019 Walker Lake nearshore (NS) and offshore (OS) benthic invertebrate sampling sites.

APPENDIX 4-2. BENTHIC INVERTEBRATE NEARSHORE AND OFFSHORE SUPPORTING SUBSTRATE DATA BY YEAR

Table A4-2-1. 2010 to 2019 Lake Winnipeg – Mossy Bay nearshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2013	fines	0.3	33.7	35.8	30.4	0.4	Clay loam/silty clay
2014	coarse + fines	0.6	99.0	0.4	0.7	0.3	Sand
2015	coarse + fines	0.6	53.0	25.7	21.2	0.5	Sand
2016	fines	0.7	70.1	18.2	14.6	0.5	Sand
2017	coarse + fines	0.5	46.6	41.2	47.2	1.3	Silty clay/sand
2018	coarse + fines	0.6	52.7	56.8	36.6	1.4	Silty clay loam
2019	coarse, fines + hard	0.4	58.5	25.7	26.1	--	Sand

Notes:

1. TOC = Total organic carbon.

Table A4-2-2. 2010 to 2019 Lake Winnipeg – Mossy Bay offshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2013	fines	5.5	22.5	39.0	38.6	0.5	Silty clay
2014	fines + coarse	6.2	27.7	36.3	36.1	0.6	Clay loam / Clay
2015	fines + coarse	5.7	46.6	40.2	13.3	0.6	Silt loam
2016	fines + coarse	5.6	21.5	29.8	48.7	1.5	Clay
2017	fines	5.5	33.4	38.3	28.3	1.1	Loam
2018	fines + coarse	5.0	47.3	30.4	22.3	0.8	Silty clay loam
2019	fines + coarse	4.9	62.3	17.5	20.3	0.9	Clay loam

Notes:

1. TOC = Total organic carbon.

Table A4-2-3. 2010 to 2019 Cross Lake nearshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010	hard	0.8	77.0	11.3	11.7	2.3	Sandy loam
2011	hard, fines + organics	no sample	-	-	-	-	-
2012	coarse + fines	0.5	72.2	19.0	8.8	1.4	Sandy loam
2013	hard, coarse + fines	no sample	-	-	-	-	-
2014	hard	0.6	64.8	8.6	26.7	1.1	Sandy clay loam
2015	hard + coarse	no sample	-	-	-	-	-
2016	hard + coarse	0.4	79.9	15.1	4.9	1.1	Loamy sand
2017	hard + coarse	0.7	80.0	13.5	6.5	0.7	Loamy sand
2018	fines, hard + coarse	0.5	78.2	20.3	2.1	1.4	Sand
2019	hard + coarse	no sample	-	-	-	-	-

Notes:

1. TOC = Total organic carbon.

Table A4-2-4. 2010 to 2019 Cross Lake offshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010	fines	7.9	3.0	58.3	38.7	2.4	Silty clay loam
2011	fines	7.9	2.7	91.5	5.8	2.3	Silt
2012	fines + organics	7.1	0.7	86.1	13.1	2.5	Silt loam
2013	fines	6.7	1.7	74.0	24.3	2.4	Silt loam
2014	fines	8.0	1.0	74.3	24.7	2.7	Silt loam
2015	fines	5.4	0.3	90.1	9.6	3.0	Silt
2016	fines	5.5	-	89.3	10.6	4.4	Silt
2017	fines	5.1	-	89.0	10.6	3.7	Silt
2018	fines + organics	3.8	2.6	87.5	11.2	4.0	Silt
2019	fines + organics	4.1	1.4	91.2	8.3	3.0	Silt

Notes:

1. TOC = Total organic carbon.

Table A4-2-5. 2010 to 2019 Playgreen Lake nearshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2012	fines + coarse	0.5	98.6	1.0	0.5	0.2	Sand
2015	fines	0.9	99.8	0.3	-	-	Sand
2018	fines + coarse	0.5	99.3	-	-	0.1	Sand

Notes:
1. TOC = Total organic carbon.

Table A4-2-6. 2010 to 2019 Playgreen Lake offshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2012	fines	6.82	15.14	76.0	8.9	1.4	Silt loam
2015	fines	7.12	31.06	62.7	6.3	1.0	Silt loam
2018	fines + organics	6.5	35.84	59.7	4.5	1.8	Silt loam

Notes:
1. TOC = Total organic carbon.

Table A4-2-7. 2010 to 2019 Little Playgreen Lake nearshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010	hard	no sample	-	-	-	-	-
2013	hard	no sample	-	-	-	-	-
2016	hard	no sample	-	-	-	-	-
2019	hard	no sample	-	-	-	-	-

Notes:
1. TOC = Total organic carbon.

Table A4-2-8. 2010 to 2019 Little Playgreen Lake offshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010	fines	8.2	2.0	55.5	42.6	2.2	Silty clay
2013	fines	7.5	1.2	69.7	29.1	2.2	Silty clay loam
2016	fines	7.8	-	80.1	19.5	3.4	Silt loam
2019	fines + organics	7.3	1.1	91.5	7.7	2.5	Silt

Notes:

1. TOC = Total organic carbon.

Table A4-2-9. 2010 to 2019 Sipiwesk Lake nearshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2011	fines	1.0	45.3	29.5	25.2	0.6	Clay/sand
2014	coarse + hard	0.6	90.2	7.8	2.0	0.2	Sand
2017	coarse + hard	0.1	84.4	9.6	6.0	-	Sand

Notes:

1. TOC = Total organic carbon.

Table A4-2-10. 2010 to 2019 Sipiwesk Lake offshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2011	fines	7.5	29.6	59.9	10.5	1.3	Silt loam
2014	fines	7.3	21.0	43.5	35.5	1.4	Silty clay loam
2017	fines	5.8	30.0	57.0	13.0	1.9	Silt loam / Silt

Notes:

1. TOC = Total organic carbon.

Table A4-2-11. 2010 to 2019 Upper Nelson River upstream of Kelsey GS nearshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2011	fines + organics	1.0	2.9	32.1	65.0	9.1	Clay
2014	fines + organics	0.6	3.8	33.6	62.6	9.7	Clay
2017	fines	0.8	2.7	44.0	54.2	4.6	Clay

Notes:

1. TOC = Total organic carbon.

Table A4-2-12. 2010 to 2019 Upper Nelson River upstream of Kelsey GS offshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2011	fines	8.7	0.8	49.8	49.4	1.9	Silty clay
2014	fines	8.4	0.4	50.8	48.8	2.0	Silty clay
2017	fines	8.7	0.0	74.9	24.8	2.3	Silty clay loam

Notes:

1. TOC = Total organic carbon.

Table A4-2-13. 2010 to 2019 Setting Lake nearshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010	coarse + hard	no sample	-	-	-	-	-
2011	coarse + hard	no sample	-	-	-	-	-
2012	coarse + hard	no sample	-	-	-	-	-
2013	hard	no sample	-	-	-	-	-
2014	hard + coarse	0.5	90.4	4.8	4.8	1.7	Sand
2015	hard + coarse	1.0	96.8	1.2	2.0	0.5	Sand
2016	hard + coarse	no sample	-	-	-	-	-
2017	coarse + fines	0.7	32.5	47.3	20.2	1.5	Clay loam
2018	hard + coarse	0.5	71.4	26.0	5.4	0.7	Sand
2019	hard, coarse + fines	0.5	52.1	35.0	13.0	0.5	Loam

Notes:

1. TOC = Total organic carbon.

Table A4-2-14. 2010 to 2019 Setting Lake offshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010	fines	7.5	12.1	35.4	52.4	2.8	Silty clay
2011	fines	7.8	1.0	42.4	56.5	3.2	Silty clay
2012	fines	7.4	1.2	49.6	49.2	3.3	Silty clay
2013	fines	7.6	1.6	51.1	47.4	3.0	Silty clay
2014	fines	8.2	5.5	41.8	52.7	3.0	Silty clay
2015	fines	8.2	1.6	50.7	47.6	3.1	Silty clay
2016	fines	7.7	5.0	75.5	23.1	3.0	Silt
2017	fines	7.6	10.7	59.2	30.1	2.8	Silty clay
2018	fines	8.4	7.8	79.2	21.6	3.1	Silt
2019	fines + organics	7.3	7.9	41.1	53.9	3.1	Clay

Notes:
1. TOC = Total organic carbon.

Table A4-2-15. 2010 to 2019 Walker Lake nearshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010	hard + coarse	no sample	-	-	-	-	-
2013	hard	no sample	-	-	-	-	-
2016	hard	no sample	-	-	-	-	-
2019	hard, coarse + fines	no sample	-	-	-	-	-

Notes:
1. TOC = Total organic carbon.

Table A4-2-16. 2010 to 2019 Walker Lake offshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010	fines + organics	7.1	71.5	17.8	10.7	7.3	Sand
2013	fines	7.9	51.6	39.0	9.5	13.6	Sandy loam
2016	fines	7.7	33.1	53.2	13.7	12.6	Silt loam
2019	fines + organics	7.2	26.3	62.3	11.4	19.1	Silt loam

Notes:
1. TOC = Total organic carbon.

5.0 FISH COMMUNITY

5.1 INTRODUCTION

The following presents the results of fish community monitoring conducted from 2008 to 2019 in the Upper Nelson River Region. Eight waterbodies were monitored in the Upper Nelson River Region: two on-system annual sites (Lake Winnipeg – Mossy Bay and Cross Lake – West Basin, herein referred to as Cross Lake); four on-system rotational sites (Playgreen Lake, Little Playgreen Lake, Sipiwesk Lake, and the upper Nelson River upstream of the Kelsey GS); one off-system annual site (Setting Lake), and one off-system rotational site (Walker Lake; Table 5.1-1 and Figure 5.1-1).

There was one departure from the planned field sampling during the 12-year period:

- Playgreen Lake was sampled in 2009 and 2010 because it was not identified as a rotational waterbody for fish community sampling and as a fish mercury sampling waterbody until 2010.

Monitoring targets both small-bodied fish species (i.e., forage fish) and large-bodied fish species (e.g., fish targeted in subsistence, commercial, and/or recreational fisheries). Within a given waterbody, sampling was conducted at approximately the same time of year during each year of monitoring. Standard gang index gill nets (GN; 51, 76, 95, 108, and 127 mm stretched mesh panels) were set at each site and a small mesh index gillnet gang (SN; 16, 20, and 25 mm bar measure panels) was attached to the end of the standard gang at approximately every third site (Appendix 5-1). Gill nets were set for approximately 24 hours. All fish captured at each site were counted by mesh size and species. Individual metrics (e.g., length, weight, deformities, erosion, lesions, and tumours [collectively referred to as DELTs], sex and maturity, age) were collected for species of management interest (i.e., “target” species). These include: Lake Whitefish (LKWH; *Coregonus clupeaformis*), Walleye (WALL; *Sander vitreus*), from all waterbodies in all years; Northern Pike (NRPK; *Esox lucius*) from all waterbodies in all years except at Lake Winnipeg – Mossy Bay where it was added as a target species in 2009 and at Playgreen Lake starting in 2010; Sauger (SAUG; *S. canadensis*) from Setting Lake from 2012-2019 and from 2017-2019 at the other waterbodies; and White Sucker (WHSC; *Catostomus commersonii*) from all waterbodies starting in 2010. All other species were bulk weighed.

Five fish community indicators (abundance, condition, growth, recruitment, and community diversity) were selected for detailed reporting (Table 5.1-2). Metrics for these indicators that are presented herein include: catch-per-unit-effort (CPUE); Fulton’s condition factor (KF); relative weight (Wr); fork length-at-age (FLA); relative year-class strength (RYCS); Hill's effective species richness (Hill's index); and relative species abundance (RSA; Table 5.1-2).

A detailed description of the program design and sampling methods is provided in Technical Document 1, Section 2.5.

Table 5.1-1. 2008-2019 Inventory of fish community sampling.

Waterbody/Area	Sampling Year											
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
LW-MB	●	●	●	●	●	●	●	●	●	●	●	●
CROSS	●	●	●	●	●	●	●	●	●	●	●	●
PLAYG		●	●[1]		●			●			●	
LPLAYG			●			●			●			●
SIP				●			●			●		
UNR				●			●			●		
SET	●	●	●	●	●	●	●	●	●	●	●	●
WLKR			●			●			●			●

Notes:

1. Playgreen Lake was sampled in 2010 to conduct a mercury program that was not completed as scheduled in 2009.

Table 5.1-2. Fish community indicators and metrics.

Indicator	Metric	Units
Abundance	• Catch-Per-Unit-Effort (CPUE)	# fish/30 m/24 hour (h) # fish/100 m/24 h
Condition	• Fulton's Condition Factor (KF)	-
	• Relative Weight (Wr)	-
Growth	• Fork Length-At-Age (FLA)	mm
Recruitment	• Relative Year-Class Strength (RYCS)	-
Diversity	• Hill's Effective Species Richness	species
	• Relative Species Abundance (RSA)[1]	%

Notes:

1. Supporting metric.

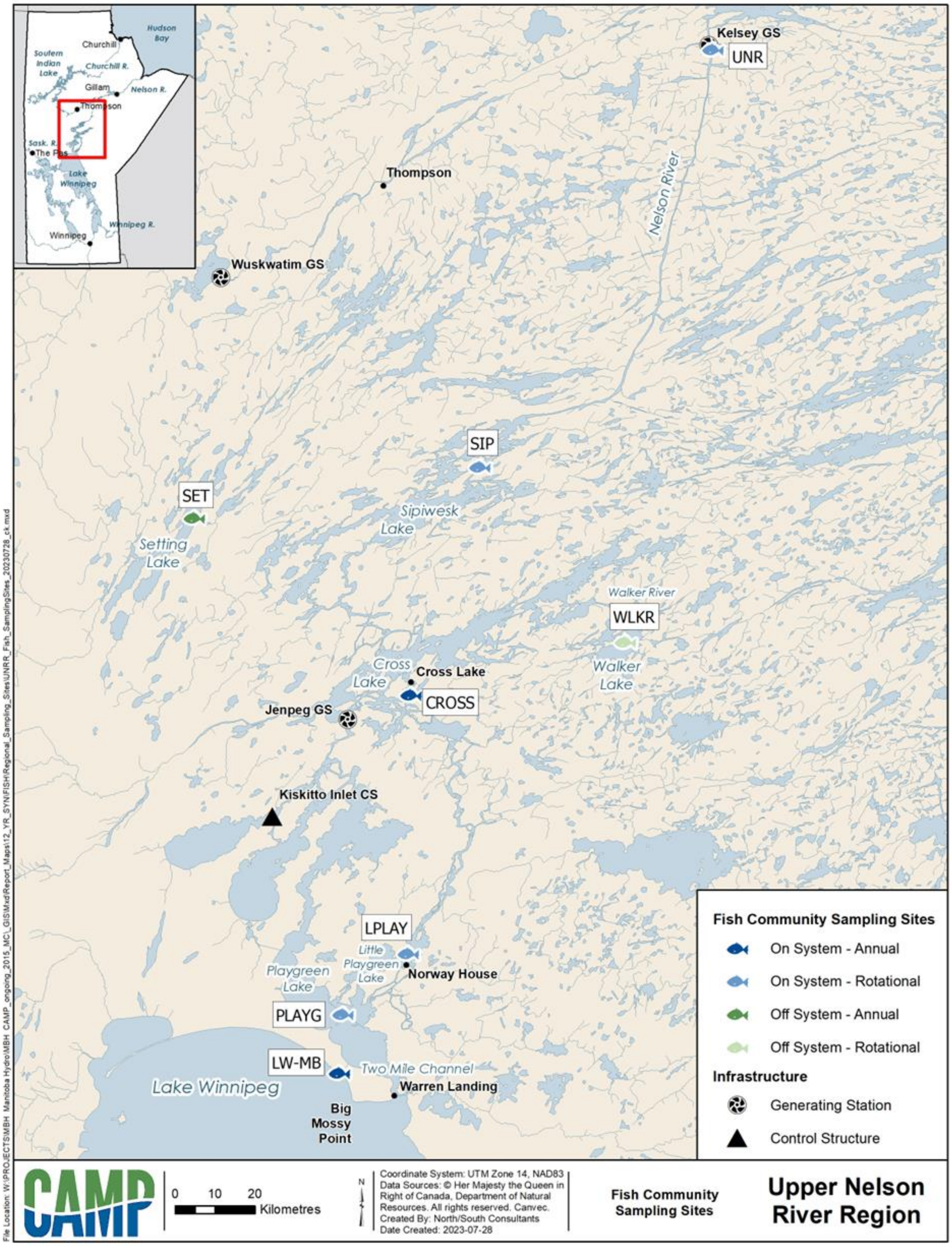


Figure 5.1-1. 2008-2019 Fish community sampling sites.

5.2 ABUNDANCE

5.2.1 CATCH-PER-UNIT-EFFORT

5.2.1.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg – Mossy Bay

Standard Gang Index Gill Nets

The annual mean CPUE over the 12 years of monitoring varied up to about two-fold from year-to-year, with the mean ranging from a low of 49.8 in 2011 to a maximum of 102.7 fish/100 m/24 h in 2013 (Table 5.2-1; Figure 5.2-1).

The overall mean CPUE was 68.5, the median was 62.2, and the IQR was 53.2-81.8 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE fell within the overall IQR except in 2011 when it was below the IQR and in 2009, 2013, and 2017 when it was above the IQR.

Small Mesh Index Gill Nets

The annual mean CPUE in the small mesh gangs over the 10 years of monitoring was more variable than in the standard gangs, with the mean ranging from a low of 18.8 in 2018 to a high of 292.0 fish/30 m/24 h in 2010 (Table 5.2-1; Figure 5.2-2). Small mesh gangs were not set at target locations in 2008 and 2009 (Appendix 5-1).

The overall mean CPUE was 84.7, the median was 61.5, and the IQR was 40.2-96.5 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE fell within the overall IQR except in 2015, 2017, and 2018 when it was below the IQR and in 2010, 2011, and 2013 when it was above the IQR.

Lake Whitefish

Catches of Lake Whitefish were relatively low in Mossy Bay over the 12 years of monitoring, with the annual mean CPUE ranging from a low of 0.3 in 2019 to a high of 3.2 fish/100 m/24 h in 2017 (Table 5.2-1; Figure 5.2-3).

The overall mean CPUE was 1.4, the median was 1.1, and the IQR was 0.7-2.0 fish/100 m/24 h (Figure 5.2-3). The annual mean CPUE fell within the overall IQR except in 2018 and 2019 when it was below the IQR and in 2010, 2013, and 2017 when it was above the IQR.

Northern Pike

Catches of Northern Pike were relatively low in Mossy Bay over the 12 years of monitoring, with the annual mean CPUE ranging from none in 2009 to a high of 2.0 fish/100 m/24 h in 2019 (Table 5.2-1; Figure 5.2-4).

The overall mean CPUE was 0.5, the median was 0.4, and the IQR was 0.1-0.6 fish/100 m/24 h (Figure 5.2-4). The annual mean CPUE fell within the overall IQR except in 2009 when it was below the IQR and in 2008, 2016, and 2019 when it was above the IQR.

Sauger

The annual mean CPUE over the 12 years of monitoring was variable from year-to-year, ranging from a low of 1.7 in 2008 to a high of 40.3 fish/100 m/24 h in 2013 (Table 5.2-1; Figure 5.2-5).

The overall mean CPUE was 11.7, the median was 9.2, and the IQR was 5.1-15.0 fish/100 m/24 h (Figure 5.2-5). The annual mean CPUE fell within the overall IQR except in 2008, 2009, and 2011 when it was below the IQR and in 2013, 2014, and 2015 when it was above the IQR.

Walleye

The annual mean CPUE over the 12 years of monitoring varied by up to about seven-fold from year-to-year, ranging from a low of 6.2 in 2011 to a high of 46.3 fish/100 m/24 h in 2009 (Table 5.2-1; Figure 5.2-6).

The overall mean CPUE was 16.1, the median was 15.0, and the IQR was 10.3-16.1 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE fell within the overall IQR except in 2011, 2012, and 2018 when it was below the IQR and in 2009 and 2013 when it was above the IQR.

White Sucker

The annual mean CPUE over the 12 years of monitoring was variable from year-to-year, ranging from a low of 4.3 in 2008 to a high of 48.2 fish/100 m/24 h in 2019 (Table 5.2-1; Figure 5.2-7).

The overall mean CPUE was 17.2, the median was 9.6, and the IQR was 6.8-28.0 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE fell within the overall IQR except in 2008, 2009, and 2011 when it was below the IQR and in 2017 and 2019 when it was above the IQR.

Cross Lake

Standard Gang Index Gill Nets

The annual mean CPUE over the 12 years of monitoring varied up to about two-fold from year-to-year, with the mean ranging from a low of 28.1 in 2016 to a high of 54.6 fish/100 m/24 h in 2015 (Table 5.2-1; Figure 5.2-1).

The overall mean CPUE was 39.9, the median was 35.6, and the IQR was 32.7-52.0 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE fell within the overall IQR except in 2016 and 2019 when it was below the IQR and in 2015 when it was above the IQR.

Small Mesh Index Gill Nets

The annual mean CPUE in the small mesh gangs over the 12 years of monitoring was more variable than in the standard gangs, with the mean ranging from a low of 95.2 in 2012 to a high of 542.7 fish/30 m/24 h in 2017 (Table 5.2-1; Figure 5.2-2).

The overall mean CPUE was 221.4, the median was 179.6, and the IQR was 148.4-250.0 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE fell within the overall IQR except in 2009, 2012, and 2019 when it was below the IQR and in 2015, 2017, and in 2018 when it was above the IQR.

Lake Whitefish

Catches of Lake Whitefish were low in Cross Lake over the 12 years of monitoring, with the annual mean ranging from none in 2009, 2010, 2011, and 2016 to a high of 0.3 fish/100 m/24 in 2008 (Table 5.2-1; Figure 5.2-3).

The overall mean and median CPUE were 0.1 and the IQR was 0-0.1 fish/100 m/24 (Figure 5.2-3). The annual mean CPUE fell within the overall IQR except in 2008 and 2013 when it was above the IQR.

Northern Pike

The annual mean CPUE over the 12 years of monitoring varied up to about three-fold from year-to-year, with the annual mean ranging from a low of 3.4 in 2019 to a high of 11.4 fish/100 m/24 in 2008 (Table 5.2-1; Figure 5.2-4).

The overall mean CPUE was 7.2, the median was 7.6, and the IQR was 5.7-8.1 fish/100 m/24 (Figure 5.2-4). The annual mean CPUE fell within the overall IQR except in 2016 and 2019 when it was below the IQR and in 2008 and 2018 when it was above the IQR.

Sauger

Catches of Sauger were relatively low in Cross Lake over the 12 years of monitoring, with the annual mean ranging from a low of 0.4 in 2017 to a high of 3.9 fish/100 m/24 h in 2009 (Table 5.2-1; Figure 5.2-5).

The overall mean CPUE was 1.5, the median was 1.2, and the IQR was 0.8-2.1 fish/100 m/24 h (Figure 5.2-5). The annual mean CPUE fell within the overall IQR except in 2012 and 2017 when it was below the IQR and in 2009 and 2014 when it was above the IQR.

Walleye

The annual mean CPUE over the 12 years of monitoring varied up to about three-fold from year-to-year, with the mean ranging from a low of 6.8 in 2011 to a high of 18.9 fish/100 m/24 h in 2008 (Table 5.2-1; Figure 5.2-6).

The overall mean CPUE was 12.3, the median was 11.5, and the IQR was 9.3-15.2 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE fell within the overall IQR except in 2009, 2011, and 2016 when it was below the IQR and in 2008, 2017, and 2018 when it was above the IQR.

White Sucker

The annual mean CPUE over the 12 years of monitoring varied up to about three-fold from year-to-year, with the mean ranging from a low of 4.9 in 2009 to a high of 16.3 fish/100 m/24 h in 2015 (Table 5.2-1; Figure 5.2-7).

The overall mean CPUE was 9.3, the median was 7.5, and the IQR was 6.5-11.7 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE fell within the overall IQR except in 2009 and 2011 when it was below the IQR and in 2015, 2017, and 2018 when it was above the IQR.

ROTATIONAL SITES

<u>Playgreen Lake</u>

Standard Gang Index Gill Nets

The annual mean CPUE over the five years of monitoring varied by up to about two-fold from year-to-year, with the mean ranging from a low of 51.9 in 2009 to a high of 87.0 fish/100 m/24 h in 2010 (Table 5.2-1; Figure 5.2-1).

The overall mean CPUE was 72.6, the median was 77.5, and the IQR was 63.4-83.1 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE was below the IQR in 2009 and was above the IQR in 2010.

Small Mesh Index Gill Nets

The annual mean CPUE in the small mesh gangs over the five years of monitoring was more variable than in the standard gangs, with the mean ranging from a low of 33.5 in 2009 to a high of 1492.0 fish/30 m/24 h in 2018 (Table 5.2-1; Figure 5.2-2).

The overall mean CPUE was 727.4, the median was 880.5, and the IQR was 98.6-1132.3 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE was below the IQR in 2009 and was above the IQR in 2018.

Lake Whitefish

Catches of Lake Whitefish were relatively low in Playgreen Lake over the five years of monitoring, with the annual mean ranging from a low of 1.1 in 2009 to a high of 4.6 fish/100 m/24 in 2015 (Table 5.2-1; Figure 5.2-3).

The overall mean CPUE was 2.8, the median was 3.1, and the IQR was 2.2-3.2 fish/100 m/24 h (Figure 5.2-3). The annual mean CPUE was below the IQR in 2009 and above the IQR in 2015.

Northern Pike

The annual mean CPUE over the five years of monitoring varied up to about two-fold from year-to-year, with the annual mean ranging from a low of 3.9 in 2018 to a high of 9.4 fish/100 m/24 in 2012 (Table 5.2-1; Figure 5.2-4).

The overall mean CPUE was 7.7, the median was 8.2, and the IQR was 8.1-8.9 fish/100 m/24 h (Figure 5.2-4). The annual mean CPUE was below the IQR in 2018 and above the IQR in 2012.

Sauger

The annual mean CPUE over the five years of monitoring varied up to about ten-fold from year-to-year, with the annual mean ranging from a low of 0.9 in 2010 to a high of 9.6 fish/100 m/24 h in 2009 (Table 5.2-1; Figure 5.2-5).

The overall mean CPUE was 4.5, the median was 3.3, and the IQR was 2.7-5.9 fish/100 m/24 h (Figure 5.2-5). The annual mean CPUE was below the IQR in 2010 and was above the IQR in 2009.

Walleye

The annual mean CPUE over the five years of monitoring varied by up to about eight-fold, with the mean ranging from a low of 1.3 in 2009 to a high of 10.4 fish/100 m/24 h in 2010 (Table 5.2-1; Figure 5.2-6).

The overall mean CPUE was 6.7, the median was 6.9, and the IQR was 4.9-10.0 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE was below the IQR in 2009 and above the IQR in 2010.

White Sucker

The annual mean CPUE over the five years of monitoring varied by up to about three-fold, with the mean ranging from a low of 20.7 in 2009 to a high of 54.2 fish/100 m/24 h in 2018 (Table 5.2-1; Figure 5.2-7).

The overall mean CPUE was 40.4, the median was 44.2, and the IQR was 31.6-51.4 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE was below the IQR in 2009 and was slightly above the IQR in 2018.

Little Playgreen Lake

Standard Gang Index Gill Nets

The annual mean CPUE over the four years of monitoring varied up to about three-fold from year-to-year, with the mean ranging from a low of 26.0 in 2019 to a high of 80.1 fish/100 m/24 h in 2010 (Table 5.2-1; Figure 5.2-1).

The overall mean was 50.9, the median was 48.8, and the IQR was 38.3-61.4 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE was below the IQR in 2019 and was above the IQR in 2010.

Small Mesh Index Gill Nets

The annual mean CPUE in the small mesh gangs over the four years of monitoring was more variable than in the standard gangs, with the mean ranging from a low of 364.5 in 2013 to a high of 1672.8 fish/30 m/24 h in 2019 (Table 5.2-1; Figure 5.2-2).

The overall mean CPUE was 1148.8, the median was 1279.0, and the IQR was 972.6-1455.3 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE was below the IQR in 2013 and was above the IQR in 2019.

Lake Whitefish

Catches of Lake Whitefish were low in Little Playgreen Lake over the four years of monitoring, with the annual mean ranging from none in 2013, 2016, and 2019 to a high of 0.6 fish/100 m/24 in 2010 (Table 5.2-1; Figure 5.2-3).

The overall mean CPUE was 0.1, the median was 0, and the IQR was 0-0.1 fish/100 m/24 h (Figure 5.2-3). The annual mean CPUE was above the IQR in 2010.

Northern Pike

The annual mean CPUE over the four years of monitoring varied up to about six-fold from year-to-year, with the annual mean ranging from a low of 2.1 in 2019 to a high of 13.5 fish/100 m/24 in 2010 (Table 5.2-1; Figure 5.2-4).

The overall mean CPUE was 6.0, the median was 4.2, and the IQR was 2.9-7.3 fish/100 m/24 h (Figure 5.2-4). The annual mean CPUE was below the IQR in 2019 and above the IQR in 2010.

Sauger

Catches of Sauger were low in Little Playgreen Lake over the four years of monitoring, with the annual mean ranging from a low of 0.1 in 2013 to a high of 0.4 fish/100 m/24 h in 2019 (Table 5.2-1; Figure 5.2-5).

The overall mean and median CPUE were 0.2 and the IQR was 0.1-0.3 fish/100 m/24 h (Figure 5.2-5). The annual mean CPUE was slightly below the IQR in 2013 and was above the IQR in 2019.

Walleye

The annual mean CPUE over the four years of monitoring was generally similar ranging from a low of 8.6 in 2013 to a high of 12.3 fish/100 m/24 h in 2010 (Table 5.2-1; Figure 5.2-6).

The overall mean CPUE was 10.3, the median was 10.1, and the IQR was 8.8-11.5 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE was slightly above the IQR in 2010.

White Sucker

The annual mean CPUE over the four years of monitoring varied by about four-fold, with the mean ranging from a low of 10.0 in 2019 to a high of 41.9 fish/100 m/24 h in 2010 (Table 5.2-1; Figure 5.2-7).

The overall mean CPUE was 25.3, the median was 24.6, and the IQR was 15.8-34.1 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE was below the IQR in 2019 and was above the IQR in 2010.

Sipiwesk Lake

Standard Gang Index Gill Nets

The annual mean CPUE over the three years of monitoring was generally similar among years ranging from a low of 38.2 in 2017 to a high of 45.3 fish/100 m/24 h in 2011 (Table 5.2-1; Figure 5.2-1).

The overall mean CPUE was 42.3, the median was 43.4, and the IQR was 40.8-44.3 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE was slightly below the IQR in 2017 and was slightly above the IQR in 2011.

Small Mesh Index Gill Nets

The annual mean CPUE in the small mesh gangs over the three years of monitoring was more variable than in the standard gangs, with the mean ranging from a low of 37.1 in 2017 to a high of 153.0 fish/30 m/24 h in 2014 (Table 5.2-1; Figure 5.2-2).

The overall mean CPUE was 100.4 the median was 111.0, and the IQR was 74.1-132.0 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE was below the IQR in 2017 and was above the IQR in 2014.

Lake Whitefish

Catches of Lake Whitefish were low in Sipiwesk Lake over the three years of monitoring, with the annual mean ranging from none in 2011 and 2017 to a high of 0.1 fish/100 m/24 in 2014 (Table 5.2-1; Figure 5.2-3).

The overall mean CPUE was <0.1, the median was 0, and the IQR was 0-<0.1 fish/100 m/24 h (Figure 5.2-3). The annual mean CPUE was above the IQR in 2014.

Northern Pike

The annual mean CPUE over the three years of monitoring varied up to about two-fold from year-to-year, with the annual mean ranging from a low of 2.6 in 2017 to a high of 5.8 fish/100 m/24 in 2011 (Table 5.2-1; Figure 5.2-4).

The overall mean CPUE was 4.6, the median was 5.5, and the IQR was 4.1-5.7 fish/100 m/24 h (Figure 5.2-4). The annual mean CPUE was below the IQR in 2017 and slightly above the IQR in 2011.

Sauger

The annual mean CPUE over the three years of monitoring was generally similar among years, ranging from a low of 7.5 in 2014 to a high of 9.0 fish/100 m/24 h in 2017 (Table 5.2-1; Figure 5.2-5).

The overall mean CPUE was 8.2, the median was 8.1, and the IQR was 7.8-8.5 fish/100 m/24 h (Figure 5.2-5). The annual mean CPUE was slightly below the IQR in 2014 and was slightly above the IQR in 2017.

Walleye

Catches of Walleye were relatively low in Sipiwesk Lake over the three years of monitoring, with the mean ranging from a low of 1.5 in 2011 to a high of 3.2 fish/100 m/24 h in 2014 (Table 5.2-1; Figure 5.2-6).

The overall mean CPUE was 2.2, the median was 1.9, and the IQR was 1.7-2.6 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE was slightly below the IQR in 2011 and was slightly above the IQR in 2014.

White Sucker

The annual mean CPUE over the three years of monitoring was generally similar among years, ranging from a low of 21.2 in 2017 to a high of 24.5 fish/100 m/24 h in 2011 (Table 5.2-1; Figure 5.2-7).

The overall mean CPUE was 23.2, the median was 23.7, and the IQR was 22.5-24.1 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE was marginally below the IQR in 2017 and was marginally above the IQR in 2011.

Upper Nelson River

Standard Gang Index Gill Nets

The annual mean CPUE over the three years of monitoring was generally similar among years ranging from a low of 20.4 in 2017 to a high of 27.5 fish/100 m/24 h in 2014 (Table 5.2-1; Figure 5.2-1).

The overall mean CPUE was 23.6, the median was 22.9, and the IQR was 21.7-25.2 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE was slightly below the IQR in 2017 and was above the IQR in 2014.

Small Mesh Index Gill Nets

The annual mean CPUE in the small mesh gangs over the three years of monitoring was more variable than in the standard gangs, with the mean ranging from a low of 9.7 in 2017 to a high of 137.3 fish/30 m/24 h in 2011 (Table 5.2-1; Figure 5.2-2).

The overall mean CPUE was 57.0, the median was 24.2, and the IQR was 16.9-80.7 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE was below the IQR in 2017 and was above the IQR in 2011.

Lake Whitefish

Catches of Lake Whitefish were low in the upper Nelson River over the three years of monitoring, with the annual mean ranging from none in 2011 and 2014 to a high of 0.1 fish/100 m/24 in 2017 (Table 5.2-1; Figure 5.2-3).

The overall mean CPUE was <0.1, the median was 0, and the IQR was 0-<0.1 fish/100 m/24 h (Figure 5.2-3). The annual mean CPUE was above the IQR in 2017.

Northern Pike

Catches of Northern Pike were relatively low in the upper Nelson River over the three years of monitoring, with the annual mean ranging from a low of 1.8 in 2017 to a high of 2.5 fish/100 m/24 in 2011 (Table 5.2-1; Figure 5.2-4).

The overall mean CPUE was 2.1, the median was 1.9, and the IQR was 1.8-2.2 fish/100 m/24 h (Figure 5.2-4). The annual mean CPUE was slightly above the IQR in 2011.

Sauger

Catches of Sauger were relatively low in the upper Nelson River over the three years of monitoring, with the annual mean ranging from a low of 0.2 in 2011 to a high of 2.8 fish/100 m/24 h in 2014 (Table 5.2-1; Figure 5.2-5).

The overall mean CPUE was 1.5, the median was 1.6, and the IQR was 0.9-2.2 fish/100 m/24 h (Figure 5.2-5). The annual mean CPUE was below the IQR in 2011 and was above the IQR in 2014.

Walleye

The annual mean CPUE over the three years of monitoring was generally similar among years, ranging from a low of 7.3 in 2014 to a high of 11.4 fish/100 m/24 h in 2011 (Table 5.2-1; Figure 5.2-6).

The overall mean CPUE was 9.1, the median was 8.7, and the IQR was 8.0-10.0 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE was slightly below the IQR in 2014 and was above the IQR in 2011.

White Sucker

The annual mean CPUE over the three years of monitoring varied by up to about three-fold from year-to-year, with the mean ranging from a low of 3.3 in 2017 to a high of 10.3 fish/100 m/24 h in 2014 (Table 5.2-1; Figure 5.2-7).

The overall mean CPUE was 6.6, the median was 6.2, and the IQR was 4.7-8.2 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE was below the IQR in 2017 and was above the IQR in 2014.

5.2.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Standard Gang Index Gill Nets

The annual mean CPUE over the 12 years of monitoring varied by up to about two-fold from year-to-year, with the mean ranging from a low of 60.5 in 2016 to a high of 95.1 fish/100 m/24 h in 2008 (Table 5.2-1; Figure 5.2-1).

The overall mean CPUE was 74.6, the median was 74.2, and the IQR was 67.6-78.5 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE fell within the overall IQR except in in 2016 when it was below the IQR and in 2008, 2010, and 2019 when it was above the IQR.

Small Mesh Index Gill Nets

The annual mean CPUE in the small mesh gangs over the 12 years of monitoring was more variable than in the standard gangs, with the mean ranging from a low of 23.9 in 2009 to a high of 157.3 fish/30 m/24 h in 2012 (Table 5.2-1; Figure 5.2-2).

The overall mean CPUE was 86.6, the median was 83.0, and the IQR was 70.0-100.2 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE fell within the overall IQR except in 2009, 2016, and 2018 when it was below the IQR and in 2012, 2013, and 2019 when it was above the IQR.

Lake Whitefish

Catches of Lake Whitefish were relatively low in Setting Lake over the 12 years of monitoring, with the annual mean CPUE ranging from a low of 0.3 in 2008 to a high of 2.9 fish/100 m/24 h in 2011 (Table 5.2-1; Figure 5.2-3).

The overall mean CPUE was 1.2, the median was 1.1, and the IQR was 0.5-1.5 fish/100 m/24 h (Figure 5.2-3). The annual mean CPUE fell within the overall IQR except in 2008, 2009, and 2014 when it was below the IQR and in 2011, 2013, and 2019 when it was above the IQR.

Northern Pike

Catches of Northern Pike were relatively low in Setting Lake over the 12 years of monitoring, with the annual mean CPUE ranging from a low of 1.4 in 2019 to a high of 4.8 fish/100 m/24 h in 2010 (Table 5.2-1; Figure 5.2-4).

The overall mean CPUE was 3.4, the median was 3.9, and the IQR was 2.6-4.0 fish/100 m/24 h (Figure 5.2-4). The annual mean CPUE fell within the overall IQR except in 2018 and 2019 when it was below the IQR and in 2008, 2010, and 2012 when it was above the IQR.

Sauger

The annual mean CPUE over the 12 years of monitoring varied by up to about two-fold, with the mean ranging from a low of 12.5 in 2009 to a high of 27.5 fish/100 m/24 h in 2008 (Table 5.2-1; Figure 5.2-5).

The overall mean CPUE was 19.3, the median was 19.0, and the IQR was 15.7-22.3 fish/100 m/24 h (Figure 5.2-5). The annual mean CPUE fell within the overall IQR except in in 2009 and 2012 when it was below the IQR and in 2008, 2017, and 2019 when it was above the IQR.

Walleye

The annual mean CPUE over the 12 years of monitoring varied by up to about two-fold, with the mean ranging from a low of 9.6 in 2016 to a high of 19.1 fish/100 m/24 h in 2018 (Table 5.2-1; Figure 5.2-6).

The overall mean CPUE was 14.3, the median was 14.2, and the IQR was 12.7-16.6 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE fell within the overall IQR except in in 2015, 2016, and 2019 when it was below the IQR and in 2018 when it was above the IQR.

White Sucker

The annual mean CPUE over the 12 years of monitoring varied by up to about two-fold, with the mean ranging from a low of 11.0 in 2016 to a high of 20.3 fish/100 m/24 h in 2008 (Table 5.2-1; Figure 5.2-7).

The overall mean CPUE was 13.2, the median was 12.2, and the IQR was 11.9-13.5 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE fell within the overall IQR except 2008 and 2015 when it was above the IQR.

ROTATIONAL SITES

Walker Lake

Standard Gang Index Gill Nets

The annual mean CPUE over the four years of monitoring varied up to about two-fold from year-to-year, with the mean ranging from a low of 25.7 in 2010 to a high of 49.5 fish/100 m/24 h in 2016 (Table 5.2-1; Figure 5.2-1).

The overall mean CPUE was 36.3, the median was 34.9, and the IQR was 30.3-40.8 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE fell within the overall IQR except in 2010 when it was below the IQR and in 2016 when it was above the IQR.

Small Mesh Index Gill Nets

The annual mean CPUE over the three years of monitoring was generally similar among years, ranging from a low of 149.9 in 2019 to a high of 172.6 fish/30 m/24 h in 2016 (Table 5.2-1; Figure 5.2-2). No data is available from small mesh gangs set in 2010 (Appendix 5-1).

The overall mean CPUE was 163.0, the median was 166.5, and the IQR was 158.2-169.5 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE fell within the overall IQR except in 2019 when it was below the IQR and in 2016 when it was above the IQR.

Lake Whitefish

Catches of Lake Whitefish were low in Walker Lake over the four years of monitoring, with the annual mean ranging from none in 2010 to a high of 0.6 fish/100 m/24 in 2019 (Table 5.2-1; Figure 5.2-3).

The overall mean and median CPUE were 0.2 and the IQR was 0.1-0.3 fish/100 m/24 (Figure 5.2-3). The annual mean CPUE fell within the overall IQR except in 2010 when it was below the IQR and in 2019 when it was above the IQR.

Northern Pike

Catches of Northern Pike were relatively low in Walker Lake over the four years of monitoring, with the annual mean ranging from a low of 3.3 in 2010 to a high of 5.7 fish/100 m/24 in 2019 (Table 5.2-1; Figure 5.2-4).

The overall mean and median CPUE were 4.5 and the IQR was 3.4-5.6 fish/100 m/24 (Figure 5.2-4). The annual mean CPUE was equal to or fell within the overall IQR in all three years

Sauger

Catches of Sauger were low in Walker Lake over the four years of monitoring, with the annual mean ranging from a low of 0.3 in 2019 to a high of 1.5 fish/100 m/24 h in 2016 (Table 5.2-1; Figure 5.2-5).

The overall mean and median CPUE were 1.0 and the IQR was 0.7-1.3 fish/100 m/24 h (Figure 5.2-5). The annual mean CPUE fell within the overall IQR except in 2019 when it was below the IQR and in 2016 when it was above the IQR.

Walleye

The annual mean CPUE over the four years of monitoring varied by up to about three-fold, with the mean ranging from a low of 3.8 in 2010 to a high of 13.0 fish/100 m/24 h in 2016 (Table 5.2-1; Figure 5.2-6).

The overall mean CPUE was 8.8, the median was 9.3, and the IQR was 7.8-10.3 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE fell within the overall IQR except in 2010 when it was below the IQR and in 2016 when it was above the IQR.

White Sucker

The annual mean CPUE over the four years of monitoring varied by up to about three-fold, with the mean ranging from a low of 7.2 in 2010 to a high of 23.3 fish/100 m/24 h in 2016 (Table 5.2-1; Figure 5.2-7).

The overall mean CPUE was 16.0, the median was 16.8, and the IQR was 11.3-21.5 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE fell within the overall IQR except in 2010 when it was below the IQR and in 2016 when it was above the IQR.

Table 5.2-1. 2008-2019 Catch-per-unit-effort.

Waterbody	Year	Small Mesh Catch[1]				Total Catch[2]				LKWH			NRPK			SAUG			WALL			WHSC		
		n_S[3]	n_F[4]	Mean	SE[5]	n_S	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE
LW-MB	2008	-	-	-	-	12	678	53.1	13.2	18	1.4	0.5	10	0.8	0.3	21	1.7	0.6	136	10.8	6.2	55	4.3	1.9
	2009	-	-	-	-	7	576	87.4	9.2	4	0.6	0.3	0	-	-	13	2.0	0.7	304	46.3	8.8	39	6.0	1.9
	2010	4	1067	292.0	43.9	12	786	62.9	5.5	33	2.6	0.7	2	0.1	0.1	68	5.3	0.9	132	10.9	3.4	88	7.1	2.4
	2011	4	361	110.1	55.5	12	621	49.8	9.7	23	1.8	0.5	2	0.1	0.1	53	4.5	1.3	75	6.2	2.2	73	5.7	2.0
	2012	4	332	87.1	13.1	12	710	52.9	4.3	9	0.7	0.2	6	0.4	0.2	126	9.5	2.1	123	8.9	2.6	116	8.5	2.3
	2013	4	374	99.6	12.2	12	1337	102.7	8.0	40	3.0	1.1	7	0.5	0.3	524	40.3	4.3	314	24.1	4.3	236	18.2	3.5
	2014	4	216	61.4	14.9	11	722	61.6	5.5	16	1.4	0.5	2	0.2	0.2	201	17.1	2.7	184	15.6	2.9	116	9.9	1.6
	2015	4	119	32.4	2.7	10	574	53.9	6.0	10	0.9	0.6	3	0.3	0.1	177	16.7	2.7	152	14.4	2.9	101	9.3	1.9
	2016	4	168	46.2	8.0	12	1001	80.6	8.8	11	0.8	0.5	12	1.0	0.3	164	13.2	1.6	208	16.6	2.6	355	28.6	4.3
	2017	4	138	38.2	21.2	12	1015	85.2	12.6	36	3.2	1.3	1	0.1	0.1	168	14.4	2.3	188	16.0	4.4	391	32.6	6.8
	2018	3	52	18.8	9.6	10	558	53.2	8.4	3	0.3	0.2	5	0.5	0.4	94	8.9	2.3	84	8.1	1.2	293	27.8	5.7
	2019	4	202	61.6	9.6	12	849	78.7	3.4	3	0.3	0.2	21	2.0	0.4	78	7.1	1.6	174	16.0	2.2	517	48.2	3.7
CROSS	2008	3	507	178.6	66.8	12	644	51.8	4.8	3	0.3	0.3	143	11.4	2.2	18	1.3	1.0	235	18.9	3.1	112	9.1	1.9
	2009	3	398	143.5	55.5	9	308	32.7	4.3	0	-	-	77	8.2	1.8	37	3.9	1.2	80	8.4	1.9	45	4.9	2.2
	2010	3	485	180.6	48.3	9	318	35.1	4.2	0	-	-	72	7.8	2.5	19	2.1	0.9	92	10.2	2.4	60	6.6	1.4
	2011	3	555	225.6	55.5	9	293	35.3	4.6	0	-	-	47	5.6	1.4	18	2.2	0.8	55	6.8	1.5	44	5.7	0.7
	2012	2	150	95.2	40.0	12	437	35.9	7.6	1	0.1	0.1	96	7.8	2.0	6	0.5	0.3	136	11.1	3.7	78	6.5	2.3
	2013	3	403	150.0	85.1	12	456	37.5	4.1	2	0.2	0.2	95	8.1	1.8	11	0.9	0.4	154	12.4	2.5	91	7.4	1.8
	2014	3	605	229.7	45.2	12	394	32.7	4.1	1	0.1	0.1	68	5.7	1.0	32	2.8	1.4	144	11.9	1.8	92	7.6	1.8
	2015	3	619	310.8	122.4	12	615	54.6	7.5	1	0.1	0.1	84	7.5	1.4	8	0.8	0.4	167	15.0	2.3	175	16.3	3.7
	2016	3	426	169.2	36.8	12	334	28.1	3.9	0	-	-	42	3.5	0.8	21	1.8	0.9	103	8.8	1.7	75	6.4	1.7
	2017	3	1329	542.7	88.1	12	615	52.8	4.9	1	0.1	0.1	79	7.1	1.1	4	0.4	0.1	217	18.3	3.9	169	14.3	2.2
	2018	3	826	321.1	78.3	10	522	52.9	5.4	1	0.1	0.1	114	10.7	1.7	11	1.1	0.5	143	15.8	5.1	158	15.7	2.3
	2019	3	306	109.8	57.2	12	353	29.9	5.0	1	0.1	0.1	41	3.4	0.5	9	0.8	0.7	112	9.5	2.7	128	10.8	2.0
PLAYG	2009	1	29	33.5	-	10	556	51.9	17.8	11	1.1	0.3	85	8.2	3.9	115	9.6	8.2	14	1.3	0.6	213	20.7	9.6
	2010	4	2618	880.5	274.5	11	802	87.0	10.0	20	2.2	1.1	85	8.9	2.8	8	0.9	0.4	98	10.4	4.7	400	44.2	7.8
	2012	4	375	98.6	40.7	12	1045	83.1	9.8	39	3.1	1.4	119	9.4	1.5	34	2.7	1.4	63	4.9	1.4	637	51.4	5.8
	2015	4	4177	1132.3	521.7	12	811	63.4	5.2	57	4.6	2.2	103	8.1	1.7	80	5.9	1.9	86	6.9	2.6	406	31.6	4.2
	2018	4	4794	1492.0	1146.9	10	774	77.5	5.6	31	3.2	1.3	41	3.9	0.8	34	3.3	1.0	97	10.0	2.1	543	54.2	5.1
LPLAYG	2010	3	2719	1175.3	813.7	10	734	80.1	4.5	5	0.6	0.4	124	13.5	2.8	2	0.2	0.1	113	12.3	1.8	382	41.9	3.7
	2013	3	1007	364.5	148.8	10	582	55.1	8.5	0	-	-	55	5.3	1.1	1	0.1	0.1	90	8.6	1.5	335	31.5	7.2
	2016	3	3799	1382.8	536.9	10	426	42.4	5.3	0	-	-	31	3.1	0.8	1	0.1	0.1	114	11.3	1.2	177	17.7	3.3
	2019	3	3897	1672.8	967.3	10	226	26.0	2.9	0	-	-	19	2.1	0.5	3	0.4	0.3	78	8.9	1.2	86	10.0	1.4
SIP	2011	5	441	111.0	46.3	15	606	45.3	8.0	0	-	-	84	5.8	2.4	107	8.1	2.5	20	1.5	0.5	322	24.5	5.4
	2014	5	707	153.0	67.0	15	657	43.4	7.3	1	0.1	0.1	83	5.5	1.0	113	7.5	1.8	49	3.2	0.7	361	23.7	5.3
	2017	4	120	37.1	18.7	13	480	38.2	10.8	0	-	-	32	2.6	0.8	111	9.0	3.1	25	1.9	0.7	268	21.2	7.1

Table 5.2-1. continued.

Waterbody	Year	Small Mesh Catch[1]				Total Catch[2]				LKWH			NRPK			SAUG			WALL			WHSC		
		n_S[3]	n_F[4]	Mean	SE[5]	n_S	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE
UNR	2011	3	353	137.3	98.3	15	199	22.9	5.0	0	-	-	22	2.5	0.8	2	0.2	0.1	94	11.4	4.1	56	6.2	1.6
	2014	3	53	24.2	12.7	9	214	27.5	3.9	0	-	-	15	1.9	1.0	21	2.8	1.2	57	7.3	1.7	79	10.3	1.6
	2017	3	30	9.7	4.3	9	194	20.4	5.1	1	0.1	0.1	18	1.8	0.7	14	1.6	0.9	81	8.7	3.5	32	3.3	0.8
SET	2008	2	149	77.9	20.4	9	900	95.1	12.4	3	0.3	0.2	45	4.8	1.1	243	27.5	14.7	163	16.4	5.9	195	20.3	2.6
	2009	2	49	23.9	5.2	10	790	66.9	4.3	4	0.4	0.3	46	3.9	1.3	147	12.5	4.3	168	14.2	4.2	162	13.7	1.7
	2010	3	236	82.3	36.8	12	1112	86.0	6.8	18	1.4	0.7	63	4.8	0.8	238	18.5	3.9	171	13.0	3.8	158	12.1	2.4
	2011	4	243	71.4	44.2	14	1022	75.0	6.2	38	2.9	0.9	54	3.9	0.9	205	15.4	3.7	177	13.5	3.8	167	12.0	2.2
	2012	4	579	157.3	28.3	14	1149	74.6	5.1	16	1.0	0.3	66	4.3	0.7	219	14.5	4.1	255	16.5	2.9	199	12.7	2.2
	2013	4	468	138.9	39.7	14	995	67.8	5.1	28	1.9	0.5	58	3.9	0.8	253	17.3	3.6	251	17.0	4.6	178	12.2	2.8
	2014	4	327	86.1	31.7	14	1128	77.8	6.5	5	0.3	0.1	56	3.9	0.9	227	15.9	3.1	211	14.2	3.6	197	13.5	2.8
	2015	4	373	99.2	43.2	14	1064	73.9	6.3	12	0.8	0.3	40	2.6	0.7	299	21.8	5.2	181	11.7	2.8	225	15.9	3.4
	2016	4	237	65.8	20.8	14	898	60.5	5.6	20	1.3	0.4	38	2.5	0.9	298	20.2	5.0	146	9.6	2.3	162	11.0	2.4
	2017	4	289	83.8	50.6	14	989	70.7	7.4	18	1.3	0.4	38	2.6	0.9	321	23.5	7.3	244	16.9	4.2	172	12.2	2.3
	2018	4	153	49.8	16.1	14	802	67.1	8.2	7	0.6	0.3	23	1.9	0.8	232	19.5	5.0	230	19.1	5.3	136	11.5	2.3
	2019	4	319	103.4	49.1	12	876	80.5	6.2	28	2.5	1.1	15	1.4	0.6	281	25.3	5.7	101	9.6	3.7	123	11.3	3.2
WLKR	2010	-	-	-	-	3	67	25.7	9.3	0	-	-	9	3.3	0.7	3	1.3	1.0	11	3.8	0.6	19	7.2	2.3
	2013	3	416	166.5	83.8	9	280	31.9	3.8	1	0.1	0.1	49	5.6	1.0	7	0.8	0.4	80	9.1	2.3	111	12.7	2.0
	2016	3	409	172.6	23.1	9	407	49.5	5.3	2	0.3	0.2	28	3.4	0.5	12	1.5	0.9	106	13.0	2.0	191	23.3	3.4
	2019	3	384	149.9	64.3	9	333	38.0	5.2	5	0.6	0.3	50	5.7	1.0	3	0.3	0.2	84	9.5	2.1	182	20.9	4.8

Notes:

1. fish/30 m/24 h.
2. fish/100 m/24 h.
3. nS = number of sites fished (excludes sets > 36 h).
4. nF = number of fish caught.
5. SE = standard error.

