



P.O. Box 1749
Halifax, Nova Scotia
B3J 3A5 Canada

Item No. 2
North West Community Council
March 11, 2019

TO: Chair and Members of North West Community Council

Original Signed

SUBMITTED BY:

Kelly Denty, Planning & Development

Original Signed

Jacques Dubé, Chief Administrative Officer

DATE: January 7, 2019

SUBJECT: **Bedford West Water Quality Status Update – Fall 2018**

INFORMATION REPORT

ORIGIN

Bedford Municipal Planning Strategy, Bedford West Secondary Planning Strategy, Policies BW-3, BW-4, and BW-5.

Development Agreements between Halifax Regional Municipality and West Bedford Holdings Ltd, and between Halifax Regional Municipality and Cresco Ltd.

LEGISLATIVE AUTHORITY

The Halifax Regional Municipality Charter, Part VIII, Planning and Development, Section 240, Development Agreements.

BACKGROUND

The Bedford West Secondary Planning Strategy, Policy BW-3, requires that a water quality monitoring program be undertaken for the Paper Mill Lake watershed to track the eutrophication process. Eutrophication is the process by which lakes naturally accumulate nutrients and biological material. The eutrophication process is typically accelerated through the impacts of human activities, resulting in relatively rapid changes in trophic state, from lower states (fewer nutrients) to higher states (more nutrients), with corresponding changes in appearance, functional uses, and amenity values.

The water quality monitoring program was specified in the Planning Strategy in response to the Municipality's stated desire to "stem the decline of lakes from the accelerated process of eutrophication, and sedimentation and inputs from other urban runoff", as published in the former Regional Municipal Planning Strategy.

The terms of the monitoring program are specified within Development Agreements that have been negotiated in consultation with the Bedford Watershed Advisory Board. The Bedford Watershed Advisory Board was dissolved in 2013 and all development agreements for the Bedford West subdivision negotiated since 2013 have been negotiated instead with the Regional Watersheds Advisory Board (RWAB).

All such development agreements have identified the value of 10 micrograms per litre ($\mu\text{g/L}$) of total phosphorus (TP) as a "trigger value", representing the transition point between the second-lowest trophic state (oligotrophic) to the next-highest trophic state (mesotrophic) per Environment Canada criteria (Table 1).

Trophic Status	TP ($\mu\text{g/L}$)
Ultra-oligotrophic	< 4
Oligotrophic	4-10
Mesotrophic	10-20
Meso-eutrophic	20-35
Eutrophic	35-100
Hypereutrophic	> 100

Table 1. Summary of Canadian trophic state trigger ranges. Environment Canada (2004).

In accordance with the terms of the Bedford West development agreements, the Municipality is required to submit test results to the Developer, the Community Council, and RWAB within three months of being received from the consultant, or immediately, if total phosphorus ("TP") or bacterial results exceed management thresholds identified therein.

DISCUSSION

The purpose of this report is to share the results of the October 2018 monitoring event. TP concentrations exceeded the trigger value of 10 $\mu\text{g/L}$ at five stations in October. The final report for the fall 2018 monitoring event was received on November 29, 2018.

As noted in the Background section of the report, the Bedford West Development agreement stipulates that results be reported within three months. This provision is based on the assumption that development activity bears some relation to the test results. Consultant research has since pointed out that changes in water quality cannot be attributed to a single source, and further has recommended that individual developments should not be regulated based on trophic state indicators in a lake.¹ The study recommendations will be taken into consideration when a review of the municipal-wide Water Quality and Watershed Assessment Program is carried out.

¹ Presentation by Rob Jamieson, Ph.D., P.Eng. entitled "Phosphorus Loading and Trophic State Assessment in the Paper Mill Lake Watershed", North West Community Council, November 15, 2016.

A summary of TP results observed at all stations during these events is presented below in Table 2. It is important to note that these results only represent water quality at the time that the samples were collected.

Sample Station	October 2018 Concentration (µg/L)	Exceedance
KL1	8	No
KL2	4	No
KL3	6	No
KL4	4	No
KL5	5	No
HWY 102-1	10	No
HWY 102-2	14	Yes
LSD	18	Yes
LU	21	Yes
PML1	12	Yes
PML2	12	Yes

Table 2. Summary of TP results and exceedances October 2018.

The first annual monitoring event for 2019 will be conducted in May, and the results from that event will be reported to the North West Community Council in September 2019

FINANCIAL IMPLICATIONS

There are no financial implications for this report.

COMMUNITY ENGAGEMENT

No community engagement was required for this report.

ATTACHMENTS

Attachment A. Bedford West Water Quality Report Fall 2018.

A copy of this report can be obtained online at halifax.ca or by contacting the Office of the Municipal Clerk at 902.490.4210.

Report Prepared by: Cameron Deacoff, Water Resources Specialist, 902.490.1926

Original Signed

Report Approved by: Shannon Miedema, Energy & Environment Program Manager, 902.490.3665

November 28, 2018

SENT VIA EMAIL: deacofc@halifax.ca

Halifax Regional Municipality
Halifax, Nova Scotia

Attention: Mr. Cameron Deacoff, MMM, PMP, CLP
Environmental Performance Officer
Planning and Development

Dear Mr. Deacoff:

**RE: Final Report: Surface Water Quality Monitoring Program, 2018 Autumn Sampling Event,
Bedford West, Bedford, Nova Scotia**

SNC-Lavalin Inc. (SLI) is pleased to submit one electronic copy of the final report presenting the results of the 2018 autumn surface water quality sampling event for the Bedford West Water Quality Monitoring Program in Bedford, Nova Scotia.

If you have any questions, please contact the undersigned or in his absence, please contact Maria Gutierrez, BSc, MEM, at 902.492.4544 Ext 308.

Yours truly,

SNC • LAVALIN INC.

Original signed

Michael Smith, AScT, B.Tech, EP
Area Lead, Environmental Engineering
Infrastructure Engineering – Eastern Canada
(709) 368-0118 Ext. 54957

631477-0001-T-4E-REP-000-0013-C01



Surface Water Quality Monitoring Program, Bedford West Bedford West, Nova Scotia, Canada

2018 Autumn Final Report

2018/11/28

Prepared for:

Halifax Regional Municipality

Attention: Cameron Deacoff, MMM, PMP, CLP

Environmental Performance Officer

Halifax, NS

PH: (902) 490-1926

Prepared by