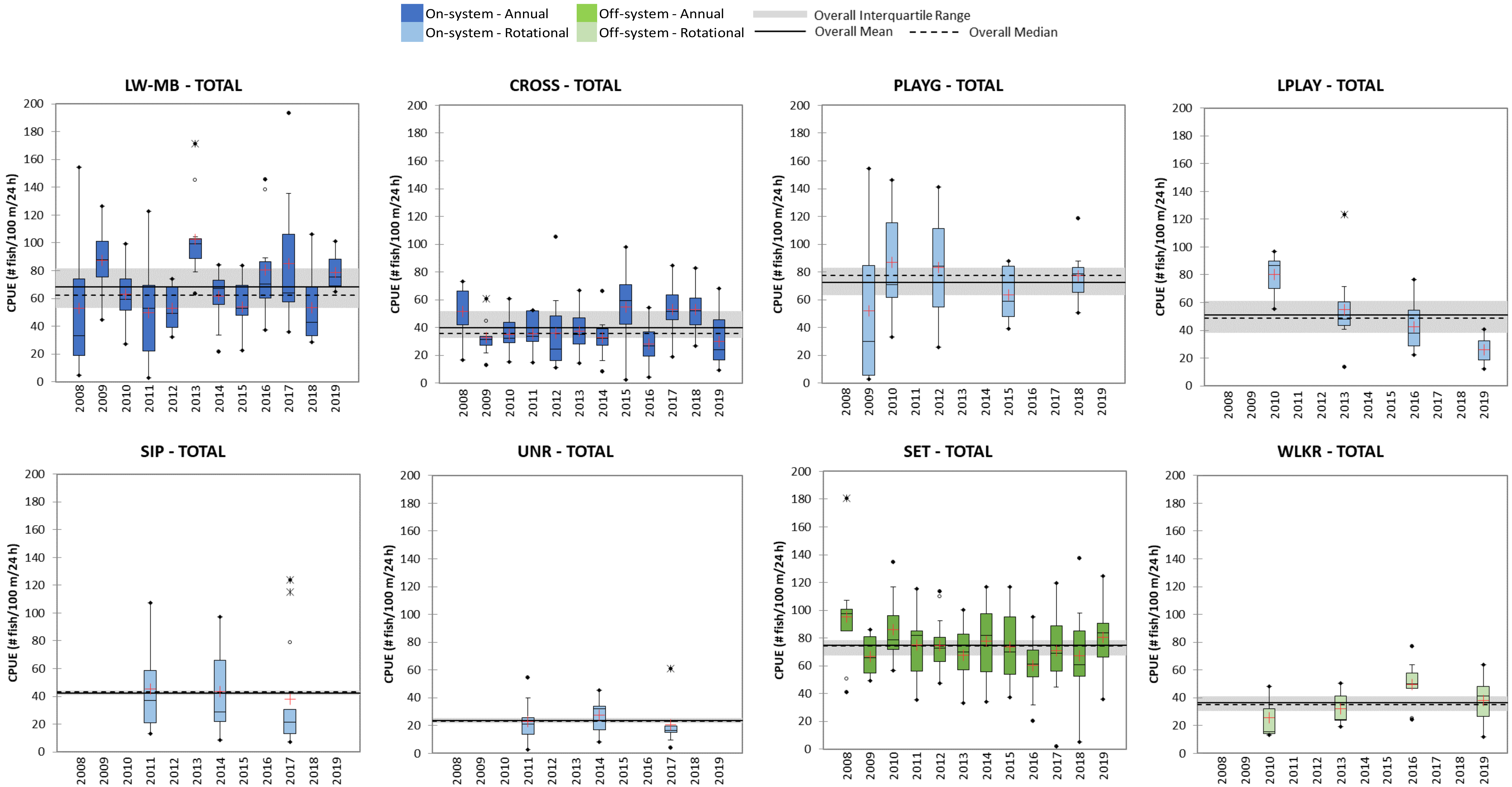


Figure 5.2-1. 2008-2019 Catch-per-unit-effort of standard gang index gill nets.

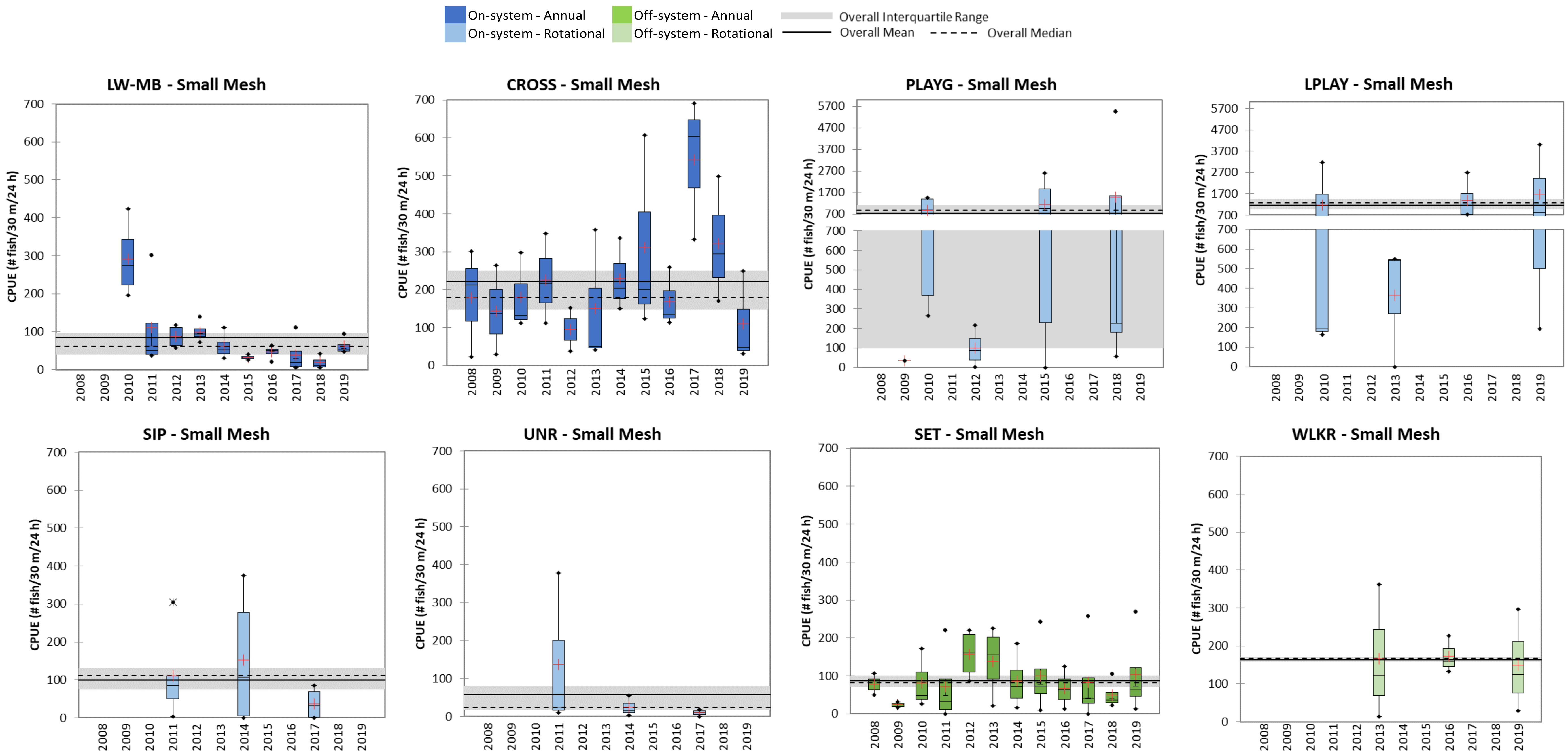


Figure 5.2-2. 2008-2019 Catch-per-unit-effort of small mesh index gill nets.

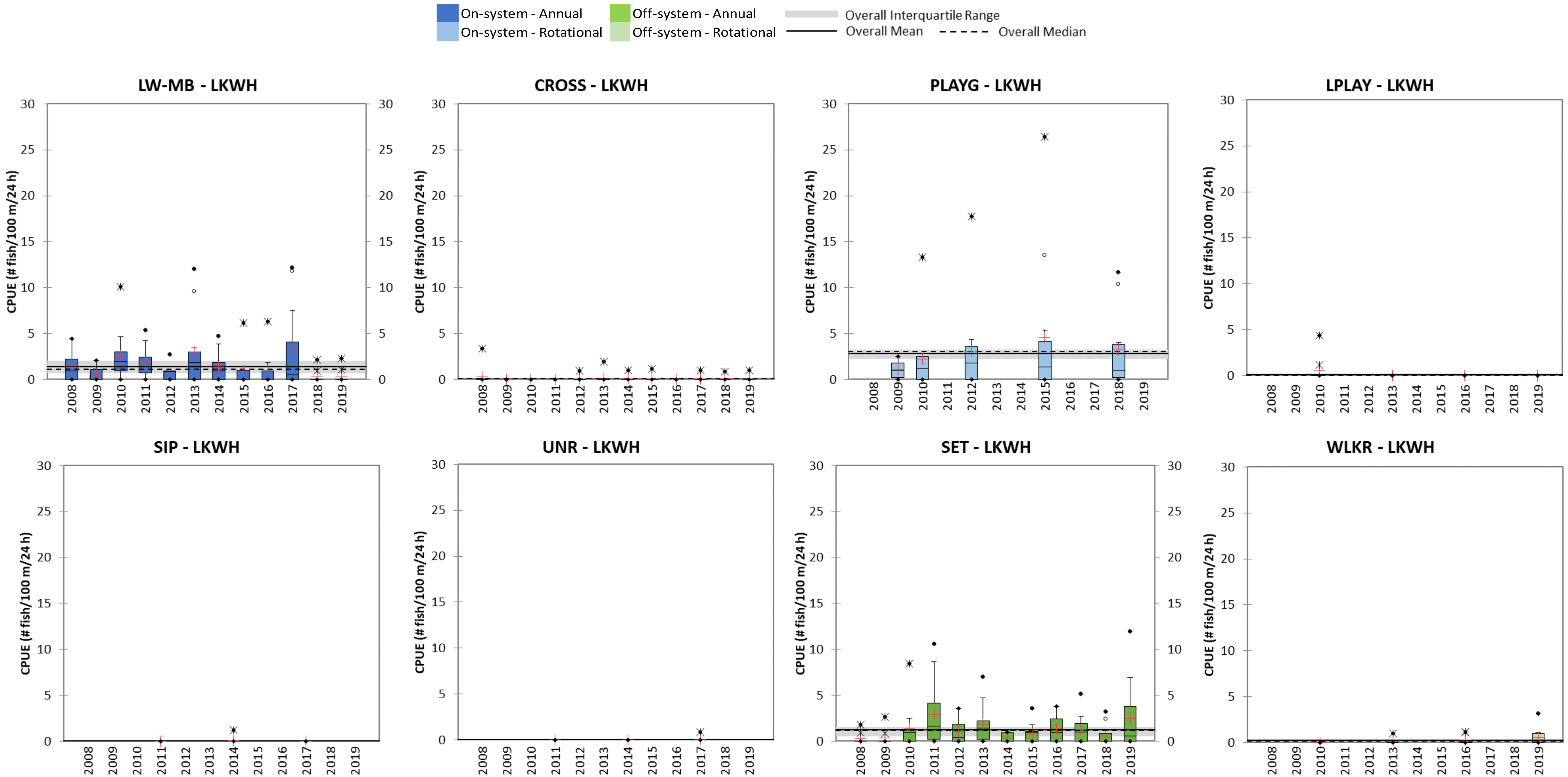


Figure 5.2-3. 2008-2019 Catch-per-unit-effort of Lake Whitefish.

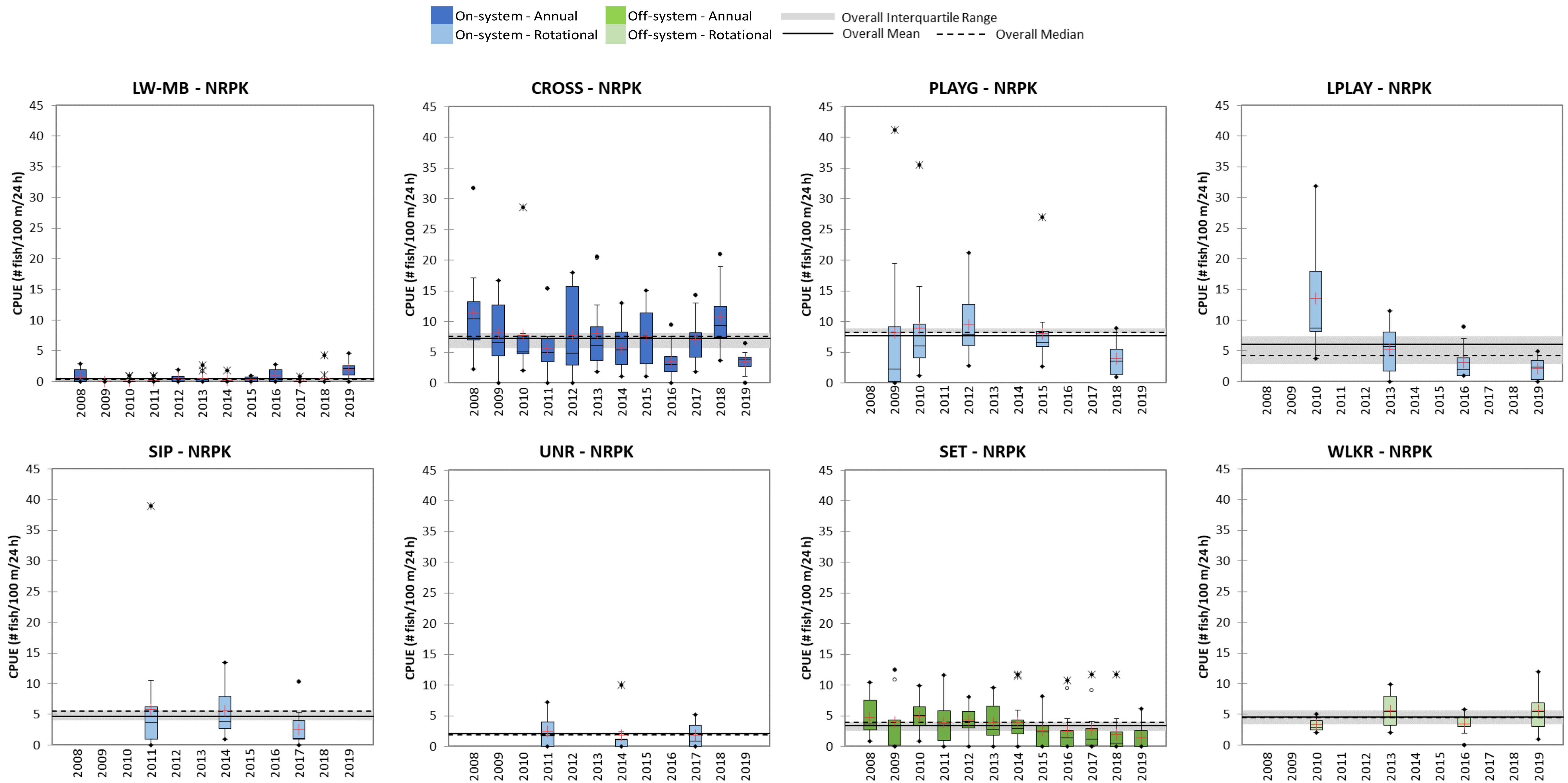


Figure 5.2-4. 2008-2019 Catch-per-unit-effort of Northern Pike.

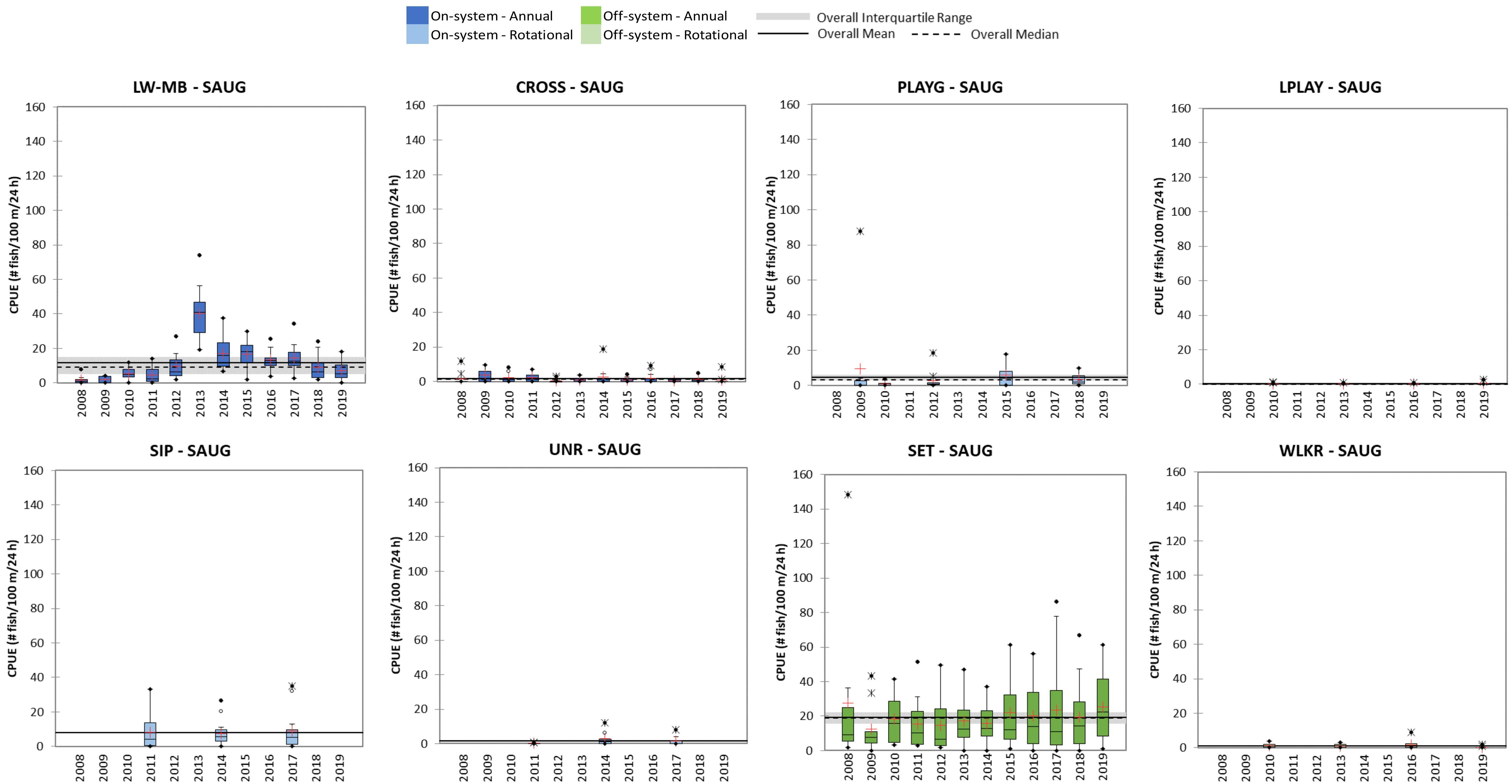


Figure 5.2-5 2008-2019 Catch-per-unit-effort of Sauger.

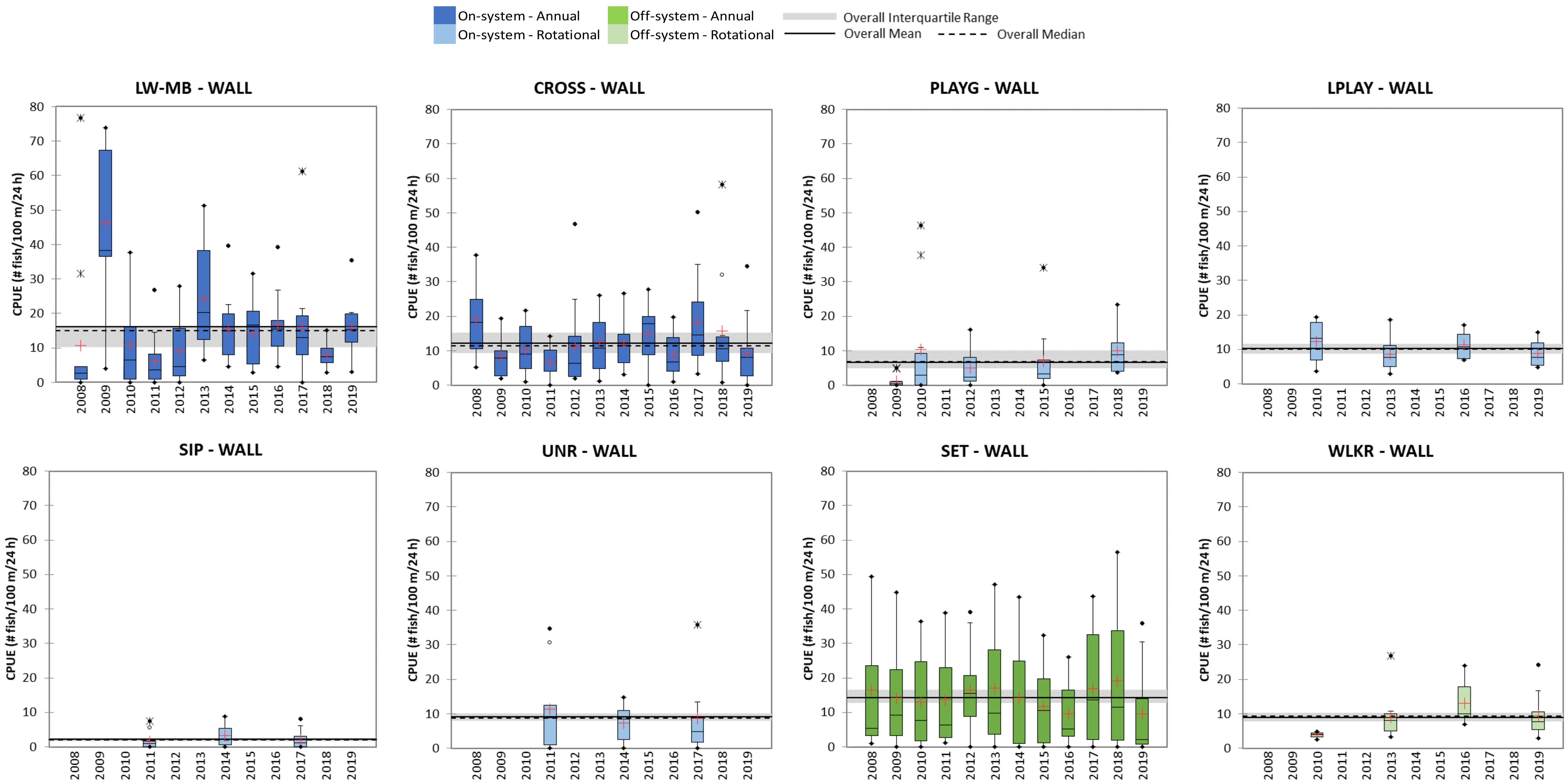


Figure 5.2-6. 2008-2019 Catch-per-unit-effort of Walleye.

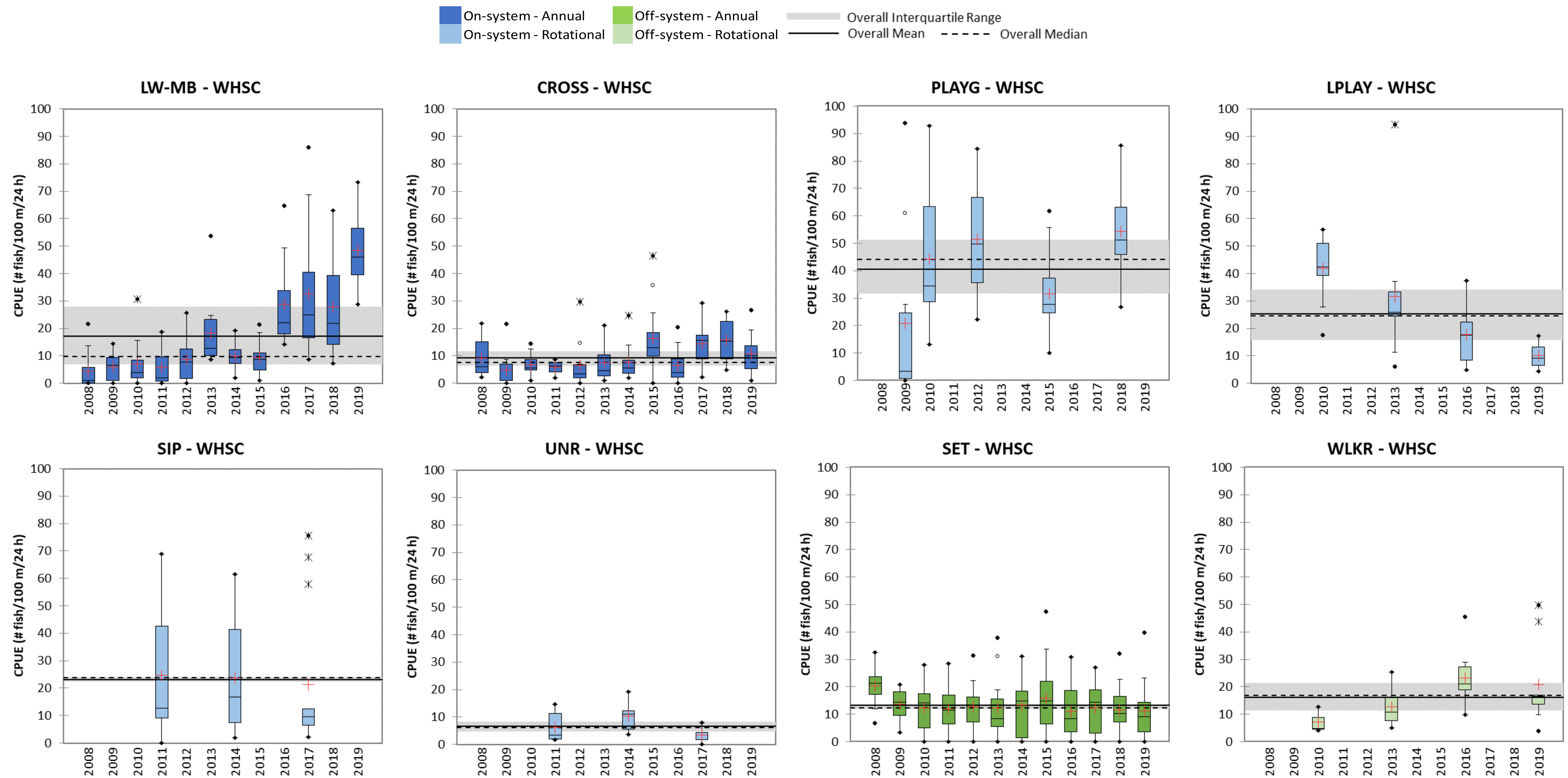


Figure 5.2-7. 2008-2019 Catch-per-unit-effort of White Sucker.

5.3 CONDITION

5.3.1 FULTON'S CONDITION FACTOR

5.3.1.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg – Mossy Bay

Lake Whitefish

The annual mean KF of Lake Whitefish between 300 and 499 mm in fork length over the 12 years of monitoring ranged from a low of 1.22 in 2015 to a high of 1.78 in 2016 (Table 5.3-1; Figure 5.3-1).

The overall mean and median KF were 1.55 and the IQR was 1.49-1.67 (Figure 5.3-1). The annual mean KF fell within the overall IQR except in 2010, 2011, and 2015 when it was below the IQR and in 2016 when it was above the IQR.

Northern Pike

Northern Pike was not a target species in Mossy Bay until 2009; over the 11 years of monitoring Northern Pike between 400 and 699 mm in fork length were not captured in 2009, 2010, or 2011 (Table 5.3-1). The annual mean KF in the years they were caught ranged from a low of 0.70 in 2019 to a high of 0.91 in 2014 (Table 5.3-1; Figure 5.3-2).

The overall mean KF was 0.75, the median was 0.74, and the IQR was 0.70-0.76 (Figure 5.3-2). The annual mean KF fell within the overall IQR except in 2013, 2014, 2015, and 2017 when it was above the IQR.

Sauger

Sauger was not a target species in Mossy Bay until 2017; the annual mean KF of Sauger between 200 and 349 mm in fork length over the three years of monitoring ranged from a low of 0.85 in 2018 to a high of 0.94 in 2017 (Table 5.3-1; Figure 5.3-3).

The overall mean and median KF were 0.91 and the IQR was 0.85-0.94 (Figure 5.3-3). The annual mean KF was equal to or fell within the overall IQR in all three years.

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the 12 years of monitoring ranged from a low of 0.99 in 2018 to a high of 1.40 in 2011 (Table 5.3-1; Figure 5.3-4).

The overall mean and median KF were 1.18 and the IQR was 1.02-1.34 (Figure 5.3-4). The annual mean KF fell within the overall IQR except in 2017 and 2018 when it was below the IQR and in 2010 and 2011 when it was above the IQR.

White Sucker

White Sucker was not a target species in Mossy Bay until 2010; the annual mean KF of White Sucker between 300 and 499 mm in fork length over the 10 years of monitoring ranged from a low of 1.63 in 2019 to a high of 1.69 in 2010, 2012, 2016, and 2017 (Table 5.3-1; Figure 5.3-5).

The overall mean KF was 1.67, the median was 1.68, and the IQR was 1.65-1.69 (Figure 5.3-5). The annual mean KF fell within the overall IQR except in 2019 when it was below the IQR.

Cross Lake

Lake Whitefish

Over the 12 years of monitoring Lake Whitefish between 300 and 499 mm in fork length were only captured in 2008, 2012, 2013, 2014, and 2019 (Table 5.3-1). The annual mean KF in these years ranged from a low of 1.36 in 2019 to a high of 1.99 in 2008 (Figure 5.3-1).

The overall mean KF was 1.75, the median was 1.69, and the IQR was 1.56-1.99 (Figure 5.3-1). The annual mean KF fell within the overall IQR except in 2019 when it was below the IQR.

Northern Pike

The annual mean KF of Northern Pike between 400 and 699 mm in fork length over the 12 years of monitoring ranged from a low of 0.67 in 2015, 2016, and 2019 to a high of 0.79 in 2010 (Table 5.3-1; Figure 5.3-2).

The overall mean KF was 0.72, the median was 0.70, and the IQR was 0.68-0.75 (Figure 5.3-2). The annual mean KF fell within the overall IQR except in 2010 when it was above the IQR.

Sauger

Sauger was not a target species in Cross Lake until 2017; the annual mean KF of Sauger between 200 and 349 mm in fork length over the three years of monitoring ranged from a low of 0.91 in 2017 to a high of 0.95 in 2019 (Table 5.3-1; Figure 5.3-3).

The overall mean KF was 0.94, the median was 0.93, and the IQR was 0.93-0.95 (Figure 5.3-3). The annual mean KF fell within the overall IQR except in 2017 when it was below the IQR.

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the 12 years of monitoring ranged from a low of 1.10 in 2015 to a high of 1.26 in 2008 (Table 5.3-1; Figure 5.3-4).

The overall mean KF was 1.18, the median was 1.16, and the IQR was 1.15-1.24 (Figure 5.3-4). The annual mean KF fell within the overall IQR except in 2013, 2015, and 2016 when it was below the IQR and in 2008 and 2010 when it was above the IQR.

White Sucker

White Sucker was not a target species in Cross Lake until 2010; the annual mean KF of White Sucker between 300 and 499 mm in fork length over the 10 years of monitoring ranged from a low of 1.61 in 2012, 2013, and 2017 to a high of 1.66 in 2010, 2014, 2016, and 2019 (Table 5.3-1; Figure 5.3-5).

The overall mean KF was 1.64, the median was 1.65, and the IQR was 1.61-1.66 (Figure 5.3-5). The annual mean KF was equal to or fell within the overall IQR in all 10 years.

ROTATIONAL SITES

<u>Playgreen Lake</u>

Lake Whitefish

The annual mean KF of Lake Whitefish between 300 and 499 mm in fork length over the five years of monitoring ranged from a low of 1.62 in 2018 to a high of 1.68 in 2010 (Table 5.3-1; Figure 5.3-1).

The overall mean and median KF were 1.64 and the IQR was 1.62-1.64 (Figure 5.3-1). The annual mean KF fell within the overall IQR except in 2009 and 2010 when it was above the IQR.

Northern Pike

The annual mean KF of Northern Pike between 400 and 699 mm in fork length over the four years of monitoring it was a target species ranged from a low of 0.69 in 2018 to a high of 0.89 in 2010 (Table 5.3-1; Figure 5.3-2).

The overall mean KF was 0.79, the median was 0.80, and the IQR was 0.77-0.89 (Figure 5.3-2). The annual mean KF fell within the overall IQR except in 2018 when it was below the IQR.

Sauger

Over the five years of monitoring, Sauger was only a target species in Playgreen Lake in 2018. In this year, Sauger between 200 and 349 mm in fork length had a mean KF of 1.12 (Table 5.3-1; Figure 5.3-3).

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the five years of monitoring ranged from a low of 1.08 in 2018 to a high of 1.37 in 2010 (Table 5.3-1; Figure 5.3-4).

The overall mean KF was 1.20, the median was 1.19, and the IQR was 1.08-1.33 (Figure 5.3-4). The annual mean KF fell within or was equal to the overall IQR except in 2010 when it was above the IQR.

White Sucker

White Sucker was not a target species in Playgreen Lake until 2010; the annual mean KF of White Sucker between 300 and 499 mm in fork length over the four years of monitoring ranged from a low of 1.66 in 2010 and 2012 to a high of 1.70 in 2015 (Table 5.3-1; Figure 5.3-5).

The overall mean KF was 1.68, the median was 1.69, and the IQR was 1.66-1.69 (Figure 5.3-5). The annual mean KF was equal to or fell within the overall IQR in all four years.

Little Playgreen Lake

Lake Whitefish

Over the four years of monitoring Lake Whitefish between 300 and 499 mm in fork length were only captured in 2010 (Table 5.3-1). The mean KF in this year was 1.77 (Figure 5.3-1).

Northern Pike

The annual mean KF of Northern Pike between 400 and 699 mm in fork length over the four years of monitoring ranged from a low of 0.64 in 2019 to a high of 0.83 in 2010 and 2013 (Table 5.3-1; Figure 5.3-2).

The overall mean KF was 0.80, the median and IQR were 0.83 (Figure 5.3-2). The annual mean KF was equal to the overall IQR except in 2016 and 2019 when it was below the IQR.

Sauger

Over the four years of monitoring, Sauger was only a target species in Little Playgreen Lake in 2019. In this year, Sauger between 200 and 349 mm in fork length had a mean KF of 1.00 (Table 5.3-1; Figure 5.3-3).

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the four years of monitoring ranged from a low of 1.08 in 2019 to a high of 1.40 in 2010 (Table 5.3-1; Figure 5.3-4).

The overall mean KF was 1.24, the median was 1.17, and the IQR was 1.17-1.40 (Figure 5.3-4). The annual mean KF fell within or was equal to the overall IQR except in 2019 when in was below the IQR.

White Sucker

The annual mean KF of White Sucker between 300 and 499 mm in fork length over the four years of monitoring ranged from a low of 1.56 in 2019 to a high of 1.69 in 2010 (Table 5.3-1; Figure 5.3-5).

The overall mean KF was 1.66, the median was 1.68, and the IQR was 1.65-1.69 (Figure 5.3-5). The annual mean KF fell within or was equal to the overall IQR except in 2019 when in was below the IQR.

Sipiwesk Lake

Lake Whitefish

Over the three years of monitoring, no Lake Whitefish between 300 and 499 mm in fork length were captured in Sipiwesk Lake (Table 5.3-1).

Northern Pike

The annual mean KF of Northern Pike between 400 and 699 mm in fork length over the three years of monitoring ranged from a low of 0.69 in 2017 to a high of 0.81 in 2011 (Table 5.3-1; Figure 5.3-2).

The overall mean KF was 0.75, the median was 0.70, and the IQR was 0.70-0.81 (Figure 5.3-2). The annual mean KF was equal to or fell within the overall IQR in all three years.

Sauger

Over three years of monitoring, Sauger was only a target species in Sipiwesk Lake in 2017. In this year, Sauger between 200 and 349 mm in fork length had a mean KF of 1.00 (Table 5.3-1; Figure 5.3-3).

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the three years of monitoring ranged from a low of 1.12 in 2017 to a high of 1.37 in 2011 (Table 5.3-1; Figure 5.3-4).

The overall mean KF was 1.17, the median was 1.14, and the IQR was 1.12-1.14 (Figure 5.3-4). The annual mean KF fell within or was equal to the overall IQR except in 2011 when it was above the IQR.

White Sucker

The annual mean KF of White Sucker between 300 and 499 mm in fork length over the three years of monitoring ranged from a low of 1.56 in 2014 to a high of 1.63 in 2011 (Table 5.3-1; Figure 5.3-5).

The overall mean KF was 1.60, the median was 1.62, and the IQR was 1.56-1.63 (Figure 5.3-5). The annual mean KF was equal to or fell within the overall IQR in all three years.

Upper Nelson River

Lake Whitefish

Over the three years of monitoring, no Lake Whitefish between 300 and 499 mm in fork length were captured in the upper Nelson River (Table 5.3-1).

Northern Pike

The annual mean KF of Northern Pike between 400 and 699 mm in fork length over the three years of monitoring ranged from a low of 0.67 in 2017 to a high of 0.81 in 2011 (Table 5.3-1; Figure 5.3-2).

The overall mean and median KF were 0.74 and the IQR was 0.67-0.81 (Figure 5.3-2). The annual mean KF was equal to or fell within the overall IQR in all three years.

Sauger

Over three years of monitoring, Sauger was only a target species in the upper Nelson River in 2017. In this year, Sauger between 200 and 349 mm in fork length had a mean KF of 0.91 (Table 5.3-1; Figure 5.3-3).

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the three years of monitoring ranged from a low of 1.07 in 2017 to a high of 1.30 in 2011 (Table 5.3-1; Figure 5.3-4).

The overall mean KF was 1.18, the median was 1.07, and the IQR was 1.07-1.29 (Figure 5.3-4). The annual mean KF was equal to or fell within the overall IQR in all three years.

White Sucker

The annual mean KF of White Sucker between 300 and 499 mm in fork length over the three years of monitoring ranged from a low of 1.62 in 2017 to a high of 1.65 in 2014 (Table 5.3-1; Figure 5.3-5).

The overall mean and median KF were 1.64 and the IQR was 1.64-1.65 (Figure 5.3-5). The annual mean KF fell within or was equal to the overall IQR except in 2017 when it was below the IQR.

5.3.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Lake Whitefish

The annual mean KF of Lake Whitefish between 300 and 499 mm in fork length over the 12 years of monitoring ranged from a low of 1.32 in 2014 to a high of 1.47 in 2008 (Table 5.3-1; Figure 5.3-1).

The overall mean KF was 1.39, the median was 1.38, and the IQR was 1.38-1.44 (Figure 5.3-1). The annual mean KF fell within the overall IQR except in 2009, 2010, 2014, and 2018 when it was below the IQR and in 2008 when it was above the IQR.

Northern Pike

The annual mean KF of Northern Pike between 400 and 699 mm in fork length over the 11 years of monitoring it was a target species ranged from a low of 0.63 in 2018 to a high of 0.72 in 2010, 2016, and 2019 (Table 5.3-1; Figure 5.3-2).

The overall mean KF was 0.69, the median was 0.68, and the IQR was 0.67-0.70 (Figure 5.3-2). The annual mean KF fell within the overall IQR except in 2015, 2017, and 2018 when it was below the IQR and in 2010, 2016, and 2019 when it was above the IQR.

Sauger

Sauger was not a target species in Setting Lake until 2012; the annual mean KF of Sauger between 200 and 349 mm in fork length over the eight years of monitoring ranged from a low of 0.91 in 2018 to a high of 0.98 in 2013 and 2014 (Table 5.3-1; Figure 5.3-3).

The overall mean KF was 0.95, the median was 0.94, and the IQR was 0.93-0.97 (Figure 5.3-3). The annual mean KF fell within the overall IQR except in 2018 and 2019 when it was below the IQR and in 2013 and 2014 when it was above the IQR.

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the 12 years of monitoring ranged from a low of 1.06 in 2019 to a high of 1.17 in 2009 (Table 5.3-1; Figure 5.3-4).

The overall mean and median KF were 1.14 and the IQR was 1.13-1.16 (Figure 5.3-4). The annual mean KF fell within the overall IQR except in 2008, 2018, and 2019 when it was below the IQR and in 2009 when it was above the IQR.

White Sucker

White Sucker was not a target species in Setting Lake until 2010; the annual mean KF of White Sucker between 300 and 499 mm in fork length over the 10 years of monitoring ranged from a low of 1.51 in 2018 to a high of 1.64 in 2010 (Table 5.3-1; Figure 5.3-5).

The overall mean KF was 1.57 and the median and IQR were 1.51 (Figure 5.3-5). The annual mean KF was higher than the overall IQR in all years except in 2018, when the annual mean was equal to the IQR.

ROTATIONAL SITES

Walker Lake

Lake Whitefish

Over the four years of monitoring Lake Whitefish between 300 and 499 mm in fork length were only captured in 2013, 2016, and 2019 (Table 5.3-1). The annual mean KF in these years ranged from a low of 1.40 in 2013 to a high of 1.75 in 2016 (Table 5.3-1; Figure 5.3-1).

The overall mean KF was 1.54, the median was 1.56, and the IQR was 1.40-1.56 (Figure 5.3-1). The annual mean KF fell within the overall IQR except in 2016 when it was above the IQR.

Northern Pike

The annual mean KF of Northern Pike between 400 and 699 mm in fork length over the four years of monitoring ranged from a low of 0.65 in 2019 to a high of 0.69 in 2013 and 2016 (Table 5.3-1; Figure 5.3-2).

The overall mean KF was 0.67, the median was 0.69, and the IQR was 0.65-0.69 (Figure 5.3-2). The annual mean KF was equal to or fell within the overall IQR in all three years.

Sauger

Over four years of monitoring, Sauger was only a target species in Walker Lake in 2019. In this year, Sauger between 200 and 349 mm in fork length had a mean KF of 0.93 (Table 5.3-1; Figure 5.3-3).

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the four years of monitoring ranged from a low of 1.10 in 2019 to a high of 1.16 in 2016 (Table 5.3-1; Figure 5.3-4).

The overall mean KF was 1.13, the median was 1.11, and the IQR was 1.10-1.16 (Figure 5.3-4). The annual mean KF was equal to or fell within the overall IQR in all four years.

White Sucker

The annual mean KF of White Sucker between 300 and 499 mm in fork length over the four years of monitoring ranged from a low of 1.47 in 2013 to a high of 1.60 in 2016 (Table 5.3-1; Figure 5.3-5).

The overall mean KF was 1.54, the median was 1.52, and the IQR was 1.52-1.60 (Figure 5.3-5). The annual mean KF fell within the overall IQR except in 2013 when it was below the IQR.

Table 5.3-1. 2008-2019 Fulton's condition factor of target species.

Waterbody	Year	LKWH			NRPK			SAUG			WALL			WHSC		
		n_F[1]	Mean	SE[2]	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE
LW-MB	2008	16	1.49	0.04							77	1.34	0.01			
	2009	4	1.67	0.07	-	-	-				246	1.34	0.01			
	2010	12	1.41	0.04	-	-	-				106	1.38	0.01	68	1.69	0.02
	2011	6	1.33	0.10	-	-	-				48	1.40	0.02	64	1.68	0.02
	2012	6	1.53	0.07	2	0.74	0.08				92	1.29	0.01	112	1.69	0.01
	2013	12	1.57	0.07	2	0.86	0.05				158	1.21	0.01	232	1.66	0.01
	2014	8	1.55	0.03	1	0.91	-				149	1.18	0.01	118	1.67	0.01
	2015	6	1.22	0.09	1	0.88	-				166	1.02	0.01	182	1.65	0.01
	2016	5	1.78	0.07	7	0.76	0.05				167	1.02	0.01	323	1.69	0.01
	2017	29	1.67	0.04	2	0.78	0.03	186	0.94	0.01	140	1.01	0.01	341	1.69	0.01
	2018	1	1.64	-	2	0.76	0.03	131	0.85	0.02	60	0.99	0.01	347	1.68	0.01
	2019	1	1.65	-	15	0.70	0.08	105	0.91	0.01	151	1.10	0.01	510	1.63	0.01
CROSS	2008	3	1.99	0.08	130	0.75	0.01				217	1.26	0.01			
	2009	-	-	-	61	0.76	0.01				71	1.24	0.01			
	2010	-	-	-	62	0.78	0.01				84	1.25	0.01	44	1.66	0.02
	2011	-	-	-	38	0.75	0.01				48	1.21	0.02	34	1.63	0.03
	2012	1	1.56	-	84	0.72	0.01				115	1.15	0.01	67	1.61	0.03
	2013	1	1.69	-	83	0.70	0.01				124	1.13	0.01	54	1.61	0.02
	2014	1	1.67	-	60	0.68	0.01				120	1.16	0.01	75	1.66	0.02
	2015	-	-	-	76	0.67	0.01				135	1.10	0.01	128	1.62	0.01
	2016	-	-	-	33	0.67	0.01				75	1.12	0.01	59	1.66	0.03
	2017	-	-	-	72	0.70	0.01	4	0.91	0.03	190	1.16	0.01	145	1.61	0.01
	2018	-	-	-	98	0.70	0.01	14	0.93	0.02	162	1.17	0.01	166	1.65	0.01
	2019	1	1.36	-	41	0.67	0.01	9	0.95	0.03	107	1.17	0.01	115	1.66	0.02
PLAYG	2009	7	1.67	0.04							11	1.27	0.03			
	2010	4	1.68	0.1	56	0.89	0.01				76	1.37	0.01	327	1.66	0.01
	2012	19	1.64	0.04	74	0.80	0.01				49	1.33	0.01	559	1.66	0.01
	2015	47	1.64	0.02	51	0.77	0.01				77	1.19	0.01	378	1.70	0.01
	2018	34	1.62	0.02	41	0.69	0.01	32	1.12	0.08	155	1.08	0.01	558	1.69	0.01
LPLAYG	2010	4	1.77	0.02	105	0.83	0.01				97	1.40	0.01	318	1.69	0.01
	2013	-	-	-	53	0.83	0.01				41	1.22	0.01	217	1.65	0.01
	2016	-	-	-	30	0.75	0.01				86	1.17	0.01	145	1.68	0.01
	2019	-	-	-	17	0.64	0.02	3	1.00	0.01	66	1.08	0.01	74	1.56	0.02
SIP	2011	-	-	-	72	0.81	0.01				17	1.37	0.02	262	1.63	0.01
	2014	-	-	-	54	0.70	0.01				37	1.14	0.01	354	1.56	0.01
	2017	-	-	-	33	0.69	0.01	86	1.00	0.01	51	1.12	0.02	332	1.62	0.01
UNR	2011	-	-	-	19	0.81	0.02				34	1.30	0.02	42	1.64	0.02
	2014	-	-	-	12	0.74	0.03				41	1.29	0.02	65	1.65	0.02
	2017	-	-	-	15	0.67	0.01	7	0.91	0.02	76	1.07	0.02	26	1.62	0.03
SET	2008	3	1.47	0.06							138	1.11	0.01			
	2009	2	1.33	0.02	38	0.70	0.01				136	1.17	0.01			
	2010	7	1.33	0.02	55	0.72	0.01				150	1.16	0.01	149	1.64	0.01
	2011	25	1.44	0.02	48	0.70	0.01				141	1.13	0.01	156	1.58	0.01
	2012	8	1.38	0.03	62	0.68	0.01	206	0.96	0.01	223	1.13	0.01	194	1.54	0.01
	2013	25	1.38	0.02	49	0.67	0.01	258	0.98	0.01	208	1.16	0.01	176	1.60	0.01
	2014	4	1.32	0.01	56	0.68	0.01	246	0.98	0.01	190	1.16	0.01	192	1.56	0.01
	2015	9	1.44	0.02	28	0.65	0.02	345	0.97	0.01	156	1.14	0.01	217	1.59	0.01
	2016	12	1.39	0.02	26	0.72	0.02	351	0.93	0.00	118	1.14	0.01	160	1.54	0.01
	2017	8	1.4	0.06	37	0.65	0.01	344	0.94	0.01	190	1.16	0.01	165	1.53	0.01
	2018	6	1.34	0.03	20	0.63	0.02	233	0.91	0.01	174	1.09	0.01	125	1.51	0.01
	2019	24	1.38	0.02	14	0.72	0.05	296	0.92	0.00	67	1.06	0.01	119	1.53	0.02
WLKR	2010	-	-	-	14	0.66	0.01				15	1.13	0.02	53	1.56	0.01
	2013	2	1.4	0.05	45	0.69	0.01				74	1.11	0.01	109	1.47	0.01
	2016	1	1.75	-	20	0.69	0.01				88	1.16	0.01	165	1.60	0.01
	2019	4	1.56	0.07	41	0.65	0.01	2	0.93	0.04	72	1.10	0.01	176	1.52	0.01

Notes:

1. n_F = number of fish measured for length and weight.
2. SE = standard error.
3. Grey shading indicates a species was not a target species in that year.

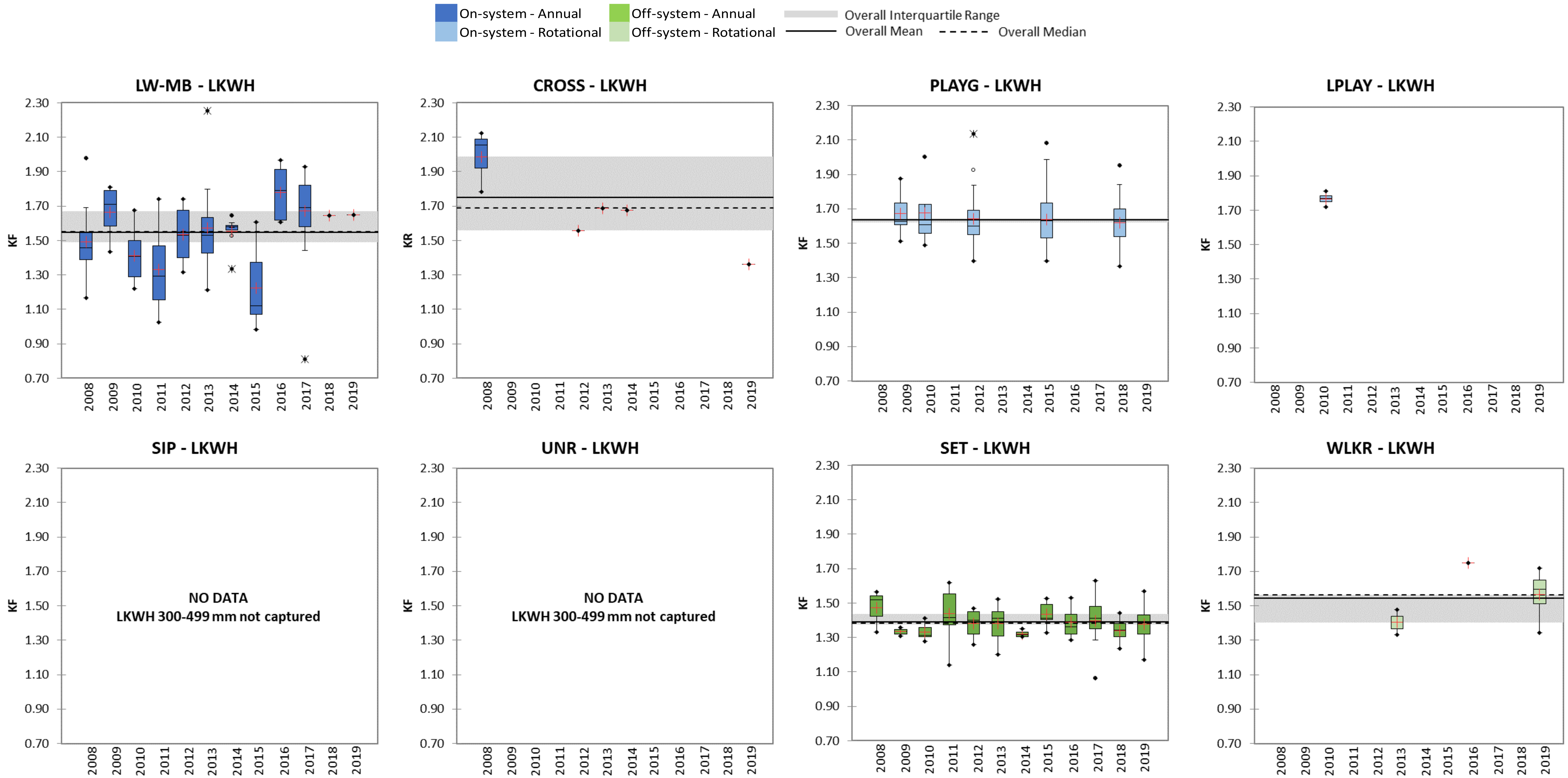


Figure 5.3-1. 2008-2019 Fulton's condition factor of Lake Whitefish.

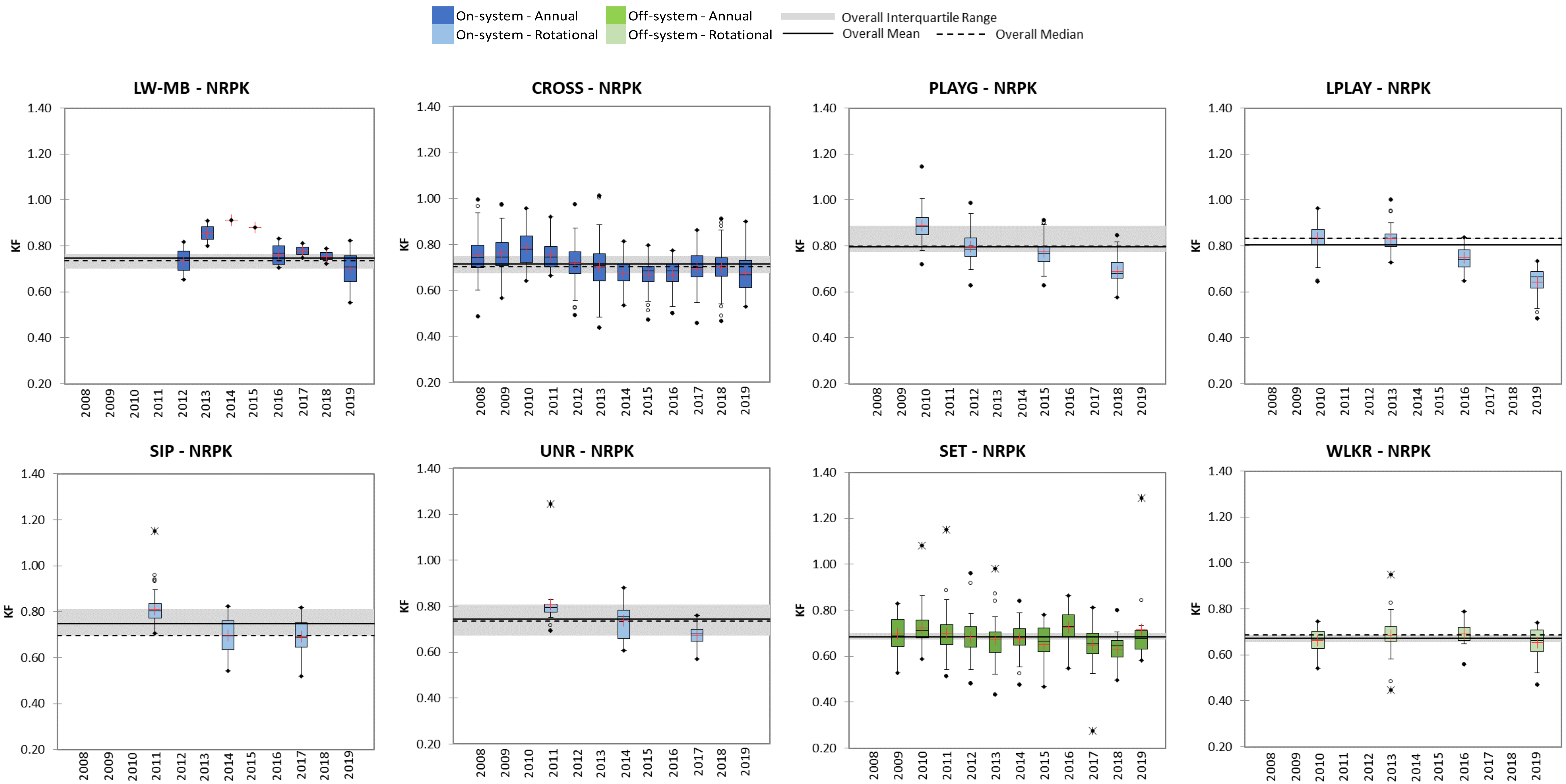


Figure 5.3-2. 2008-2019 Fulton's condition factor of Northern Pike.

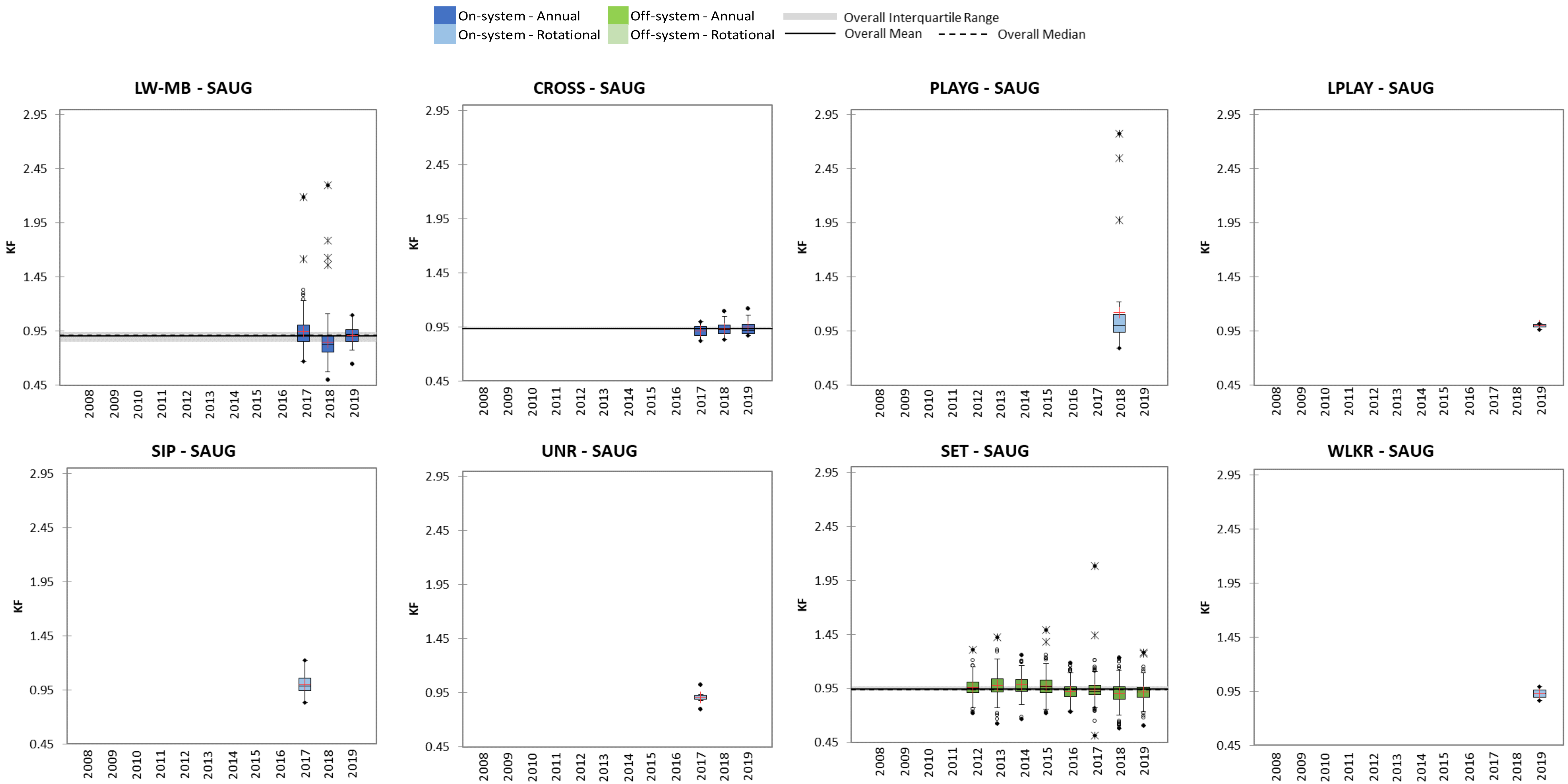


Figure 5.3-3. 2008-2019 Fulton's condition factor of Sauger.

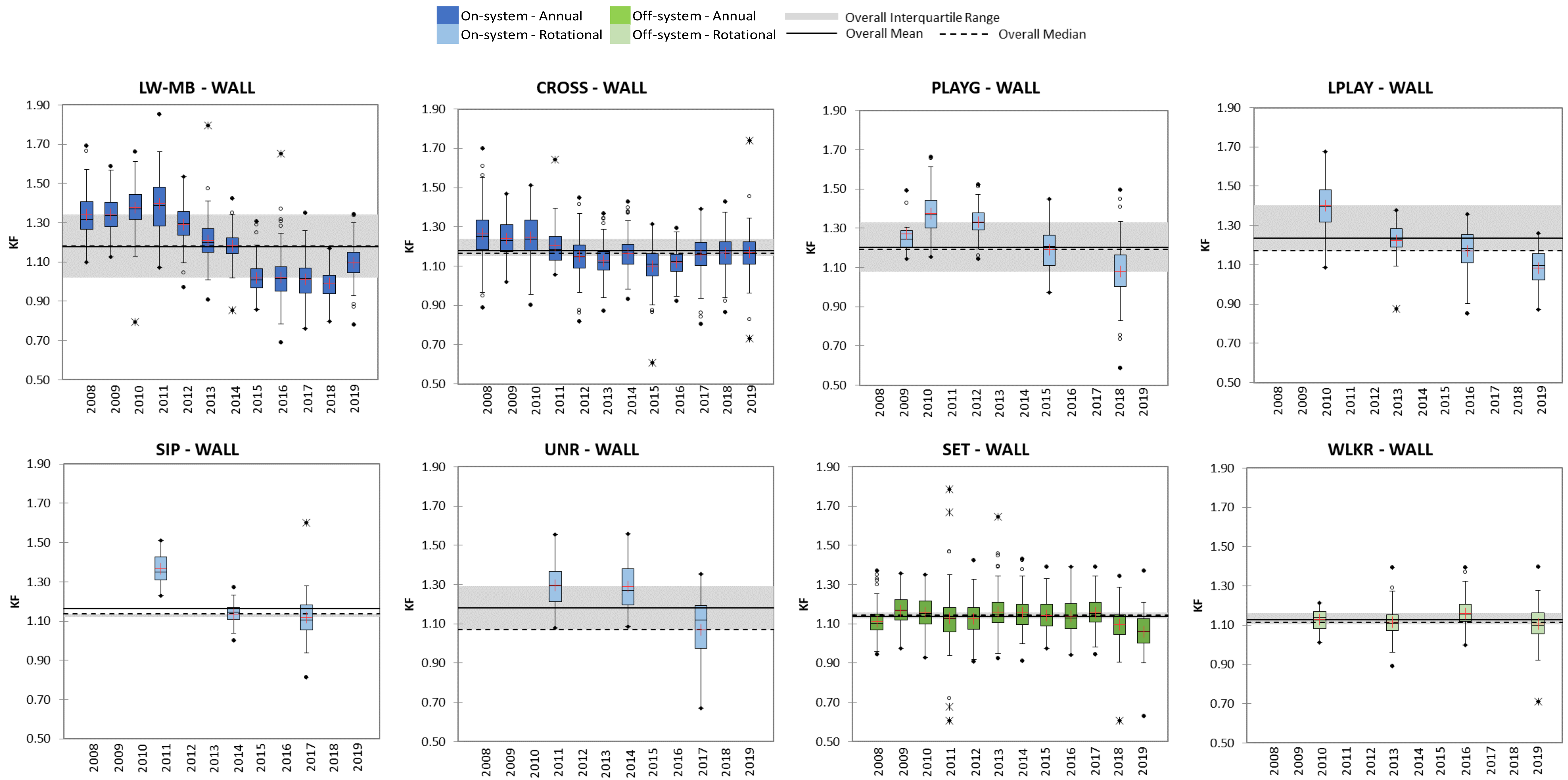


Figure 5.3-4. 2008-2019 Fulton's condition factor of Walleye.

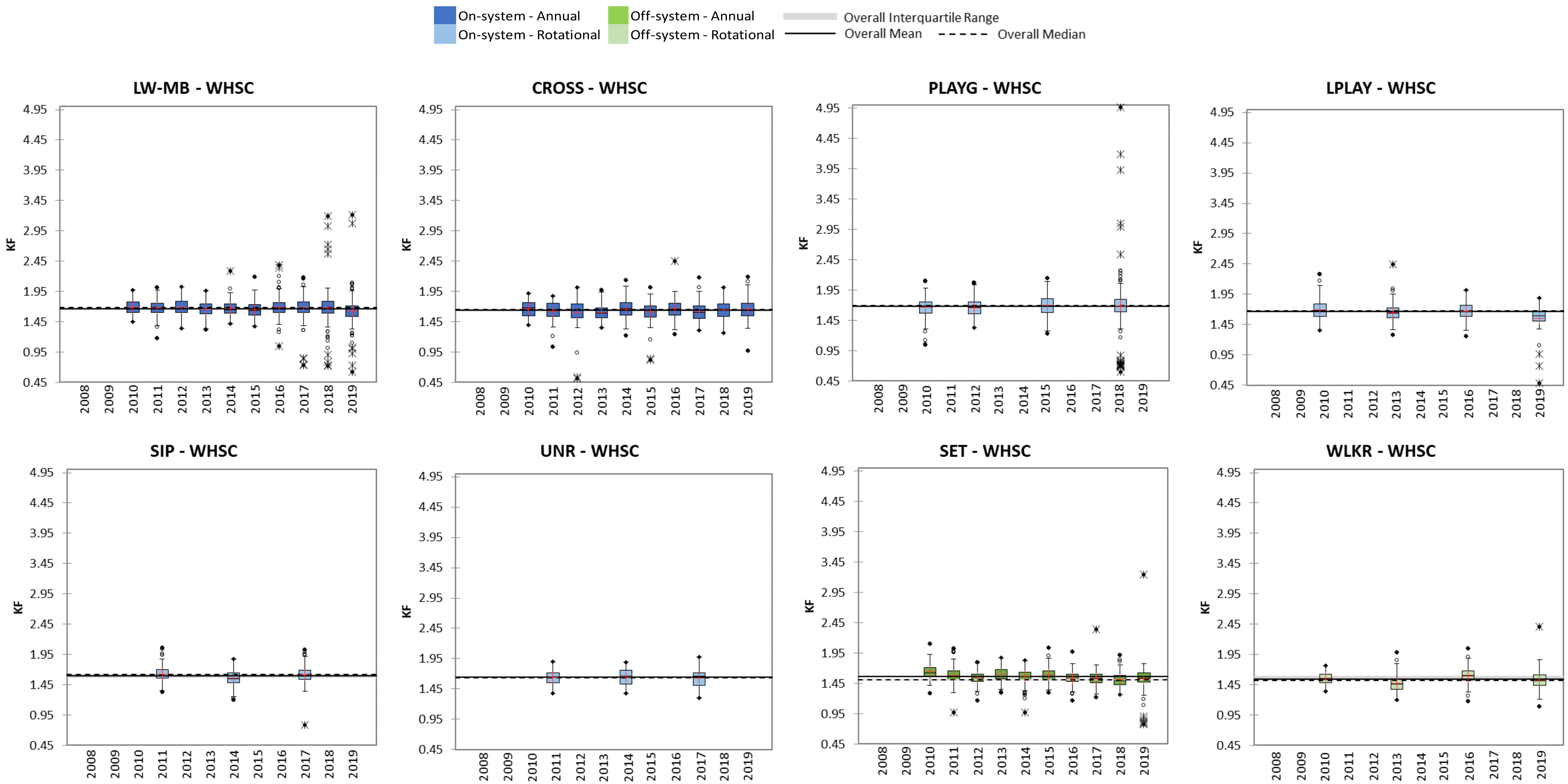


Figure 5.3-5. 2008-2019 Fulton's condition factor of White Sucker.

5.3.2 RELATIVE WEIGHT

5.3.2.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg – Mossy Bay

Lake Whitefish

The annual mean Wr of Lake Whitefish between 99 mm and 701 mm in total length over the 12 years of monitoring ranged from a low of 91 in 2011 to a high of 121 in 2016 (Table 5.3-2; Figure 5.3-6).

The overall mean Wr was 107, the median was 106, and the IQR was 105-110 (Figure 5.3-6). The annual mean Wr fell within the overall IQR except in 2008, 2011, and 2015 when it was below the IQR and in 2009, 2016, and 2017 when it was above the IQR.

Northern Pike

Northern Pike was not a target species in Mossy Bay until 2009; over the 11 years of monitoring Northern Pike greater than 99 mm in total length were not captured in 2009 (Table 5.3-2). The annual mean Wr of Northern Pike in the years they were caught ranged from a low of 86 in 2019 to a high of 112 in 2014 (Table 5.3-2; Figure 5.3-7).

The overall mean Wr was 92, the median was 90, and the IQR was 86-96 (Figure 5.3-7). The annual mean Wr fell within the overall IQR except in 2010, 2011, and 2014 when it was above the IQR.

Sauger

Sauger was not a target species in Lake Winnipeg until 2017; the annual mean Wr of Sauger greater than 69 mm in total length over the three years of monitoring ranged from a low of 81 in 2018 to a high of 88 in 2017 (Table 5.3-2; Figure 5.3-8).

The overall mean and median Wr were 86 and the IQR was 81-88 (Figure 5.3-8). The annual mean Wr was equal to or fell within the overall IQR in all three years.

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the 12 years of monitoring ranged from a low of 81 in 2018 to a high of 108 in 2010 (Table 5.3-2; Figure 5.3-9).

The overall mean Wr was 94, the median was 95, and the IQR was 85-103 (Figure 5.3-9). The annual mean Wr fell within the overall IQR except in 2016, 2017, and 2018 when it was below the IQR and in 2009, 2010, and 2011 when it was above the IQR.

White Sucker

White Sucker was not a target species in Lake Winnipeg until 2010; the annual mean Wr of White Sucker greater than 99 mm in total length over the 10 years of monitoring ranged from a low of 105 in 2019 to a high of 109 in 2011, 2012, 2016, 2017, and 2018 (Table 5.3-2; Figure 5.3-10).

The overall mean Wr was 108, the median was 109, and the IQR was 107-109 (Figure 5.3-10). The annual mean Wr fell within the overall IQR except in 2019 when it was below the IQR.

Cross Lake

Lake Whitefish

Over the 12 years of monitoring Lake Whitefish between 99 and 701 mm in total length were only captured in 2008, 2012, 2013, 2014, 2015, 2017, 2018, and 2019 (Table 5.3-2). The annual mean Wr in these years ranged from a low of 100 in 2017 and 2019 to a high of 138 in 2008 (Table 5.3-2; Figure 5.3-6).

The overall mean Wr was 116, the median was 106, and the IQR was 102-138 (Figure 5.3-6). The annual mean Wr fell within the overall IQR except in 2017 and 2019 when it was below the IQR.

Northern Pike

The annual mean Wr of Northern Pike greater than 99 mm in total length over the 12 years of monitoring ranged from a low of 82 in 2016 to a high of 96 in 2010 (Table 5.3-2; Figure 5.3-7).

The overall mean and median Wr were 88 and the IQR was 86-91 (Figure 5.3-7). The annual mean Wr fell within the overall IQR except in 2014, 2015, 2016, and 2019 when it was below the IQR and in 2009, 2010, and 2011 when it was above the IQR.

Sauger

Sauger was not a target species in Cross Lake until 2017; the annual mean Wr of Sauger greater than 69 mm in total length over the three years of monitoring ranged from a low of 86 in 2017 to a high of 90 in 2019 (Table 5.3-2; Figure 5.3-8).

The overall mean and median Wr were 89 and the IQR was 89-90 (Figure 5.3-8). The annual mean Wr fell within the overall IQR except in 2017 when it was below the IQR.

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the 12 years of monitoring ranged from a low of 87 in 2015 to a high of 100 in 2008 and 2009 (Table 5.3-2; Figure 5.3-9).

The overall mean and median Wr were 93 and the IQR was 89-96 (Figure 5.3-9). The annual mean Wr fell within the overall IQR except in 2015 when it was below the IQR and in 2008, 2009, and 2010 when it was above the IQR.

White Sucker

White Sucker was not a target species in Cross Lake until 2010; the annual mean Wr of White Sucker greater than 99 mm in total length over the 10 years of monitoring ranged from a low of 101 in 2015 to a high of 107 in 2014 (Table 5.3-2; Figure 5.3-10).

The overall mean and median Wr were 104 and the IQR was 102-106 (Figure 5.3-10). The annual mean KF fell within the overall IQR except in 2015 when it was below the IQR and in 2014 when it was above the IQR.

ROTATIONAL SITES

Playgreen Lake

Lake Whitefish

The annual mean Wr of Lake Whitefish between 99 mm and 701 mm in total length over the five years of monitoring ranged from a low of 107 in 2010 to a high of 115 in 2015 (Table 5.3-2; Figure 5.3-6).

The overall mean Wr was 112, the median was 113, and the IQR was 111-115 (Figure 5.3-6). The annual mean Wr fell within the overall IQR except in 2010 when it was below the IQR.

Northern Pike

The annual mean Wr of Northern Pike greater than 99 mm in total length over the four years of monitoring it was a target species ranged from a low of 88 in 2018 to a high of 107 in 2010 (Table 5.3-2; Figure 5.3-7).

The overall mean and median Wr were 95 and the IQR was 90-95 (Figure 5.3-7). The annual mean Wr fell within the overall IQR except in 2018 when it was below the IQR and in 2010 when it was above the IQR.

Sauger

Over five years of monitoring, Sauger was only a target species in Playgreen Lake in 2018. In this year, Sauger greater than 69 mm in total length had a mean Wr of 105 (Table 5.3-2; Figure 5.3-8).

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the five years of monitoring ranged from a low of 88 in 2018 to a high of 106 in 2009 and 2010 (Table 5.3-2; Figure 5.3-9).

The overall mean and median Wr were 97 and the IQR was 88-106 (Figure 5.3-9). The annual mean Wr was equal to or fell within the overall IQR in all five years.

White Sucker

White Sucker was not a target species in Playgreen Lake until 2010; the annual mean Wr of White Sucker greater than 99 mm in total length over the four years of monitoring ranged from a low of 107 in 2010 and 2012 to a high of 110 in 2015 (Table 5.3-2; Figure 5.3-10).

The overall mean Wr was 108, the median was 107, and the IQR was 107-109 (Figure 5.3-10). The annual mean Wr fell within the overall IQR except in 2015 when it was above the IQR.

Little Playgreen Lake

Lake Whitefish

Over the four years of monitoring Lake Whitefish between 99 and 701 mm in total length were captured in only 2010 (Table 5.3-2). The mean Wr in this year was 122 (Figure 5.3-6).

Northern Pike

The annual mean Wr of Northern Pike greater than 99 mm in total length over the four years of monitoring ranged from a low of 80 in 2019 to a high of 103 in 2010 (Table 5.3-2; Figure 5.3-7).

The overall mean Wr was 99, the median was 103, and the IQR was 102-103 (Figure 5.3-7). The annual mean Wr fell within the overall IQR except in 2016 and 2019 when it was below the IQR.

Sauger

Over four years of monitoring, Sauger was only a target species in Little Playgreen Lake in 2019. In this year, Sauger greater than 69 mm in total length had a mean Wr of 96 (Table 5.3-2; Figure 5.3-8).

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the four years of monitoring ranged from a low of 88 in 2019 to a high of 111 in 2010 (Table 5.3-2; Figure 5.3-9).

The overall mean Wr was 98, the median was 94, and the IQR was 94-111 (Figure 5.3-9). The annual mean Wr fell within the overall IQR except in 2019 when it was below the IQR.

White Sucker

The annual mean Wr of White Sucker greater than 99 mm in total length over the four years of monitoring ranged from a low of 98 in 2019 to a high of 109 in 2010 (Table 5.3-2; Figure 5.3-10).

The overall mean Wr was 106, the median was 107, and the IQR was 104-109 (Figure 5.3-10). The annual mean Wr fell within the overall IQR except in 2019 when it was below the IQR.

Sipiwesk Lake

Lake Whitefish

Over the three years of monitoring a single Lake Whitefish between 99 and 701 mm in total length was captured in only 2014 (Table 5.3-2). The Wr of this fish was 88 (Figure 5.3-6).

Northern Pike

The annual mean Wr of Northern Pike greater than 99 mm in total length over the three years of monitoring ranged from a low of 84 in 2014 to a high of 99 in 2011 (Table 5.3-2; Figure 5.3-7).

The overall mean Wr was 90, the median was 87, and the IQR was 84-99 (Figure 5.3-7). The annual mean Wr was equal to or fell within the overall IQR in all three years.

Sauger

Over three years of monitoring, Sauger was only a target species in Sipiwesk Lake in 2017. In this year, Sauger greater than 69 mm in total length had a mean Wr of 91 (Table 5.3-2; Figure 5.3-8).

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the three years of monitoring ranged from a low of 90 in 2017 to a high of 108 in 2011 (Table 5.3-2; Figure 5.3-9).

The overall mean Wr was 93, the median was 91, and the IQR was 90-91 (Figure 5.3-9). The annual mean Wr fell within the overall IQR except in 2011 when it was above the IQR.

White Sucker

The annual mean Wr of White Sucker greater than 99 mm in total length over the three years of monitoring ranged from a low of 101 in 2014 to a high of 104 in 2011 and 2017 (Table 5.3-2; Figure 5.3-10).

The overall mean Wr was 103, the median was 104, and the IQR was 101-104 (Figure 5.3-10). The annual mean Wr was equal to or fell within the overall IQR in all three years.

Upper Nelson River

Lake Whitefish

Over the three years of monitoring a single Lake Whitefish between 99 and 701 mm in total length was captured in only 2017 (Table 5.3-2). The Wr of this fish was 149 (Figure 5.3-6).

Northern Pike

The annual mean Wr of Northern Pike greater than 99 mm in total length over the three years of monitoring ranged from a low of 83 in 2017 to a high of 99 in 2011 (Table 5.3-2; Figure 5.3-7).

The overall mean and median Wr were 92 and the IQR was 83-99 (Figure 5.3-7). The annual mean Wr was equal to or fell within the overall IQR in all three years.

Sauger

Over three years of monitoring, Sauger was only a target species in the upper Nelson River in 2017. In this year, Sauger greater than 69 mm in total length had a mean Wr of 84 (Table 5.3-2; Figure 5.3-8).

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the three years of monitoring ranged from a low of 86 in 2017 to a high of 102 in 2011 (Table 5.3-2; Figure 5.3-9).

The overall mean Wr was 96, the median was 101, and the IQR was 86-102 (Figure 5.3-9). The annual mean Wr was equal to or fell within the overall IQR in all three years.

White Sucker

The annual mean Wr of White Sucker greater than 99 mm in total length over the three years of monitoring ranged from a low of 101 in 2011 to a high of 106 in 2014 (Table 5.3-2; Figure 5.3-10).

The overall mean and median Wr were 104 and the IQR was 101-106 (Figure 5.3-10). The annual mean Wr was equal to or fell within the overall IQR in all three years.

5.3.2.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Lake Whitefish

The annual mean Wr of Lake Whitefish between 99 mm and 701 mm in total length over the 12 years of monitoring ranged from a low of 95 in 2009 to a high of 104 in 2015 (Table 5.3-2; Figure 5.3-6).

The overall mean Wr was 100, the median was 99, and the IQR was 98-102 (Figure 5.3-6). The annual mean Wr fell within the overall IQR except in 2009, 2014, and 2018 when it was below the IQR and in 2008, 2010, and 2015 when it was above the IQR.

Northern Pike

The annual mean Wr of Northern Pike greater than 99 mm in total length over the 11 years of monitoring it was a target species ranged from a low of 78 in 2018 to a high of 90 in 2010 and 2016 (Table 5.3-2; Figure 5.3-7).

The overall mean and median Wr were 85 and the IQR was 84-87 (Figure 5.3-7). The annual mean Wr fell within the overall IQR except in 2017 and 2018 when it was below the IQR and in 2010 and 2016 when it was above the IQR.

Sauger

Sauger was not a target species in Setting Lake until 2012; the annual mean Wr of Sauger greater than 69 mm in total length over the eight years of monitoring ranged from a low of 86 in 2018 and 2019 to a high of 93 in 2013 and 2014 (Table 5.3-2; Figure 5.3-8).

The overall mean Wr was 90, the median was 89, and the IQR was 88-92 (Figure 5.3-8). The annual mean Wr fell within the overall IQR except in 2018 and 2019 when it was below the IQR.

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the 12 years of monitoring ranged from a low of 86 in 2019 to a high of 94 in 2009, 2010, 2013, and 2014 (Table 5.3-2; Figure 5.3-9).

The overall mean Wr was 91, the median was 92, and the IQR was 90-94 (Figure 5.3-9). The annual mean Wr fell within the overall IQR except in 2008, 2018, and 2019 when it was below the IQR.

White Sucker

White Sucker was not a target species in Setting Lake until 2010; the annual mean Wr of White Sucker greater than 99 mm in total length over the 10 years of monitoring ranged from a low of 97 in 2018 to a high of 106 in 2010 (Table 5.3-2; Figure 5.3-10).

The overall mean Wr was 101 and the median and IQR were 97 (Figure 5.3-10). The annual mean Wr was higher than the overall IQR in all years except in 2018, when the annual mean was equal to the IQR.

ROTATIONAL SITES

Walker Lake

Lake Whitefish

Over the four years of monitoring Lake Whitefish between 99 and 701 mm in total length were captured in only 2013, 2016, and 2019 (Table 5.3-2). The annual mean Wr in these years ranged from a low of 98 in 2013 to a high of 109 in 2016 and 2019 (Table 5.3-2; Figure 5.3-6).

The overall mean Wr was 106 and the median and IQR were 109 (Figure 5.3-6). The annual mean Wr was below the overall IQR in 2013.

Northern Pike

The annual mean Wr of Northern Pike greater than 99 mm in total length over the four years of monitoring ranged from a low of 82 in 2019 to a high of 87 in 2016 (Table 5.3-2; Figure 5.3-7).

The overall mean Wr was 84, the median was 85, and the IQR was 82-86 (Figure 5.3-7). The annual mean Wr fell within the overall IQR except in 2016 when it was above the IQR.

Sauger

Over four years of monitoring, Sauger was only a target species in Walker Lake in 2019. In this year, Sauger greater than 69 mm in total length had a mean Wr of 87 (Table 5.3-2; Figure 5.3-8).

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the four years of monitoring ranged from a low of 86 in 2013 to a high of 92 in 2016 (Table 5.3-2; Figure 5.3-9).

The overall mean Wr was 89, the median was 88, and the IQR was 86-92 (Figure 5.3-9). The annual mean Wr was equal to or fell within the overall IQR in all four years.

White Sucker

The annual mean Wr of White Sucker greater than 99 mm in total length over the four years of monitoring ranged from a low of 95 in 2013 to a high of 102 in 2016 (Table 5.3-2; Figure 5.3-10).

The overall mean Wr was 99, the median was 98, and the IQR was 98-102 (Figure 5.3-10). The annual mean Wr fell within the overall IQR in all years except 2013 when it was below the IQR.

Table 5.3-2. 2008-2019 Relative weight of target species.

Waterbody	Year	LKWH			NRPK			SAUG			WALL			WHSC		
		n_F[1]	Mean	SE[2]	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE
LW-MB	2008	18	103	3							136	103	1			
	2009	5	113	4	-	-	-				321	106	0			
	2010	33	106	3	2	104.9	1				133	108	1	87	108	1
	2011	23	91	3	2	99	2				79	105	2	69	109	1
	2012	9	110	3	6	96	3				125	101	1	116	109	1
	2013	40	105	2	7	97	3				315	98	0	234	107	1
	2014	16	106	2	2	112	0				207	95	1	121	107	1
	2015	10	98	7	3	91	8				227	85	1	184	107	1
	2016	11	121	2	12	90	3				222	84	1	354	109	0
	2017	36	117	2	2	95	3	250	88	1	195	84	1	387	109	1
	2018	7	107	4	5	88	3	159	81	2	104	81	1	354	109	1
	2019	3	108	4	21	86	2	181	86	1	198	86	1	517	105	1
CROSS	2008	3	138	6	151	91	1				238	100	1			
	2009	-	-	-	77	95	1				80	100	1			
	2010	-	-	-	72	96	1				92	99	1	60	104	1
	2011	-	-	-	46	93	1				54	96	1	44	103	2
	2012	1	106	-	97	88	1				136	91	1	77	102	2
	2013	2	102	10	100	87	1				172	89	1	64	102	1
	2014	1	116	-	67	83	1				143	93	1	86	107	1
	2015	1	134	-	85	83	1				168	87	1	175	101	1
	2016	-	-	-	42	82	1				103	89	1	75	106	1
	2017	1	100	-	80	86	1	4	86	3	228	93	1	168	104	1
	2018	1	105	-	135	88	1	15	89	2	181	93	1	185	106	1
	2019	1	100	-	43	83	2	9	90	2	118	93	1	128	106	1
PLAYG	2009	11	113	3							14	106	3			
	2010	20	107	3	84	107	1				101	106	1	395	107	0
	2012	40	111	2	123	95	1				65	103	1	630	107	0
	2015	57	115	1	105	90	1				90	97	1	404	110	0
	2018	36	113	1	79	88	1	35	105	7	173	88	1	605	109	1
LPLAYG	2010	5	122	1	122	103	1				114	111	1	380	109	0
	2013	-	-	-	55	102	1				90	96	1	335	104	1
	2016	-	-	-	31	92	1				123	94	1	179	107	1
	2019	-	-	-	20	80	2	3	96	1	83	88	1	86	98	2
SIP	2011	-	-	-	84	99	1				20	108	2	321	104	0
	2014	1	88	-	87	84	1				50	91	1	361	101	0
	2017	-	-	-	54	87	1	156	91	1	57	90	1	351	104	0
UNR	2011	-	-	-	22	99	3				94	102	1	56	101	2
	2014	-	-	-	15	92	3				58	101	1	79	106	1
	2017	1	149	-	18	83	1	14	84	2	82	86	1	32	104	2
SET	2008	3	103	3							189	89	1			
	2009	4	95	1	45	87	1				167	94	1			
	2010	18	103	2	62	90	1				173	94	1	156	106	1
	2011	38	102	2	54	86	2				177	91	1	167	102	1
	2012	16	98	1	71	85	1	287	91	1	279	90	0	199	99	0
	2013	27	99	1	59	84	1	335	93	1	263	94	1	178	103	1
	2014	5	96	2	60	84	1	292	93	1	232	94	1	197	101	1
	2015	12	104	3	40	84	2	384	92	0	240	90	1	225	103	0
	2016	20	102	2	39	90	2	393	88	0	172	92	1	162	100	1
	2017	18	98	2	41	81	2	372	89	1	281	92	1	171	99	1
	2018	7	97	2	25	78	2	274	86	1	252	88	1	136	97	1
	2019	28	98	1	15	88	5	325	86	0	107	86	2	123	98	1
WLKR	2010	-	-	-	20	86	2				17	90	1	59	100	1
	2013	2	98	3	54	85	1				96	86	1	112	95	1
	2016	2	109	9	28	87	2				106	92	1	191	102	1
	2019	5	109	4	55	82	2	3	87	3	92	88	1	182	98	1

Notes:

1. n_F = number of fish measured for length and weight.
2. SE = standard error.
3. Grey shading indicates a species was not a target species in that year.

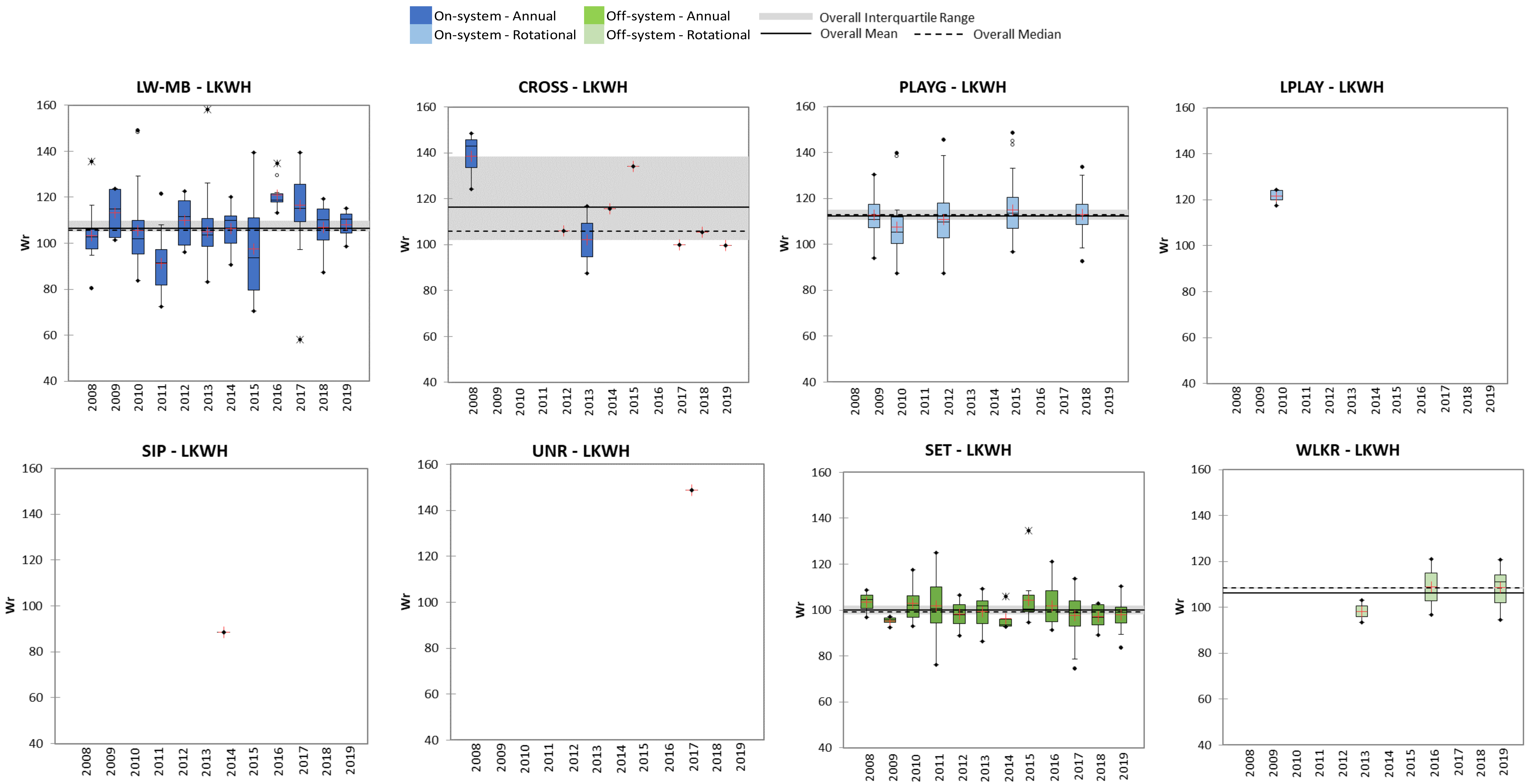


Figure 5.3-6. 2008-2019 Relative weight (Wr) of Lake Whitefish.

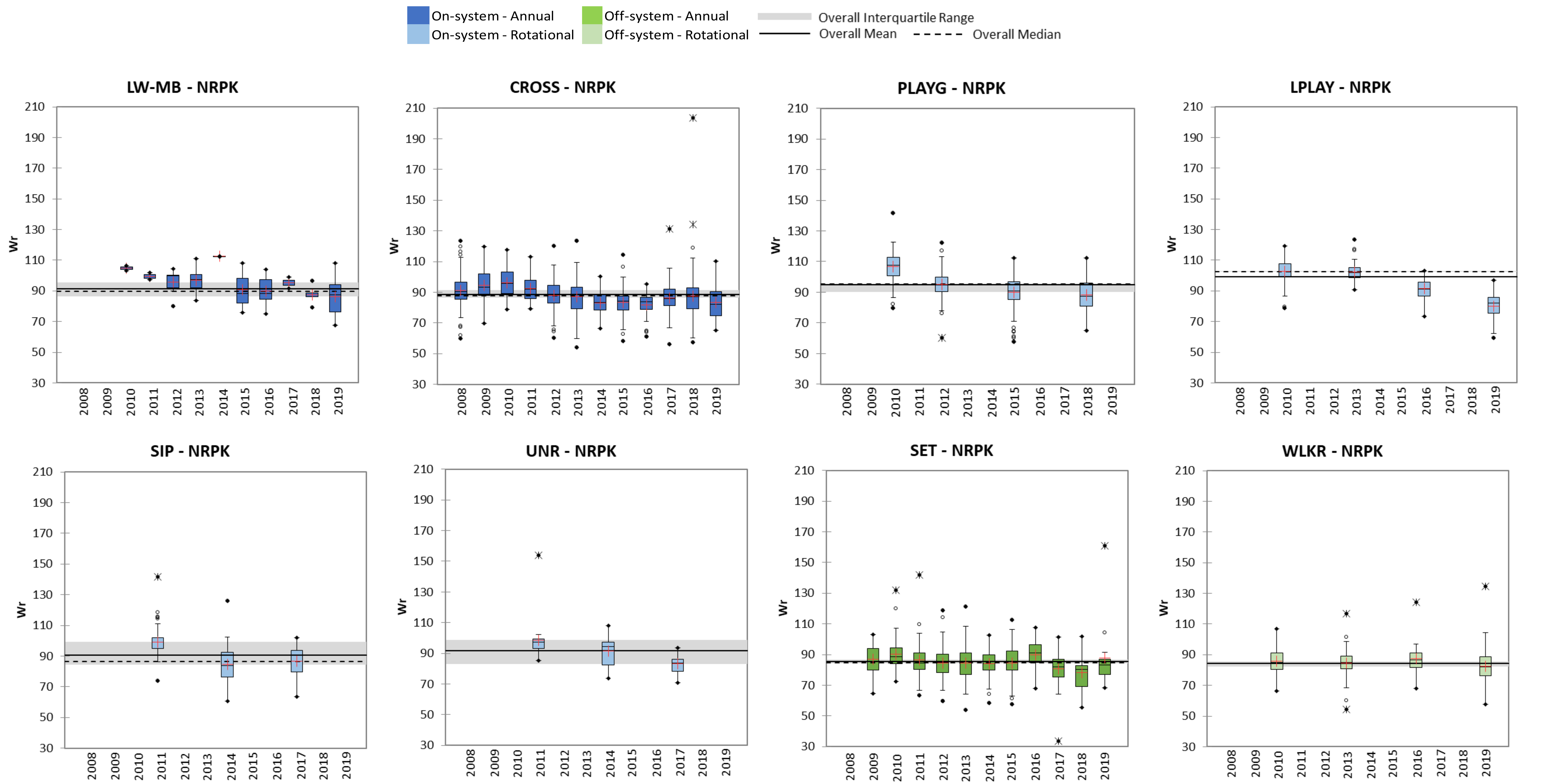


Figure 5.3-7. 2008-2019 Relative weight (Wr) of Northern Pike.

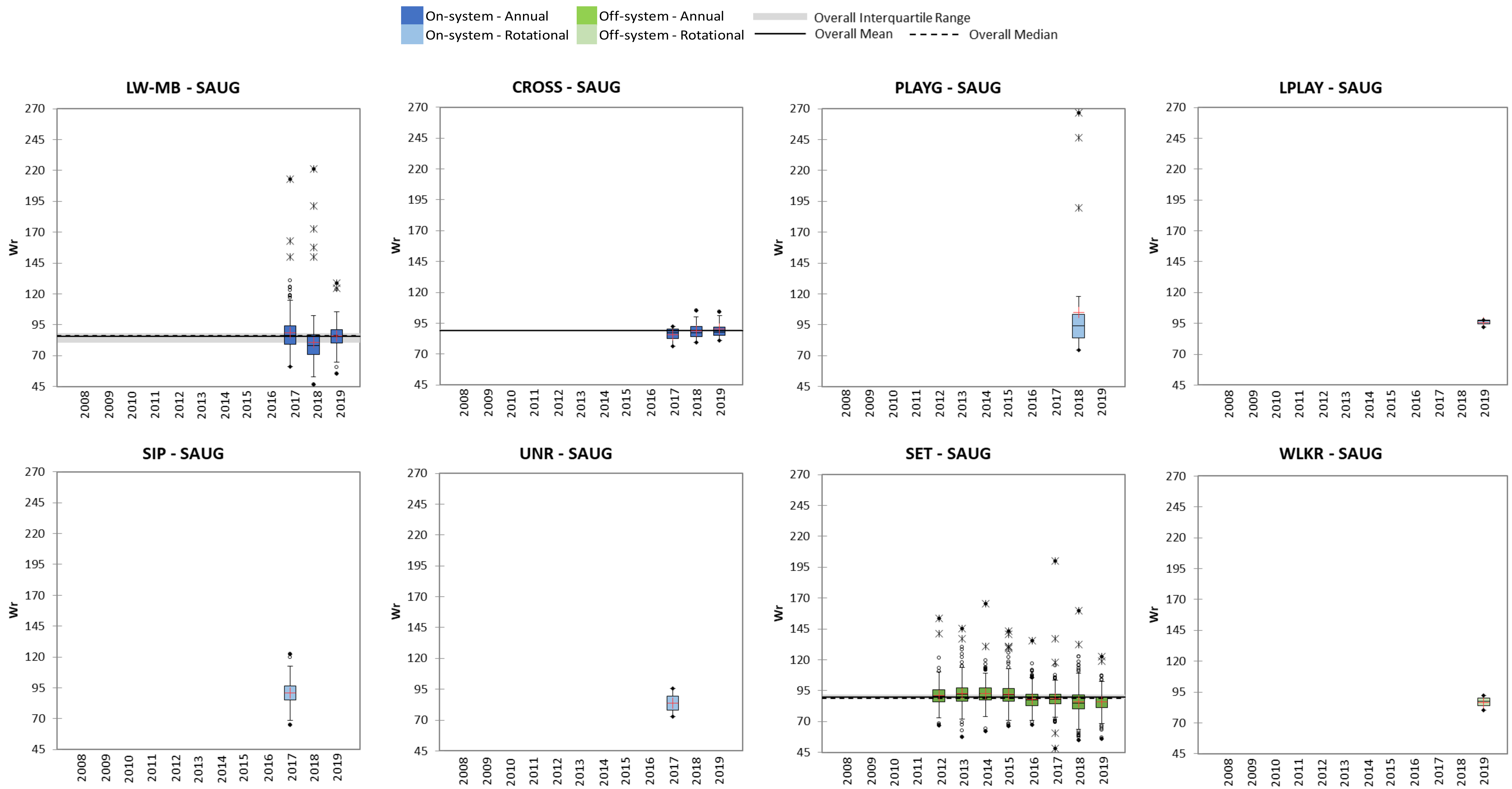


Figure 5.3-8. 2008-2019 Relative weight (Wr) of Sauger.

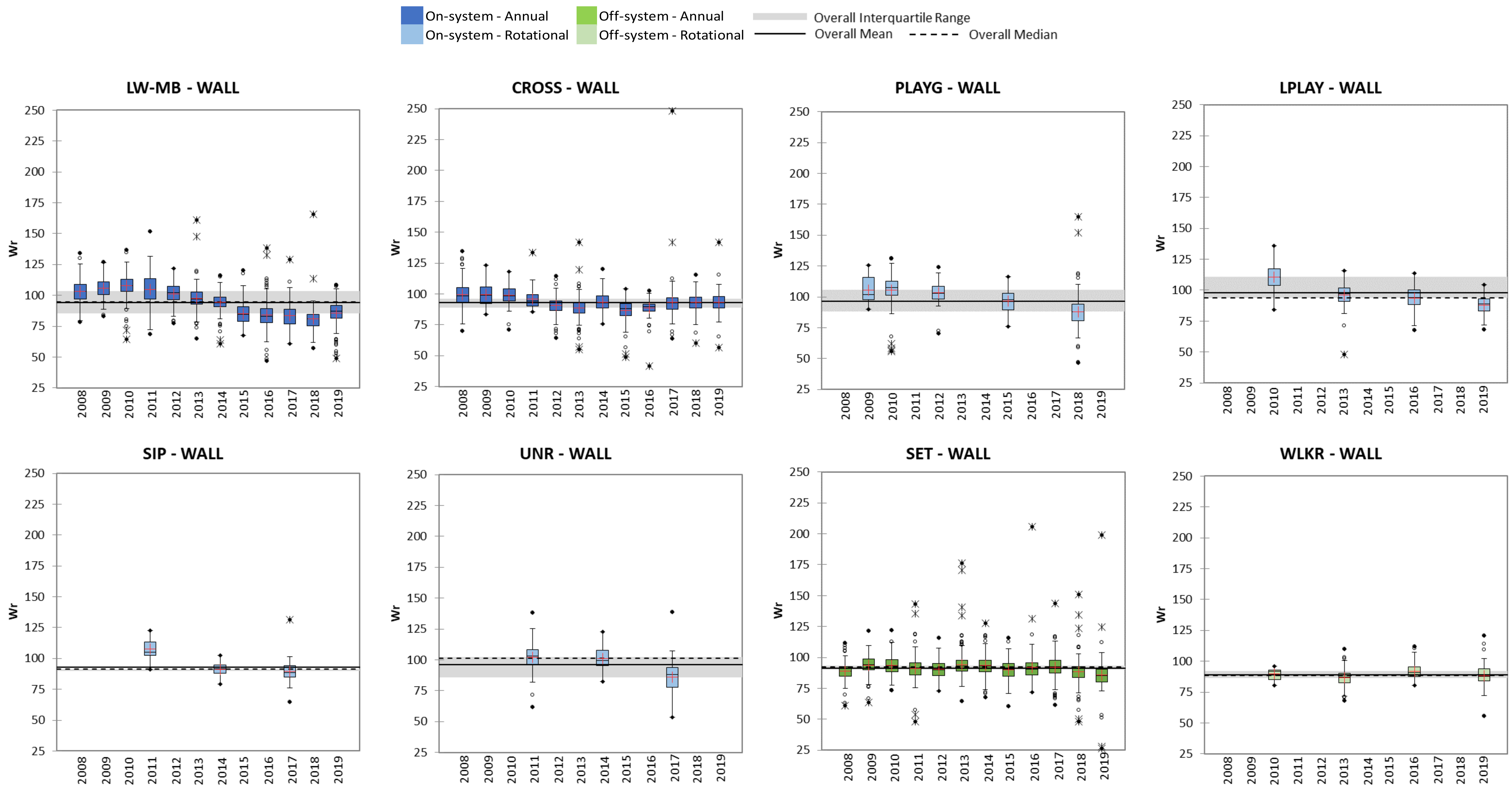


Figure 5.3-9. 2008-2019 Relative weight (Wr) of Walleye.

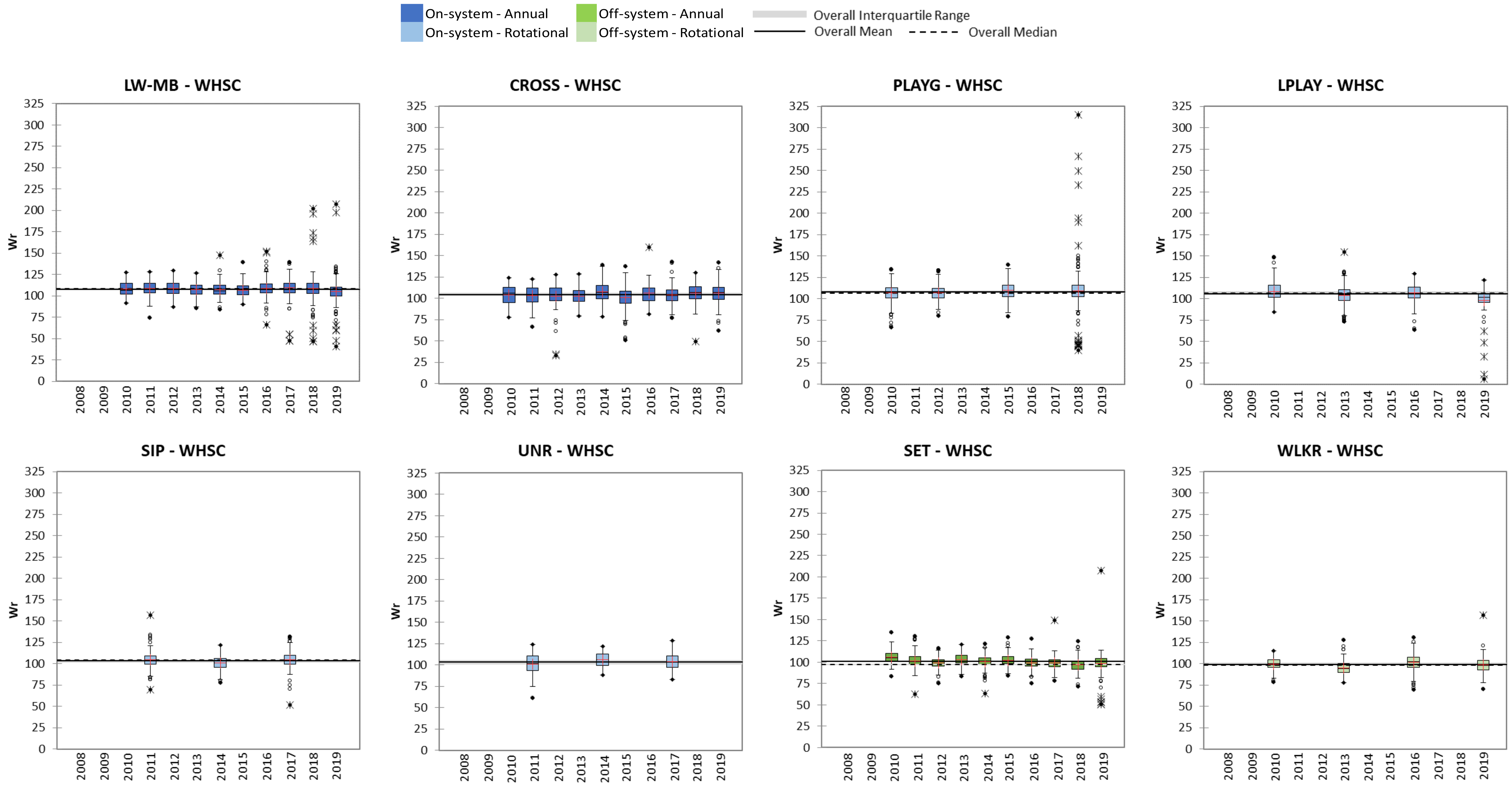


Figure 5.3-10. 2008-2019 Relative weight (Wr) of White Sucker.

5.4 GROWTH

5.4.1 LENGTH-AT-AGE

5.4.1.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg – Mossy Bay

Lake Whitefish

The annual mean FLA of 4-year-old Lake Whitefish over the 12 years of monitoring ranged from a low of 347 in 2015 to a high of 406 mm in 2018 (Table 5.4-1; Figure 5.4-1). Four-year olds were not caught in 2010, 2012, 2016, or 2019.

The overall mean and median FLA were 367 and the IQR was 360-371 mm (Figure 5.4-1). The annual mean FLA fell within the overall IQR except in 2015 and 2017 when it was below the IQR and in 2011 and 2018 when it was above the IQR.

Northern Pike

Over the 11 years of monitoring that Northern Pike was a target species in Mossy Bay, a single 4-year-old Northern Pike was captured in only 2012, 2016, and 2019 (Table 5.4-1). The FLA of these fish ranged from 502-604 mm (Figure 5.4-2).

Sauger

Sauger was not a target species in Mossy Bay until 2017; the annual mean FLA of 3-year-old Sauger over the three years of monitoring ranged from a low of 187 in 2019 to a high of 203 mm in 2017 (Table 5.4-1; Figure 5.4-3).

The overall mean FLA was 193, the median was 192, and the IQR was 187-203 mm (Figure 5.4-3). The annual mean FLA was equal to or fell within the overall IQR in all three years.

Walleye

The annual mean FLA of 3-year-old Walleye over the 12 years of monitoring ranged from a low of 206 in 2019 to a high of 326 mm in 2014 (Table 5.4-1; Figure 5.4-4).

The overall mean FLA was 280, the median was 276, and the IQR was 263-307 mm (Figure 5.4-4). The annual mean FLA fell within the overall IQR except in 2011, 2015, 2016, 2017, 2018, and 2019 when it was below the IQR and in 2014 when it was above the IQR.

White Sucker

White Sucker was not aged as part of CAMP.

Cross Lake

Lake Whitefish

Over the 12 years of monitoring a single 4-year-old Lake Whitefish was captured in only 2013, 2017, and 2019 (Table 5.4-1). The FLA of these fish ranged from 251-301 mm (Figure 5.4-1).

Northern Pike

The annual mean FLA of 4-year-old Northern Pike over the 12 years of monitoring ranged from a low of 437 in 2011 to a high of 566 mm in 2016 (Table 5.4-1; Figure 5.4-2).

The overall mean FLA was 521, the median was 528, and the IQR was 508-546 mm (Figure 5.4-2). The annual mean FLA fell within the overall IQR except in 2010, 2011, and 2012 when it was below the IQR and in 2016 and 2018 when it was above the IQR.

Sauger

Sauger was not a target species in Cross Lake until 2017, but not all fish were aged in 2017; the annual mean FLA of 3-year-old Sauger over the two years of monitoring was 235 mm in 2018 and 230 mm in 2019 (Table 5.4-1; Figure 5.4-3).

Walleye

The annual mean FLA of 3-year-old Walleye over the 12 years of monitoring ranged from a low of 254 in 2019 to a high of 337 mm in 2014 (Table 5.4-1; Figure 5.4-4).

The overall mean FLA was 306, the median was 299, and the IQR was 286-322 mm (Figure 5.4-4). The annual mean FLA fell within the overall IQR except in 2008, 2011, and 2019 when it was below the IQR and in 2014 when it was above the IQR.

White Sucker

White Sucker was not aged as part of CAMP.

ROTATIONAL SITES

Playgreen Lake

Lake Whitefish

The annual mean FLA of 4-year-old Lake Whitefish over the five years of monitoring ranged from a low of 344 in 2012 to a high of 393 mm in 2015 (Table 5.4-1; Figure 5.4-1). Four-year olds were not caught in 2009 and 2010.

The overall mean FLA was 386, the median was 390, and the IQR was 390-393 mm (Figure 5.4-1). The annual mean FLA fell within the overall IQR except in 2012 when it was below the IQR.

Northern Pike

The annual mean FLA of 4-year-old Northern Pike over the four years of monitoring it was a target species ranged from a low of 467 in 2018 to a high of 582 mm in 2015 (Table 5.4-1; Figure 5.4-2).

The overall mean FLA was 553, the median was 582, and the IQR was 511-582 mm (Figure 5.4-2). The annual mean FLA fell within the overall IQR except in 2018 when it was below the IQR.

Sauger

Over five years of monitoring, Sauger was only a target species in Playgreen Lake in 2018. In this year, 3-year-old Sauger had a mean FLA of 231 mm (Table 5.4-1; Figure 5.3-3).

Walleye

The annual mean FLA of 3-year-old Walleye over the five years of monitoring ranged from a low of 150 in 2018 to a high of 328 mm in 2010 (Table 5.4-1; Figure 5.4-4). Three-year olds were not caught in 2009.

The overall mean FLA was 282, the median was 278, and the IQR was 278-286 mm (Figure 5.4-4). The annual mean FLA fell within the overall IQR except in 2018 when it was below the IQR and in 2010 when it was above the IQR.

White Sucker

White Sucker was not aged as part of CAMP.

Little Playgreen Lake

Lake Whitefish

Over the four years of monitoring 4-year-old Lake Whitefish were not caught in Little Playgreen Lake (Table 5.4-1).

Northern Pike

The annual mean FLA of 4-year-old Northern Pike over the four years of monitoring ranged from a low of 483 in 2016 to a high of 526 mm in 2013 (Table 5.4-1; Figure 5.4-2).

The overall mean FLA was 503, the median was 497, and the IQR was 497-526 mm (Figure 5.4-2). The annual mean FLA fell within the overall IQR except in 2016 when it was below the IQR.

Sauger

Over four years of monitoring, Sauger was only a target species in Little Playgreen Lake in 2019. In this year, the single 3-year-old Sauger collected had a FLA of 238 mm (Table 5.4-1; Figure 5.3-3).

Walleye

The annual mean FLA of 3-year-old Walleye over the four years of monitoring ranged from a low of 267 in 2019 to a high of 304 mm in 2013 (Table 5.4-1; Figure 5.4-4).

The overall mean and median FLA were 290 and the IQR was 283-304 mm (Figure 5.4-4). The annual mean FLA fell within the overall IQR except in 2019 when it was below the IQR.

White Sucker

White Sucker was not aged as part of CAMP.

Sipiwesk Lake

Lake Whitefish

Over the three years of monitoring 4-year-old Lake Whitefish were not caught in Sipiwesk Lake (Table 5.4-1).

Northern Pike

The annual mean FLA of 4-year-old Northern Pike over the three years of monitoring ranged from a low of 507 in 2011 to a high of 603 mm in 2017 (Table 5.4-1; Figure 5.4-2).

The overall mean FLA was 528, the median was 507, and the IQR was 507-534 mm (Figure 5.4-2). The annual mean FLA fell within the overall IQR except in 2017 when it was above the IQR.

Sauger

Over three years of monitoring, Sauger was only a target species in Sipiwesk Lake in 2017. In this year, 3-year-old Sauger had a mean FLA of 268 mm (Table 5.4-1; Figure 5.3-3).

Walleye

The annual mean FLA of 3-year-old Walleye over the three years of monitoring ranged from a low of 292 in 2017 to a high of 386 mm in 2011 (Table 5.4-1; Figure 5.4-4).

The overall mean and median FLA and IQR were 310 mm (Figure 5.4-4). The annual mean FLA was below the IQR in 2017 and was above the IQR in 2011.

White Sucker

White Sucker was not aged as part of CAMP.

Upper Nelson River

Lake Whitefish

Over the three years of monitoring 4-year-old Lake Whitefish were not caught in the upper Nelson River (Table 5.4-1).

Northern Pike

The annual mean FLA of 4-year-old Northern Pike over the three years of monitoring ranged from a low of 431 in 2011 to a high of 504 mm in 2014 (Table 5.4-1; Figure 5.4-2).

The overall mean FLA was 469, the median was 500, and the IQR was 431-500 mm (Figure 5.4-2). The annual mean FLA fell within the overall IQR except in 2014 when it was above the IQR.

Sauger

Over three years of monitoring, Sauger was only a target species in the upper Nelson River in 2017. Three-year-old Sauger were not captured in 2017.

Walleye

The annual mean FLA of 3-year-old Walleye over the three years of monitoring ranged from a low of 316 in 2014 to a high of 325 mm in 2011 (Table 5.4-1; Figure 5.4-4). Three-year-olds were not captured in 2017.

White Sucker

White Sucker was not aged as part of CAMP.

5.4.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Lake Whitefish

The annual mean FLA of 4-year-old Lake Whitefish over the 12 years of monitoring ranged from a low of 300 in 2017 to a high of 394 mm in 2009 (Table 5.4-1; Figure 5.4-1). Four-year olds were not caught in 2008, 2010, 2012, 2014, or 2015.

The overall mean FLA was 344, the median was 338, and the IQR was 320-366 mm (Figure 5.4-1). The annual mean FLA fell within the overall IQR except in 2017 and 2019 when it was below the IQR and in 2009 when it was above the IQR.

Northern Pike

The annual mean FLA of 4-year-old Northern Pike over the 11 years of monitoring it was a target species ranged from a low of 416 in 2009 to a high of 502 mm in 2011 (Table 5.4-1; Figure 5.4-2).

The overall mean FLA was 473, the median was 470, and the IQR was 462-495 mm (Figure 5.4-2). The annual mean FLA fell within the overall IQR except in 2009, 2015, 2016, and 2019 when it was below the IQR and in 2011 when it was above the IQR.

Sauger

Sauger was not a target species in Setting Lake until 2012; the annual mean FLA of 3-year-old Sauger over the eight years of monitoring ranged from a low of 200 in 2016 to a high of 235 in 2014 (Table 5.4-1; Figure 5.4-3).

The overall mean and median FLA were 223 and the IQR was 218-233 (Figure 5.4-3). The annual mean FLA fell within the overall IQR except in 2016 when it was below the IQR and in 2014 when it was above the IQR.

Walleye

The annual mean FLA of 3-year-old Walleye over the 12 years of monitoring ranged from a low of 253 in 2011 to a high of 284 mm in 2012 (Table 5.4-1; Figure 5.4-4).

The overall mean FLA was 262, the median was 258, and the IQR was 255-271 mm (Figure 5.4-4). The annual mean FLA fell within the overall IQR except in 2011 when it was below the IQR and in 2012, 2014, and 2016 when it was above the IQR.

White Sucker

White Sucker was not aged as part of CAMP.

ROTATIONAL SITES

Walker Lake

Lake Whitefish

Over the four years of monitoring a single 4-year-old Lake Whitefish was captured in only 2019 (Table 5.4-1). The FLA of this fish was 317 mm (Figure 5.4-1).

Northern Pike

The annual mean FLA of 4-year-old Northern Pike over the four years of monitoring was 433 in 2010 to a high of 499 mm in 2019 (Table 5.4-1; Figure 5.4-2).

The overall mean FLA was 473, the median was 470, and the IQR was 462-495 mm (Figure 5.4-2). The annual mean FLA fell within the overall IQR except in 2010 and 2013 when it was below the IQR and in 2019 when it was above the IQR.

Sauger

Over four years of monitoring, Sauger was only a target species in Walker Lake in 2019. Three-year-old Sauger were not captured in 2019.

Walleye

Over the four years of monitoring, 3-year-old Walleye were captured in only 2016 and 2019. In these years, the FLA was 236 and 235 mm, respectively (Table 5.4-1; Figure 5.4-4).

White Sucker

White Sucker was not aged as part of CAMP.

Table 5.4-1. 2008-2019 Fork length-at-age of target species.

Waterbody	Year	LKWH			NRPK			SAUG			WALL		
		n_F[1]	Mean	SE[2]	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE
LW-MB	2008	3	367	2							51	293	5
	2009	1	360	-	-	-	-				31	307	4
	2010	-	-	-	-	-	-				6	263	19
	2011	3	380	14	-	-	-				20	240	10
	2012	-	-	-	1	604	-				32	274	6
	2013	5	367	10	-	-	-				75	276	4
	2014	6	371	11	-	-	-				65	326	3
	2015	4	347	24	-	-	-				32	234	3
	2016	-	-	-	1	524	-				11	230	5
	2017	1	350	-	-	-	-	32	203	5	12	249	9
	2018	1	406	-	-	-	-	25	192	8	4	228	20
	2019	-	-	-	1	502	-	52	187	3	5	206	15
CROSS	2008	-	-	-	14	528	11				3	268	31
	2009	-	-	-	16	514	12				3	285	11
	2010	-	-	-	10	483	20				1	312	0
	2011	-	-	-	6	437	19				4	265	19
	2012	-	-	-	8	456	15				7	320	5
	2013	1	262	-	10	508	13				24	297	7
	2014	-	-	-	12	543	13				28	337	8
	2015	-	-	-	11	520	12				21	322	6
	2016	-	-	-	7	566	15				15	299	14
	2017	1	251	-	13	543	13				27	286	5
	2018	-	-	-	18	547	10	12	235	6	2	294	17
	2019	1	301	-	11	546	20	2	230	7	2	254	7
PLAYG	2009	-	-	-							-	-	-
	2010	-	-	-	5	548	10				3	328	35
	2012	3	344	11	7	511	16				6	286	9
	2015	9	393	6	17	582	7				8	278	9
	2018	17	390	5	2	467	13	7	231	4	1	150	-
LPLAYG	2010	-	-	-	18	497	10				5	290	5
	2013	-	-	-	10	526	17				15	304	6
	2016	-	-	-	7	483	22				11	283	4
	2019	-	-	-	3	514	10	1	238	-	6	267	6
SIP	2011	-	-	-	18	507	10				1	386	-
	2014	-	-	-	11	534	23				17	310	10
	2017	-	-	-	4	603	56	4	268	30	4	292	3
UNR	2011	-	-	-	5	431	15				11	325	7
	2014	-	-	-	2	504	25				5	316	12
	2017	-	-	-	4	500	15	-	-	-	-	-	-
SET	2008	-	-	-							29	254	4
	2009	1	394		4	416	22				6	259	6
	2010	-	-	-	13	462	13				9	258	9
	2011	21	366	3	9	502	12				25	253	3
	2012	-	-	-	14	483	20	2	221	11	20	284	6
	2013	12	338	8	9	464	17	16	224	5	37	271	3
	2014	-	-	-	13	495	16	13	235	4	2	279	15
	2015	-	-	-	3	453	19	15	222	6	31	257	6
	2016	6	320	3	7	453	8	10	200	6	3	272	24
	2017	1	300	-	11	470	12	15	218	3	28	255	3
	2018	4	324	20	5	495	23	11	233	8	42	265	5
	2019	6	317	29	5	441	15	10	223	3	11	260	7
WLKR	2010	-	-	-	4	433	17				-	-	-
	2013	-	-	-	6	439	25				-	-	-
	2016	-	-	-	5	465	19				5	236	5
	2019	1	317	-	17	499	15	-	-	-	1	235	-

Notes:

1. n_F = number of fish measured for length and weight.
2. SE = standard error.
3. Grey shading indicates that a species was not a target species in that year.

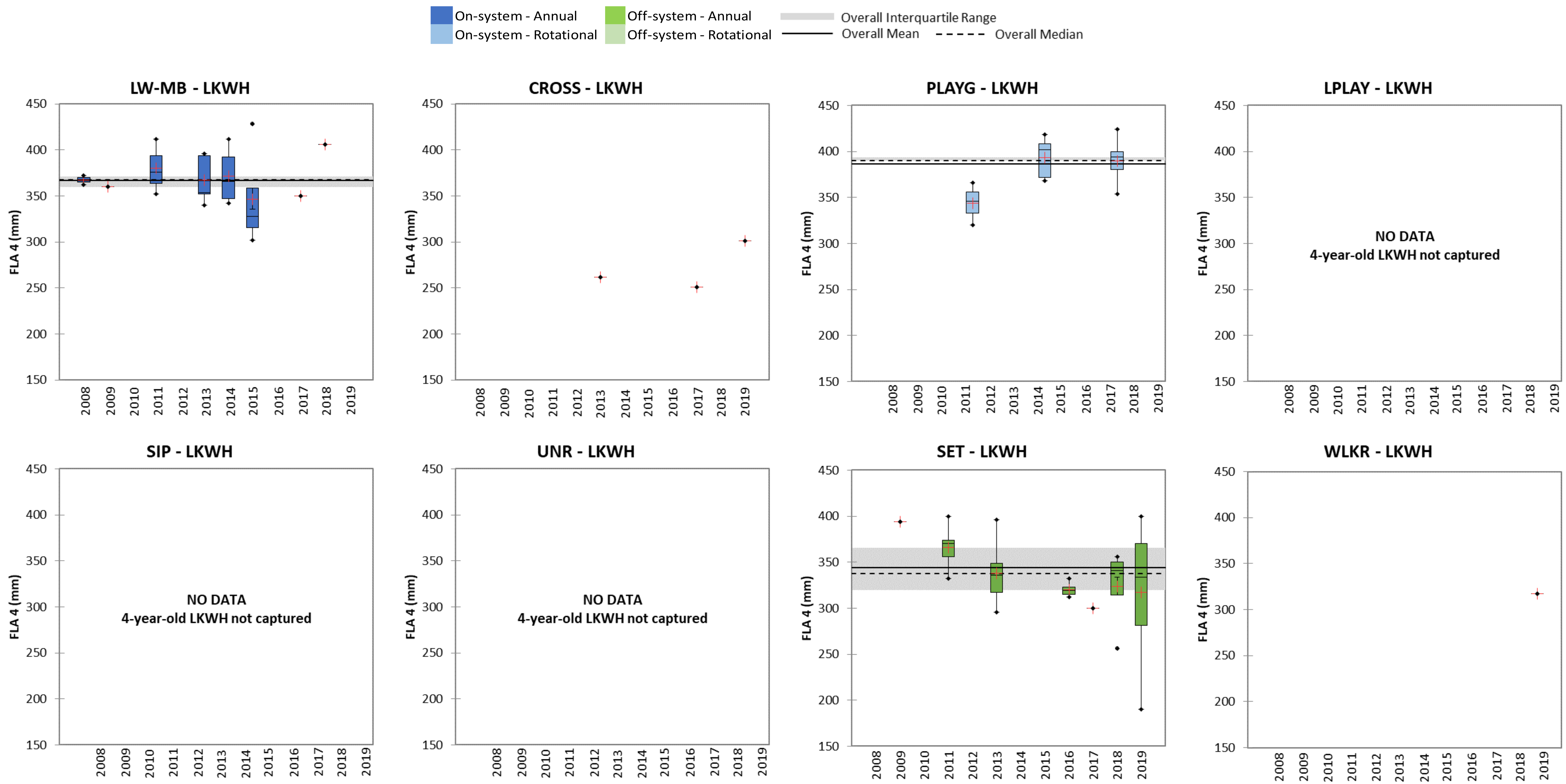


Figure 5.4-1. 2008-2019 Fork length-at-age (FLA) 4 of Lake Whitefish.

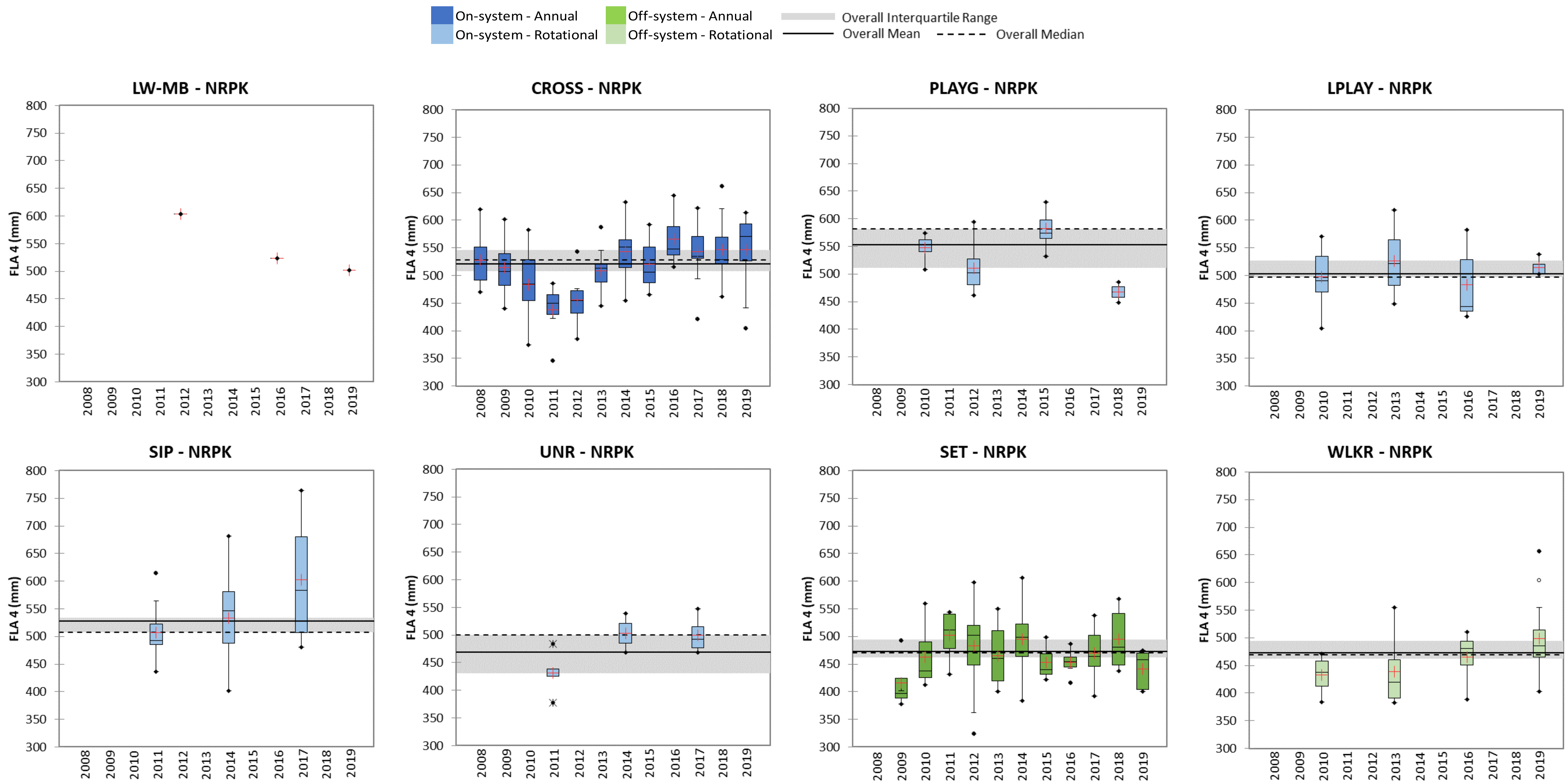


Figure 5.4-2. 2008-2019 Fork length-at-age (FLA) 4 of Northern Pike.

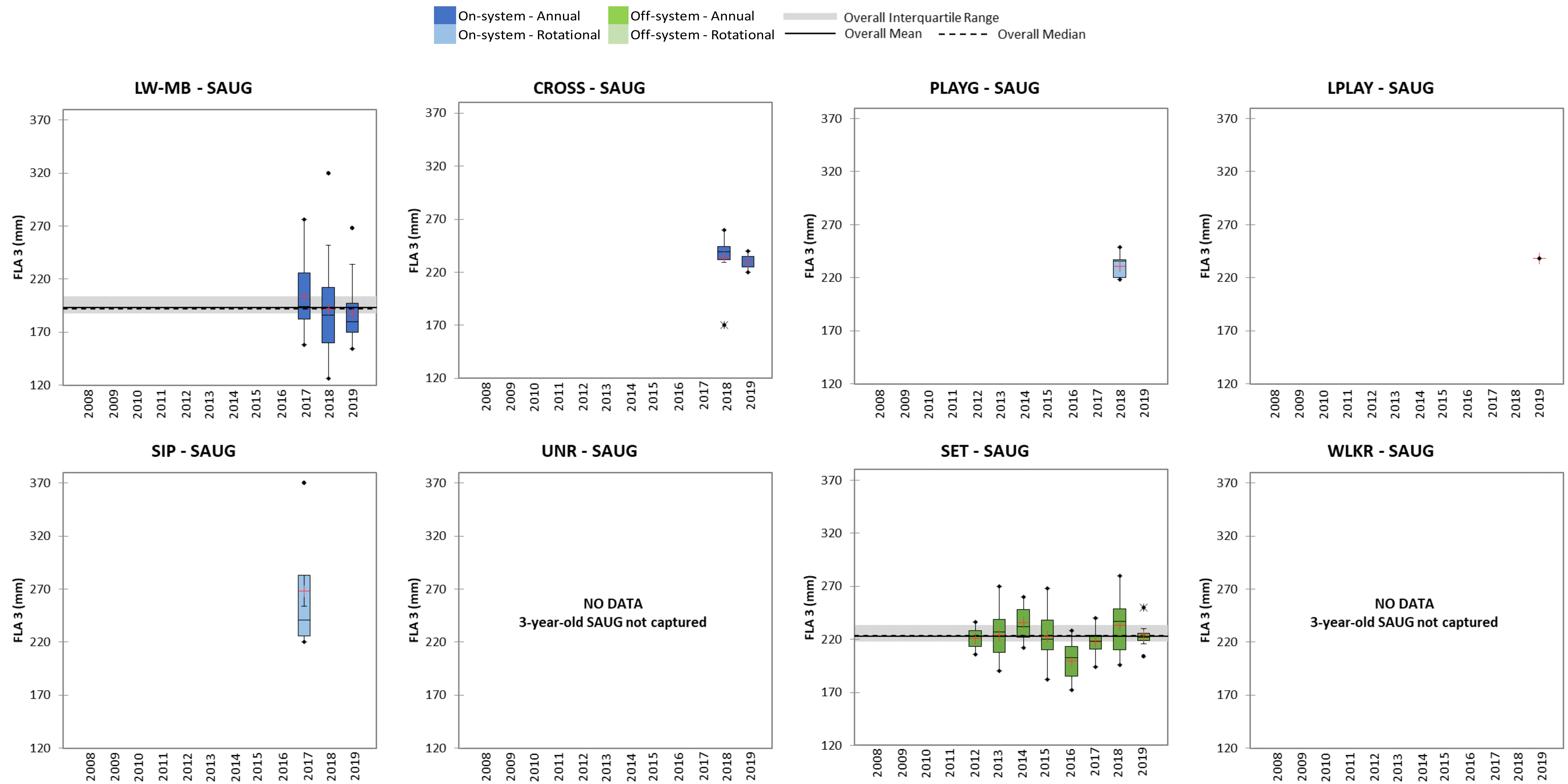


Figure 5.4-3. 2008-2019 Fork length-at-age (FLA) 3 of Sauger.

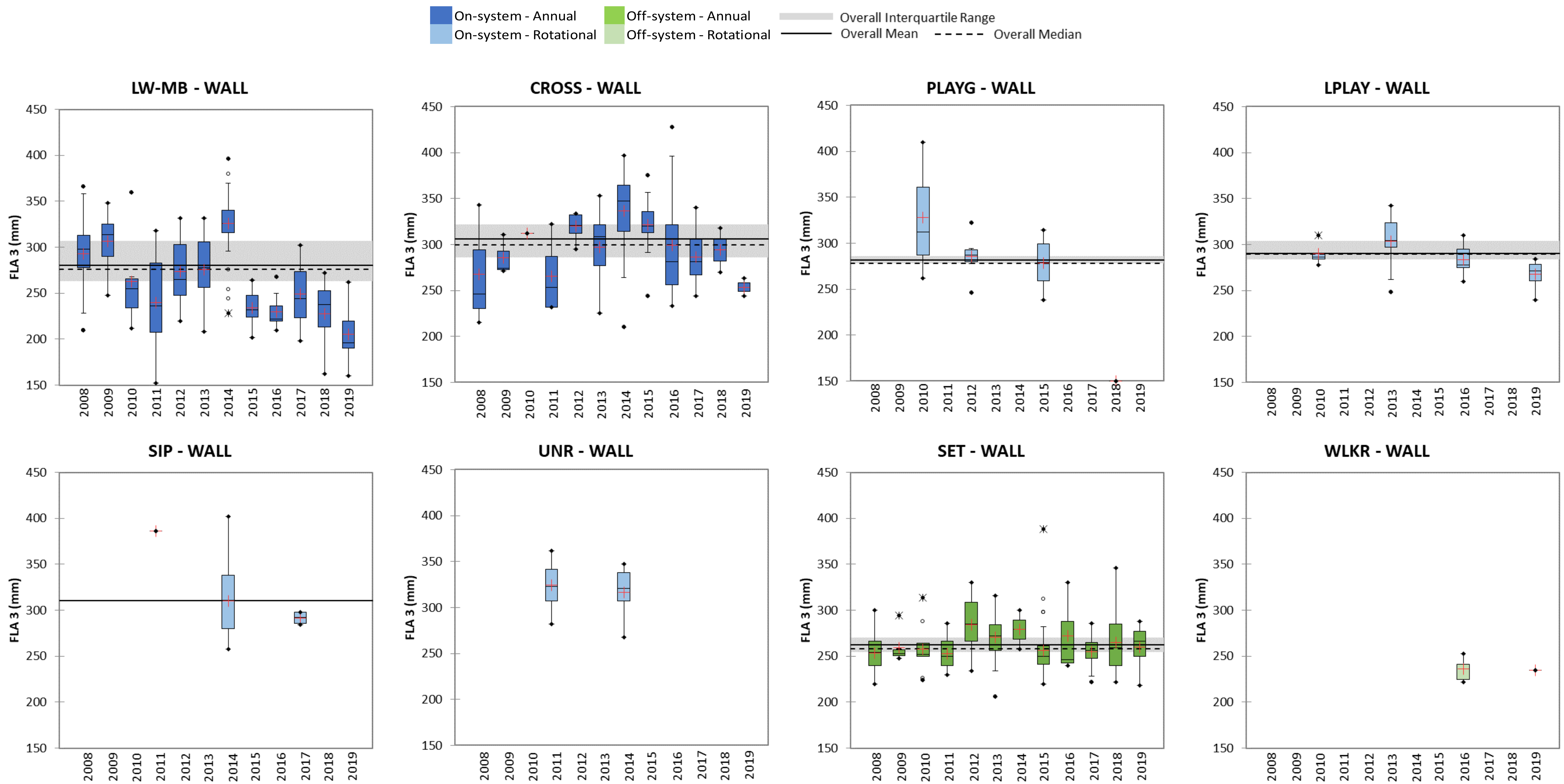


Figure 5.4-4. 2008-2019 Fork length-at-age (FLA) 3 of Walleye.

5.5 RECRUITMENT

5.5.1 RELATIVE YEAR-CLASS STRENGTH

5.5.1.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg – Mossy Bay

Lake Whitefish

Age data for Lake Whitefish were insufficient to allow year-class strength determination.

Northern Pike

Age data for Northern Pike were insufficient to allow year-class strength determination.

Sauger

The RYCS of Sauger over the three years of monitoring that it was a target species ranged from a low of 43 for the 2012 cohort to a high of 115 for the 2010 and 2011 cohorts (Figure 5.5-1). There were no missing cohorts from 2009-2013. Strong cohorts (>100) were produced in 2010 and 2011 followed by a weak (<50) cohort in 2012.

Walleye

The RYCS of Walleye over the 12 years of monitoring ranged from a low of 22 for the 2004 cohort to a high of 478 for the 2001 cohort (Figure 5.5-2). There were no missing cohorts from 2000-2014. Strong cohorts (>100) were produced in over half of the years, from 2000-2001, 2005-2006, and 2008-2012. A particularly weak cohort (<50) occurred in 2004 and 2014.

White Sucker

White Sucker was not aged as part of CAMP.

Cross Lake

Lake Whitefish

Age data for Lake Whitefish were insufficient to allow year-class strength determination.

Northern Pike

The RYCS of Northern Pike over the 12 years of monitoring ranged from a low of 61 for the 2002 cohort to a high of 167 for the 2003 cohort (Figure 5.5-3). There were no missing cohorts from 2002-2014. Particularly strong cohorts (>100) were produced in over a three-year period from 2003-2005, and again in 2007 and 2014.

Sauger

Age data for Sauger were insufficient to allow year-class strength determination.

Walleye

The RYCS of Walleye over the 12 years of monitoring ranged from a low of 52 for the 2007 cohort to a high of 237 for the 2001 cohort (Figure 5.5-2). There were no missing cohorts from 2000-2014. Strong cohorts (>100) were produced in over half of the years, from 2000-2002 and again from 2010-2014.

White Sucker

White Sucker was not aged as part of CAMP.

ROTATIONAL SITES

RYCS analysis requires data be collected in at least three consecutive years and therefore cannot be conducted for rotational waterbodies.

5.5.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

Lake Whitefish

Age data for Lake Whitefish were insufficient to allow year-class strength determination.

Northern Pike

The RYCS of Northern Pike over the 11 years of monitoring it was a target species ranged from a low of 60 for the 2011 cohort to a high of 149 for the 2004 cohort (Figure 5.5-3). There were no missing cohorts from 2003-2014. Strong cohorts (>100) were produced in two two-year periods (2004-2005 and 2013-2014).

Sauger

The RYCS of Sauger over the eight years of monitoring ranged from a low of 12 for the 2004 cohort to a high of 149 for the 2007 cohort (Figure 5.5-1). There were no missing cohorts from 2004-2013. Strong cohorts (>100) were produced from 2006-2007 and again from 2010-2012. A particularly weak (<50) cohort was produced in 2004 and 2009.

Walleye

The RYCS of Walleye over the 12 years of monitoring ranged from a low of 20 for the 2013 cohort to a high of 563 for the 2002 cohort (Figure 5.5-2). There were no missing cohorts from 2000-2014. Strong cohorts (>100) were produced in over half of the years, from 2001-2003, in 2005, 2007-2010, 2012, and 2014. A particularly weak cohort (<50) occurred in 2000, 2011, and 2013.

White Sucker

White Sucker was not aged as part of CAMP.

ROTATIONAL SITES

RYCS analysis requires data be collected in at least three consecutive years and therefore cannot be conducted for rotational waterbodies.

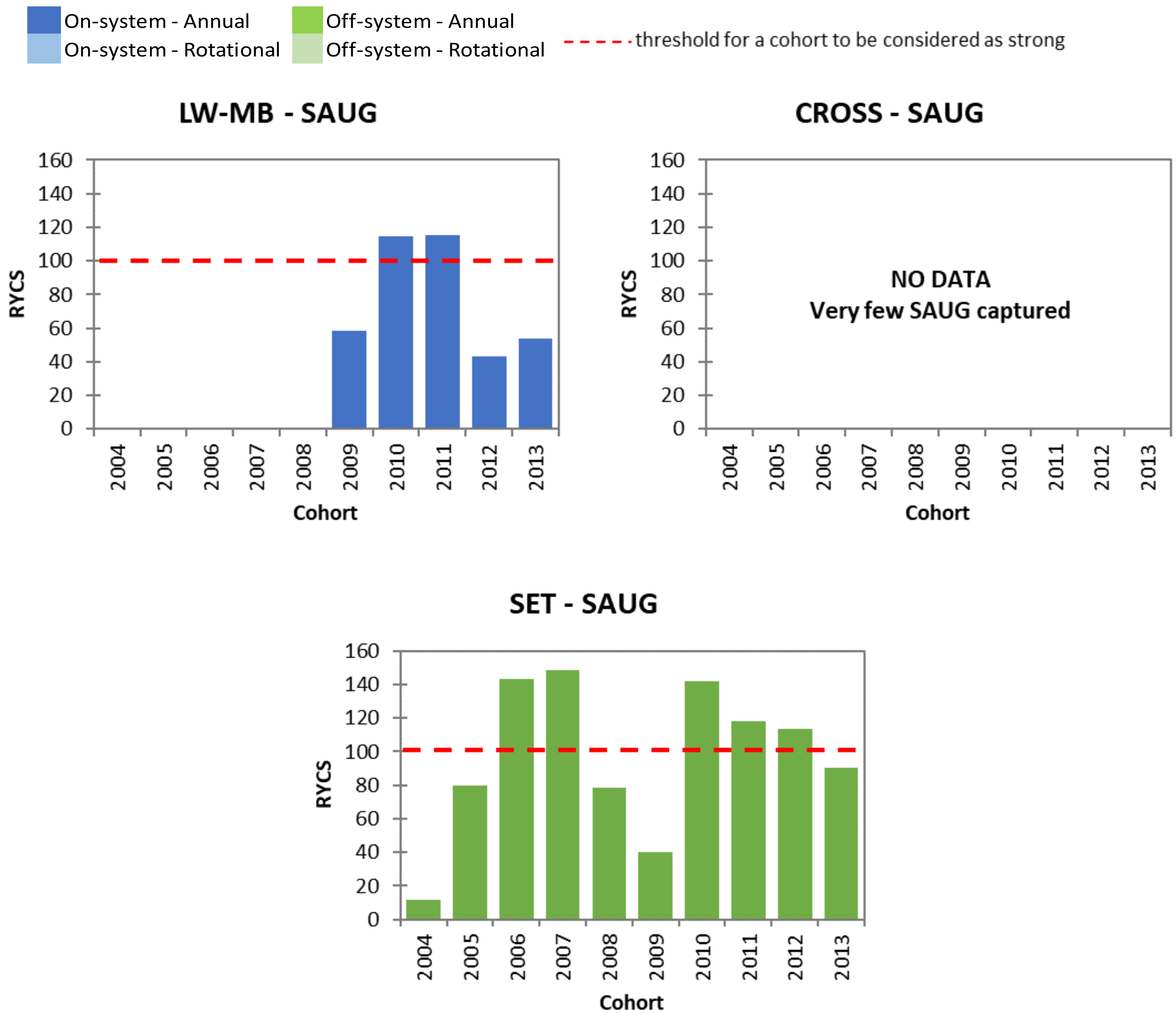


Figure 5.5-1. Relative year class strength (RYCS) of Sauger.

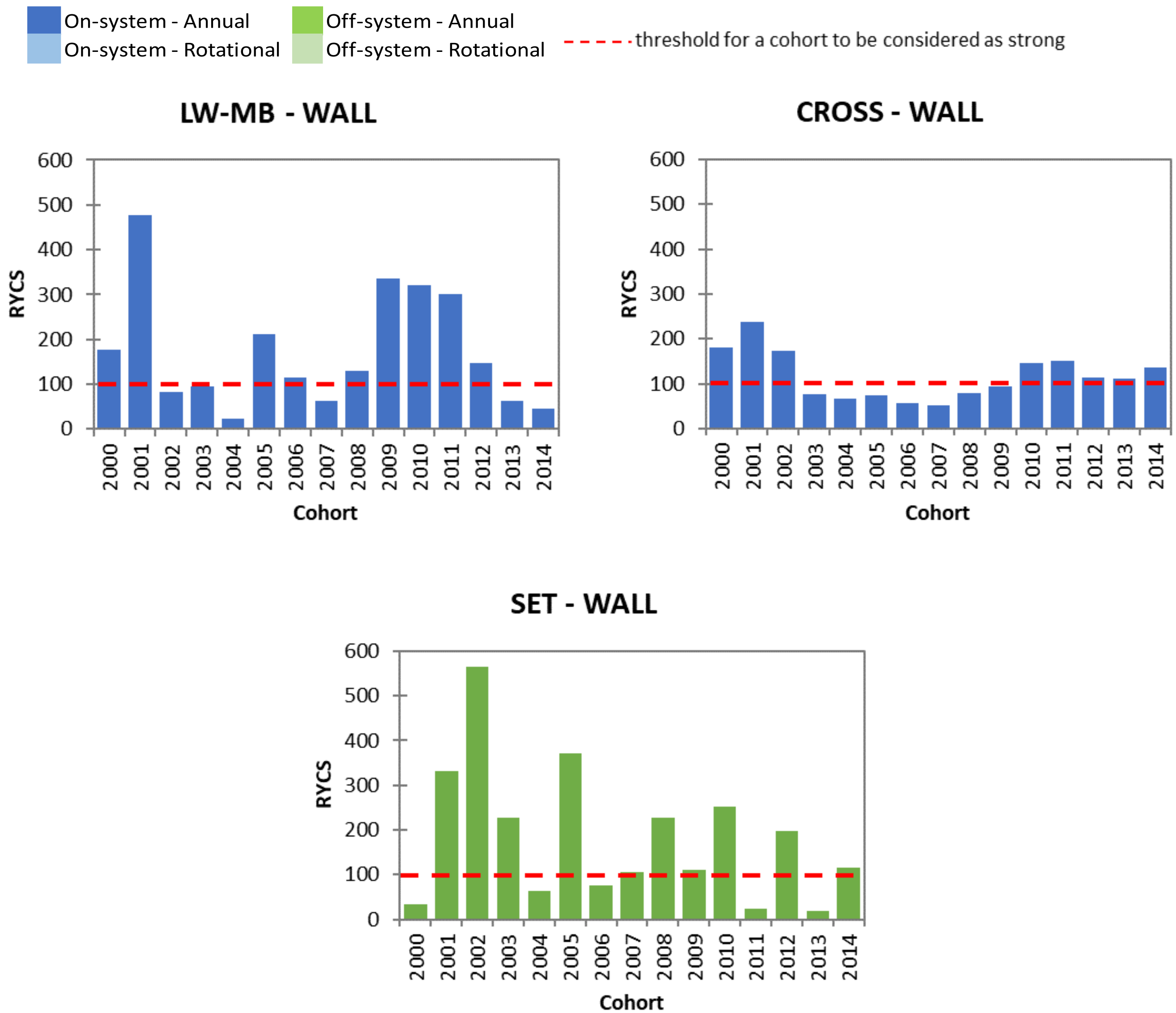


Figure 5.5-2. Relative year class strength (RYCS) of Walleye.

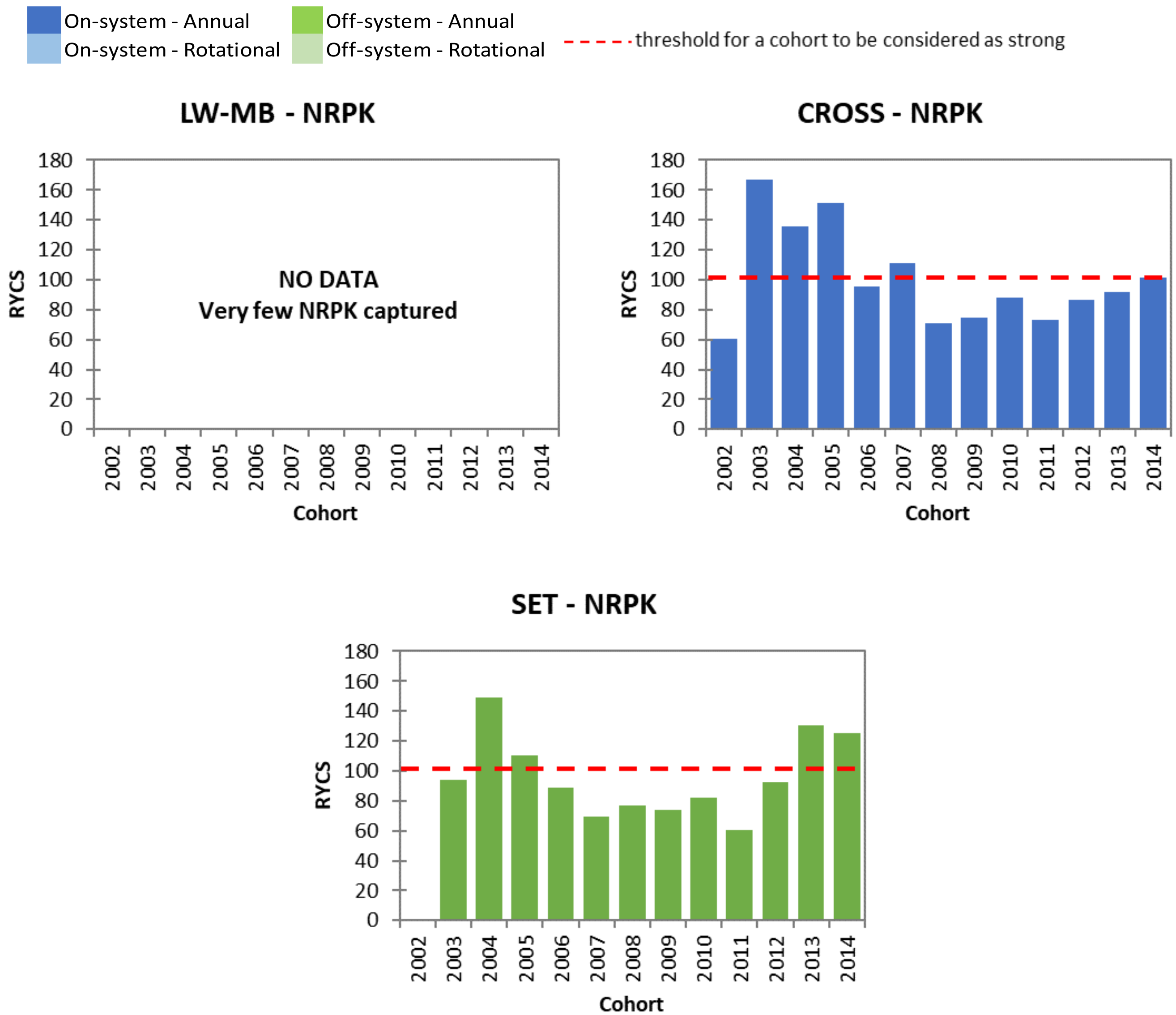


Figure 5.5-3. Relative year class strength (RYCS) of Northern Pike.

5.6 DIVERSITY

5.6.1 RELATIVE SPECIES ABUNDANCE

5.6.1.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg – Mossy Bay

A total of 20 fish species were captured in the combined standard and small mesh gangs in Mossy Bay over 12 years of monitoring (Table 5.6-1) with the number of species caught each year ranging from 9-15 (Tables 5.6-2 and 5.6-3).

Standard Gang Index Gill Nets

Yellow Perch was the most frequently captured species at Mossy Bay over 12 years of monitoring, accounting for an average of >25% of the catch (Table 5.6-2). The annual RSA for Yellow Perch ranged from a low of 2% in 2019 to a high of 54% in 2011. Three species accounted for >25% of the catch in some years, Sauger in 2013, 2014, and 2015, Walleye in 2009, 2014, and 2015, and White Sucker in 2016, 2017, 2018, and 2019.

Small Mesh Index Gill Nets

The most common species captured in the Mossy Bay over 10 years that small mesh nets were set at target locations (see Appendix 5-1) were Trout-perch (*Percopsis omiscomaycus*) and Sauger, each accounting for an average of >25% of the catch (Table 5.6-3). The annual RSA for Trout-perch ranged from a low of 21% in 2019 to a high of 95% in 2011. The annual RSA for Sauger ranged from a low of <1% in 2010 and 2011 to a high of 60% in 2018. Rainbow Smelt accounted for >25% of the catch in 2010.

Cross Lake

A total of 22 fish species were captured in the combined standard and small mesh gangs at Cross Lake over 12 years of monitoring (Table 5.6-1), with the number of species caught each year ranging from 11-16 (Tables 5.6-4 and 5.6-5).

Standard Gang Index Gill Nets

Walleye was the most frequently captured species at Cross Lake over 12 years of monitoring, accounting for an average of >25% of the catch (Table 5.6-4). The annual RSA for Walleye ranged from a low of 19% in 2011 to a high of 37% in 2014. Two species accounted for >25% of the catch in some years, White Sucker in 2015, 2017, 2018, and 2019, and Yellow Perch in 2011.

Small Mesh Index Gill Nets

The most common species captured in Cross Lake over 12 years of monitoring were Yellow Perch and Spottail Shiner (*Notropis hudsonius*), each accounting for an average of >25% of the catch (Table 5.6-5). The annual RSA for Yellow Perch ranged from a low of 13% in 2015 to a high of 72% in 2012. The annual RSA for Spottail Shiner ranged from a low of 10% in 2013 and 2017 to a high of 62% in 2016. Emerald Shiner (*Notropis atherinoides*) accounted for >25% of the catch in some years (2017 and 2018).

ROTATIONAL SITES

Playgreen Lake

A total of 19 fish species were captured in the combined standard and small mesh gangs at the Playgreen Lake over five years of monitoring (Table 5.6-1), with the number of species caught each year ranging from 11-16 (Tables 5.6-6 and 5.6-7).

Standard Gang Index Gill Nets

White Sucker was the most frequently captured species at Playgreen Lake over five years of monitoring, accounting for an average of >25% of the catch (Table 5.6-6). The annual RSA for White Sucker ranged from a low of 38% in 2009 to a high of 70% in 2018.

Small Mesh Index Gill Nets

The most common species captured at Playgreen Lake over five years of monitoring was Spottail Shiner, which accounted for an average of >25% of the catch (Table 5.6-7). The annual RSA for Spottail Shiner ranged from a low of 0% in 2009 to a high of 96% in 2018. Rainbow Smelt (*Osmerus mordax*) accounted for >25% of the catch in 2009.

Little Playgreen Lake

A total of 18 fish species were captured in the combined standard and small mesh gangs at Little Playgreen Lake over four years of monitoring (Table 5.6-1), with the number of species caught each year ranging from 12-14 (Tables 5.6-8 and 5.6-9).

Standard Gang Index Gill Nets

White Sucker was the most frequently captured species at Little Playgreen Lake over four years of monitoring, accounting for an average of >25% of the catch (Table 5.6-8). The annual RSA of White Sucker ranged from a low of 38% in 2018 to a high of 58% in 2013. Walleye accounted for >25% of the catch in some years (2016 and 2019).

Small Mesh Index Gill Nets

The most common species captured in Little Playgreen Lake over four years of monitoring was Spottail Shiner, which accounted for an average of >25% of the catch (Table 5.6-9). The annual RSA for Spottail Shiner ranged from a low of 63% in 2013 to a high of 92% in 2010. Yellow Perch accounted for >25% of the catch in 2013.

Sipiwesk Lake

A total of 17 fish species were captured in the combined standard and small mesh gangs at Sipiwesk Lake over three years of monitoring (Table 5.6-1), with 14 species caught each year (Tables 5.6-10 and 5.6-11).

Standard Gang Index Gill Nets

White Sucker was the most frequently captured species at Sipiwesk Lake over three years of monitoring, accounting for an average of >25% of the catch (Table 5.6-10). The annual RSA of White Sucker ranged from a low of 53% in 2011 to a high of 56% in 2017.

Small Mesh Index Gill Nets

The most common species captured in Sipiwesk Lake over three years of monitoring were Trout-perch and Emerald Shiner, which each accounted for an average of >25% of the catch (Table 5.6-11). The annual RSA for Trout-perch ranged from a low of 36% in 2014 to a high of 63% in 2017. The annual RSA for Emerald Shiner ranged from a low of 21% in 2017 to a high of 34% in 2014.

Upper Nelson River

A total of 17 fish species were captured in the combined standard and small mesh gangs in the upper Nelson River over three years of monitoring (Table 5.6-1), with the number of species caught each year ranging from 10-15 (Tables 5.6-12 and 5.6-13).

Standard Gang Index Gill Nets

Walleye and White Sucker were the most frequently captured species in the upper Nelson River over three years of monitoring, accounting for an average of >25% of the catch (Table 5.6-12). The annual RSA for Walleye ranged from a low of 27% in 2014 to a high of 47% in 2011. The annual RSA of White Sucker ranged from a low of 16% in 2017 to a high of 37% in 2014.

Small Mesh Index Gill Nets

The most common species captured in upper Nelson River over three years of monitoring were Trout-perch and Spottail Shiner, which each accounted for an average of >25% of the catch (Table 5.6-13). The annual RSA for Trout-perch ranged from a low of 14% in 2011 to a high of 89% in 2014. The annual RSA for Spottail Shiner ranged from a low of 6% in 2014 to a high of 77% in 2011.

5.6.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

A total of 16 fish species were captured in the combined standard and small mesh gangs at Setting Lake over 12 years of monitoring (Table 5.6-1), with the number of species caught each year ranging from 11-14 (Tables 5.6-14 and 5.6-15). Rainbow Smelt were not captured at Setting Lake.

Standard Gang Index Gill Nets

Sauger was the most frequently captured species at Setting Lake over 12 years of monitoring, accounting for an average of >25% of the catch (Table 5.6-14). The annual RSA for Sauger ranged from a low of 19% in 2009 and 2012 to a high of 33% in 2016. Two species accounted for >25% of the catch in some years, Walleye in 2013 and 2018 and Cisco (*Coregonus artedi*) in 2009, 2010, 2011, 2012, 2014, and 2019.

Small Mesh Index Gill Nets

The most common species captured in Setting Lake over 12 years of monitoring was Spottail Shiner, which accounted for an average of >25% of the catch (Table 5.6-15). The annual RSA for Spottail Shiner ranged from a low of 17% in 2012 to a high of 62% in 2011. Three other species accounted for >25% of the catch in some years, Emerald Shiner in 2013 and 2019, Cisco in 2012, and Sauger in 2008, 2009, 2010, 2016, and 2018.

ROTATIONAL SITES

Walker Lake

A total of 12 fish species were captured in the combined standard and small mesh gangs at Walker Lake over four years of monitoring (Table 5.6-1), with the number of species caught each year ranging from 6-11 (Tables 5.6-16 and 5.6-17). Rainbow Smelt were not captured at Walker Lake.

Standard Gang Index Gill Nets

White Sucker was the most frequently captured species at Walker Lake over four years of monitoring, accounting for an average of >25% of the catch (Table 5.6-16). The annual RSA for White Sucker ranged from a low of 28% in 2010 to a high of 55% in 2019. Two other species accounted for >25% of the catch in some years, Walleye in 2013, 2016, and 2019 and Cisco in 2010.

Small Mesh Index Gill Nets

The most common species captured in Walker Lake over three years of monitoring that data is available (see Appendix 5-1) was Spottail Shiner, which accounted for an average of >25% of the catch (Table 5.6-17). The annual RSA for Spottail Shiner ranged from a low of 57% in 2013 to a high of 63% in 2019. Yellow Perch also accounted for >25% of the catch in 2016.

Table 5.6-1. 2008-2019 Inventory of fish species.

Family	Species	Abbreviation	Status	Target	LW-MB	CROSS	PLAYG	LPLAY	SIP	UNR	SET	WLKR
Acipenseridae	Lake Sturgeon	LKST	Native			●				●		
Hiodontidae	Mooneye	MOON	Native			●		●	●	●		
	Goldeye	GOLD	Native		●	●		●				
Cyprinidae	Lake Chub	LKCH	Native			●						
	Common Carp	CARP	Introduced			●						
	Golden Shiner	GLSH	Native			●						
	Emerald Shiner	EMSH	Native		●	●	●	●	●	●	●	●
	Spottail Shiner	SPSH	Native		●	●	●	●	●	●	●	●
Catostomidae	Quillback	QUIL	Native				●					
	Longnose Sucker	LNSC	Native		●		●		●	●	●	
	White Sucker	WHSC	Native	●	●	●	●	●	●	●	●	●
	Shorthead Redhorse	SHRD	Native		●	●	●	●	●	●	●	
	Silver Redhorse	SLRD	Native						●			
Esocidae	Northern Pike	NRPK	Native	●	●	●	●	●	●	●	●	●
Osmeridae	Rainbow Smelt	RNSM	Introduced		●	●	●	●	●	●		
Salmonidae	Cisco	CISC	Native		●	●	●	●		●	●	●
	Lake Whitefish	LKWH	Native	●	●	●	●	●	●	●	●	●
Percopsidae	Trout-perch	TRPR	Native		●	●	●	●	●	●	●	●
Gadidae	Burbot	BURB	Native		●	●	●		●	●	●	●
Cottidae	Mottled Sculpin	MTSC	Native		●						●	
	Slimy Sculpin	SLSC	Native		●	●	●				●	●
	Spoonhead Sculpin	SPSC	Native		●			●	●		●	
Centrarchidae	Rock Bass	RCBS	Native				●	●				
Percidae	Yellow Perch	YLPR	Native		●	●	●	●	●	●	●	●
	Logperch	LGPR	Native		●	●	●	●				
	Sauger	SAUG	Native	●	●	●	●	●	●	●	●	●
	Walleye	WALL	Native	●	●	●	●	●	●	●	●	●
Sciaenidae	Freshwater Drum	FRDR	Native		●	●	●	●	●	●		

Notes:

1. Assigned from Stewart and Watkinson (2004).
2. Status under review by Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Table 5.6-2. 2008-2019 Relative species abundance in standard gang index gill nets in Lake Winnipeg – Mossy Bay.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean
Target	LKWH	3%	1%	4%	4%	1%	3%	2%	2%	1%	4%	1%	0.4%	2%
	NRPK	1%	0%	0.3%	0.3%	1%	1%	0.3%	1%	1%	0.1%	1%	2%	1%
	SAUG	3%	2%	9%	9%	18%	39%	28%	31%	16%	17%	17%	9%	16%
	WALL	20%	53%	17%	12%	17%	23%	25%	26%	21%	19%	15%	20%	22%
	WHSC	8%	7%	11%	12%	16%	18%	16%	18%	35%	39%	53%	61%	24%
Sturgeon	LKST	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mooneyes	MOON	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GOLD	0%	0%	0%	0%	0.3%	0%	0%	0%	0%	0%	0.4%	0%	0.1%
Minnows	CARP	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	EMSH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SPSH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	FLCH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Suckers	QUIL	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	LNSC	4%	3%	3%	5%	9%	1%	1%	1%	3%	2%	3%	1%	3%
	GLRD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SLRD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SHRD	0%	0.2%	0%	0%	0%	0.2%	0%	0%	0.1%	0%	3%	1%	0.3%
Catfishes	CHCT	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Smelts	RNSM	9%	5%	6%	0.5%	0%	0.1%	0%	0%	0%	0%	0%	0%	2%
Coregonids	CISC	4%	0.3%	1%	4%	15%	2%	7%	3%	1%	3%	1%	2%	3%
Trout-perch	TRPR	0%	0%	0%	0.2%	0%	0.1%	0%	0%	0%	0%	0%	0%	0.02%
Codfishes	BURB	0%	0%	0%	0.3%	0%	0.2%	0%	0%	0.3%	1%	0.2%	0.1%	0.2%
Sunfishes	RCBS	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Perch	YLPR	48%	29%	49%	54%	22%	13%	21%	19%	20%	17%	8%	2%	25%
Drums	FRDR	0%	0.2%	0%	0%	0.4%	0.2%	0%	0.2%	0%	0%	0.2%	0.1%	0.1%

Table 5.6-3. 2008-2019 Relative species abundance in small mesh index gill nets in Lake Winnipeg – Mossy Bay.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean
Mooneyes	MOON	-	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GOLD	-	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Minnows	LKCH	-	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GLSH	-	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	EMSH	-	-	0%	0%	0%	4%	12%	1%	0%	0%	0%	0%	2%
	SPSH	-	-	0.1%	0%	0%	0%	0.5%	0%	1%	0%	0%	0%	0.2%
Suckers	LNSC	-	-	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0.1%
	WHSC	-	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SHRD	-	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Pikes	NRPK	-	-	0.1%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0.1%
Smelts	RNSM	--	-	39%	1%	3%	13%	21%	3%	0%	0%	0%	1%	8%
Coregonids	CISC	-	-	0.1%	0%	2%	0%	0%	0%	1%	0%	0%	13%	2%
	LKWH	-	-	0.2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.02%
Trout-perch	TRPR	-	-	44%	95%	56%	51%	52%	50%	61%	25%	23%	21%	48%
Codfishes	BURB	-	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Sculpins	MTSC	-	-	0.2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.0%
	SLSC	-	-	0%	0%	0.3%	0%	0.5%	0.8%	0%	0%	0%	0%	0.2%
	SPSC	-	-	0%	0%	0%	0%	0%	1%	0%	1%	0%	0%	0.2%
Sunfishes	RCBS	-	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Perch	YLPR	-	-	4%	1%	0.3%	1%	3%	1%	2%	6%	4%	1%	2%
	LGPR	-	-	4%	0.3%	12%	1%	2%	22%	14%	3%	0%	0%	6%
	SAUG	-	-	0.1%	0.8%	27%	24%	5%	18%	13%	59%	60%	51%	26%
	WALL	-	-	8%	2%	0.6%	7%	4%	4%	8%	5%	13%	12%	6%

Table 5.6-4. 2008-2019 Relative species abundance in standard gang index gill nets in Cross Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean
Target	LKWH	0.5%	0%	0%	0%	0.2%	0.4%	0.3%	0.2%	0%	0.2%	0.2%	0.3%	0.2%
	NRPK	22%	25%	23%	16%	22%	21%	17%	14%	13%	13%	22%	12%	18%
	SAUG	3%	12%	6%	6%	1%	2%	8%	1%	6%	1%	2%	3%	4%
	WALL	36%	26%	29%	19%	31%	34%	37%	27%	31%	35%	27%	32%	30%
	WHSC	17%	15%	19%	15%	18%	20%	23%	28%	22%	27%	30%	36%	23%
Sturgeon	LKST	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.3%	0.02%
Mooneyes	MOON	0.3%	0%	0%	0%	0%	0%	0.3%	0%	0%	0%	1%	0%	0.1%
	GOLD	0%	0.3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.03%
Minnows	CARP	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0.1%
	EMSH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SPSH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	FLCH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Suckers	QUIL	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	LNSC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GLRD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SLRD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SHRD	6%	11%	8%	4%	4%	6%	6%	6%	5%	8%	13%	10%	7%
Catfishes	CHCT	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Smelts	RNSM	1%	1%	1%	4%	0%	2%	0.3%	0%	0%	0%	0%	0%	1%
Coregonids	CISC	4%	2%	0.3%	3%	11%	2%	3%	18%	0.3%	5%	2%	5%	5%
Trout-perch	TRPR	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
Codfishes	BURB	0%	0%	0%	0%	0%	0.2%	0%	0%	0%	0%	0%	0%	0.02%
Sunfishes	RCBS	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Perch	YLPR	9%	9%	14%	32%	13%	13%	4%	6%	23%	10%	3%	1%	11%
Drums	FRDR	0.2%	0%	1%	0%	0%	0%	0.3%	0%	0%	0.3%	0%	1%	0.2%

Table 5.6-5. 2008-2019 Relative species abundance in small mesh index gill nets in Cross Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean
Mooneyes	MOON	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.1%	0%	0.01%
	GOLD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Minnows	LKCH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.3%	0.03%
	GLSH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.3%	0.03%
	EMSH	4%	4%	1%	9%	3%	10%	18%	20%	10%	72%	38%	24%	18%
	SPSH	35%	41%	48%	28%	20%	10%	50%	60%	62%	10%	31%	11%	34%
Suckers	LNSC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	WHSC	2%	2%	0%	0%	0%	0%	0.3%	0.2%	0.2%	0.1%	0.1%	0.3%	0.4%
	SHRD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.1%	0.1%	0%	0.02%
Pikes	NRPK	2%	1%	0.4%	1%	1%	1%	0.3%	1%	0%	0.2%	0.1%	1%	1%
Smelts	RNSM	2%	3%	3%	19%	1%	3%	1%	1%	0.2%	0%	0%	0%	3%
Coregonids	CISC	0%	0%	0%	0%	0%	0%	0%	0.2%	0%	0%	0%	0.3%	0.04%
	LKWH	0%	0%	0%	0%	0%	0%	0.3%	0%	0%	0%	0%	0%	0.03%
Trout-perch	TRPR	4%	0%	5%	15%	4%	0.5%	3%	2%	5%	1%	3%	8%	4%
Codfishes	BURB	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Sculpins	MTSC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SLSC	0%	0.3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.02%
	SPSC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Sunfishes	RCBS	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Perch	YLPR	52%	49%	40%	25%	72%	70%	24%	13%	21%	16%	24%	50%	38%
	LGPR	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	2%	0.5%
	SAUG	0%	0.3%	1%	0.4%	0%	0.2%	0.2%	0.3%	0.2%	0.1%	0.5%	0%	0.3%
	WALL	1%	0.3%	0.4%	3%	0%	4%	2%	2%	1%	1%	0.2%	2%	1%

Table 5.6-6. 2008-2019 Relative species abundance in standard gang index gill nets in Playgreen Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2009	2010	2012	2015	2018	Mean
Target	LKWH	2%	2%	4%	7%	4%	4%
	NRPK	15%	11%	11%	13%	5%	11%
	SAUG	21%	1%	3%	10%	4%	8%
	WALL	3%	12%	6%	11%	13%	9%
	WHSC	38%	50%	61%	50%	70%	54%
Sturgeon	LKST	0%	0%	0%	0%	0%	0%
Mooneyes	MOON	0%	0%	0%	0%	0%	0%
	GOLD	0%	0%	0%	0%	0%	0%
Minnows	CARP	0%	0%	0%	0%	0%	0%
	EMSH	0%	0%	0%	0%	0%	0%
	SPSH	0%	0.4%	0%	0%	0%	0.1%
	FLCH	0%	0%	0%	0%	0%	0%
Suckers	QUIL	0%	0.1%	0%	0%	0%	0.02%
	LNSC	0.4%	0.1%	0%	0%	0.3%	0.1%
	GLRD	0%	0%	0%	0%	0%	0%
	SLRD	0%	0%	0%	0%	0%	0%
	SHRD	0.2%	0.5%	0.5%	1%	1%	1%
Catfishes	CHCT	0%	0%	0%	0%	0%	0%
Smelts	RNSM	1%	15%	0.5%	0%	0%	3%
Coregonids	CISC	2%	2%	2%	4%	2%	3%
Trout-perch	TRPR	0%	0%	0%	0.1%	0.1%	0.1%
Codfishes	BURB	0%	0%	0%	0%	0.1%	0.03%
Sunfishes	RCBS	0%	0%	0.3%	0%	0%	0.1%
Perch	YLPR	18%	5%	10%	5%	0.3%	8%
Drums	FRDR	0%	0.2%	1%	0%	0%	0.2%

Table 5.6-7. 2008-2019 Relative species abundance in small mesh index gill nets in Playgreen Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2009	2010	2012	2015	2018	Mean
Mooneyes	MOON	0%	0%	0%	0%	0%	0%
	GOLD	0%	0%	0%	0%	0%	0%
Minnows	LKCH	0%	0%	0%	0%	0%	0%
	GLSH	0%	0%	0%	0%	0%	0%
	EMSH	0%	15%	19%	7%	1%	9%
	SPSH	0%	63%	25%	92%	96%	55%
Suckers	LNSC	0%	0%	0%	0%	0%	0%
	WHSC	0%	0.2%	1%	0.05%	0%	0.1%
	SHRD	0%	0%	0%	0%	0%	0%
Pikes	NRPK	0%	0.3%	1%	0.1%	0.1%	0.3%
Smelts	RNSM	79%	19%	17%	0.4%	0%	23%
Coregonids	CISC	0%	0.04%	0.3%	0%	0.3%	0.1%
	LKWH	0%	0%	0.3%	0%	0%	0.1%
Trout-perch	TRPR	21%	1%	16%	0.5%	2%	8%
Codfishes	BURB	0%	0%	0%	0%	0%	0%
Sculpins	MTSC	0%	0%	0%	0%	0%	0%
	SLSC	0.0%	0.0%	0.3%	0%	0%	0.1%
	SPSC	0%	0%	0%	0%	0%	0%
Sunfishes	RCBS	0%	0%	0%	0%	0%	0%
Perch	YLPR	0%	1%	1%	0%	0.04%	0.3%
	LGPR	0%	0%	7%	0.1%	0.04%	1%
	SAUG	0%	0%	12%	0.1%	0.02%	2%
	WALL	0%	1%	1%	0.1%	1%	0.4%

Table 5.6-8. 2008-2019 Relative species abundance in standard gang index gill nets in Little Playgreen Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2010	2013	2016	2019	Mean
Target	LKWH	1%	0%	0%	0%	0.2%
	NRPK	17%	9%	7%	8%	11%
	SAUG	0.3%	0.2%	0.2%	1%	1%
	WALL	15%	15%	27%	35%	23%
	WHSC	52%	58%	42%	38%	47%
Sturgeon	LKST	0%	0%	0%	0%	0%
Mooneyes	MOON	0%	0%	0%	0.4%	0.1%
	GOLD	0%	0.2%	0%	0%	0.04%
Minnows	CARP	0%	0%	0%	0%	0%
	EMSH	0%	0%	0%	0%	0%
	SPSH	0%	0%	0%	0%	0%
	FLCH	0%	0%	0%	0%	0%
Suckers	QUIL	0%	0%	0%	0%	0%
	LNSC	0%	0%	0%	0%	0%
	GLRD	0%	0%	0%	0%	0%
	SLRD	0%	0%	0%	0%	0%
	SHRD	7%	1%	2%	12%	6%
Catfishes	CHCT	0%	0%	0%	0%	0%
Smelts	RNSM	1%	0%	0%	0%	0.1%
Coregonids	CISC	0.1%	0%	0%	0%	0.03%
Trout-perch	TRPR	0%	0%	0%	0%	0%
Codfishes	BURB	0%	0%	0%	0%	0%
Sunfishes	RCBS	0.1%	2%	0%	2%	1%
Perch	YLPR	7%	9%	20%	3%	10%
Drums	FRDR	0.1%	5%	2%	0%	2%

Table 5.6-9. 2008-2019 Relative species abundance in small mesh index gill nets in Little Playgreen Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2010	2013	2016	2019	Mean
Mooneyes	MOON	0%	0%	0%	0%	0%
	GOLD	0%	0%	0%	0%	0%
Minnows	LKCH	0%	0%	0%	0%	0%
	GLSH	0%	0%	0%	0%	0%
	EMSH	3%	2%	12%	0.2%	4%
	SPSH	92%	63%	77%	80%	78%
Suckers	LNSC	0%	0%	0%	0%	0%
	WHSC	0.1%	0%	0.1%	0.15%	0.1%
	SHRD	0%	0%	0%	0%	0%
Pikes	NRPK	0.1%	0.1%	0%	0.03%	0.1%
Smelts	RNSM	1%	0%	0%	0%	0.2%
Coregonids	CISC	0%	0%	0%	0%	0%
	LKWH	0.0%	0%	0%	0%	0.01%
Trout-perch	TRPR	2%	3%	1%	0.7%	2%
Codfishes	BURB	0%	0%	0%	0%	0%
Sculpins	MTSC	0%	0%	0%	0%	0%
	SLSC	0%	0%	0%	0%	0%
	SPSC	0%	0%	0%	13%	3%
Sunfishes	RCBS	0%	0%	0.03%	0%	0.01%
Perch	YLPR	2%	31%	10%	6%	12%
	LGPR	0%	0.2%	0.03%	0%	0.1%
	SAUG	0%	0%	0%	0%	0%
	WALL	0.4%	1%	0.2%	0.1%	0.4%

Table 5.6-10. 2008-2019 Relative species abundance in standard gang index gill nets in Sipiwesk Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2011	2014	2017	Mean
Target	LKWH	0%	0.2%	0%	0.1%
	NRPK	14%	13%	7%	11%
	SAUG	18%	17%	23%	19%
	WALL	3%	7%	5%	5%
	WHSC	53%	55%	56%	55%
Sturgeon	LKST	0%	0%	0%	0%
Mooneyes	MOON	0.5%	0.3%	1%	1%
	GOLD	0%	0%	0%	0%
Minnows	CARP	0%	0%	0%	0%
	EMSH	0%	0%	0%	0%
	SPSH	0%	0%	0%	0%
	FLCH	0%	0%	0%	0%
Suckers	QUIL	0%	0%	0%	0%
	LNSC	1%	1%	1%	1%
	GLRD	0%	0%	0%	0%
	SLRD	0%	0%	0.2%	0.1%
	SHRD	3%	3%	5%	4%
Catfishes	CHCT	0%	0%	0%	0%
Smelts	RNSM	0%	0%	0%	0%
Coregonids	CISC	0%	0%	0%	0%
Trout-perch	TRPR	0.3%	0.2%	0%	0.2%
Codfishes	BURB	3%	0%	0.4%	1.0%
Sunfishes	RCBS	0%	0%	0%	0%
Perch	YLPR	4%	4%	2%	3%
Drums	FRDR	0.5%	0%	0%	0.2%

Table 5.6-11. 2008-2019 Relative species abundance in small mesh index gill nets in Sipiwesk Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2011	2014	2017	Mean
Mooneyes	MOON	0%	0%	0%	0%
	GOLD	0%	0%	0%	0%
Minnows	LKCH	0%	0%	0%	0%
	GLSH	0%	0%	0%	0%
	EMSH	27%	34%	21%	27%
	SPSH	10%	27%	11%	16%
Suckers	LNSC	0%	0%	0%	0%
	WHSC	0%	0.1%	0%	0.05%
	SHRD	0%	0%	0%	0%
Pikes	NRPK	0%	1%	0%	0.2%
Smelts	RNSM	5%	0.4%	1%	2%
Coregonids	CISC	0%	0%	0%	0%
	LKWH	0%	0%	0%	0%
Trout-perch	TRPR	55%	36%	63%	52%
Codfishes	BURB	0%	0%	0%	0%
Sculpins	MTSC	0%	0%	0%	0%
	SLSC	0%	0%	0%	0%
	SPSC	0%	0.1%	0%	0.05%
Sunfishes	RCBS	0%	0%	0%	0%
Perch	YLPR	2%	1%	0%	1%
	LGPR	0%	0%	0%	0%
	SAUG	0.2%	0.6%	4%	2%
	WALL	0%	0.1%	0%	0.05%

Table 5.6-12. 2008-2019 Relative species abundance in standard gang index gill nets in the upper Nelson River.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2011	2014	2017	Mean
Target	LKWH	0%	0%	1%	0.2%
	NRPK	11%	7%	9%	9%
	SAUG	1%	10%	7%	6%
	WALL	47%	27%	42%	39%
	WHSC	28%	37%	16%	27%
Sturgeon	LKST	1%	0%	0%	0.2%
Mooneyes	MOON	1%	0%	1%	1%
	GOLD	0%	0%	0%	0%
Minnows	CARP	0%	0%	0%	0%
	EMSH	0%	0%	0%	0%
	SPSH	0%	0%	0%	0%
	FLCH	0%	0%	0%	0%
Suckers	QUIL	0%	0%	0%	0%
	LNSC	2%	7%	9%	6%
	GLRD	0%	0%	0%	0%
	SLRD	0%	0%	0%	0%
	SHRD	7%	12%	13%	11%
Catfishes	CHCT	0%	0%	0%	0%
Smelts	RNSM	0%	0%	0%	0%
Coregonids	CISC	1%	0%	0%	0.2%
Trout-perch	TRPR	0%	0%	1%	0.2%
Codfishes	BURB	1%	0%	0%	0.2%
Sunfishes	RCBS	0%	0%	0%	0%
Perch	YLPR	2%	0.5%	1%	1%
Drums	FRDR	0%	0%	1%	0.2%

Table 5.6-13. 2008-2019 Relative species abundance in small mesh index gill nets in the upper Nelson River.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2011	2014	2017	Mean
Mooneyes	MOON	0%	0%	0%	0%
	GOLD	0%	0%	0%	0%
Minnows	LKCH	0%	0%	0%	0%
	GLSH	0%	0%	0%	0%
	EMSH	7%	4%	3%	5%
	SPSH	77%	6%	7%	30%
Suckers	LNSC	0%	0%	0%	0%
	WHSC	0%	0%	0%	0%
	SHRD	0%	0%	0%	0%
Pikes	NRPK	1%	0%	0%	0.3%
Smelts	RNSM	1%	0%	0%	0.2%
Coregonids	CISC	0%	0%	0%	0%
	LKWH	0%	0%	0%	0%
Trout-perch	TRPR	14%	89%	87%	63%
Codfishes	BURB	0%	0%	0%	0%
Sculpins	MTSC	0%	0%	0%	0%
	SLSC	0%	0%	0%	0%
	SPSC	0%	0%	0%	0%
Sunfishes	RCBS	0%	0%	0%	0%
Perch	YLPR	0%	0%	0%	0%
	LGPR	0%	0%	0%	0%
	SAUG	0%	0%	0%	0%
	WALL	0%	2%	3%	2%

Table 5.6-14. 2008-2019 Relative species abundance in standard gang index gill nets in Setting Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean
Target	LKWH	0.3%	1%	2%	4%	1%	3%	0.4%	1%	2%	2%	1%	3%	2%
	NRPK	5%	6%	6%	5%	6%	6%	5%	4%	4%	4%	3%	2%	5%
	SAUG	27%	19%	21%	20%	19%	25%	20%	28%	33%	32%	29%	32%	26%
	WALL	18%	21%	15%	17%	22%	25%	19%	17%	16%	25%	29%	12%	20%
	WHSC	22%	21%	14%	16%	17%	18%	17%	21%	18%	17%	17%	14%	18%
Sturgeon	LKST	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mooneyes	MOON	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GOLD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Minnows	CARP	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	EMSH	0%	0%	0.1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.01%
	SPSH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	FLCH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Suckers	QUIL	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	LNSC	2%	3%	4%	5%	4%	3%	5%	6%	5%	6%	3%	5%	4%
	GLRD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SLRD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SHRD	0.2%	1%	0%	0.1%	0.3%	0.3%	0.1%	0.2%	0.1%	0%	0.1%	0%	0.2%
Catfishes	CHCT	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Smelts	RNSM	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Coregonids	CISC	17%	27%	34%	29%	28%	17%	30%	17%	15%	10%	14%	27%	22%
Trout-perch	TRPR	0%	0%	0%	0%	0%	0%	0.1%	0.1%	0%	0%	0%	0%	0.02%
Codfishes	BURB	0.1%	0.1%	0.4%	1%	0.3%	0.4%	1%	1%	0.2%	0.1%	1%	3%	1%
Sunfishes	RCBS	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Perch	YLPR	8%	3%	3%	2%	1%	2%	3%	5%	6%	4%	3%	2%	4%
Drums	FRDR	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table 5.6-15. 2008-2019 Relative species abundance in small mesh index gill nets in Setting Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean
Mooneyes	MOON	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GOLD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Minnows	LKCH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GLSH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	EMSH	21%	0%	22%	1%	18%	38%	7%	6%	2%	0.3%	5%	35%	13%
	SPSH	24%	49%	26%	62%	17%	22%	31%	34%	24%	39%	30%	23%	32%
Suckers	LNSC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	WHSC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SHRD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Pikes	NRPK	1%	4%	0%	1%	1%	0.2%	1%	0%	0.4%	1%	1%	0%	1%
Smelts	RNSM	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Coregonids	CISC	1%	0%	17%	6%	35%	1%	20%	12%	16%	1%	8%	15%	11%
	LKWH	0%	0%	0%	0.4%	0%	0%	0%	0%	0%	0%	0%	0%	0.03%
Trout-perch	TRPR	1%	0%	5%	7%	1%	4%	6%	3%	3%	4%	11%	9%	5%
Codfishes	BURB	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Sculpins	MTSC	0%	0%	0%	0.4%	0%	0%	0%	0%	0%	0%	0%	0%	0.03%
	SLSC	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
	SPSC	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0.1%
Sunfishes	RCBS	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Perch	YLPR	7%	4%	0%	9%	12%	14%	7%	6%	4%	19%	1%	0.3%	7.0%
	LGPR	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SAUG	27%	37%	27%	7%	12%	18%	20%	23%	40%	20%	28%	15%	23%
	WALL	16%	6%	2%	6%	4%	3%	6%	16%	11%	14%	14%	2%	8%

Table 5.6-16. 2008-2019 Relative species abundance in standard gang index gill nets in Walker Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2010	2013	2016	2019	Mean
Target	LKWH	0%	0.4%	0.5%	2%	1%
	NRPK	13%	18%	7%	15%	13%
	SAUG	4%	3%	3%	1%	3%
	WALL	16%	29%	26%	25%	24%
	WHSC	28%	40%	47%	55%	42%
Sturgeon	LKST	0%	0%	0%	0%	0%
Mooneyes	MOON	0%	0%	0%	0%	0%
	GOLD	0%	0%	0%	0%	0%
Minnows	CARP	0%	0%	0%	0%	0%
	EMSH	0%	0%	0%	0%	0%
	SPSH	0%	0%	0%	0%	0%
	FLCH	0%	0%	0%	0%	0%
Suckers	QUIL	0%	0%	0%	0%	0%
	LNSC	0%	0%	0%	0%	0%
	GLRD	0%	0%	0%	0%	0%
	SLRD	0%	0%	0%	0%	0%
	SHRD	0%	0%	0%	0%	0%
Catfishes	CHCT	0%	0%	0%	0%	0%
Smelts	RNSM	0%	0%	0%	0%	0%
Coregonids	CISC	25%	6%	8%	2%	10%
Trout-perch	TRPR	0%	0%	0%	0%	0%
Codfishes	BURB	0%	0%	0%	0.3%	0.1%
Sunfishes	RCBS	0%	0%	0%	0%	0%
Perch	YLPR	12%	6%	9%	0.3%	6.6%
Drums	FRDR	0%	0%	0%	0%	0%

Table 5.6-17. 2008-2019 Relative species abundance in small mesh index gill nets in Walker Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2010	2013	2016	2019	Mean
Mooneyes	MOON	-	0%	0%	0%	0%
	GOLD	-	0%	0%	0%	0%
Minnows	LKCH	-	0%	0%	0%	0%
	GLSH	-	0%	0%	0%	0%
	EMSH	-	0%	0%	10%	3%
	SPSH	-	57%	61%	63%	60%
Suckers	LNSC	-	0%	0%	0%	0%
	WHSC	-	1%	0%	0%	0.5%
	SHRD	-	0%	0%	0%	0%
Pikes	NRPK	-	1%	1%	2%	1%
Smelts	RNSM	-	0%	0%	0%	0%
Coregonids	CISC	-	4%	0%	0%	1%
	LKWH	-	0.2%	0.2%	0%	0.2%
Trout-perch	TRPR	-	0.2%	2%	1%	1%
Codfishes	BURB	-	0%	0%	0%	0%
Sculpins	MTSC	-	0%	0%	0%	0%
	SLSC	-	0%	0.2%	0%	0.1%
	SPSC	-	0%	0%	0%	0%
Sunfishes	RCBS	-	0%	0%	0%	0%
Perch	YLPR	-	25%	29%	20%	25%
	LGPR	-	0%	0%	0%	0%
	SAUG	-	0.2%	2%	0.3%	0.8%
	WALL	-	11%	4%	4%	6%

5.6.2 HILL'S EFFECTIVE RICHNESS

5.6.2.1 ON-SYSTEM SITES

ANNUAL SITES

Lake Winnipeg – Mossy Bay

The Hill's effective species richness over the 12 years of monitoring ranged from a low of 3.6 in 2009 to a high of 8.2 species in 2012 (Table 5.6-18; Figure 5.6-1).

The overall mean Hill's index value was 5.8, the median was 5.9, and the IQR was 5.0-6.3 species (Figure 5.6-1). The annual mean Hill's index value fell within the overall IQR except in 2009, 2018, and 2019 when it was below the IQR and in 2012, and 2014, and 2015 when it was above the IQR.

Cross Lake

The Hill's effective species richness over the 12 years of monitoring ranged from a low of 5.1 in 2017 to a high of 8.2 species in 2019 (Table 5.6-12; Figure 5.6-1).

The overall mean and median Hill's index value were 6.9 and the IQR was 6.4-7.5 species (Figure 5.6-1). The annual mean Hill's index value fell within the overall IQR except in 2013 and 2017 when it was below the IQR and in 2011, 2018, and 2019 when it was above the IQR.

ROTATIONAL SITES

Playgreen Lake

The Hill's effective species richness over the five years of monitoring ranged from a low of 2.1 in 2018 to a high of 7.4 species in 2012 (Table 5.6-12; Figure 5.6-1).

The overall mean Hill's index value was 4.5, the median was 4.8, and the IQR was 2.7-5.6 species (Figure 5.6-1). The annual mean Hill's index value was below the IQR in 2018 and was above the IQR in 2012.

Little Playgreen Lake

The Hill's effective species richness over the four years of monitoring ranged from a low of 2.5 in 2019 to a high of 5.0 species in 2013 (Table 5.6-12; Figure 5.6-1).

The overall mean Hill's index value was 3.4, the median was 3.0, and the IQR was 2.9-3.5 species (Figure 5.6-1). The annual mean Hill's index value fell within the overall IQR except in 2019 when it was below the IQR and in 2013 when it was above the IQR.

Sipiwesk Lake

The Hill's effective species richness over the three years of monitoring ranged from a low of 5.7 in 2017 to a high of 7.3 species in 2011 (Table 5.6-12; Figure 5.6-1).

The overall mean Hill's index value was 6.7, the median was 7.0, and the IQR was 6.4-7.2 species (Figure 5.6-1). The annual mean Hill's index value fell within the overall IQR except in 2017 when it was below the IQR and in 2011 when it was above the IQR.

Upper Nelson River

The Hill's effective species richness over the three years of monitoring ranged from a low of 5.1 in 2011 to a high of 6.7 species in 2017 (Table 5.6-12; Figure 5.6-1).

The overall mean Hill's index value was 6.1, the median was 6.4, and the IQR was 5.8-6.6 species (Figure 5.6-1). The annual mean Hill's index value fell within the overall IQR except in 2011 when it was below the IQR and in 2017 when it was above the IQR.

5.6.2.2 OFF-SYSTEM SITES

ANNUAL SITES

Setting Lake

The Hill's effective species richness over the 12 years of monitoring ranged from a low of 6.3 in 2009 to a high of 8.5 species in 2013 (Table 5.6-12; Figure 5.6-1).

The overall mean Hill's index value was 7.3, the median was 7.2, and the IQR was 6.9-7.6 species (Figure 5.6-1). The annual mean Hill's index value fell within the overall IQR except in 2009, 2016, and 2018 when it was below the IQR and in 2011, 2013, and 2019 when it was above the IQR.

ROTATIONAL SITES

Walker Lake

The Hill's effective species richness over the four years of monitoring ranged from a low of 5.3 in 2010 to a high of 5.7 species in 2019 (Table 5.6-12; Figure 5.6-1).

The overall mean and median Hill's index value were 5.5 and the IQR was 5.4-5.6 species (Figure 5.6-1). The annual mean Hill's index value fell within the overall IQR except in 2010 when it was below the IQR and in 2019 when it was above the IQR.

Table 5.6-18. 2008-2019 Hill's effective species richness.

Waterbody	Year	n_F[1]	n_{spp}[2]	Value
LW-MB	2008	678	9	5.1
	2009	576	10	3.6
	2010	1853	13	6.2
	2011	982	12	5.2
	2012	1042	14	8.2
	2013	1711	15	6.2
	2014	938	14	7.5
	2015	693	15	6.5
	2016	1169	13	6.3
	2017	1153	12	5.7
	2018	610	13	4.7
	2019	1051	13	4.6
CROSS	2008	1151	14	7.1
	2009	706	12	6.7
	2010	803	12	6.4
	2011	848	11	7.8
	2012	587	12	6.5
	2013	859	13	6.1
	2014	999	15	7.5
	2015	1234	12	7.4
	2016	760	11	6.3
	2017	1944	12	5.1
	2018	1348	13	7.9
	2019	659	16	8.2
PLAYG	2009	585	11	5.6
	2010	3420	15	4.8
	2012	1420	16	7.4
	2015	4988	13	2.7
	2018	5568	14	2.1
LPLAYG	2010	3453	14	3.0
	2013	1589	13	5.0
	2016	4225	12	3.0
	2019	4123	12	2.5
SIP	2011	1047	14	7.3
	2014	1364	14	7.0
	2017	600	14	5.7

Table 5.6-18. continued.

Waterbody	Year	n_F[1]	n_{spp}[2]	Value
UNR	2011	552	15	5.1
	2014	267	10	6.4
	2017	224	13	6.7
SET	2008	1049	14	7.0
	2009	839	11	6.3
	2010	1348	13	7.1
	2011	1265	14	7.9
	2012	1728	13	7.5
	2013	1463	13	8.5
	2014	1455	14	7.4
	2015	1437	13	7.5
	2016	1135	13	6.8
	2017	1278	13	7.0
	2018	955	13	6.6
	2019	1195	12	7.7
WLKR	2010	67	6	5.3
	2013	696	9	5.5
	2016	816	10	5.6
	2019	716	11	5.7

Notes:

1. nF = number of fish caught in standard and small mesh gill nets.
2. nspp = number of species caught in standard and small mesh gill nets.

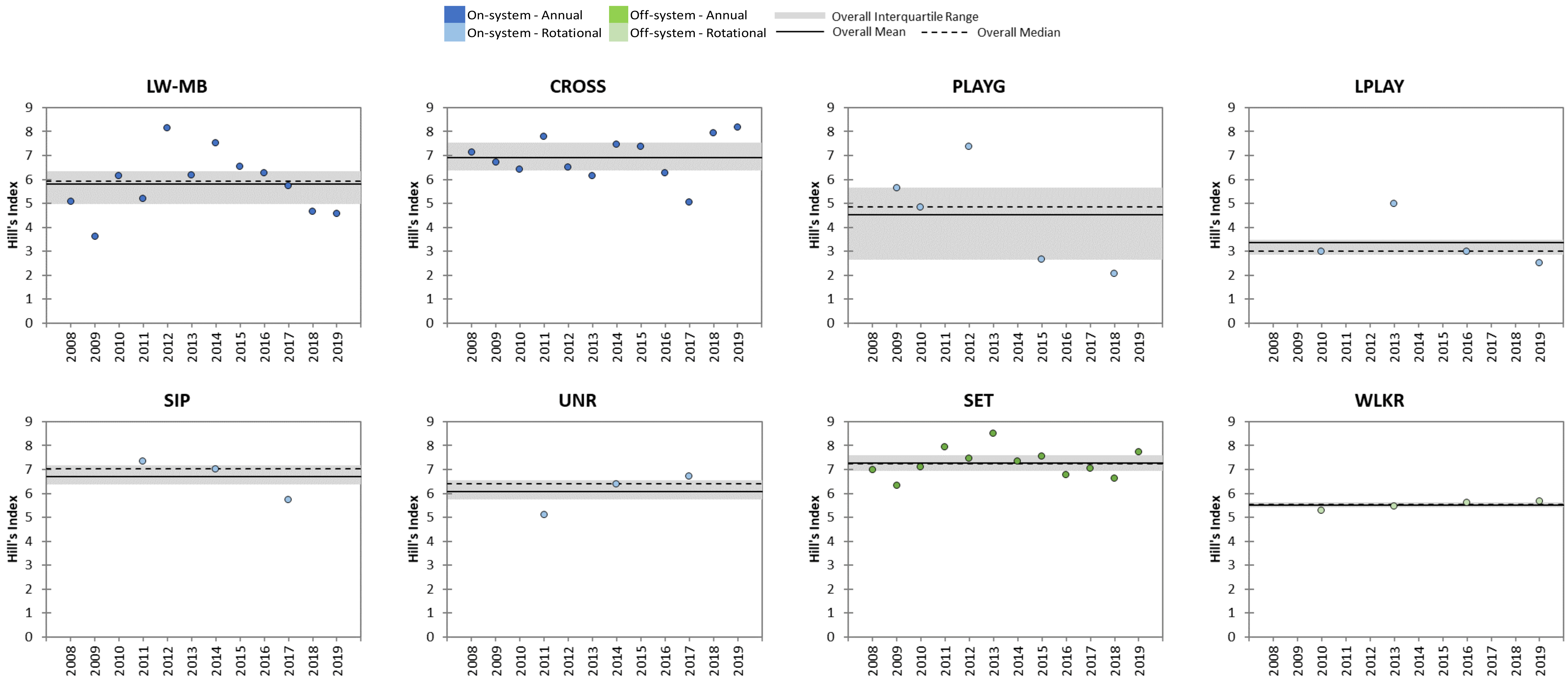


Figure 5.6-1. 2008-2019 Hill's effective species richness.

APPENDIX 5-1. GILLNETTING SITE INFORMATION AND LOCATIONS

The following is a summary of modifications and deviations in sampling locations over the 12 years of monitoring in the Upper Nelson River Region:

Lake Winnipeg – Mossy Bay

- Gill nets were set at the target locations in all 12 years with the following exceptions:
  - There are no small mesh nets set at target locations in 2008 or 2009 because SN-03, SN-06, SN-09, and SN-12 were not selected as target locations until 2010.
  - GN-01, GN-03, GN-08, and GN-12 were not set in 2009.
  - In 2008, some of the gill nets set had to be relocated from the target due to the presence of commercial nets.

Cross Lake

- Gill nets were set at the target locations in all 12 years with a few modifications:
  - The target location of GN-15 was modified after 2009.
  - GN-18 was set at a slightly different location in 2015.

Playgreen Lake

- Gill nets were set at the target locations in all five years with the following exceptions:
  - GN-10, GN/SN-12, SN-06, and SN-09 were not selected as target locations until after the Pilot Program, starting in 2012.
  - SN-05 is not a target location but was included as an alternate location to SN-06 in 2010 since it was set in close proximity to GN-06 and SN-10 is not a target location but was included as alternate location to SN-12 in 2010 since it was set along a bay on the north shore similar to GN-12.
  - GN-08 was not set in 2009.

Little Playgreen Lake

- Gill nets were set at the target locations in all four years.

Sipiwesk Lake

- Gill nets were set at the target locations in all three years.

Upper Nelson River

- Gill nets were set at the target locations in all three years.

Setting Lake

- Gill nets were set at the target locations in all 12 years with the following exceptions:
    - GN-04, GN/SN-06, GN-07, and GN-08 were not selected as target locations until 2010.
    - In 2011 several sites were set at different locations: GN-07 was set at the location of GN-09, GN-10 was set at the location of GN-11, and GN-08 and GN-09 were set at non-target locations.
    - GN-10 was not set in 2010.
    - GN-13 was not set in 2019.
    - GN-14 was not set in 2010 and 2019.
    - SN-12 was not set in 2009 and 2010.

Walker Lake

- Gill nets were set at the target locations in all four years with the following exceptions:
    - GN-10, GN/SN-11, GN-12, and SN-04 were not selected as target locations until after the Pilot Program, starting in 2013.

Table A5-1-1. 2008-2019 Set information for gillnetting sites.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
LW-MB	GN-01	14	562698	5949816	4-Jul-08	21.6	6.6	6.6	13.0
	GN-02	14	563442	5950780	27-Jun-08	23.2	4.4	3.6	15.2
	GN-03	14	560084	5950213	3-Jul-08	24.2	10.3	10.6	12.8
	GN-04	14	560427	5952434	28-Jun-08	21.9	8.7	8.5	13.8
	GN-05	14	562444	5952248	28-Jun-08	22.7	5.3	5.2	13.1
	GN-06	14	561219	5954359	28-Jun-08	22.5	5.9	5.6	13.6
	GN-07	14	559295	5954065	29-Jun-08	22.3	7.9	7.9	16.1
	GN-08	14	559168	5956778	9-Jul-08	22.6	4.3	4.4	14.0
	GN-09	14	557736	5955603	29-Jun-08	23.7	7.9	7.6	16.1
	GN-10	14	558760	5957320	9-Jul-08	21.6	4.6	3.7	14.1
	GN-11	14	556011	5956798	30-Jun-08	21.1	7.9	8.0	15.3
	GN-12	14	554796	5958165	8-Jul-08	22.9	7.6	7.4	14.4
	GN-02	14	563747	5950196	11-Jul-09	19.5	4.0	2.7	14.6
	GN-04	14	560403	5952514	11-Jul-09	20.4	8.5	9.0	15.2
	GN-05	14	562750	5952300	8-Jul-09	46.8	5.9	6.1	15.6
	GN-06	14	561219	5954359	12-Jul-09	18.7	5.9	5.6	15.7
	GN-07	14	559295	5954065	12-Jul-09	19.4	7.9	7.9	16.2
	GN-09	14	557736	5955603	13-Jul-09	20.8	7.9	7.6	16.1
	GN-10	14	558264	5957258	14-Jul-09	19.2	-	-	15.4
	GN-11	14	556011	5956798	14-Jul-09	20.3	7.9	8.0	15.7
	GN-01	14	562767	5950043	26-Jun-10	22.5	7.0	6.9	14.7
	GN-02	14	563432	5950851	26-Jun-10	21.3	4.9	4.5	15.3
	GN-03	14	560408	5950177	27-Jun-10	22.9	10.8	10.8	14.6
	GN-04	14	560481	5951953	27-Jun-10	21.7	8.9	8.8	14.7
	GN-05	14	562932	5953318	27-Jun-10	22.8	4.0	3.5	15.0
	GN-06	14	561799	5954102	27-Jun-10	24.9	5.7	5.4	15.0
	GN-07	14	559351	5954117	28-Jun-10	22.3	7.9	7.7	14.5
	GN-08	14	559956	5956536	28-Jun-10	21.2	3.4	4.2	15.3

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
LW-MB	GN-09	14	557557	5955578	28-Jun-10	21.1	7.9	8.2	15.1
	GN-10	14	558243	5957269	28-Jun-10	21.8	8.2	7.9	16.0
	GN-11	14	555921	5956893	29-Jun-10	22.4	8.5	8.2	15.5
	GN-12	14	554794	5958169	29-Jun-10	18.0	7.9	7.9	16.3
	SN-03	14	560408	5950177	27-Jun-10	22.9	10.8	10.8	14.6
	SN-06	14	561799	5954102	27-Jun-10	24.9	5.7	5.4	15.0
	SN-09	14	557557	5955578	28-Jun-10	21.1	7.9	8.2	15.1
	SN-12	14	554794	5958169	29-Jun-10	18.0	7.9	7.9	16.3
	GN-01	14	562760	5949986	6-Jul-11	23.9	7.4	7.1	20.5
	GN-02	14	563488	5950963	6-Jul-11	24.6	5.2	5.6	20.5
	GN-03	14	560332	5950146	7-Jul-11	21.5	10.7	10.7	19.0
	GN-04	14	560563	5951830	7-Jul-11	21.8	8.8	9.4	17.5
	GN-05	14	562599	5953223	9-Jul-11	21.4	5.5	5.5	17.5
	GN-06	14	561804	5954047	8-Jul-11	21.4	6.4	6.4	19.5
	GN-07	14	559401	5954219	8-Jul-11	25.0	8.8	8.8	19.0
	GN-08	14	560014	5956550	8-Jul-11	22.5	5.5	4.6	20.0
	GN-09	14	557626	5955594	9-Jul-11	17.9	10.7	10.7	19.0
	GN-10	14	558261	5957278	9-Jul-11	19.5	6.4	6.4	20.0
	GN-11	14	555997	5956948	10-Jul-11	19.4	9.1	9.4	17.8
	GN-12	14	554876	5958054	10-Jul-11	19.6	8.2	8.8	18.0
	SN-03	14	560332	5950146	7-Jul-11	21.5	10.7	10.7	18.6
	SN-06	14	561804	5954047	8-Jul-11	21.4	6.4	6.4	18.5
	SN-09	14	557626	5955594	9-Jul-11	17.9	10.7	10.7	18.5
	SN-12	14	555020	5958173	10-Jul-11	19.6	8.2	8.8	18.5
	GN-01	14	562774	5950048	6-Jul-12	24.9	6.3	6.7	18.2
	GN-02	14	563425	5950864	6-Jul-12	25.5	4.7	4.4	18.2
	GN-03	14	560362	5950175	8-Jul-12	24.6	10.2	10.2	18.4
	GN-04	14	560483	5951934	7-Jul-12	21.0	8.7	8.6	18.1

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
LW-MB	GN-05	14	562912	5953355	7-Jul-12	21.6	3.5	3.8	18.1
	GN-06	14	561819	5954108	9-Jul-12	22.3	5.4	4.9	19.7
	GN-07	14	559325	5954139	8-Jul-12	24.4	7.7	7.6	18.9
	GN-08	14	559974	5956533	8-Jul-12	25.5	3.7	4.1	19.2
	GN-09	14	557558	5955534	10-Jul-12	23.0	7.8	8.0	21.1
	GN-10	14	558289	5957343	9-Jul-12	22.4	4.7	3.9	20.3
	GN-11	14	555931	5956876	9-Jul-12	22.6	8.1	7.9	20.2
	GN-12	14	554788	5958200	10-Jul-12	22.1	7.6	7.5	21.1
	SN-03	14	560395	5950181	8-Jul-12	24.6	10.2	10.2	18.4
	SN-06	14	561786	5954094	9-Jul-12	22.3	5.4	4.9	19.7
	SN-09	14	557566	5955570	10-Jul-12	23.0	7.8	8.0	21.1
	SN-12	14	554780	5958164	10-Jul-12	22.1	7.6	7.5	21.1
	GN-01	14	562772	5949989	7-Jul-13	23.6	6.4	5.8	14.0
	GN-02	14	563402	5950817	7-Jul-13	24.3	5.2	4.6	14.0
	GN-03	14	560408	5950248	9-Jul-13	22.5	10.1	10.3	15.0
	GN-04	14	560487	5951956	9-Jul-13	22.1	8.3	8.9	15.0
	GN-05	14	562870	5953329	8-Jul-13	22.5	4	4.3	14.9
	GN-06	14	561850	5954113	8-Jul-13	21.3	5.8	5.2	14.1
	GN-07	14	559342	5954135	10-Jul-13	22.7	8.2	7.9	15.2
	GN-08	14	559991	5956453	11-Jul-13	22.7	4.3	4	15.8
	GN-09	14	557539	5955493	11-Jul-13	24.1	8.5	8.2	15.9
	GN-10	14	558223	5957206	12-Jul-13	23.2	4.9	4.8	15.7
	GN-11	14	555861	5956838	12-Jul-13	22.1	7.9	8.2	15.0
	GN-12	14	554889	5958248	13-Jul-13	23.3	8.2	7.9	15.6
	SN-03	14	560429	5950281	9-Jul-13	22.5	10.1	10.3	15.0
	SN-06	14	561792	5954112	8-Jul-13	21.3	5.8	5.2	14.1
	SN-09	14	557569	5955518	11-Jul-13	24.1	8.2	8.2	15.9
	SN-12	14	554921	5958249	13-Jul-13	23.3	8.5	7.9	15.6

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
LW-MB	GN-01	14	562748	5950009	8-Jul-14	23.4	7.0	7.1	13.7
	GN-02	14	563459	5950723	8-Jul-14	24.3	4.9	4.7	13.7
	GN-03	14	560443	5950119	8-Jul-14	22.3	10.6	10.4	13.4
	GN-04	14	560431	5952124	9-Jul-14	21.5	9.4	9.5	14.0
	GN-05	14	562929	5953334	9-Jul-14	22.6	-	4.2	14.0
	GN-06	14	562044	5953875	7-Jul-14	18.6	-	4.6	14.5
	GN-07	14	559391	5954113	7-Jul-14	18.2	8.6	8.0	14.2
	GN-08	14	559795	5956515	10-Jul-14	21.9	5.1	5.3	13.7
	GN-09	14	557492	5955507	11-Jul-14	24.9	9.0	8.9	13.6
	GN-10	14	558222	5957218	10-Jul-14	24.9	5.5	5.5	13.7
	GN-11	14	555874	5956785	12-Jul-14	46.8	8.3	8.5	13.7
	GN-12	14	554939	5958239	11-Jul-14	23.2	8.0	8.7	13.4
	GN-13	14	557492	5955503	12-Jul-14	44.3	9.0	8.9	13.9
	SN-03	14	560478	5950131	8-Jul-14	22.3	10.4	9.7	13.4
	SN-06	14	562018	5953849	7-Jul-14	18.6	4.6	5.6	14.5
	SN-09	14	557527	5955530	11-Jul-14	24.9	8.9	9.0	13.6
	SN-12	14	554973	5958246	11-Jul-14	23.2	8.7	7.9	13.4
	GN-01	14	562724	5950048	11-Jul-15	24.0	6.0	6.5	16.3
	GN-02	14	563417	5950766	11-Jul-15	22.3	4.8	4.2	17.0
	GN-03	14	560434	5950212	11-Jul-15	22.8	10.0	9.9	16.8
	GN-04	14	560495	5951982	12-Jul-15	22.3	8.7	8.4	16.6
	GN-05	14	562890	5953401	10-Jul-15	21.1	3.5	3.5	15.8
	GN-06	14	561785	5954129	10-Jul-15	22.5	5.4	5.1	16.0
	GN-07	14	559542	5954087	8-Jul-15	46.6	7.2	7.9	14.5
	GN-08	14	560023	5956438	8-Jul-15	47.6	4.0	4.1	15.3
	GN-09	14	557527	5955500	12-Jul-15	22.4	7.6	7.9	17.4
	GN-10	14	558263	5957300	12-Jul-15	24.5	4.6	4.5	17.5
	GN-11	14	555889	5956853	13-Jul-15	21.1	7.5	7.8	15.5

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
LW-MB	GN-12	14	554821	5958153	13-Jul-15	20.7	7.6	7.2	15.6
	SN-03	14	560317	5950176	11-Jul-15	22.8	10.0	9.9	16.8
	SN-06	14	561743	5954097	10-Jul-15	22.5	5.4	5.1	16.0
	SN-09	14	557576	5955519	12-Jul-15	22.4	7.6	7.9	17.4
	SN-12	14	554788	5958104	13-Jul-15	20.7	7.6	7.2	15.6
	GN-01	14	562776	5950036	5-Jul-16	18.1	7.6	7.6	15.7
	GN-02	14	563447	5950805	5-Jul-16	18.5	4.6	4.6	15.2
	GN-03	14	560385	5950144	5-Jul-16	21.4	10.0	10.0	13.5
	GN-04	14	560399	5951958	6-Jul-16	22.2	8.8	8.8	14.0
	GN-05	14	562933	5953329	6-Jul-16	22.8	3.7	4.0	13.7
	GN-06	14	561776	5954174	6-Jul-16	22.5	5.2	4.8	16.0
	GN-07	14	559387	5954071	6-Jul-16	23.4	7.5	8.0	15.9
	GN-08	14	559961	5956566	8-Jul-16	22.4	9.7	11.8	16.4
	GN-09	14	557443	5955746	7-Jul-16	21.0	7.3	7.7	16.6
	GN-10	14	558129	5957140	7-Jul-16	21.6	5.1	6.1	13.7
	GN-11	14	555944	5956801	7-Jul-16	22.3	7.9	8.2	14.6
	GN-12	14	554756	5968161	8-Jul-16	22.3	7.4	7.6	14.6
	SN-03	14	560411	5950168	5-Jul-16	21.4	10.0	10.0	13.5
	SN-06	14	561731	5954154	6-Jul-16	22.5	5.3	4.8	16.0
	SN-09	14	557487	5955746	7-Jul-16	21.0	7.8	7.7	16.6
	SN-12	14	554736	5958128	8-Jul-16	22.3	7.9	7.6	14.6
	GN-01	14	562785	5950059	11-Jul-17	19.1	5.7	6.7	13.4
	GN-02	14	563429	5950834	11-Jul-17	19.6	4.5	4.4	13.4
	GN-03	14	560362	5950205	11-Jul-17	18.9	10.2	10.3	14.9
	GN-04	14	560590	5951859	12-Jul-17	21.9	8.7	8.9	15.7
	GN-05	14	562922	5953322	12-Jul-17	24.4	3.5	4.1	15.4
	GN-06	14	561842	5954083	12-Jul-17	22.5	5.6	4.9	15.4
	GN-07	14	559318	5954152	13-Jul-17	19.6	7.4	7.8	16.3

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
LW-MB	GN-08	14	559912	5956581	13-Jul-17	19.5	4.0	4.6	15.3
	GN-09	14	557502	5955525	13-Jul-17	19.6	8.4	8.3	15.7
	GN-10	14	558230	5957285	14-Jul-17	19.9	5.1	5.2	15.7
	GN-11	14	555759	5956908	14-Jul-17	20.7	8.3	7.9	15.9
	GN-12	14	554699	5958211	14-Jul-17	21.6	8.0	7.7	15.8
	SN-03	14	560394	5950211	11-Jul-17	18.9	10.4	10.3	14.9
	SN-06	14	561808	5954066	12-Jul-17	22.5	5.6	4.9	15.4
	SN-09	14	557538	5955534	13-Jul-17	19.6	8.3	8.4	15.7
	SN-12	14	554723	5958170	14-Jul-17	21.6	8.1	8.0	15.8
	GN-01	14	562737	5949877	5-Jul-18	22.0	6.0	6.3	15.0
	GN-02	14	563579	5950875	4-Jul-18	20.3	-	-	14.8
	GN-03	14	560453	5950115	5-Jul-18	22.3	9.6	9.5	14.9
	GN-04	14	560433	5951910	5-Jul-18	23.4	3.3	3.4	14.9
	GN-05	14	562946	5953380	4-Jul-18	19.8	6.0	6.3	14.8
	GN-06	14	561812	5954084	16-Jul-18	40.2	4.8	4.3	18.3
	GN-07	14	559340	5954093	16-Jul-18	40.9	24.0	23.9	18.5
	GN-08	14	559985	5956497	18-Jul-18	22.1	3.1	3.7	18.6
	GN-09	14	557442	5955586	18-Jul-18	21.2	7.5	7.6	19.8
	GN-10	14	558241	5957255	18-Jul-18	22.7	4.2	4.5	19.1
	GN-11	14	555882	5956912	19-Jul-18	21.9	7.3	7.2	18.7
	GN-12	14	554876	5958144	19-Jul-18	22.0	6.9	6.8	18.6
	SN-03	14	560476	5950096	5-Jul-18	22.3	9.4	9.6	14.9
	SN-06	14	561773	5954084	16-Jul-18	40.2	4.6	4.8	18.3
	SN-09	14	557454	5955616	18-Jul-18	21.2	7.4	7.5	19.8
	SN-12	14	554862	5958109	19-Jul-18	22.0	6.9	6.9	18.6
	GN-01	14	562716	5950057	14-Jul-19	17.8	6.4	6.3	18.1
	GN-02	14	563424	5950838	14-Jul-19	17.3	4.4	4.7	18.1
	GN-03	14	560399	5950155	14-Jul-19	18.2	10.3	10.3	18.1

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
LW-MB	GN-04	14	560459	5951925	14-Jul-19	17.8	8.6	8.7	18.1
	GN-05	14	562887	5953343	14-Jul-19	18.3	3.3	3.0	18.1
	GN-06	14	561805	5954090	14-Jul-19	18.9	5.2	5.6	18.1
	GN-07	14	559357	5954257	13-Jul-19	19.6	7.6	7.9	16.8
	GN-08	14	560024	5956623	13-Jul-19	19.5	2.8	3.2	16.8
	GN-09	14	557538	5955740	13-Jul-19	21.0	7.8	7.8	16.8
	GN-10	14	558251	5957426	13-Jul-19	19.0	4.6	4.7	16.8
	GN-11	14	555941	5957018	13-Jul-19	19.2	7.4	8.1	16.8
	GN-12	14	554883	5958266	13-Jul-19	20.1	7.3	7.7	16.8
	SN-03	14	560399	5950155	14-Jul-19	18.2	10.6	10.3	18.1
	SN-06	14	561730	5953980	14-Jul-19	18.9	5.6	5.5	18.1
	SN-09	14	557556	5955606	13-Jul-19	21.0	7.8	8.0	16.8
	SN-12	14	554907	5958295	13-Jul-19	20.1	7.3	7.3	16.8
CROSS	GN-01	14	570269	6042514	28-Aug-08	22.0	4.3	5.5	18.0
	GN-03	14	570180	6043795	28-Aug-08	23.0	7.5	7.0	18.0
	GN-07	14	568701	6043540	29-Aug-08	20.8	5.5	10.5	18.0
	GN-09	14	560957	6044894	31-Aug-08	21.8	2.8	2.3	18.0
	GN-12	14	560284	6050197	31-Aug-08	23.0	3.0	3.0	17.0
	GN-13	14	562756	6052993	31-Aug-08	24.2	3.0	3.5	17.0
	GN-15	14	572869	6060875	1-Sep-08	20.8	3.0	3.1	18.0
	GN-16	14	574822	6058884	1-Sep-08	18.9	3.4	3.8	18.0
	GN-18	14	579566	6060785	1-Sep-08	18.9	4.4	5.6	18.5
	GN-19	14	591373	6066630	2-Sep-08	23.1	4.1	5.0	16.0
	GN-20	14	595631	6067562	2-Sep-08	21.7	5.1	5.6	16.0
	GN-21	14	597811	6067147	2-Sep-08	21.1	5.2	5.3	16.0
	SN-03	14	570129	6043718	28-Aug-08	23.0	8.0	7.5	18.0
	SN-09	14	560795	6044928	31-Aug-08	22.5	2.8	2.5	18.0
	SN-15	14	573002	6060734	1-Sep-08	20.8	3.1	3.2	18.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
CROSS	GN-01	14	570371	6042396	20-Aug-09	21.9	8.0	6.3	16.0
	GN-03	14	570208	6043753	21-Aug-09	22.5	4.8	4.2	16.0
	GN-07	14	568655	6043411	21-Aug-09	22.0	8.7	6.4	16.0
	GN-09	14	560862	6044971	20-Aug-09	21.4	3.4	3.3	15.0
	GN-12	14	560164	6050157	19-Aug-09	21.1	4.7	3.3	15.0
	GN-13	14	562574	6053035	19-Aug-09	20.6	4.1	4.1	15.0
	GN-15	14	573036	6060714	18-Aug-09	23.0	2.9	3.0	15.0
	GN-16	14	574649	6058909	18-Aug-09	23.9	3.4	3.5	15.0
	GN-19	14	591203	6066868	18-Aug-09	21.3	3.0	3.8	15.0
	SN-03	14	570204	6043804	21-Aug-09	22.5	5.1	4.8	16.0
	SN-09	14	560878	6044970	20-Aug-09	21.4	3.3	3.4	15.0
	SN-15	14	573036	6060714	18-Aug-09	23.0	2.9	2.8	15.0
	GN-01	14	570433	6042356	20-Aug-10	19.3	8.5	7.5	18.0
	GN-03	14	570568	6043543	20-Aug-10	21.8	5.0	4.0	18.0
	GN-07	14	568233	6043471	19-Aug-10	23.3	9.0	9.0	18.0
	GN-09	14	560831	6044947	19-Aug-10	22.0	3.1	3.0	15.0
	GN-12	14	560269	6050172	17-Aug-10	20.4	3.8	3.5	16.0
	GN-13	14	562518	6052908	17-Aug-10	20.8	3.0	3.5	16.0
	GN-15	14	574167	6060511	18-Aug-10	21.3	3.3	3.0	14.0
	GN-16	14	575008	6059244	18-Aug-10	22.0	3.5	3.5	14.0
	GN-19	14	591299	6066715	18-Aug-10	19.4	3.5	3.5	14.0
	SN-03	14	570608	6043545	20-Aug-10	21.4	6.0	5.0	15.0
	SN-09	14	560784	6044958	19-Aug-10	21.9	3.0	3.1	15.0
	SN-15	14	574150	6060526	18-Aug-10	21.2	3.0	3.3	14.0
	GN-01	14	570353	6042483	24-Aug-11	20.5	8.4	8.6	18.0
	GN-03	14	570333	6043362	23-Aug-11	20.7	8.4	8.3	18.0
	GN-07	14	568250	6043337	23-Aug-11	21.2	9.2	9.3	18.0
	GN-09	14	560969	6045034	24-Aug-11	21.8	3.6	3.8	18.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
CROSS	GN-12	14	560461	6050294	25-Aug-11	21.2	3.6	3.4	18.0
	GN-13	14	562755	6052988	25-Aug-11	23.8	3.9	4.1	17.5
	GN-15	14	574648	6060565	26-Aug-11	13.9	3.8	3.4	18.0
	GN-16	14	575096	6059081	26-Aug-11	14.3	4.2	3.4	18.0
	GN-19	14	591199	6066621	26-Aug-11	12.3	4.7	4.5	18.0
	SN-03	14	570279	6043365	23-Aug-11	20.5	8.0	8.4	18.0
	SN-09	14	560944	6045055	24-Aug-11	21.6	3.6	3.4	18.0
	SN-15	14	574668	6060590	26-Aug-11	13.7	3.8	3.8	18.0
	GN-01	14	570459	6042457	24-Aug-12	18.7	7.3	0.8	20.0
	GN-03	14	570164	6043698	24-Aug-12	18.0	6.1	2.9	20.0
	GN-07	14	568780	6043318	24-Aug-12	17.9	7.8	8.2	20.0
	GN-09	14	560892	6044976	23-Aug-12	22.1	2.4	2.5	20.0
	GN-12	14	560291	6050109	23-Aug-12	22.9	2.4	3.6	20.0
	GN-13	14	562902	6053057	23-Aug-12	24.0	2.7	2.7	20.0
	GN-15	14	574682	6060584	22-Aug-12	21.6	2.3	2.6	20.0
	GN-16	14	575065	6059187	22-Aug-12	21.9	3.0	2.7	20.0
	GN-18	14	579648	6060861	22-Aug-12	21.5	3.4	3.1	20.0
	GN-19	14	591394	6066697	21-Aug-12	22.2	3.2	3.2	20.0
	GN-20	14	595811	6067445	21-Aug-12	21.8	3.9	3.9	20.0
	GN-21	14	597180	6066906	21-Aug-12	21.1	3.7	2.3	18.0
	SN-03	14	570144	6043667	24-Aug-12	18.2	5.6	6.0	20.0
	SN-15	14	574659	6060470	22-Aug-12	21.8	2.3	2.5	20.0
	GN-01	14	570465	6042554	21-Aug-13	21.4	7.2	3.0	20.0
	GN-03	14	570230	6043792	21-Aug-13	21.8	7.0	5.8	20.0
	GN-07	14	568812	6043469	21-Aug-13	21.7	5.0	4.0	20.0
	GN-09	14	560885	6044985	22-Aug-13	18.3	2.5	2.6	20.0
	GN-12	14	560298	6050177	22-Aug-13	18.5	2.8	2.4	20.0
	GN-13	14	562795	6053027	22-Aug-13	18.7	1.0	2.5	20.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
CROSS	GN-15	14	574672	6060495	23-Aug-13	22.3	2.6	2.5	20.0
	GN-16	14	574959	6059259	23-Aug-13	21.8	3.0	2.7	20.0
	GN-18	14	579782	6060879	23-Aug-13	20.8	2.5	2.7	20.0
	GN-19	14	591280	6066719	24-Aug-13	21.7	3.3	3.4	20.0
	GN-20	14	595798	6067568	24-Aug-13	22.7	3.7	3.9	20.0
	GN-21	14	597189	6066916	24-Aug-13	22.9	3.4	3.7	20.0
	SN-03	14	570239	6043812	21-Aug-13	21.8	6.9	7.0	20.0
	SN-09	14	560857	6044975	22-Aug-13	18.3	2.6	2.5	20.0
	SN-15	14	574665	6060479	23-Aug-13	22.3	2.6	2.6	20.0
	GN-01	14	570363	6042442	27-Aug-14	20.9	8.1	8.5	10.0
	GN-03	14	570447	6043398	27-Aug-14	21.0	7.0	5.0	10.0
	GN-07	14	568792	6043406	27-Aug-14	21.5	9.1	6.1	10.0
	GN-09	14	560910	6044957	28-Aug-14	18.1	3.4	3.6	10.0
	GN-12	14	560342	6050085	28-Aug-14	19.1	2.0	3.5	10.0
	GN-13	14	562789	6052925	28-Aug-14	20.1	3.7	4.1	10.0
	GN-15	14	574579	6060528	26-Aug-14	22.4	3.5	3.5	9.5
	GN-16	14	574771	6059464	26-Aug-14	23.1	3.5	3.0	9.5
	GN-18	14	579760	6060651	26-Aug-14	22.1	4.0	4.1	10.0
	GN-19	14	591390	6066697	29-Aug-14	20.4	3.8	3.8	10.0
	GN-20	14	595811	6067455	29-Aug-14	20.3	4.2	4.2	10.0
	GN-21	14	597189	6066916	29-Aug-14	20.7	4.5	3.5	10.0
	SN-03	14	570470	6043408	27-Aug-14	21.0	7.5	7.0	10.0
	SN-09	14	560930	6044955	28-Aug-14	18.1	3.4	3.4	10.0
	SN-15	14	574540	6060550	26-Aug-14	22.4	3.5	3.5	9.5
	GN-01	14	570487	6042700	4-Sep-15	19.7	7.4	3.4	17.5
	GN-03	14	570401	6043589	4-Sep-15	18.8	6.6	3.9	17.5
	GN-07	14	568153	6043401	4-Sep-15	18.7	8.4	8.8	17.5
	GN-09	14	560930	6044917	3-Sep-15	15.3	2.1	2.2	18.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
CROSS	GN-12	14	560384	6050235	3-Sep-15	16.3	2.1	3.2	18.0
	GN-13	14	562926	6052899	3-Sep-15	17.1	2.7	2.6	18.0
	GN-15	14	574373	6060433	2-Sep-15	15.6	1.9	2.4	18.0
	GN-16	14	574926	6059239	2-Sep-15	15.8	2.6	2.7	18.0
	GN-18	14	578716	6060240	2-Sep-15	15.4	3.7	2.5	18.0
	GN-19	14	591198	6066727	1-Sep-15	26.2	3.2	3.4	17.0
	GN-20	14	595780	6067444	1-Sep-15	25.0	3.6	3.6	17.0
	GN-21	14	597513	6067135	1-Sep-15	24.2	3.4	2.4	17.0
	SN-03	14	570376	6043566	4-Sep-15	18.8	6.6	6.6	17.5
	SN-09	14	560961	6044881	3-Sep-15	15.3	2.1	2.1	18.0
	SN-15	14	574394	6060415	2-Sep-15	15.6	1.9	1.9	18.0
	GN-01	14	570362	6042449	22-Aug-16	21.8	7.6	7.8	16.0
	GN-03	14	570438	6043604	22-Aug-16	22.3	5.8	7.3	15.0
	GN-07	14	568325	6043742	22-Aug-16	22.3	8.7	8.3	15.0
	GN-09	14	560870	6044843	21-Aug-16	19.3	2.8	2.8	16.0
	GN-12	14	560328	6050189	21-Aug-16	20.1	2.8	3.8	16.0
	GN-13	14	562626	6053044	21-Aug-16	20.7	3.7	3.4	19.0
	GN-15	14	574209	6060481	20-Aug-16	19.7	2.8	2.7	19.0
	GN-16	14	575016	6059206	20-Aug-16	20.0	3.2	3.2	19.0
	GN-18	14	579750	6060968	20-Aug-16	19.5	3.6	3.7	18.0
	GN-19	14	591266	6066728	19-Aug-16	19.7	3.7	3.5	15.0
	GN-20	14	595846	6067539	19-Aug-16	20.5	4.0	3.8	15.0
	GN-21	14	597156	6066915	19-Aug-16	21.2	3.7	3.1	15.0
	SN-03	14	570444	6043631	22-Aug-16	22.3	5.9	5.8	15.0
	SN-09	14	560837	6044836	21-Aug-16	19.3	2.8	2.8	16.0
	SN-15	14	574179	6060505	20-Aug-16	19.7	2.8	2.8	19.0
	GN-01	14	570394	6042435	24-Aug-17	16.5	7.2	7.3	18.0
	GN-03	14	570545	6043408	24-Aug-17	15.5	5.4	7.7	18.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
CROSS	GN-07	14	567953	6043513	24-Aug-17	15.5	8.2	8.4	18.0
	GN-09	14	560902	6044971	26-Aug-17	19.0	2.3	2.3	18.0
	GN-12	14	560262	6050046	26-Aug-17	19.6	1.6	3.5	18.0
	GN-13	14	562909	6053048	26-Aug-17	18.8	2.6	2.4	18.0
	GN-15	14	574331	6060525	22-Aug-17	22.1	2.6	2.3	18.0
	GN-16	14	574932	6059163	22-Aug-17	22.9	3.0	2.7	18.0
	GN-18	14	579782	6060901	22-Aug-17	21.8	3.4	2.2	18.0
	GN-19	14	591283	6066753	23-Aug-17	22.6	3.2	3.4	18.0
	GN-20	14	595765	6067621	23-Aug-17	22.1	3.6	3.8	18.0
	GN-21	14	597176	6066934	23-Aug-17	21.5	3.4	2.4	18.0
	SN-03	14	570580	6043398	24-Aug-17	15.5	6.3	5.4	18.0
	SN-09	14	560859	6044963	26-Aug-17	19.0	2.2	2.3	18.0
	SN-15	14	574316	6060548	22-Aug-17	22.1	2.7	2.6	18.0
	GN-01	14	570458	6042588	21-Aug-18	21.8	7.0	1.0	16.0
	GN-03	14	570362	6043493	21-Aug-18	20.9	5.2	3.4	16.0
	GN-07	14	568146	6043365	21-Aug-18	20.3	7.2	7.5	16.0
	GN-09	14	560843	6044828	22-Aug-18	24.3	1.7	1.6	16.5
	GN-12	14	560303	6050163	22-Aug-18	24.9	1.6	1.8	16.5
	GN-13	14	562756	6053001	22-Aug-18	25.3	1.9	2.0	16.5
	GN-15	14	574368	6060436	23-Aug-18	17.0	1.6	1.7	14.5
	GN-16	14	575008	6059204	23-Aug-18	16.2	2.2	2.3	14.5
	GN-18	14	579780	6060801	23-Aug-18	16.9	2.8	3.0	14.5
	GN-19	14	591413	6066744	24-Aug-18	41.5	2.5	2.6	14.0
	GN-20	14	595760	6067610	26-Aug-18	23.3	2.8	2.8	10.0
	GN-21	14	597256	6066841	24-Aug-18	39.8	1.9	2.4	14.0
	SN-03	14	570464	6043522	21-Aug-18	21.4	3.4	3.5	16.0
	SN-09	14	560810	6044813	22-Aug-18	24.3	1.7	1.7	16.5
	SN-15	14	574242	6060460	23-Aug-18	17.0	1.7	1.8	14.5

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
CROSS	GN-01	14	570315	6042430	27-Aug-19	23.1	1.9	6.8	16.0
	GN-03	14	570476	6043651	27-Aug-19	23.1	6.3	3.4	16.0
	GN-07	14	568259	6043459	27-Aug-19	22.4	7.9	7.7	16.0
	GN-09	14	560971	6044741	28-Aug-19	20.1	1.4	1.3	14.0
	GN-12	14	560247	6049840	28-Aug-19	20.3	2.4	1.3	14.0
	GN-13	14	562717	6052880	28-Aug-19	20.3	2.1	2.5	14.0
	GN-15	14	574207	6060457	26-Aug-19	19.7	1.3	1.6	17.0
	GN-16	14	574973	6059281	26-Aug-19	19.7	2.1	2.3	17.0
	GN-18	14	579771	6060878	26-Aug-19	19.4	2.8	3.0	18.0
	GN-19	14	591278	6066719	25-Aug-19	21.2	2.9	2.7	-
	GN-20	14	595803	6067565	25-Aug-19	21.3	3.3	3.3	-
	GN-21	14	597181	6066918	25-Aug-19	20.5	2.0	3.0	17.0
	SN-03	14	570498	6043672	27-Aug-19	23.1	3.4	3.6	16.0
	SN-09	14	560836	6044779	28-Aug-19	20.1	1.3	1.8	14.0
	SN-15	14	574179	6060470	26-Aug-19	19.7	1.5	1.3	17.0
PLAYG	GN-01	14	570186	5961634	8-Jun-09	20.6	-	-	-
	GN-02	14	570519	5958487	8-Jun-09	20.4	-	-	-
	GN-03	14	563133	5961596	8-Jun-09	20.8	-	-	-
	GN-04	14	559008	5965489	10-Jun-09	21.8	-	-	-
	GN-05	14	559906	5969507	10-Jun-09	22.4	-	-	-
	GN-06	14	561236	5972171	10-Jun-09	22.0	-	-	-
	GN-07	14	560870	5973983	10-Jun-09	20.3	-	-	9.0
	GN-08	14	553774	5968626	9-Jun-09	23.7	-	-	7.7
	GN-09	14	553976	5972516	9-Jun-09	25.3	-	-	6.3
	GN-11	14	549032	5977904	12-Jun-09	20.4	-	-	-
	SN-03	14	563133	5961596	8-Jun-09	20.8	-	-	-
	GN-01	14	570062	5961764	24-Jun-10	17.4	2.4	2.4	17.4
	GN-02	14	570417	5958708	24-Jun-10	17.8	9.1	6.2	16.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
PLAYG	GN-03	14	562662	5961404	24-Jun-10	21.7	2.4	1.6	15.3
	GN-04	14	559140	5965536	23-Jun-10	19.0	2.3	2.2	-
	GN-05	14	559906	5969510	23-Jun-10	17.3	3.0	2.8	-
	GN-06	14	561061	5972058	23-Jun-10	17.4	3.3	5.8	16.1
	GN-07	14	560732	5974015	23-Jun-10	18.9	1.8	2.3	19.4
	GN-09	14	553985	5972432	24-Jun-10	16.9	2.9	3.1	-
	GN-10	14	557002	5976770	24-Jun-10	18.1	2.8	2.6	-
	GN-11	14	549574	5975530	25-Jun-10	14.9	3.1	3.4	19.3
	GN-12	14	552138	5979837	25-Jun-10	16.3	3.7	4.0	19.7
	SN-03	14	562662	5961404	24-Jun-10	21.7	2.4	1.6	15.3
	SN-12	14	552138	5979837	25-Jun-10	16.3	3.7	4.0	19.7
	GN-01	14	570071	5961772	21-Jun-12	23.6	2.1	2.2	13.3
	GN-02	14	570413	5958723	20-Jun-12	21.8	8.1	4.7	12.4
	GN-03	14	562623	5961393	20-Jun-12	23.5	2.0	1.9	12.1
	GN-04	14	559149	5965540	19-Jun-12	19.1	2.1	1.9	14.0
	GN-05	14	559831	5969534	19-Jun-12	18.1	2.8	2.8	14.1
	GN-06	14	561076	5972091	21-Jun-12	22.4	3.8	3.9	13.5
	GN-07	14	560774	5974077	22-Jun-12	24.7	2.1	2.1	17.0
	GN-08	14	556063	5969229	22-Jun-12	21.1	3.2	3.2	14.1
	GN-09	14	554020	5972454	23-Jun-12	24.1	2.9	3.1	14.1
	GN-10	14	557037	5976840	23-Jun-12	20.8	2.5	2.5	17.3
	GN-11	14	549555	5975558	25-Jun-12	22.6	3.2	3.1	15.1
	GN-12	14	552123	5979862	24-Jun-12	21.7	3.5	3.6	15.7
	SN-03	14	562657	5961412	20-Jun-12	23.5	2.0	1.9	12.1
	SN-06	14	561058	5972058	21-Jun-12	22.4	3.8	3.9	13.5
	SN-09	14	554014	5972417	23-Jun-12	24.1	2.9	3.1	14.1
	SN-12	14	552123	5979862	24-Jun-12	21.7	3.5	3.6	15.7
	GN-01	14	570084	5961783	20-Jun-15	20.6	2.0	2.1	13.2

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
PLAYG	GN-02	14	570351	5958857	20-Jun-15	21.7	6.3	6.6	12.6
	GN-03	14	562620	5961385	21-Jun-15	23.5	2.2	1.9	13.1
	GN-04	14	559188	5965560	17-Jun-15	23.4	1.9	1.9	11.9
	GN-05	14	559950	5969579	16-Jun-15	23.3	2.7	2.6	11.8
	GN-06	14	561141	5971992	16-Jun-15	22.0	4.0	2.8	12.1
	GN-07	14	560780	5974084	18-Jun-15	21.0	1.9	1.9	13.6
	GN-08	14	556126	5969176	17-Jun-15	24.6	3.1	3.0	12.0
	GN-09	14	553881	5972454	18-Jun-15	22.8	2.7	2.9	12.0
	GN-10	14	556971	5976831	19-Jun-15	20.9	2.4	2.4	13.9
	GN-11	14	549551	5975534	19-Jun-15	23.5	3.0	3.0	12.3
	GN-12	14	552149	5979798	19-Jun-15	22.2	3.5	3.7	13.3
	SN-03	14	562650	5961409	21-Jun-15	23.5	2.2	2.2	13.1
	SN-06	14	561068	5972106	21-Jun-15	22.0	2.6	2.6	12.1
	SN-09	14	553842	5972448	21-Jun-15	22.8	2.8	2.8	12.0
	SN-12	14	552166	5979833	21-Jun-15	22.2	4.5	4.5	13.3
	GN-01	14	570070	5961778	18-Jun-18	17.9	-	1.7	17.0
	GN-02	14	570403	5958742	18-Jun-18	18.7	7.3	4.8	15.1
	GN-03	14	562843	5961577	19-Jun-18	21.1	1.9	1.9	13.1
	GN-04	14	559245	5965603	19-Jun-18	22.2	1.6	1.7	17.3
	GN-05	14	559967	5969421	20-Jun-18	23.5	2.3	2.2	14.6
	GN-06	14	561024	5972030	20-Jun-18	19.1	2.3	5.0	17.1
	GN-07	14	560724	5974047	21-Jun-18	43.7	1.5	1.7	22.5
	GN-08	14	556074	5969193	21-Jun-18	44.7	2.7	2.7	20.1
	GN-09	14	553986	5972371	23-Jun-18	22.5	2.3	2.4	15.1
	GN-10	14	556991	5976878	23-Jun-18	22.0	2.0	1.9	18.0
	GN-11	14	549545	5975628	24-Jun-18	23.0	2.6	3.0	17.4
	GN-12	14	552117	5979809	25-Jun-18	21.8	3.1	3.2	18.0
	SN-03	14	562837	5961613	19-Jun-18	21.1	1.7	1.9	13.1

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
PLAYG	SN-06	14	561039	5971994	20-Jun-18	19.1	2.4	2.3	17.1
	SN-09	14	554011	5972399	23-Jun-18	22.5	2.4	2.3	15.1
	SN-12	14	552129	5979869	25-Jun-18	21.8	3.0	3.1	18.0
LPLAY	GN-01	14	567396	5981638	10-Jun-10	19.1	2.1	2.1	13.0
	GN-02	14	569156	5983028	10-Jun-10	18.8	4.3	4.3	13.3
	GN-03	14	572141	5984818	11-Jun-10	18.4	3.4	3.4	14.7
	GN-04	14	572641	5986286	11-Jun-10	20.3	3.1	3.7	13.2
	GN-05	14	576197	5984530	12-Jun-10	18.0	2.1	3.1	15.5
	GN-06	14	576903	5983742	12-Jun-10	16.9	3.7	3.1	14.2
	GN-07	14	579112	5986714	13-Jun-10	20.2	3.7	4.6	16.7
	GN-08	14	581052	5987088	13-Jun-10	19.9	3.1	3.1	18.0
	GN-09	14	582352	5988626	14-Jun-10	21.2	2.4	3.4	15.0
	GN-10	14	579439	5988799	14-Jun-10	19.2	2.4	2.4	17.6
	SN-03	14	572141	5984818	11-Jun-10	18.4	3.4	3.4	14.7
	SN-06	14	576903	5983742	12-Jun-10	16.9	3.7	3.1	14.2
	SN-09	14	582352	5988626	14-Jun-10	21.2	2.4	3.4	15.0
	GN-01	14	567511	5981605	18-Jul-13	21.9	2.7	2.1	18.6
	GN-02	14	569213	5983031	18-Jul-13	21.3	2.8	2.8	18.7
	GN-03	14	572064	5984735	17-Jul-13	22.5	2.5	2.4	18.4
	GN-04	14	572715	5986296	17-Jul-13	21.8	2.3	2.4	18.6
	GN-05	14	576198	5984564	14-Jul-13	20.0	9.2	9.2	17.2
	GN-06	14	576943	5983758	16-Jul-13	21.7	2.6	2.4	19.2
	GN-07	14	579097	5986707	10-Jul-13	23.6	3.1	4.0	17.4
	GN-08	14	581036	5987079	14-Jul-13	20.4	2.4	2.6	17.2
	GN-09	14	582282	5988734	15-Jul-13	23.0	2.2	2.2	19.3
	GN-10	14	579446	5988840	15-Jul-13	22.0	2.7	2.2	19.0
	SN-03	14	572003	5984719	17-Jul-13	22.5	2.5	2.4	18.4
	SN-06	14	576910	5983761	16-Jul-13	21.7	2.6	2.4	19.2

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
LPLAY	SN-09	14	582221	5988738	15-Jul-13	23.0	2.2	2.2	19.3
	GN-01	14	567396	5981599	11-Jul-16	20.9	2.2	2.2	18.1
	GN-02	14	569149	5983073	11-Jul-16	21.2	2.8	2.9	18.1
	GN-03	14	572121	5984761	11-Jul-16	21.5	2.6	2.5	18.6
	GN-04	14	572657	5986280	10-Jul-16	21.9	3.0	3.1	18.2
	GN-05	14	576185	5984548	8-Jul-16	18.9	2.6	2.6	18.6
	GN-06	14	576873	5983714	9-Jul-16	23.6	5.1	5.1	17.9
	GN-07	14	579147	5986724	9-Jul-16	21.0	6.8	8.6	18.1
	GN-08	14	581039	5987104	9-Jul-16	21.4	5.5	5.4	18.6
	GN-09	14	582367	5988606	10-Jul-16	22.1	3.3	3.2	18.4
	GN-10	14	579404	5988812	10-Jul-16	20.8	3.3	2.9	18.1
	SN-03	14	572161	5984766	11-Jul-16	21.5	2.6	2.5	18.6
	SN-06	14	576843	5983695	9-Jul-16	23.6	5.1	5.1	17.9
	SN-09	14	582336	5988590	10-Jul-16	22.1	3.2	3.2	18.4
	GN-01	14	567529	5981795	17-Jul-19	17.3	7.2	7.2	19.5
	GN-02	14	569173	5983009	17-Jul-19	17.2	8.4	7.6	19.5
	GN-03	14	572184	5984973	17-Jul-19	19.1	6.3	6.8	20.2
	GN-04	14	572661	5986293	17-Jul-19	19.6	6.8	6.4	20.6
	GN-05	14	576176	5984672	16-Jul-19	16.9	7.7	7.8	23.3
	GN-06	14	577017	5983712	16-Jul-19	16.6	6.3	6.4	23.8
	GN-07	14	579205	5986791	16-Jul-19	17.0	11.4	8.6	23.5
	GN-08	14	581046	5987220	16-Jul-19	23.8	7.2	7.3	22.4
	GN-09	14	582442	5988878	16-Jul-19	17.1	7.0	6.7	22.4
	GN-10	14	579779	5988772	16-Jul-19	16.3	8.1	10.1	22.4
	SN-03	14	572130	5984796	17-Jul-19	19.1	6.3	-	20.2
	SN-06	14	577017	5983712	16-Jul-19	16.6	6.3	6.4	23.8
	SN-09	14	582442	5988878	16-Jul-19	17.1	7.0	6.7	22.4
SIP	GN-01	14	574093	6095532	21-Jun-11	16.4	-	8.5	-

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIP	GN-02	14	573494	6091697	21-Jun-11	17.0	-	12.2	-
	GN-03	14	573418	6088389	21-Jun-11	19.4	-	9.1	-
	GN-04	14	577951	6089652	22-Jun-11	18.0	-	7.9	-
	GN-05	14	579599	6093863	22-Jun-11	18.3	-	8.5	-
	GN-06	14	581479	6098564	22-Jun-11	19.9	-	8.0	-
	GN-07	14	604246	6118571	23-Jun-11	21.5	-	16.4	-
	GN-08	14	603049	6117184	23-Jun-11	24.6	-	7.6	-
	GN-09	14	592909	6113486	23-Jun-11	19.8	-	7.3	-
	GN-10	14	599705	6110018	24-Jun-11	19.8	-	18.6	-
	GN-11	14	595589	6107486	24-Jun-11	17.7	-	8.5	-
	GN-12	14	593356	6107878	24-Jun-11	16.6	-	7.3	-
	GN-13	14	594357	6103924	25-Jun-11	22.9	-	21.9	-
	GN-14	14	601124	6103921	25-Jun-11	21.0	-	17.3	-
	GN-15	14	600869	6101856	25-Jun-11	20.0	-	19.2	-
	SN-03	14	573418	6088389	21-Jun-11	19.4	-	-	-
	SN-06	14	581479	6098564	22-Jun-11	19.9	-	-	-
	SN-09	14	592909	6113486	23-Jun-11	19.8	-	-	-
	SN-12	14	593356	6107878	24-Jun-11	16.6	-	-	-
	SN-15	14	600869	6101856	25-Jun-11	20.0	-	-	-
	GN-01	14	574125	6095413	18-Jun-14	18.7	4.5	22.8	21.5
	GN-02	14	573599	6091601	18-Jun-14	17.5	10.5	3.4	19.0
	GN-03	14	573491	6088291	19-Jun-14	22.4	7.2	4.5	22.0
	GN-04	14	577934	6089650	19-Jun-14	23.3	3.7	6.7	21.0
	GN-05	14	579691	6093767	20-Jun-14	21.8	7.6	4.3	16.8
	GN-06	14	581364	6098598	20-Jun-14	22.1	15.2	3.5	16.3
	GN-07	14	604302	6118436	23-Jun-14	19.5	15.0	2.5	16.0
	GN-08	14	603070	6117054	23-Jun-14	20.4	11.4	4.1	16.0
	GN-09	14	592832	6113592	23-Jun-14	20.5	8.0	3.5	16.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIP	GN-10	14	599842	6109996	22-Jun-14	23.8	18.7	3.4	17.0
	GN-11	14	595609	6107606	22-Jun-14	23.8	11.6	6.5	17.0
	GN-12	14	593439	6107790	22-Jun-14	22.5	7.4	3.1	16.9
	GN-13	14	594292	6104042	21-Jun-14	22.9	17.4	2.4	16.8
	GN-14	14	601100	6103797	21-Jun-14	22.6	11.2	5.3	16.5
	GN-15	14	600777	6101940	21-Jun-14	22.3	16.0	5.7	16.1
	SN-03	14	573494	6088252	19-Jun-14	22.4	7.6	4.5	22.0
	SN-06	14	581329	6098616	20-Jun-14	22.1	13.7	3.5	16.3
	SN-09	14	592816	6113618	23-Jun-14	20.5	8.3	3.5	16.0
	SN-12	14	593452	6107755	22-Jun-14	22.5	7.2	3.1	16.9
	SN-15	14	600751	6101962	21-Jun-14	22.3	15.2	5.7	16.1
	GN-01	14	574142	6095418	13-Jun-17	18.3	6.9	4.1	16.1
	GN-02	14	573661	6091627	13-Jun-17	19.1	10.6	5.0	15.3
	GN-03	14	573428	6088248	14-Jun-17	44.2	7.1	6.1	14.3
	GN-04	14	577936	6089668	14-Jun-17	43.4	2.0	6.6	14.0
	GN-05	14	579608	6093729	16-Jun-17	24.2	7.8	5.5	13.5
	GN-06	14	581378	6098637	16-Jun-17	23.5	16.2	8.5	13.4
	GN-07	14	604314	6118445	18-Jun-17	23.1	14.1	3.8	13.6
	GN-08	14	603050	6117040	18-Jun-17	22.6	10.8	6.1	13.7
	GN-09	14	592852	6113607	17-Jun-17	20.0	8.1	4.2	13.5
	GN-10	14	599821	6109964	17-Jun-17	17.7	10.3	7.2	13.5
	GN-11	14	595624	6107610	17-Jun-17	17.7	10.3	7.2	13.5
	GN-12	14	593433	6107764	18-Jun-17	18.9	7.0	4.6	14.2
	GN-13	14	594330	6104056	19-Jun-17	20.8	19.1	7.5	15.5
	GN-14	14	601188	6103920	19-Jun-17	20.9	13.7	7.6	16.5
	GN-15	14	600801	6101964	19-Jun-17	21.1	16.9	6.9	16.6
	SN-03	14	573437	6088215	14-Jun-17	44.2	7.1	7.1	14.3
	SN-06	14	581348	6098656	16-Jun-17	23.5	13.4	16.2	13.4

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIP	SN-09	14	592833	6113631	17-Jun-17	20.0	8.1	8.3	13.5
	SN-12	14	593453	6107717	18-Jun-17	18.9	7.0	7.0	14.2
	SN-15	14	600784	6101995	19-Jun-17	21.1	15.9	16.6	16.6
UNR	GN-01	14	653575	6209062	5-Jul-11	18.5	4.5	3.0	20.0
	GN-02	14	653112	6205316	5-Jul-11	15.8	17.0	3.0	20.0
	GN-03	14	653228	6203774	6-Jul-11	23.0	5.8	10.0	18.0
	GN-04	14	653200	6200637	6-Jul-11	25.0	5.8	2.5	18.0
	GN-05	14	651966	6197443	7-Jul-11	22.3	20.0	7.5	19.0
	GN-06	14	652255	6196145	7-Jul-11	24.0	9.5	4.5	19.0
	GN-07	14	650945	6192128	7-Jul-11	24.0	12.0	8.0	19.0
	GN-08	14	652323	6204972	8-Jul-11	21.8	7.5	6.0	20.0
	GN-09	14	654302	6208758	8-Jul-11	20.3	2.5	4.5	20.0
	SN-03	14	653228	6203774	6-Jul-11	23.0	5.8	5.8	18.0
	SN-06	14	652255	6196145	7-Jul-11	24.0	9.5	9.5	19.0
	SN-09	14	654302	6208758	8-Jul-11	20.3	2.5	2.5	20.0
	GN-01	14	653587	6209188	11-Jul-14	21.8	8.6	7.6	18.0
	GN-02	14	653039	6205289	10-Jul-14	17.3	16.0	5.0	18.0
	GN-03	14	653224	6203805	9-Jul-14	17.3	6.2	6.0	18.0
	GN-04	14	653196	6200641	8-Jul-14	20.0	5.8	5.9	19.0
	GN-05	14	651925	6197406	8-Jul-14	17.6	19.7	11.0	18.0
	GN-06	14	652262	6196144	8-Jul-14	17.0	9.1	8.1	18.0
	GN-07	14	650887	6192042	9-Jul-14	17.5	9.8	1.2	18.0
	GN-08	14	652347	6204873	9-Jul-14	18.8	9.3	6.2	18.0
	GN-09	14	654017	6208693	10-Jul-14	17.7	9.5	10.0	18.0
	SN-03	14	653233	6203769	9-Jul-14	17.3	6.0	6.2	18.0
	SN-06	14	652249	6196123	8-Jul-14	17.0	7.7	9.1	18.0
	SN-09	14	654039	6208653	10-Jul-14	17.7	6.5	9.5	18.0
	GN-01	14	653658	6209256	25-Jul-17	23.8	10.8	6.7	18.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
UNR	GN-02	14	653011	6205281	25-Jul-17	24.3	3.9	16.1	18.0
	GN-03	14	653205	6203849	24-Jul-17	26.4	6.4	10.9	18.0
	GN-04	14	653243	6200700	24-Jul-17	24.8	7.0	7.9	18.0
	GN-05	14	651921	6197435	23-Jul-17	21.6	10.2	18.3	18.0
	GN-06	14	652256	6196219	23-Jul-17	21.4	11.2	10.9	18.0
	GN-07	14	650882	6192055	23-Jul-17	18.2	6.2	13.4	18.0
	GN-08	14	652345	6204892	24-Jul-17	25.3	5.7	9.3	18.0
	GN-09	14	654014	6208740	25-Jul-17	23.9	8.8	11.4	18.0
	SN-03	14	653208	6203820	24-Jul-17	26.4	5.3	6.4	18.0
	SN-06	14	652265	6196158	23-Jul-17	21.4	8.6	11.2	18.0
	SN-09	14	654028	6208704	25-Jul-17	23.9	8.1	8.8	18.0
SET	GN-01	14	512135	6076808	25-Aug-08	20.2	8.4	6.1	-
	GN-02	14	514970	6078909	25-Aug-08	19.5	9.6	5.6	18.8
	GN-03	14	515883	6084260	25-Aug-08	22.5	10.1	5.4	-
	GN-05	14	518232	6087694	25-Aug-08	23.6	13.4	13.9	-
	GN-09	14	522935	6094349	26-Aug-08	44.9	18.7	18.7	18.6
	GN-10	14	524897	6098339	29-Aug-08	22.8	6.0	5.5	18.4
	GN-11	14	526230	6101015	28-Aug-08	24.9	5.7	5.4	18.4
	GN-12	14	526915	6105298	29-Aug-08	23.2	7.8	7.1	18.2
	GN-13	14	528077	6105706	29-Aug-08	23.1	4.6	7.2	18.6
	GN-14	14	530472	6105746	29-Aug-08	22.9	3.3	4.8	-
	SN-03	14	515883	6084260	25-Aug-08	22.5	10.1	5.4	-
	SN-09	14	522935	6094349	26-Aug-08	44.9	18.7	18.7	18.6
	SN-12	14	526915	6105298	29-Aug-08	23.2	7.8	7.1	18.2
	GN-01	14	512135	6076808	2-Sep-09	24.5	8.4	6.1	15.0
	GN-02	14	514970	6078909	2-Sep-09	24.6	9.6	5.6	15.8
	GN-03	14	515883	6084260	3-Sep-09	24.5	10.1	5.4	16.2
	GN-05	14	518232	6087694	3-Sep-09	24.7	13.4	13.9	16.5

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SET	GN-09	14	522935	6094348	8-Sep-09	24.7	18.7	18.7	-
	GN-10	14	524897	6098339	9-Sep-09	23.5	6.0	5.5	-
	GN-11	14	526230	6101015	10-Sep-09	25.5	5.7	5.4	-
	GN-12	14	526915	6105299	10-Sep-09	24.3	7.8	7.1	-
	GN-13	14	528078	6105706	11-Sep-09	25.0	4.6	7.2	-
	GN-14	14	530472	6105746	11-Sep-09	26.3	3.3	4.8	-
	SN-03	14	515883	6084260	3-Sep-09	24.5	10.1	5.4	-
	SN-09	14	522935	6094348	8-Sep-09	24.7	18.7	18.7	-
	GN-01	14	512135	6076808	19-Aug-10	23.4	8.4	6.1	15.3
	GN-02	14	514970	6078909	19-Aug-10	24.1	9.6	5.6	16.2
	GN-03	14	515661	6083916	20-Aug-10	22.5	10.1	5.4	16.8
	GN-04	14	518124	6085573	20-Aug-10	20.9	13.4	13.9	17.2
	GN-05	14	518361	6087649	20-Aug-10	20.6	5.8	6.9	16.9
	GN-06	14	521553	6088887	20-Aug-10	23.7	18.7	18.7	17.3
	GN-07	14	521565	6092584	21-Aug-10	20.3	11.4	14.6	17.0
	GN-08	14	524308	6092935	20-Aug-10	25.2	7.1	14.1	17.4
	GN-09	14	523267	6094461	20-Aug-10	24.3	17.9	8.1	17.0
	GN-11	14	526156	6101101	30-Aug-10	21.7	7.8	7.1	15.4
	GN-12	14	526832	6105358	30-Aug-10	22.4	4.6	7.2	16.0
	GN-13	14	528021	6105429	30-Aug-10	23.3	3.3	4.8	15.8
	SN-03	14	515661	6083916	20-Aug-10	22.5	10.1	5.4	16.8
	SN-06	14	521553	6088887	20-Aug-10	23.7	18.7	18.7	17.3
	SN-09	14	523267	6094461	20-Aug-10	24.3	17.9	8.1	17.0
	GN-01	14	512077	6076919	23-Aug-11	23.5	10.2	8.8	20.5
	GN-02	14	515032	6078938	23-Aug-11	23.8	10.9	9.3	20.0
	GN-03	14	515645	6083890	24-Aug-11	22.8	13.4	3.0	18.4
	GN-04	14	518146	6085551	24-Aug-11	19.4	4.7	13.9	19.1
	GN-05	14	518256	6087576	25-Aug-11	17.8	12.3	3.0	19.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SET	GN-06	14	521685	6089007	25-Aug-11	19.6	29.9	31.1	18.8
	GN-07	14	523242	6094504	26-Aug-11	16.8	11.6	4.6	18.3
	GN-08	14	525427	6098261	26-Aug-11	20.1	4.6	9.9	18.5
	GN-09	14	526951	6098394	27-Aug-11	16.8	14.7	15.6	18.3
	GN-10	14	526242	6101002	28-Aug-11	20.7	4.6	14.8	17.8
	GN-11	14	524824	6098381	27-Aug-11	18.0	2.8	4.4	18.5
	GN-12	14	526947	6105247	28-Aug-11	21.3	8.2	4.9	18.3
	GN-13	14	527970	6105688	29-Aug-11	23.5	2.1	4.0	17.3
	GN-14	14	530472	6105759	29-Aug-11	20.9	4.0	2.2	17.2
	SN-03	14	515645	6083890	24-Aug-11	22.8	13.4	13.4	18.4
	SN-06	14	521685	6089007	25-Aug-11	19.6	29.9	29.9	18.8
	SN-09	14	526951	6098394	27-Aug-11	16.8	14.7	14.7	18.3
	SN-12	14	526947	6105247	28-Aug-11	21.3	8.2	8.2	18.3
	GN-01	14	512135	6076810	10-Sep-12	22.4	8.1	8.7	15.3
	GN-02	14	514972	6078904	12-Sep-12	24.8	9.4	10.0	14.5
	GN-03	14	515659	6083899	10-Sep-12	22.6	7.3	10.4	16.0
	GN-04	14	518127	6085576	10-Sep-12	22.7	13.0	12.2	16.1
	GN-05	14	518370	6087656	12-Sep-12	25.4	7.3	5.9	15.5
	GN-06	14	521549	6088932	11-Sep-12	20.7	19.4	19.9	16.0
	GN-07	14	521573	6092583	13-Sep-12	21.7	13.1	14.9	15.7
	GN-08	14	524306	6092953	13-Sep-12	22.2	8.7	19.1	15.8
	GN-09	14	523013	6094309	14-Sep-12	23.9	7.3	14.2	15.2
	GN-10	14	524990	6098399	14-Sep-12	23.6	3.0	3.2	14.0
	GN-11	14	526228	6101002	15-Sep-12	22.1	6.7	8.3	13.9
	GN-12	14	526950	6105236	15-Sep-12	22.4	4.5	6.1	13.9
	GN-13	14	528093	6105691	16-Sep-12	23.3	4.1	5.7	13.1
	GN-14	14	530531	6105757	16-Sep-12	23.9	5.6	6.0	13.2
	SN-03	14	515691	6083889	10-Sep-12	22.6	7.3	10.4	16.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SET	SN-06	14	521570	6088889	11-Sep-12	20.7	19.1	19.9	16.0
	SN-09	14	523053	6094299	14-Sep-12	23.9	7.3	15.6	15.2
	SN-12	14	526937	6105248	15-Sep-12	22.4	4.5	6.5	13.9
	GN-01	14	512129	6076812	4-Sep-13	23.2	8.0	8.4	16.9
	GN-02	14	515007	6078962	4-Sep-13	22.6	9.6	9.8	17.3
	GN-03	14	515659	6083921	5-Sep-13	20.0	6.5	10.2	17.3
	GN-04	14	518151	6085607	5-Sep-13	20.9	12.6	12.4	17.4
	GN-05	14	518341	6087586	6-Sep-13	22.0	7.1	6.6	17.1
	GN-06	14	521557	6088879	6-Sep-13	22.2	19.0	18.8	17.3
	GN-07	14	521564	6092577	7-Sep-13	22.9	11.8	14.8	17.3
	GN-08	14	524304	6092918	7-Sep-13	22.1	7.1	18.0	17.1
	GN-09	14	522975	6094268	8-Sep-13	23.4	2.0	13.4	17.1
	GN-10	14	524923	6098323	8-Sep-13	24.0	2.1	4.0	17.0
	GN-11	14	526253	6101038	9-Sep-13	21.5	4.6	6.1	17.1
	GN-12	14	526908	6105240	9-Sep-13	18.4	5.4	7.1	17.3
	GN-13	14	528063	6105719	10-Sep-13	22.2	4.5	5.5	16.7
	GN-14	14	530511	6105755	10-Sep-13	23.6	5.6	5.8	16.7
	SN-03	14	515688	6083898	5-Sep-13	20.0	10.2	10.3	17.3
	SN-06	14	521588	6088853	6-Sep-13	22.2	18.8	18.6	17.3
	SN-09	14	523000	6094240	8-Sep-13	23.4	13.4	13.1	17.1
	SN-12	14	526933	6105214	9-Sep-13	18.4	5.4	5.6	17.3
	GN-01	14	512132	6076796	3-Sep-14	19.6	8.1	8.4	16.1
	GN-02	14	514990	6078941	3-Sep-14	19.2	9.9	9.3	16.2
	GN-03	14	515649	6083896	3-Sep-14	23.9	10.5	7.4	16.4
	GN-04	14	518115	6085578	4-Sep-14	21.6	13.5	12.3	15.8
	GN-05	14	518322	6087597	4-Sep-14	22.5	6.8	7.3	16.1
	GN-06	14	521511	6088912	4-Sep-14	23.3	19.4	19.4	16.1
	GN-07	14	521570	6092572	5-Sep-14	20.8	12.9	15.1	16.8

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SET	GN-08	14	524311	6092913	5-Sep-14	21.0	7.0	16.8	16.0
	GN-09	14	523255	6094471	5-Sep-14	21.6	16.5	7.1	16.0
	GN-10	14	524911	6098342	6-Sep-14	21.4	4.0	2.0	15.3
	GN-11	14	526225	6101018	6-Sep-14	22.2	8.5	8.2	15.0
	GN-12	14	526897	6105257	7-Sep-14	22.5	6.7	4.4	14.2
	GN-13	14	528089	6105716	7-Sep-14	21.6	4.1	5.7	14.2
	GN-14	14	530498	6105771	7-Sep-14	23.7	4.5	5.8	14.4
	GN-15	14	529797	6102096	8-Sep-14	21.8	6.9	3.2	14.6
	GN-16	14	526899	6105248	8-Sep-14	22.9	6.7	4.5	13.7
	SN-03	14	515674	6083867	3-Sep-14	23.9	10.6	7.4	16.4
	SN-06	14	521545	6088885	4-Sep-14	23.3	19.2	19.4	16.1
	SN-09	14	523270	6094442	5-Sep-14	21.6	16.9	7.1	16.0
	SN-12	14	526923	6105227	7-Sep-14	22.5	6.2	4.4	14.2
	GN-01	14	512131	6076789	1-Sep-15	18.1	8.4	8.8	17.4
	GN-02	14	514992	6078921	1-Sep-15	18.7	10.3	9.6	17.4
	GN-03	14	515629	6083901	1-Sep-15	19.1	10.8	6.4	17.6
	GN-04	14	518129	6085564	2-Sep-15	20.9	13.3	12.6	18.2
	GN-05	14	518311	6087594	2-Sep-15	21.3	7.3	7.7	18.4
	GN-06	14	521520	6088951	3-Sep-15	22.0	19.7	19.8	17.1
	GN-07	14	521555	6092595	3-Sep-15	23.4	-	15.4	18.2
	GN-08	14	524311	6092930	5-Sep-15	23.5	7.6	19.4	16.8
	GN-09	14	523249	6094481	4-Sep-15	22.4	16.2	-	17.1
	GN-10	14	524846	6098336	4-Sep-15	23.0	3.5	3.3	17.7
	GN-11	14	526235	6101003	5-Sep-15	23.5	7.1	8.6	17.1
	GN-12	14	526859	6105213	7-Sep-15	23.6	7.3	4.8	15.5
	GN-13	14	528088	6105718	6-Sep-15	22.7	4.5	6.2	16.8
	GN-14	14	530492	6105764	7-Sep-15	23.4	5.4	6.3	15.5
	GN-15	14	529807	6102192	6-Sep-15	21.6	6.0	7.7	16.5

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SET	SN-03	14	515661	6093974	1-Sep-15	19.1	10.9	6.4	17.6
	SN-06	14	521554	6088935	3-Sep-15	22.0	19.8	19.7	17.1
	SN-09	14	557576	5955519	4-Sep-15	22.4	17.2	-	17.1
	SN-12	14	526875	6105180	7-Sep-15	23.6	6.8	4.8	15.5
	GN-01	14	512143	6076793	23-Aug-16	19.8	7.6	9.6	18.1
	GN-02	14	515019	6078964	23-Aug-16	20.7	10.4	10.3	18.0
	GN-03	14	515621	6083874	24-Aug-16	21.1	10.5	5.6	18.1
	GN-04	14	518158	6085582	24-Aug-16	22.0	11.4	12.6	17.9
	GN-05	14	518355	6087653	25-Aug-16	21.5	6.3	7.4	18.4
	GN-06	14	521590	6088872	25-Aug-16	22.3	18.9	19.5	18.4
	GN-07	14	521578	6092568	26-Aug-16	22.0	13.5	15.0	17.9
	GN-08	14	524321	6092919	27-Aug-16	23.4	6.4	13.9	17.9
	GN-09	14	523266	6094491	27-Aug-16	24.3	16.4	6.8	18.1
	GN-10	14	524945	6098361	28-Aug-16	23.1	3.9	2.6	18.1
	GN-11	14	526139	6101077	28-Aug-16	22.6	6.6	8.2	18.0
	GN-12	14	526871	6105216	28-Aug-16	20.9	6.7	4.8	18.2
	GN-13	14	528107	6105744	29-Aug-16	24.4	3.9	5.8	17.4
	GN-14	14	530504	6105762	29-Aug-16	22.9	5.8	5.8	17.5
	GN-15	14	529823	6102167	29-Aug-16	23.2	6.1	7.1	17.6
	GN-16	14	527947	6099892	30-Aug-16	21.4	10.8	10.6	17.3
	SN-03	14	515629	6083845	24-Aug-16	21.1	10.6	5.6	18.1
	SN-06	14	521605	6088842	25-Aug-16	22.3	18.3	19.5	18.4
	SN-09	14	523289	6094462	27-Aug-16	24.3	17.0	6.8	18.1
	SN-12	14	526874	6105186	28-Aug-16	20.9	6.4	4.8	18.2
	GN-01	14	512134	6076931	6-Sep-17	17.8	8.0	8.8	16.3
	GN-02	14	514956	6078876	6-Sep-17	18.2	9.8	9.6	16.2
	GN-03	14	515637	6083882	7-Sep-17	20.9	10.4	6.4	16.4
	GN-04	14	518132	6085578	7-Sep-17	22.1	11.4	13.5	16.6

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SET	GN-05	14	518359	6087625	7-Sep-17	22.8	6.8	7.2	16.8
	GN-06	14	521545	6088889	8-Sep-17	20.3	19.5	19.4	16.7
	GN-07	14	521607	6092574	9-Sep-17	20.5	10.8	14.7	16.7
	GN-08	14	524295	6092928	8-Sep-17	21.2	7.6	17.9	17.0
	GN-09	14	523279	6094542	9-Sep-17	22.1	15.6	2.9	16.4
	GN-10	14	524900	6098393	9-Sep-17	23.1	3.8	2.2	16.2
	GN-11	14	526222	6101003	10-Sep-17	20.6	7.1	7.9	16.3
	GN-12	14	526926	6105274	10-Sep-17	20.5	6.8	4.8	16.3
	GN-13	14	528105	6105733	11-Sep-17	21.5	7.0	9.4	16.0
	GN-14	14	530491	6105736	11-Sep-17	22.2	10.1	10.0	16.1
	SN-03	14	515658	6083852	7-Sep-17	20.9	10.4	10.4	16.4
	SN-06	14	521549	6088855	8-Sep-17	20.3	19.1	19.5	16.7
	SN-09	14	523324	6094557	9-Sep-17	22.1	16.8	15.6	16.4
	SN-12	14	526965	6105265	10-Sep-17	20.5	6.0	6.8	16.3
	GN-01	14	511831	6076753	4-Sep-18	16.6	7.3	10.7	15.6
	GN-02	14	514917	6078883	4-Sep-18	15.2	7.3	10.6	15.6
	GN-03	14	515544	6083952	4-Sep-18	16.9	-	10.6	15.5
	GN-04	14	518129	6085567	5-Sep-18	19.5	15.2	14.6	13.0
	GN-05	14	518354	6087612	5-Sep-18	19.5	14.6	15.2	13.0
	GN-06	14	521555	6088895	5-Sep-18	19.5	14.6	-	13.1
	GN-07	14	521600	6092604	6-Sep-18	18.6	7.6	16.7	15.2
	GN-08	14	524344	6092881	6-Sep-18	18.6	7.2	10.2	15.2
	GN-09	14	523210	6094598	6-Sep-18	19.9	-	2.1	15.3
	GN-10	14	524935	6098376	7-Sep-18	17.2	4.4	8.2	14.7
	GN-11	14	526219	6100996	7-Sep-18	18.0	1.4	9.0	14.7
	GN-12	14	526816	6105341	7-Sep-18	18.4	-	5.2	14.8
	GN-13	14	528125	6105759	8-Sep-18	17.8	4.8	6.2	14.0
	GN-14	14	530498	6105799	8-Sep-18	18.3	4.6	6.2	14.1

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SET	SN-03	14	515662	6083783	4-Sep-18	16.9	7.3	-	15.5
	SN-06	14	521664	6088792	5-Sep-18	19.5	14.6	-	13.1
	SN-09	14	523304	6094491	6-Sep-18	19.9	17.7	-	15.3
	SN-12	14	526970	6105280	7-Sep-18	18.4	6.8	-	14.8
	GN-01	14	512125	6076879	22-Aug-19	18.0	6.6	8.7	15.8
	GN-02	14	514969	6078916	22-Aug-19	18.9	11.6	11.4	15.8
	GN-03	14	515656	6084075	22-Aug-19	20.1	9.2	13.8	15.8
	GN-04	14	518107	6085592	22-Aug-19	21.5	16.0	12.6	15.8
	GN-05	14	518308	6087674	22-Aug-19	20.0	7.3	7.5	15.8
	GN-06	14	521536	6088943	22-Aug-19	19.3	19.9	20.0	15.8
	GN-07	14	521541	6092552	23-Aug-19	18.2	14.5	17.3	15.2
	GN-08	14	524317	6092963	23-Aug-19	18.8	8.9	23.9	15.2
	GN-09	14	523242	6094443	23-Aug-19	19.3	18.0	16.8	15.4
	GN-10	14	525338	6098051	23-Aug-19	17.1	9.1	10.8	15.4
	GN-11	14	526145	6101137	23-Aug-19	17.6	8.1	8.7	15.4
	GN-12	14	526923	6105298	23-Aug-19	17.9	7.3	7.6	15.4
	SN-03	14	515671	6083942	22-Aug-19	20.1	13.8	14.1	15.8
	SN-06	14	521554	6088892	22-Aug-19	19.3	19.9	19.9	15.8
	SN-09	14	523230	6094516	23-Aug-19	19.3	14.9	18.0	15.4
	SN-12	14	527021	6105196	23-Aug-19	17.9	7.6	7.4	15.4
WLKR	GN-03	14	629383	6066545	21-Aug-10	16.5	7.8	6.0	17.0
	GN-04	14	635001	6070392	22-Aug-10	21.6	4.2	5.0	17.0
	GN-05	14	635619	6073665	22-Aug-10	20.6	4.1	4.0	17.0
	GN-07	14	626660	6065515	23-Aug-10	45.1	4.0	3.5	17.5
	GN-08	14	624877	6064758	23-Aug-10	44.5	2.5	2.5	17.5
	GN-09	14	630975	6065359	23-Aug-10	43.6	4.5	4.5	17.5
	SN-07	14	626692	6065507	23-Aug-10	44.9	3.8	4.0	17.5
	GN-03	14	629388	6066555	26-Aug-13	21.5	7.4	3.1	23.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
WLKR	GN-04	14	635029	6070405	27-Aug-13	19.9	2.5	3.3	22.0
	GN-05	14	635532	6073584	27-Aug-13	19.0	2.0	3.2	22.0
	GN-07	14	626660	6065319	26-Aug-13	21.1	2.7	3.2	23.0
	GN-08	14	624765	6064565	26-Aug-13	21.2	0.9	1.9	23.0
	GN-09	14	630985	6065369	27-Aug-13	20.8	5.0	7.2	22.0
	GN-10	14	636265	6064652	28-Aug-13	19.2	7.4	5.5	22.0
	GN-11	14	632416	6060527	28-Aug-13	19.6	5.0	11.4	21.0
	GN-12	14	630741	6059492	28-Aug-13	19.7	6.9	2.6	21.0
	SN-04	14	635011	6070394	27-Aug-13	19.9	1.5	2.5	22.0
	SN-07	14	626690	6065525	26-Aug-13	21.1	2.5	2.7	23.0
	SN-11	14	632446	6060528	28-Aug-13	19.6	5.5	5.0	21.0
	GN-03	14	629531	6066568	18-Aug-16	21.0	4.9	3.9	18.0
	GN-04	14	634963	6070400	16-Aug-16	18.0	3.4	2.4	18.5
	GN-05	14	635649	6073685	16-Aug-16	17.9	1.9	4.3	19.0
	GN-07	14	626607	6065434	18-Aug-16	21.1	3.1	3.0	18.0
	GN-08	14	624864	6064709	18-Aug-16	21.5	1.5	1.2	19.0
	GN-09	14	630955	6065294	17-Aug-16	18.8	5.4	1.1	18.0
	GN-10	14	636058	6064511	16-Aug-16	18.5	8.0	7.8	18.5
	GN-11	14	632420	6060500	17-Aug-16	18.4	9.0	17.6	18.5
	GN-12	14	630736	6059503	17-Aug-16	18.3	1.4	5.1	19.0
	SN-04	14	634996	6070391	16-Aug-16	18.0	3.5	3.4	18.5
	SN-07	14	626587	6065460	18-Aug-16	21.1	3.3	3.1	18.0
	SN-11	14	632426	6060476	17-Aug-16	18.4	8.3	9.0	18.5
	GN-03	14	629381	6066561	24-Aug-19	21.1	5.4	6.7	17.0
	GN-04	14	635005	6070404	22-Aug-19	19.4	3.4	2.3	17.0
	GN-05	14	635611	6073669	22-Aug-19	19.0	3.0	3.7	17.0
	GN-07	14	626666	6065528	24-Aug-19	21.2	2.1	2.2	17.0
	GN-08	14	624898	6064726	24-Aug-19	21.3	0.9	1.0	17.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
WLKR	GN-09	14	631004	6065323	23-Aug-19	21.5	3.6	5.2	17.0
	GN-10	14	636275	6064745	22-Aug-19	19.8	2.3	5.9	17.0
	GN-11	14	632432	6060558	23-Aug-19	20.9	10.0	17.7	17.0
	GN-12	14	630754	6059501	23-Aug-19	21.5	1.9	6.2	17.0
	SN-04	14	635014	6070403	22-Aug-19	19.4	2.9	3.4	17.0
	SN-07	14	626692	6065523	24-Aug-19	21.2	2.2	2.1	17.0
	SN-11	14	632459	6060546	23-Aug-19	20.9	8.5	10.0	17.0

Notes:

1. Gill nets that were set for >36 h (red font) were excluded from the data analysis for abundance and diversity metrics.

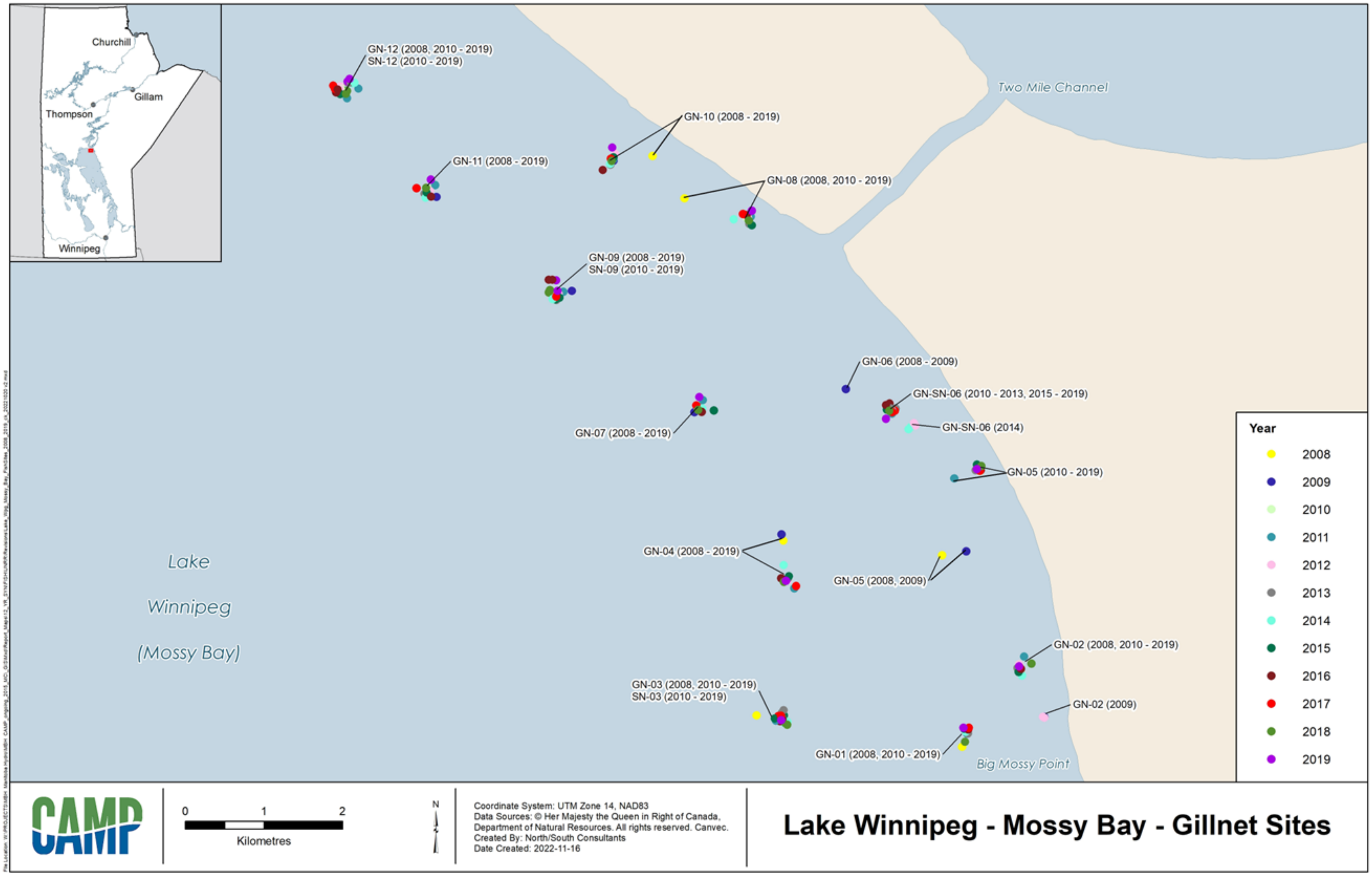


Figure A5-1-1. 2008-2019 Gillnetting sites in the Mossy Bay area of Lake Winnipeg.

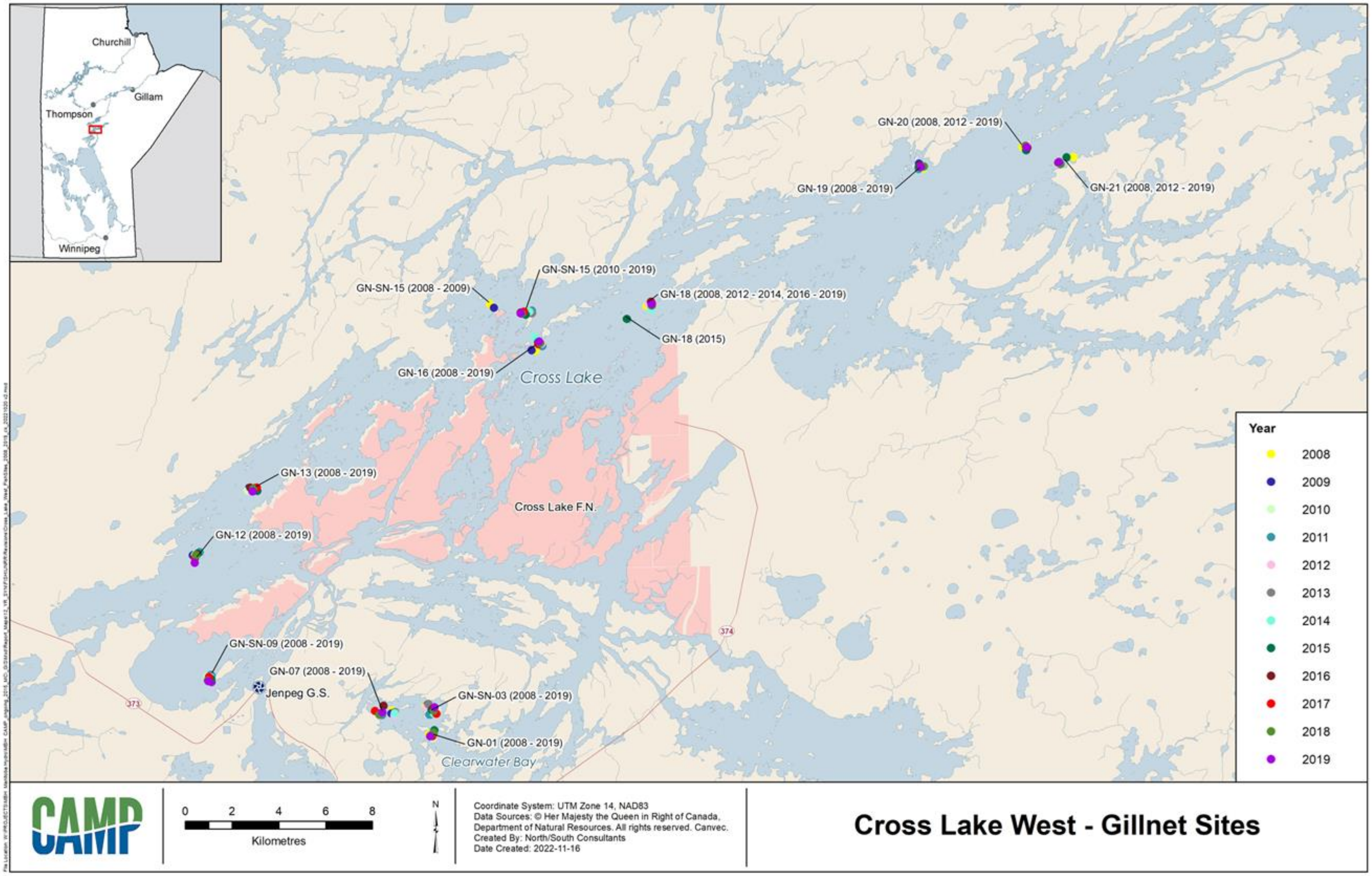


Figure A5-1-2. 2008-2019 Gillnetting sites in the west basin of Cross Lake.

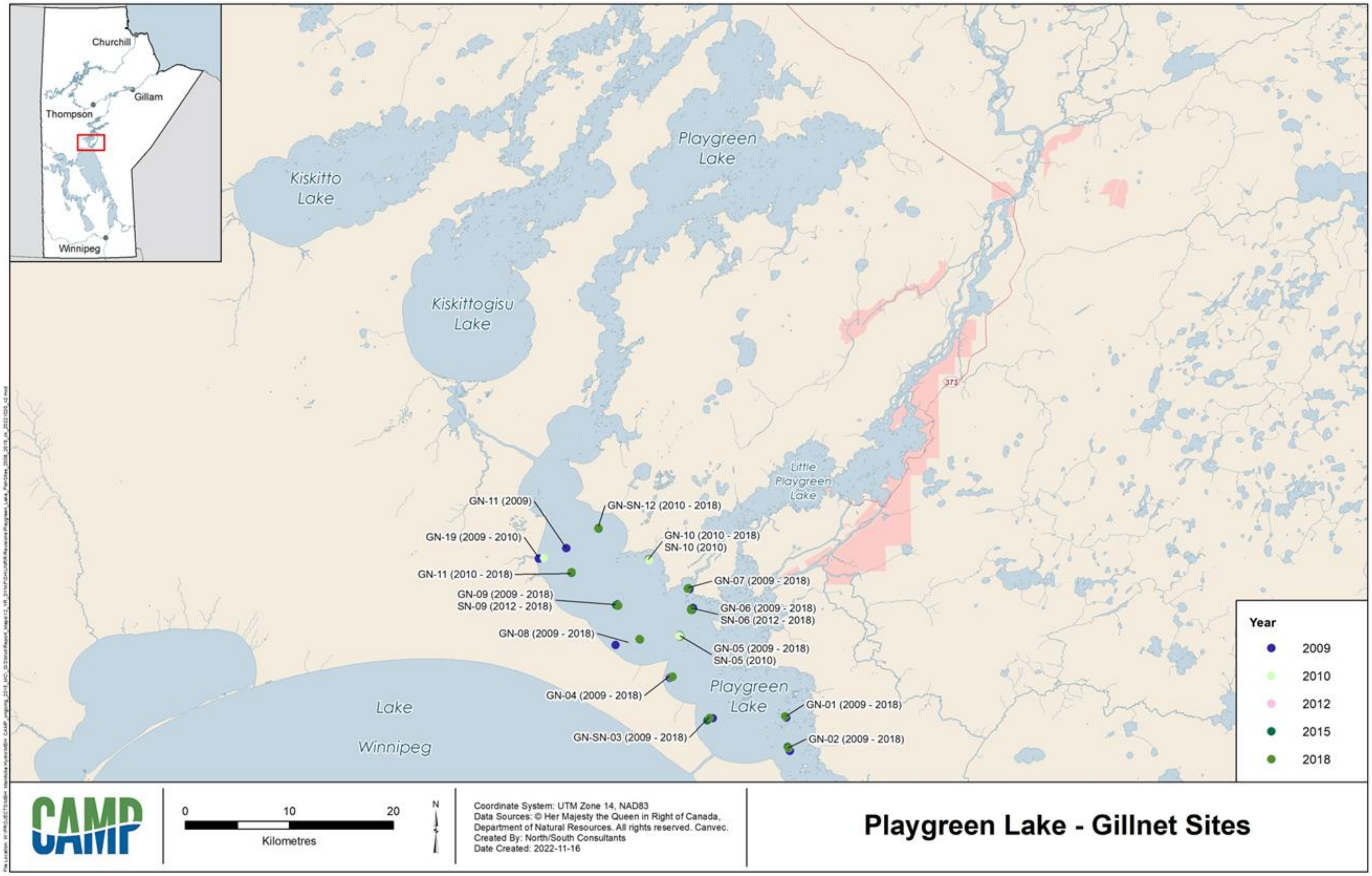


Figure A5-1-3. 2009-2018 Gillnetting sites in the Playgreen Lake.

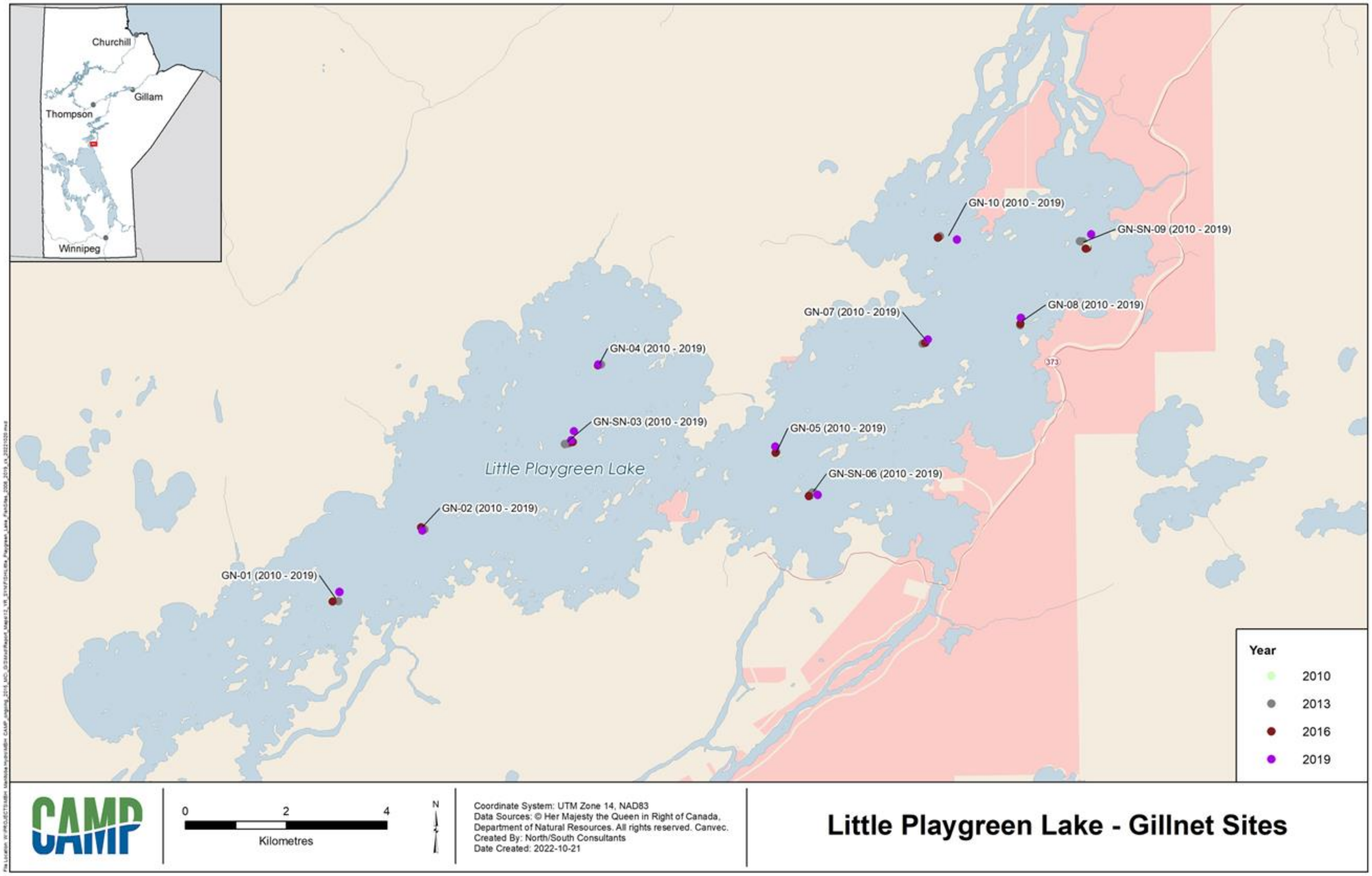


Figure A5-1-4. 2010-2019 Gillnetting sites in Little Playgreen Lake.

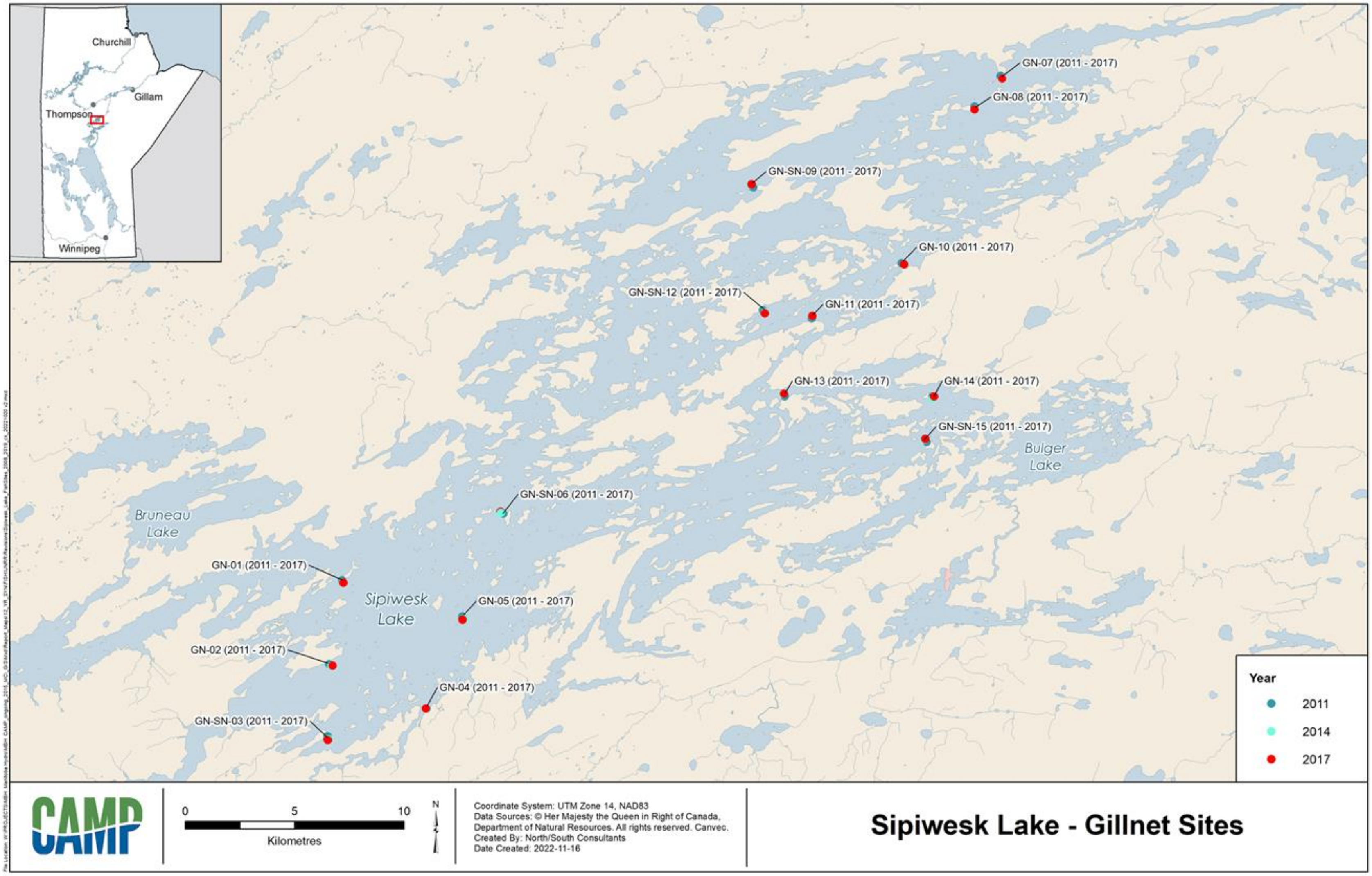


Figure A5-1-5. 2011-2017 Gillnetting sites in Sipiwesk Lake.

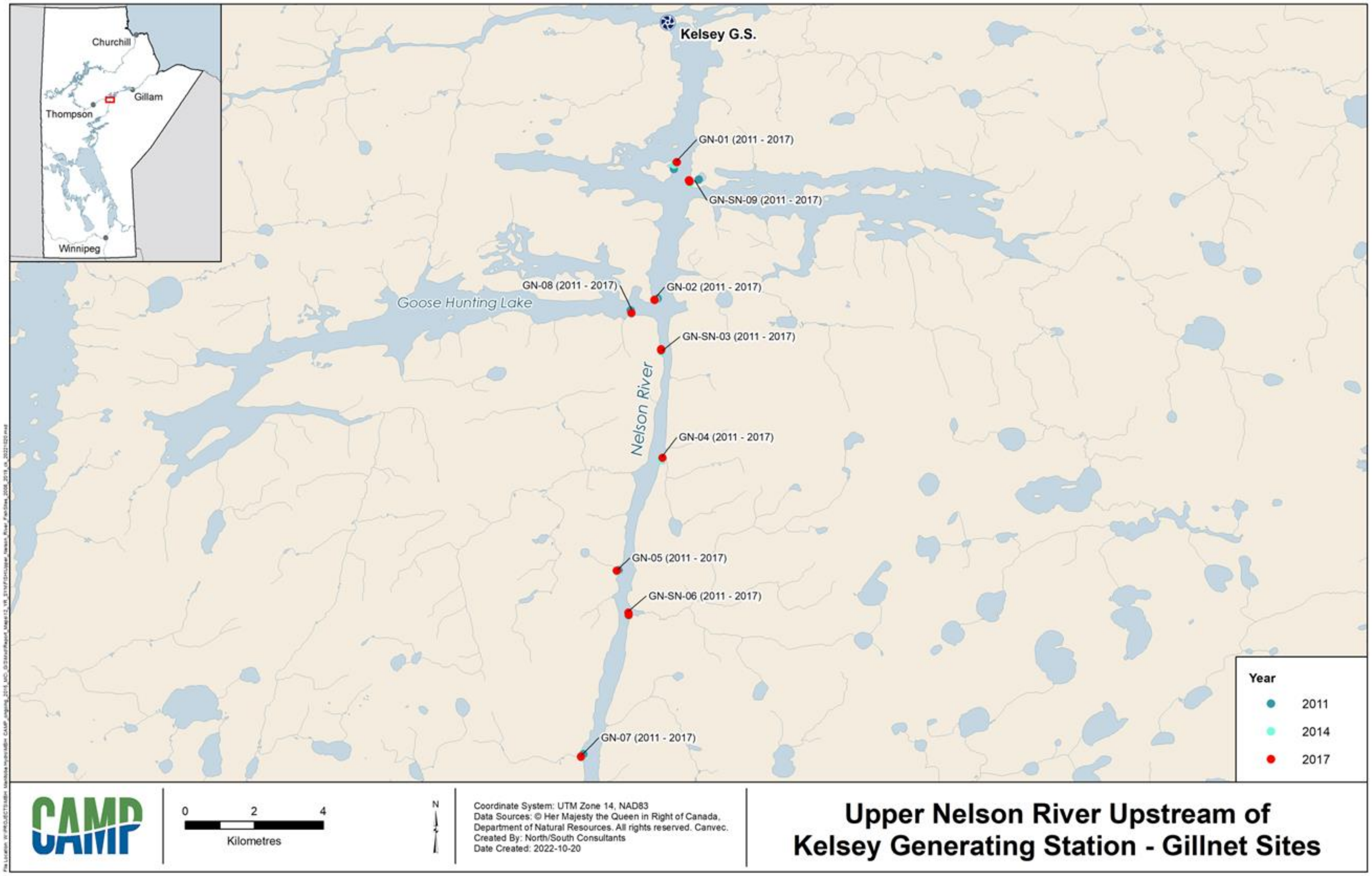


Figure A5-1-6. 2011-2017 Gillnetting sites in the upper Nelson River upstream of the Kelsey GS.

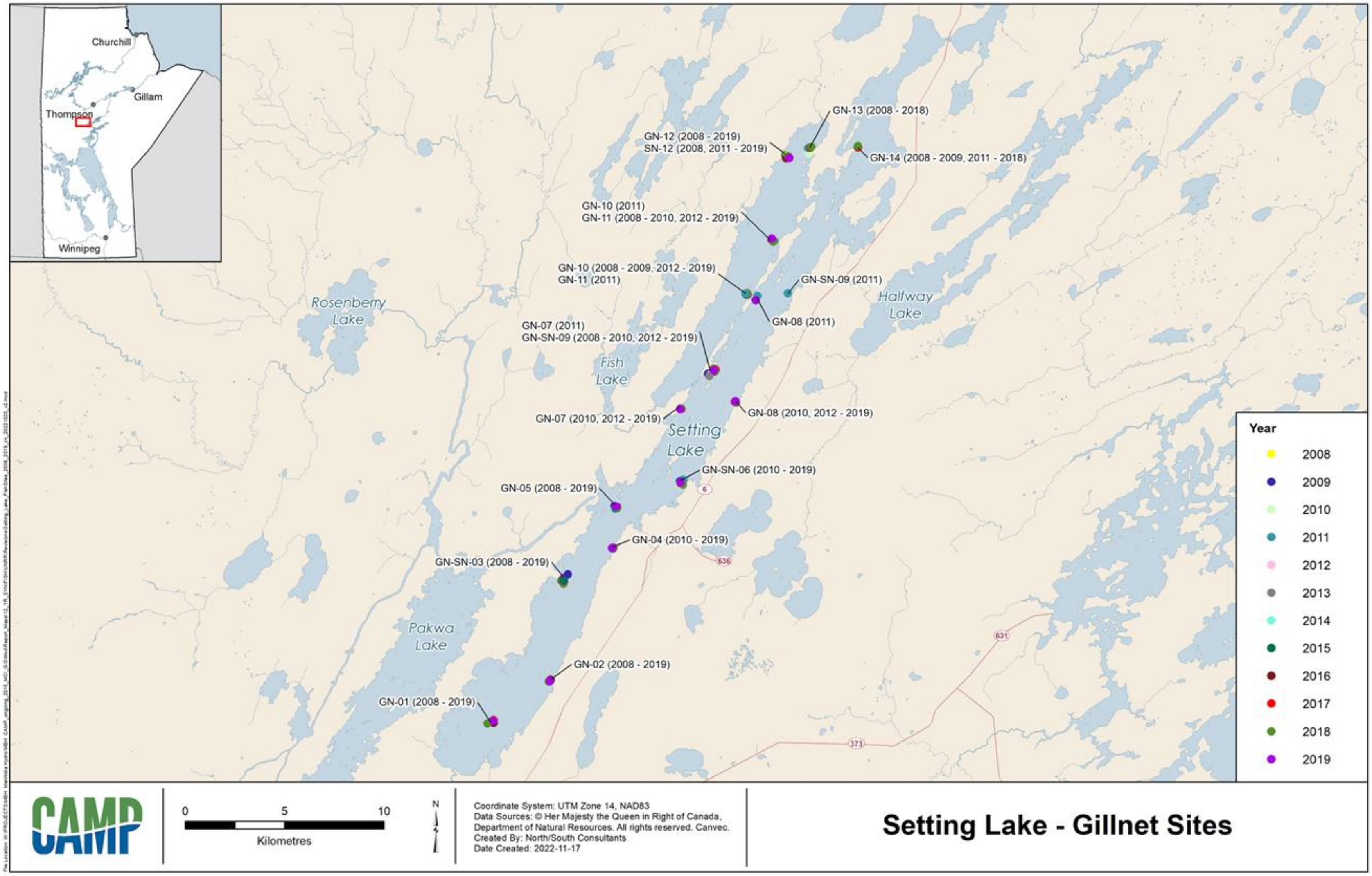


Figure A5-1-7. 2008-2019 Gillnetting sites in Setting Lake.

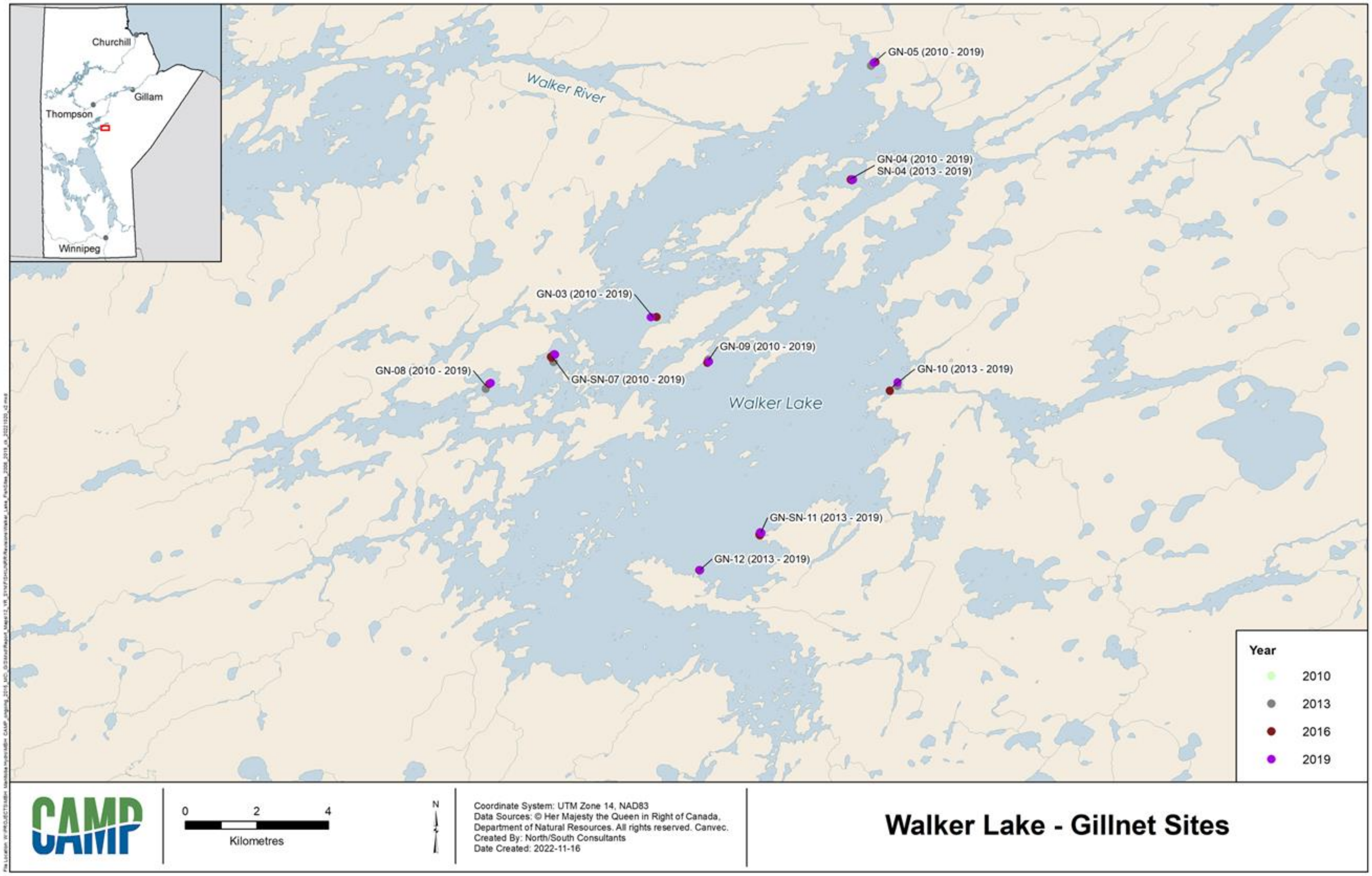


Figure A5-1-8. 2010-2019 Gillnetting sites in Walker Lake.

6.0 MERCURY IN FISH

6.1 INTRODUCTION

The following presents the results of fish mercury monitoring conducted from 2008-2019 in the Upper Nelson River Region. Fish mercury sampling was conducted on a three-year rotation beginning in 2010 at four on-system waterbodies (Lake Winnipeg - Mossy Bay, Playgreen Lake, Little Playgreen Lake, and Cross Lake) and one off-system waterbody (Setting Lake; Table 6.1-1; Figure 6.1-1). Sampling at the on-system Sipiwesk Lake was initiated in 2011.

Mercury concentrations are measured in muscle tissue of commercially important fish species – Northern Pike, Walleye, and Lake Whitefish. Monitoring of mercury in 1-year-old Yellow Perch is also conducted as a potential early indicator of changes in mercury in the food web. Samples of fish muscle are collected during the conduct of fish community monitoring. Mercury is analysed in the trunk muscle of Northern Pike, Lake Whitefish, and Walleye selected over a range of fork lengths. Yearling Yellow Perch are analyzed for mercury as carcass, with the head, pelvic and pectoral girdles, caudal fin, and digestive tract removed.

There were two departures from the planned field sampling schedule during the 12-year period:

- mercury samples were collected in error from Lake Winnipeg - Mossy Bay in 2011; and
- mercury samples were collected from Playgreen Lake in 2010 because they were not collected as scheduled in 2009.

Two metrics were selected for detailed reporting: arithmetic mean mercury concentrations; and length-standardized mean mercury concentrations (also referred to as "standard mean(s)"; Table 6.1-2). Standard lengths varied by species as follows: Lake Whitefish (350 mm); Northern Pike (550 mm); and Walleye (400 mm). As CAMP targets a specific age class of Yellow Perch, fish captured for this component are inherently of a limited size range; therefore, length-standardization for this species was not undertaken.

A detailed description of the program design and sampling methods is provided in Technical Document 1, Section 2.6.

Table 6.1-1. 2008-2019 Inventory of fish mercury sampling.

Waterbody/Area	Sampling Year											
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
LW-MB			●	● [1]		●			●			●
PLAYG			● [2]		●			●			●	
LPLAY			●			●			●			●
CROSS			●			●			●			●
SIP				●			●			●		
SET			●			●			●			●

Notes:

1. Samples collected in error.
2. Samples collected in 2010 because samples not collected in 2009.

Table 6.1-2. Mercury in fish indicators and metrics.

Key Indicator	Key Metric	Units
Mercury in Fish	• Arithmetic mean mercury concentration	Parts per million (ppm)
	• Length-standardized mean mercury concentration of large-bodied species	ppm

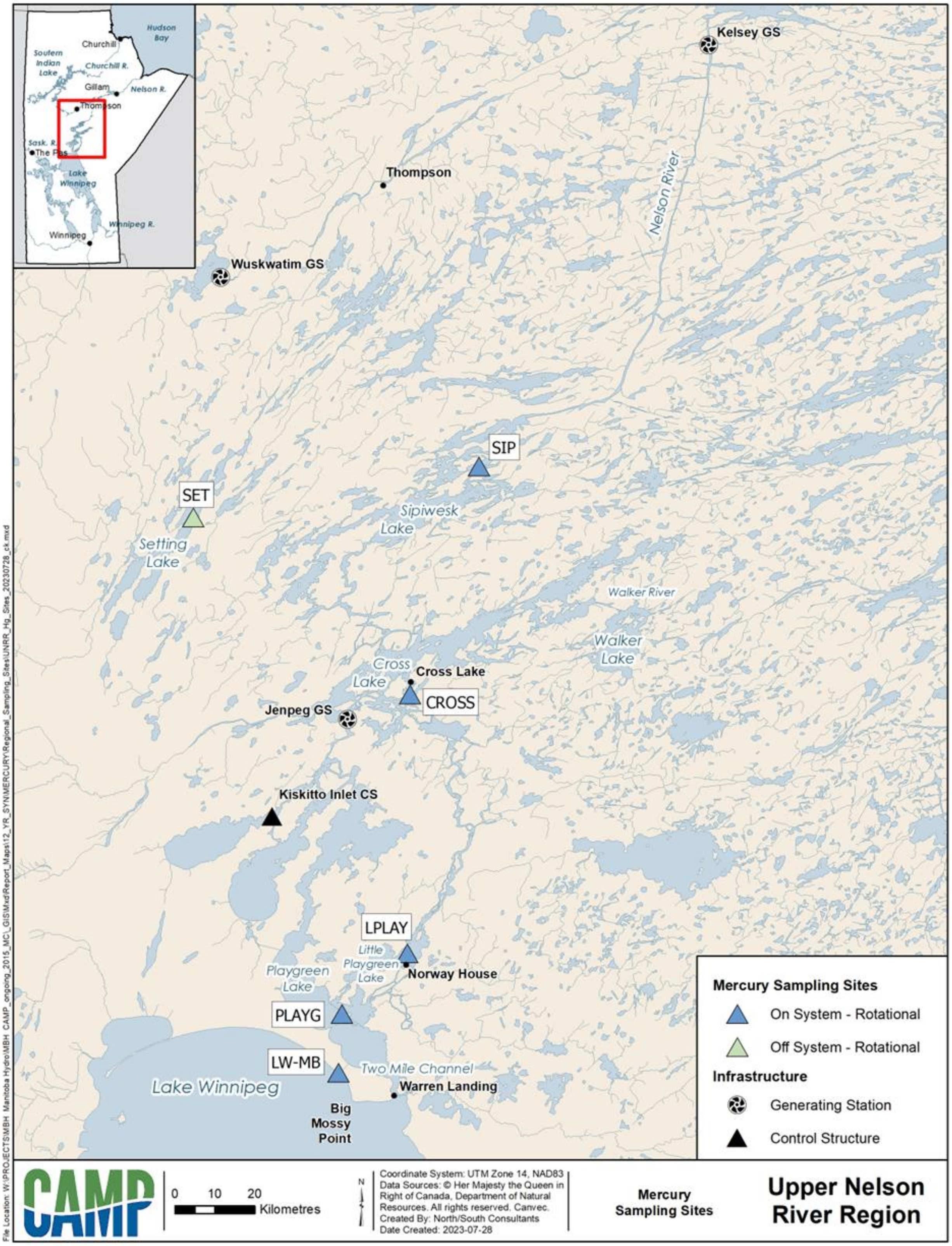


Figure 6.1-1. 2008-2019 Fish mercury sampling sites.

6.2 MERCURY IN FISH

6.2.1 ARITHMETIC MEAN MERCURY CONCENTRATION

6.2.1.1 ON-SYSTEM SITES

ANNUAL SITES

There are no waterbodies in the Upper Nelson River Region that are monitored for fish mercury annually.

ROTATIONAL SITES

Lake Winnipeg – Mossy Bay

Lake Whitefish

The arithmetic mean mercury concentration of Lake Whitefish over the five years of monitoring ranged from a low of 0.011 parts per million (ppm) in 2010 to a high of 0.028 ppm in 2013 (Table 6.2-1). The mercury concentration typically increased with fork length (Figure 6.2-1).

Northern Pike

The arithmetic mean mercury concentration of Northern Pike over the five years of monitoring ranged from a low of 0.227 ppm in 2010 to a high of 0.361 ppm in 2016 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Northern Pike of the same length (Figure 6.2-2).

Walleye

The arithmetic mean mercury concentration of Walleye over the five years of monitoring ranged from a low of 0.087 ppm in 2013 to a high of 0.137 ppm in 2019 (Table 6.2-1). The mercury concentration typically increased with fork length (Figure 6.2-3).

Yellow Perch

Over the three years of monitoring, Yellow Perch were only submitted for mercury analysis in 2013. The arithmetic mean mercury concentration of 1-year-old Yellow Perch in this year was below the detection limit (<0.010 ppm; Figure 6.2-4).

Playgreen Lake

Lake Whitefish

The arithmetic mean mercury concentration of Lake Whitefish over the four years of monitoring ranged from a low of 0.018 ppm in 2010 to a high of 0.031 ppm in 2015 (Table 6.2-1). The mercury concentration typically increased with fork length (Figure 6.2-1).

Northern Pike

The arithmetic mean mercury concentration of Northern Pike over the four years of monitoring ranged from a low of 0.242 ppm in 2010 to a high of 0.413 ppm in 2018 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Northern Pike of the same length (Figure 6.2-2).

Walleye

The arithmetic mean mercury concentration of Walleye over the four years of monitoring ranged from a low of 0.131 ppm in 2018 to a high of 0.199 ppm in 2015 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Walleye of the same length (Figure 6.2-3).

Yellow Perch

The arithmetic mean mercury concentration of 1-year-old Yellow Perch over the two years of monitoring was 0.057 ppm in 2015 and 0.026 ppm in 2018 (Figure 6.2-4).

Little Playgreen Lake

Lake Whitefish

Over the four years of monitoring, Lake Whitefish were analyzed for mercury only in 2010 (Figure 6.2-1). The arithmetic mean mercury concentration in this year was 0.059 ppm (Table 6.2-1).

Northern Pike

The arithmetic mean mercury concentration of Northern Pike over the four years of monitoring ranged from a low of 0.184 ppm in 2013 to a high of 0.287 ppm in 2019 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Northern Pike of the same length (Figure 6.2-2).

Walleye

The arithmetic mean mercury concentration of Walleye over the four years of monitoring ranged from a low of 0.193 ppm in 2016 to a high of 0.265 ppm in 2010 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Walleye of the same length (Figure 6.2-3).

Yellow Perch

The arithmetic mean mercury concentration of 1-year-old Yellow Perch over the four years of monitoring was 0.011 ppm in 2013 and 0.016 ppm in 2016 (Figure 6.2-4). None of the Yellow Perch collected for mercury analysis in 2010 or 2019 were 1 years old.

<u>Cross Lake</u>

Lake Whitefish

Over the four years of monitoring, only three Lake Whitefish were analyzed for mercury, two in 2013 and one in 2019 (Figure 6.2-1). The arithmetic mean mercury concentrations in these years were 0.042 ppm and 0.020 ppm, respectively (Table 6.2-1).

Northern Pike

The arithmetic mean mercury concentration of Northern Pike over the four years of monitoring ranged from a low of 0.233 ppm in 2010 to a high of 0.437 ppm in 2016 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Northern Pike of the same length (Figure 6.2-2).

Walleye

The arithmetic mean mercury concentration of Walleye over the four years of monitoring ranged from a low of 0.188 ppm in 2013 to a high of 0.232 ppm in 2019 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Walleye of the same length (Figure 6.2-3).

Yellow Perch

The arithmetic mean mercury concentration of 1-year-old Yellow Perch over the four years of monitoring ranged from a low of 0.029 ppm in 2019 to a high of 0.074 ppm in 2010 (Figure 6.2-4). None of the Yellow Perch collected for mercury analysis in 2016 were 1 years old.

Sipiwesk Lake

Lake Whitefish

Over the three years of monitoring, only one Lake Whitefish was analyzed for mercury in 2014 and it had a mercury concentration of 0.021 ppm (Table 6.2-1; Figure 6.2-1).

Northern Pike

The arithmetic mean mercury concentration of Northern Pike over the three years of monitoring ranged from a low of 0.286 ppm in 2011 to a high of 0.441 ppm in 2017 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Northern Pike of the same length (Figure 6.2-2).

Walleye

The arithmetic mean mercury concentration of Walleye over the three years of monitoring ranged from a low of 0.159 ppm in 2014 to a high of 0.308 ppm in 2017 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Walleye of the same length (Figure 6.2-3).

Yellow Perch

The arithmetic mean mercury concentration of 1-year-old Yellow Perch over the two years of monitoring was 0.042 ppm in 2014 and 0.037 ppm in 2017 (Table 6.2-2, Figure 6.2-4).

6.2.1.2 OFF-SYSTEM SITES

ANNUAL SITES

There are no waterbodies in the Upper Nelson River Region that are monitored for fish mercury annually.

ROTATIONAL SITES

Setting Lake

Lake Whitefish

The arithmetic mean mercury concentration of Lake Whitefish over the four years of monitoring ranged from a low of 0.025 ppm in 2010 and 2013 to a high of 0.038 ppm in 2016 (Table 6.2-1). There was little variation in the mercury concentration of Lake Whitefish with fork length (Figure 6.2-1).

Northern Pike

The arithmetic mean mercury concentration of Northern Pike over the four years of monitoring ranged from a low of 0.264 ppm in 2016 to a high of 0.391 ppm in 2010 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Northern Pike of the same length (Figure 6.2-2).

Walleye

The arithmetic mean mercury concentration of Walleye over the four years of monitoring ranged from a low of 0.173 ppm in 2013 to a high of 0.269 ppm in 2010 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Walleye of the same length (Figure 6.2-3).

Yellow Perch

The arithmetic mean mercury concentration of 1-year-old Yellow Perch over the four years of monitoring were below the laboratory detection limits in 2010 (<0.051 ppm) and 2013 (<0.010 ppm) and was 0.020 ppm in 2016 (Figure 6.2-4). Yellow Perch were not submitted for mercury analysis in 2019.

Table 6.2-1. 2010-2019 Fork length, age, and mercury concentrations of Lake Whitefish, Northern Pike, and Walleye.

Species	Waterbody	Year	Fork Length (mm)					Age (years)					Mercury (ppm)						
			n[1]	Mean	Min[2]	Max[2]	SE[3]	n	Mean	Min	Max	SE	n	Mean	Min	Max	SE	Standard Mean[4]	95% CL[5]
LKWH	LW-MB	2010	32	272	148	420	11	30	2	1	3	0	32	0.011	<0.010	0.017	0.001	0.012	0.011-0.014
		2011	20	268	190	412	16	20	3	2	6	0	20	0.016	<0.010	0.037	0.002	not significant	
		2013	36	295	220	474	13	33	4	2	19	1	36	0.028	<0.010	0.174	0.006	0.028	0.021-0.037
		2016	35	337	220	482	13	35	4	2	24	1	35	0.019	<0.010	0.092	0.003	0.017	0.015-0.020
		2019	1	402	-	-	-	1	5	-	-	-	1	0.017	-	-		-	
	PLAYG	2010	27	260	182	524	22	26	4	1	18	1	27	0.018	<0.010	0.061	0.003	0.024	0.019-0.031
		2012	36	340	146	544	21	36	8	1	31	2	36	0.026	<0.010	0.109	0.004	0.021	0.018-0.024
		2015	35	419	188	526	11	35	7	1	21	1	35	0.031	<0.010	0.070	0.003	0.019	0.017-0.022
		2018	36	404	202	482	10	36	5	2	11	0	36	0.028	0.0109	0.067	0.002	0.021	0.018-0.026
	LPLAY	2010	5	472	436	528	16	5	10	5	18	3	5	0.059	0.033	0.106	0.014	not significant	
		2013	0	-	-	-	-	-	-	-	-	-	0	-	-	-		-	
		2016	0	-	-	-	-	-	-	-	-	-	0	-	-	-		-	
		2019	0	-	-	-	-	-	-	-	-	-	0	-	-	-		-	
	CROSS	2010	0	-	-	-	-	-	-	-	-	-	0	-	-	-		-	
		2013	2	348	262	433	86	2	6	4	7	2	2	0.042	0.029	0.054	0.013	-	
		2016	0	-	-	-	-	-	-	-	-	-	0	-	-	-		-	
		2019	1	301	-	-	-	1	4	4	4	0	1	0.020	-	-		-	
	SIP	2011	0	-	-	-	-	-	-	-	-	-	0	-	-	-		-	
		2014	1	286	-	-	-	1	23	-	-	-	1	0.021	-	-		-	
		2017	0	-	-	-	-	-	-	-	-	-	0	-	-	-		-	
	SET	2010	24	287	188	396	9	24	3	1	4	0	24	0.025	0.017	0.038	0.001	not significant	
		2013	28	341	296	396	5	28	4	3	6	0	28	0.025	<0.010	0.060	0.002	0.025	0.021-0.030
		2016	21	291	180	404	16	21	4	1	7	0	21	0.038	0.025	0.061	0.002	not significant	
		2019	24	355	190	456	11	24	6	3	11	0	24	0.035	0.015	0.056	0.002	0.033	0.030-0.037
NRPK	LW-MB	2010	2	757	726	788	31	2	10	8	11	2	2	0.227	0.191	0.262	0.036	-	
		2011	2	709	700	718	9	2	9	8	9	1	2	0.228	0.202	0.254	0.026	-	
		2013	17	689	494	904	26	7	9	6	12	1	17	0.253	0.103	0.385	0.023	0.173	0.124-0.242
		2016	12	698	524	894	32	12	8	4	16	1	12	0.361	0.117	0.890	0.061	0.170	0.111-0.261
		2019	21	662	502	792	16	21	6	3	9	0	21	0.308	0.088	0.576	0.025	0.161	0.130-0.199
	PLAYG	2010	36	614	354	928	18	34	6	2	12	0	36	0.242	0.138	0.393	0.011	0.215	0.197-0.235
		2012	37	672	400	956	19	36	8	2	15	1	37	0.281	0.074	0.549	0.018	0.187	0.158-0.221
		2015	36	723	438	942	20	36	8	3	16	1	36	0.366	0.123	0.778	0.027	0.186	0.151-0.228
		2018	36	705	448	928	19	36	8	4	12	0	36	0.413	0.088	0.701	0.028	0.197	0.167-0.232
	LPLAY	2010	35	561	274	826	18	35	6	2	11	0	35	0.227	0.091	0.373	0.013	0.214	0.196-0.235
		2013	34	521	384	714	14	34	5	2	9	0	34	0.184	0.091	0.350	0.014	0.196	0.179-0.215
		2016	36	540	354	676	14	36	6	2	12	0	36	0.222	0.096	0.500	0.016	0.216	0.196-0.237
		2019	18	545	356	712	25	18	4	2	8	0	18	0.287	0.043	0.776	0.047	0.250	0.223-0.281
	CROSS	2010	36	589	274	912	23	34	6	2	13	0	36	0.233	0.080	0.745	0.026	0.187	0.159-0.219
		2013	36	643	366	965	23	36	7	4	13	0	36	0.300	0.108	0.651	0.023	0.237	0.200-0.280

Table 6.2-1. continued.

Species	Waterbody	Year	Fork Length (mm)					Age (years)					Mercury (ppm)						
			n[1]	Mean	Min[2]	Max[2]	SE[3]	n	Mean	Min	Max	SE	n	Mean	Min	Max	SE	Standard Mean[4]	95% CL[5]
NRPK	CROSS	2016	35	599	353	803	16	35	5	2	9	0	35	0.437	0.082	0.946	0.041	0.292	0.249-0.341
		2019	36	574	404	738	14	36	5	3	7	0	36	0.304	0.083	0.854	0.030	0.233	0.200-0.272
	SIP	2011	36	567	360	856	18	36	6	2	14	0	36	0.286	0.117	0.823	0.031	0.238	0.212-0.267
		2014	36	597	222	974	26	36	5	2	12	0	36	0.385	0.083	0.778	0.033	0.300	0.265-0.339
		2017	37	585	324	1064	28	37	6	2	10	0	37	0.441	0.097	1.67	0.052	0.338	0.301-0.380
	SET	2010	36	514	290	838	17	36	6	1	11	0	36	0.391	0.050	1.49	0.048	0.392	0.332-0.463
		2013	36	494	312	782	17	36	5	1	10	0	36	0.272	0.036	0.840	0.033	0.314	0.269-0.367
		2016	36	463	298	738	17	36	4	1	8	0	36	0.264	0.069	0.681	0.030	0.362	0.316-0.415
		2019	14	458	360	590	15	14	4	2	7	0	14	0.292	0.141	0.439	0.026	0.395	0.287-0.543
WALL	LW-MB	2010	36	393	128	574	17	33	5	2	10	0	36	0.118	0.032	0.300	0.010	0.112	0.100-0.125
		2011	30	314	142	520	20	30	4	2	10	0	30	0.092	0.029	0.244	0.010	0.108	0.089-0.132
		2013	35	314	198	588	16	35	4	2	12	0	35	0.087	0.046	0.364	0.009	0.109	0.096-0.124
		2016	36	346	136	484	14	36	6	2	8	0	36	0.105	0.039	0.266	0.007	0.119	0.107-0.132
		2019	34	361	230	588	13	34	7	4	13	0	34	0.137	0.049	0.324	0.010	0.150	0.134-0.168
	PLAYG	2010	36	412	98	560	19	32	6	2	9	0	36	0.181	0.024	0.398	0.017	0.157	0.138-0.179
		2012	37	400	124	570	18	37	5	1	11	0	37	0.147	0.058	0.421	0.015	0.134	0.116-0.154
		2015	35	381	210	544	11	34	5	2	9	0	35	0.199	0.050	0.417	0.016	0.190	0.161-0.224
		2018	39	368	112	550	12	38	7	2	12	0	39	0.131	0.040	0.694	0.016	0.131	0.114-0.149
	LPLAY	2010	36	410	124	546	13	33	7	2	15	0	36	0.265	0.031	0.598	0.020	0.231	0.199-0.269
		2013	36	345	226	571	15	36	4	2	12	0	36	0.198	0.080	0.508	0.019	0.237	0.213-0.264
		2016	36	339	158	504	13	36	5	1	9	0	36	0.193	0.084	0.515	0.017	0.215	0.183-0.252
		2019	35	376	206	514	14	35	7	2	12	0	35	0.214	0.074	0.536	0.019	0.216	0.188-0.247
	CROSS	2010	36	428	313	671	11	36	7	3	24	1	36	0.202	0.070	0.724	0.021	0.149	0.130-0.170
		2013	36	386	253	556	14	35	6	2	12	0	36	0.188	0.066	0.540	0.018	0.183	0.163-0.205
		2016	35	414	228	581	13	35	6	2	14	0	35	0.198	0.082	0.402	0.014	0.180	0.162-0.199
		2019	35	438	291	552	10	35	8	4	16	0	35	0.232	0.080	0.584	0.017	0.183	0.160-0.209
	SIP	2011	23	414	260	552	14	21	5	2	8	0	23	0.253	0.113	0.652	0.028	not significant	
		2014	35	343	240	560	10	35	4	2	11	0	35	0.159	0.053	0.508	0.015	0.201	0.174-0.233
		2017	36	386	284	560	10	36	6	3	21	1	36	0.308	0.104	0.768	0.027	0.303	0.268-0.343
	SET	2010	35	376	152	476	11	35	6	1	10	0	35	0.269	0.036	0.694	0.021	0.277	0.243-0.315
		2013	36	351	112	510	13	36	5	0	11	0	36	0.173	0.018	0.318	0.012	0.206	0.185-0.230
		2016	38	343	128	474	14	38	5	1	7	0	38	0.209	0.059	0.347	0.011	0.242	0.222-0.263
		2019	33	340	152	464	14	33	5	1	13	0	33	0.238	0.046	0.501	0.018	0.281	0.250-0.316

Notes:

1. n = sample size.
2. Min = minimum; Max = maximum.
3. SE = standard error.
4. For standard lengths of 350 mm for LKWH, 550 mm for NRPK, and 400 mm for WALL.
5. CL = confidence limits.

Table 6.2-2. 2010-2019 Fork length and mercury concentrations of 1-year-old Yellow Perch.

Species	Waterbody	Year	n[1]	Fork Length (mm)				Mercury (ppm)			
				Mean	Min[2]	Max[2]	SE[3]	Mean	Min	Max	SE
YLPR	LW-MB	2013	2	76	70	82	4	<0.010	<0.010	0.011	-
		2016	0	-	-	-	-	-	-	-	-
		2019	0	-	-	-	-	-	-	-	-
	PLAYG	2015	10	78	64	98	4	0.057	0.021	0.161	0.012
		2018	19	70	62	84	1	0.026	0.010	0.063	0.003
	LPLAY	2010	0	-	-	-	-	-	-	-	-
		2013	3	81	76	88	3	0.011	<0.010	0.014	0.002
		2016	13	77	72	82	1	0.016	0.011	0.025	0.001
		2019	0	-	-	-	-	-	-	-	-
	CROSS	2010	21	84	73	94	1	0.074	0.045	0.102	0.003
		2013	2	84	80	88	3	0.059	0.036	0.082	0.016
		2016	0	-	-	-	-	-	-	-	-
		2019	6	82	80	84	1	0.029	0.0142	0.053	0.006
	SIP	2014	4	82	62	94	13	0.042	0.013	0.075	0.026
		2017	2	102	66	138	25	0.037	0.0162	0.057	0.014
	SET	2010	1	70	-	-	-	<0.051	-	-	-
		2013	4	63	60	68	2	<0.010	<0.010	<0.010	-
		2016	11	88	78	100	2	0.020	0.012	0.030	0.002
		2019	0	-	-	-	-	-	-	-	-

Notes:

1. n = sample size.
2. Min = minimum; Max = maximum.
3. SE = standard error.

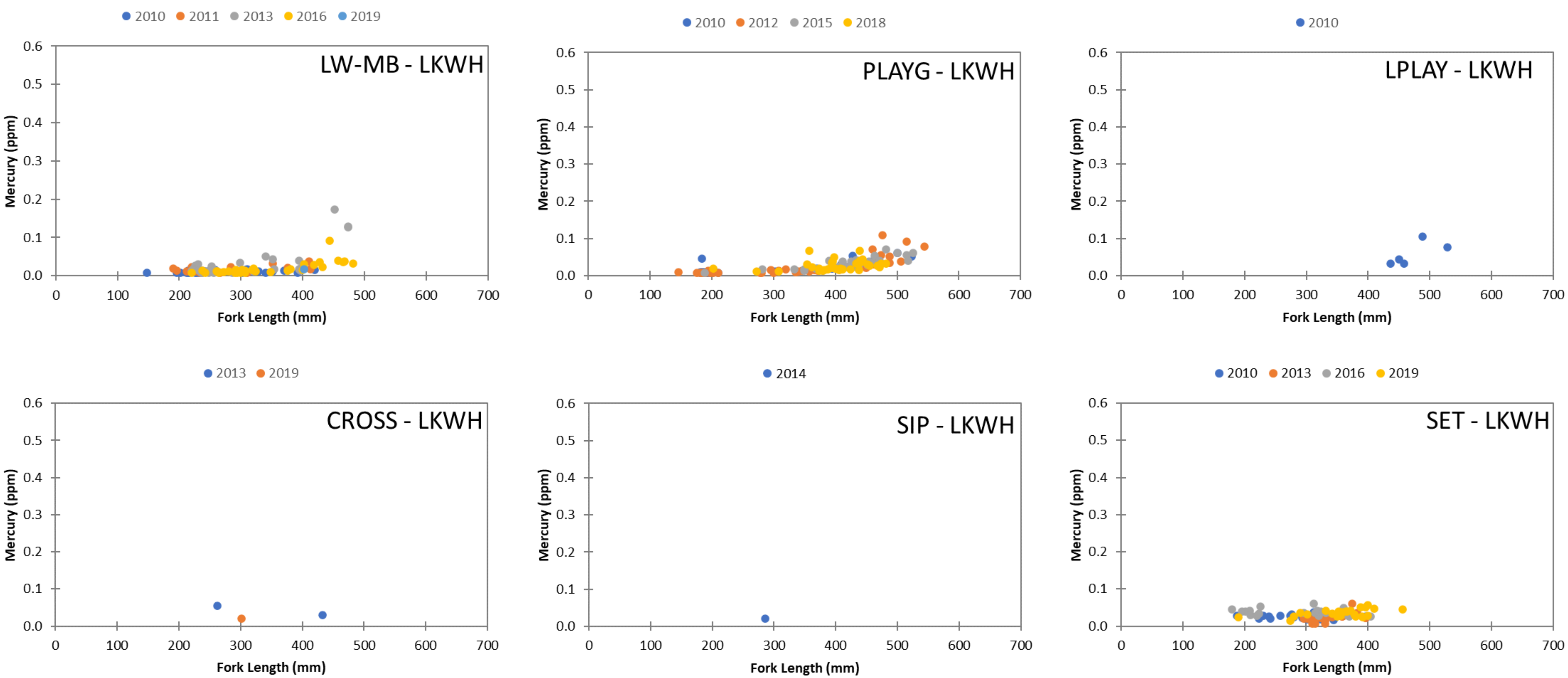


Figure 6.2-1. 2010-2019 Mercury concentration versus fork length of Lake Whitefish.

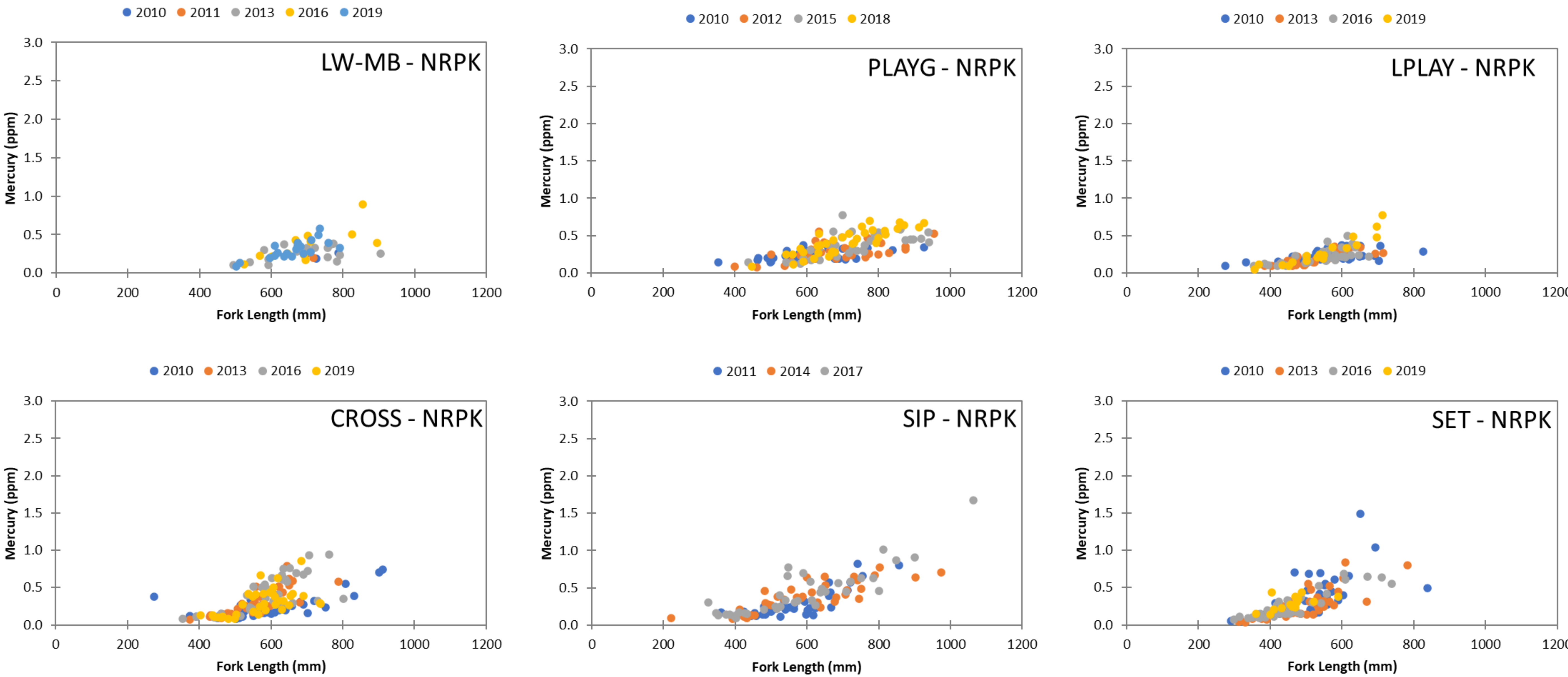


Figure 6.2-2. 2010-2019 Mercury concentration versus fork length of Northern Pike.

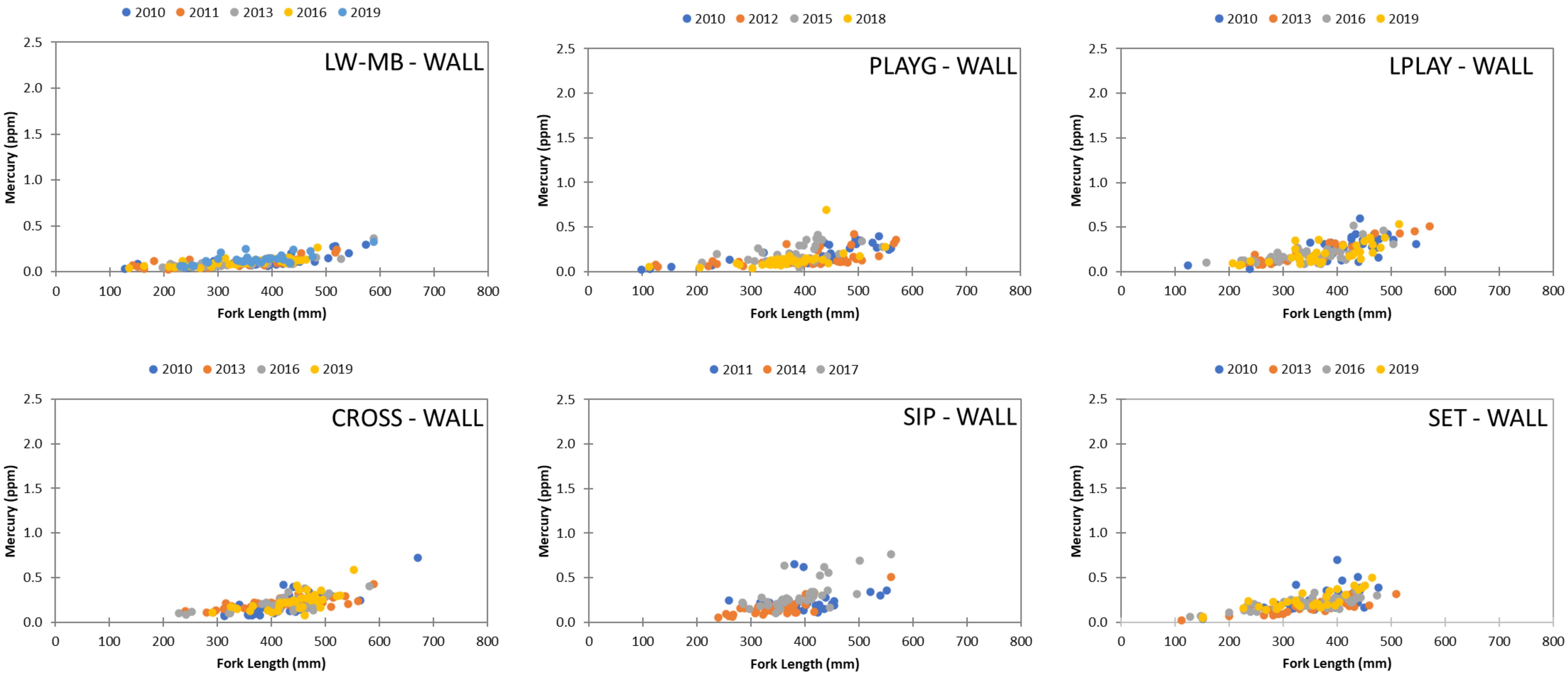


Figure 6.2-3. 2010-2019 Mercury concentration versus fork length of Walleye.

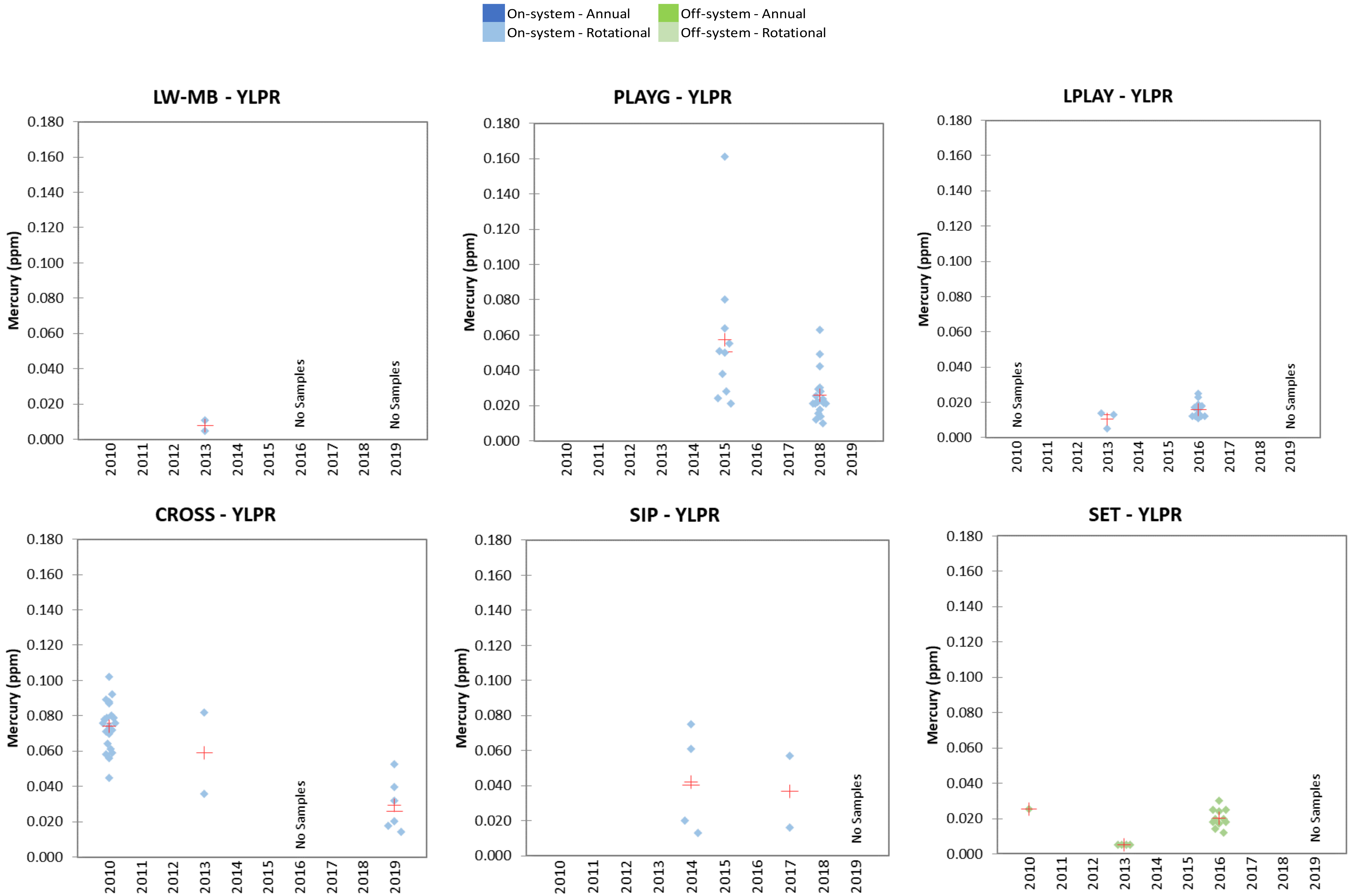


Figure 6.2-4. 2010-2019 Mercury concentrations of 1-year-old Yellow Perch.

6.2.2 LENGTH-STANDARDIZED MEAN CONCENTRATION

6.2.2.1 ON-SYSTEM SITES

ANNUAL SITES

There are no waterbodies in the Upper Nelson River Region that are monitored for fish mercury annually.

ROTATIONAL SITES

Lake Winnipeg – Mossy Bay

Lake Whitefish

The length-standardized mean mercury concentration of a 350 mm Lake Whitefish over the five years of monitoring ranged from 0.012 in 2010 to a high of 0.028 ppm in 2013 (Table 6.2-1). A standard mean could not be calculated for 2011 because there was not a significant relationship between mercury concentration and fork length or in 2019 because only one Lake Whitefish was analyzed for mercury.

The overall mean concentration was 0.019 ppm, the median concentration was 0.017 ppm, and the IQR was 0.015–0.023 ppm (Figure 6.2-5). The annual mean mercury concentration fell within the IQR except in 2010 when it was below the IQR and in 2013 when it was above the IQR.

Northern Pike

The length-standardized mean mercury concentration of a 550 mm Northern Pike over the five years of monitoring ranged from a low of 0.161 ppm in 2019 to a high of 0.173 ppm in 2013 (Table 6.2-1). A standard mean could not be calculated for 2010 and 2011 because only two Northern Pike were analyzed for mercury in those years.

The overall mean concentration was 0.168 ppm, the median concentration was 0.170 ppm, and the IQR was 0.166–0.172 ppm (Figure 6.2-6). The annual mean mercury concentration fell within the IQR except in 2019 when it was below the IQR and in 2013 when it was above the IQR.

Walleye

The length-standardized mean mercury concentration of a 400 mm Walleye over the five years of monitoring ranged from a low of 0.108 ppm in 2011 to a high of 0.150 ppm in 2019 (Table 6.2-1).

The overall mean concentration was 0.120 ppm, the median concentration was 0.112 ppm, and the IQR was 0.109–0.119 ppm (Figure 6.2-7). The annual mean mercury concentration fell within the IQR except in 2019 when it was above the IQR.

Playgreen Lake

Lake Whitefish

The length-standardized mean mercury concentration of a 350 mm Lake Whitefish over the four years of monitoring ranged from 0.019 in 2015 to a high of 0.024 ppm in 2010 (Table 6.2-1).

The overall mean and median concentrations were 0.021 ppm and the IQR was 0.020–0.022 ppm (Figure 6.2-5). The annual mean mercury concentration fell within the IQR except in 2015 when it was below the IQR and in 2010 when it was above the IQR.

Northern Pike

The length-standardized mean mercury concentration of a 550 mm Northern Pike over the four years of monitoring ranged from a low of 0.186 ppm in 2015 to a high of 0.215 ppm in 2010 (Table 6.2-1).

The overall mean concentration was 0.196 ppm, the median concentration was 0.192 ppm, and the IQR was 0.186–0.202 ppm (Figure 6.2-6). The annual mean mercury concentration fell within the IQR except in 2010 when it was above the IQR.

Walleye

The length-standardized mean mercury concentration of a 400 mm Walleye over the four years of monitoring ranged from a low of 0.131 ppm in 2018 to a high of 0.190 ppm in 2015 (Table 6.2-1).

The overall mean concentration was 0.153 ppm, the median concentration was 0.145 ppm, and the IQR was 0.133–0.165 ppm (Figure 6.2-7). The annual mean mercury concentration fell within the IQR except in 2018 when it was below the IQR and in 2015 when it was above the IQR.

Little Playgreen Lake

Lake Whitefish

A standard mean could not be calculated for Little Playgreen Lake over the four years of monitoring because there was not a significant relationship between mercury concentration and fork length for the few Lake Whitefish analyzed in 2010 and no Lake Whitefish were analyzed for mercury in the other years (Table 6.2-1).

Northern Pike

The length-standardized mean mercury concentration of a 550 mm Northern Pike over the four years of monitoring ranged from a low of 0.196 ppm in 2013 to a high of 0.250 ppm in 2019 (Table 6.2-1).

The overall mean concentration was 0.219 ppm, the median concentration was 0.215 ppm, and the IQR was 0.210–0.224 ppm (Figure 6.2-6). The annual mean mercury concentration fell within the IQR except in 2013 when it was below the IQR and in 2019 when it was above the IQR.

Walleye

The length-standardized mean mercury concentration of a 400 mm Walleye over the four years of monitoring ranged from a low of 0.215 ppm in 2016 to a high of 0.237 ppm in 2013 (Table 6.2-1).

The overall mean concentration was 0.225 ppm, the median concentration was 0.223 ppm, and the IQR was 0.215–0.233 ppm (Figure 6.2-7). The annual mean mercury concentration fell within the IQR except in 2013 when it was above the IQR.

Cross Lake

Lake Whitefish

A standard mean could not be calculated for Cross Lake over the four years of monitoring because too few Lake Whitefish were analyzed for mercury in 2013 and 2019 and no Lake Whitefish were analyzed in the other years (Table 6.2-1).

Northern Pike

The length-standardized mean mercury concentration of a 550 mm Northern Pike over the four years of monitoring ranged from a low of 0.187 ppm in 2010 to a high of 0.292 ppm in 2016 (Table 6.2-1).

The overall mean concentration was 0.237 ppm, the median concentration was 0.235 ppm, and the IQR was 0.221–0.250 ppm (Figure 6.2-6). The annual mean mercury concentration fell within the IQR except in 2010 when it was below the IQR and in 2016 when it was above the IQR.

Walleye

The length-standardized mean mercury concentration of a 400 mm Walleye over the four years of monitoring ranged from a low of 0.149 ppm in 2010 to a high of 0.183 ppm in 2019 (Table 6.2-1).

The overall mean concentration was 0.174 ppm, the median concentration was 0.181 ppm, and the IQR was 0.172–0.183 ppm (Figure 6.2-7). The annual mean mercury concentration fell within the IQR except in 2010 when it was below the IQR.

Sipiwesk Lake

Lake Whitefish

A standard mean could not be calculated for Sipiwesk Lake over the three years of monitoring because only one Lake Whitefish was analyzed for mercury in 2014 and no Lake Whitefish were analyzed for mercury in the other years (Table 6.2-1).

Northern Pike

The length-standardized mean mercury concentration of a 550 mm Northern Pike over the three years of monitoring ranged from a low of 0.238 ppm in 2011 to a high of 0.338 ppm in 2017 (Table 6.2-1).

The overall mean concentration was 0.292 ppm, the median concentration was 0.300 ppm, and the IQR was 0.269–0.319 ppm (Figure 6.2-6). The annual mean mercury concentration fell within the IQR except in 2011 when it was below the IQR and in 2017 when it was above the IQR.

Walleye

The length-standardized mean mercury concentration of a 400 mm Walleye was 0.201 ppm in 2014 and 0.303 ppm in 2017 (Table 6.2-1). A standard mean could not be calculated for 2011 because there was not a significant relationship between mercury concentration and fork length.

6.2.2.2 OFF-SYSTEM SITES

ANNUAL SITES

There are no waterbodies in the Upper Nelson River Region that are monitored for fish mercury annually.

ROTATIONAL SITES

Setting Lake

Lake Whitefish

The length-standardized mean mercury concentration of a 350 mm Lake Whitefish was 0.025 ppm in 2013 and 0.033 ppm in 2019 (Table 6.2-1). A standard mean could not be calculated for 2010 and 2016 because there was not a significant relationship between mercury concentration and fork length.

Northern Pike

The length-standardized mean mercury concentration of a 550 mm Northern Pike over the four years of monitoring ranged from a low of 0.314 ppm in 2013 to a high of 0.395 ppm in 2019 (Table 6.2-1).

The overall mean concentration was 0.366 ppm, the median concentration was 0.377 ppm, and the IQR was 0.350–0.393 ppm (Figure 6.2-6). The annual mean mercury concentration fell within the IQR except in 2013 when it was below the IQR and in 2019 when it was above the IQR.

Walleye

The length-standardized mean mercury concentration of a 400 mm Walleye over the four years of monitoring ranged from a low of 0.206 ppm in 2013 to a high of 0.281 ppm in 2019 (Table 6.2-1).

The overall mean concentration was 0.251 ppm, the median concentration was 0.259 ppm, and the IQR was 0.233–0.278 ppm (Figure 6.2-7). The annual mean mercury concentration fell within the IQR except in 2013 when it was below the IQR and in 2019 when it was above the IQR.

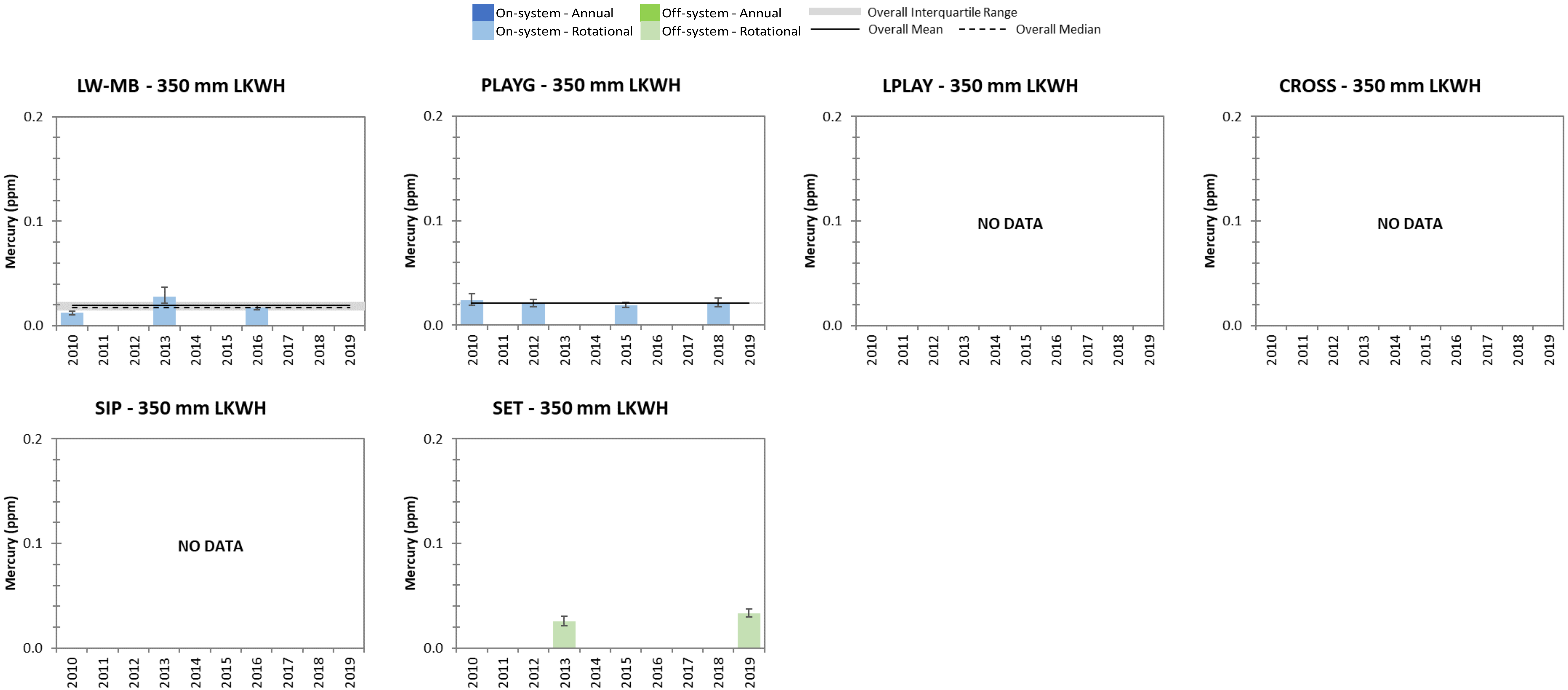


Figure 6.2-5. 2010-2019 Length-standardized mean mercury concentrations (±95% confidence intervals) of Lake Whitefish.

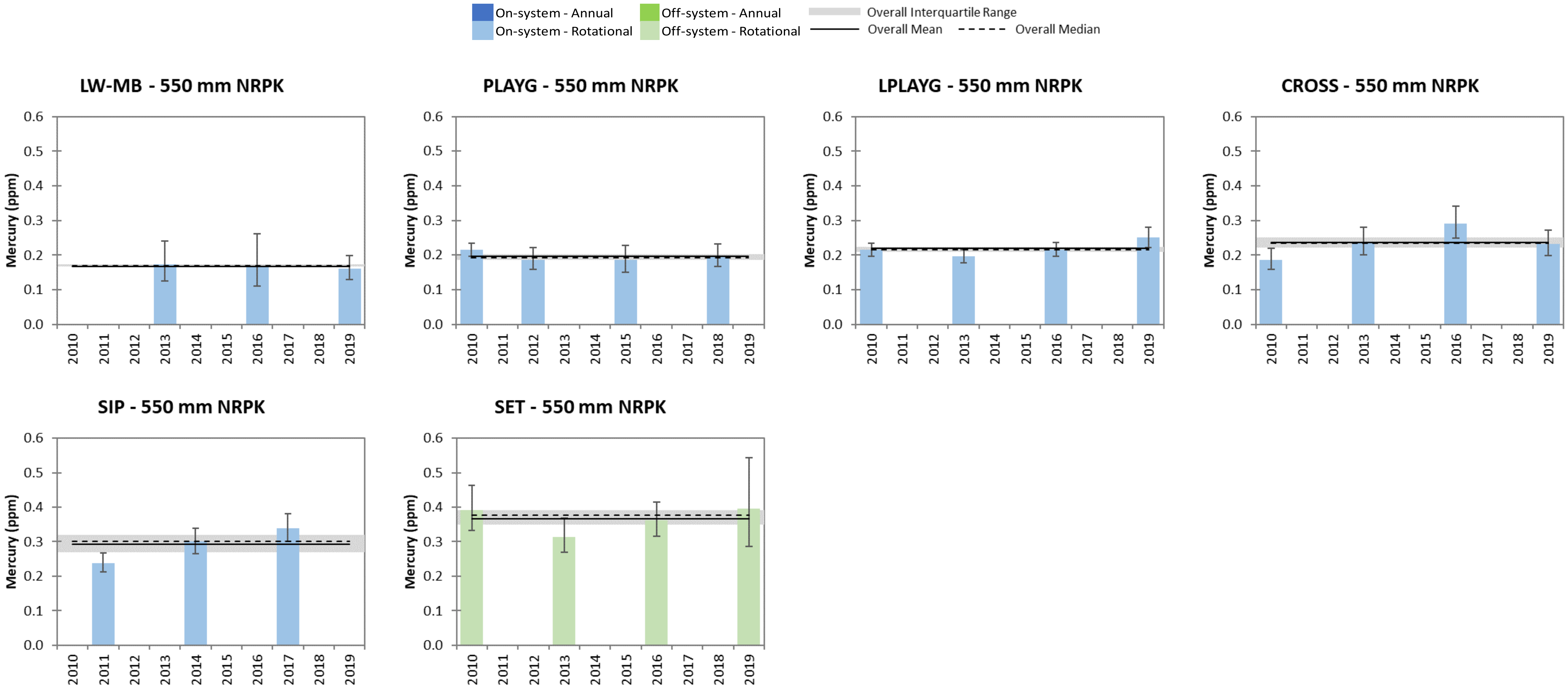


Figure 6.2-6. 2010-2019 Length-standardized mean mercury concentrations (±95% confidence intervals) of Northern Pike.

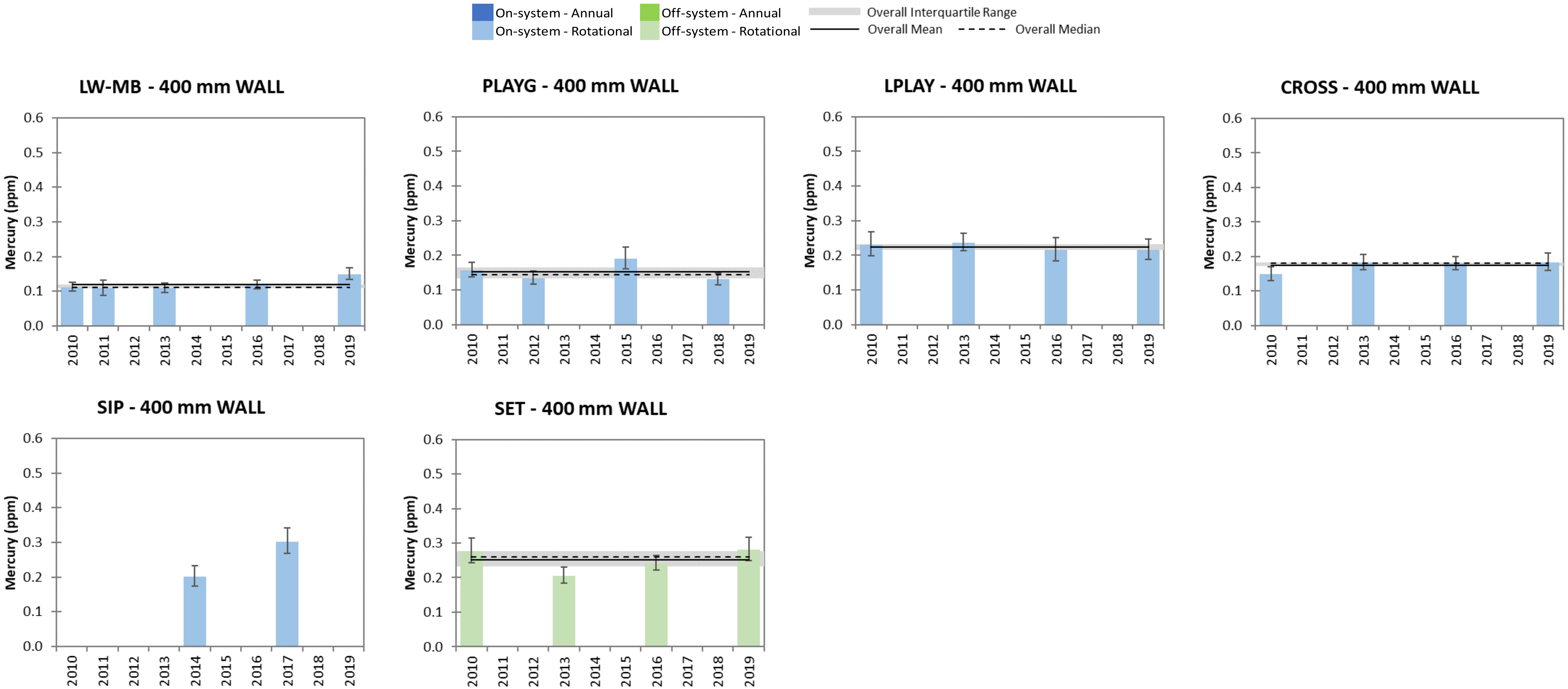


Figure 6.2-7. 2010-2019 Length-standardized mean mercury concentrations (±95% confidence intervals) of Walleye.

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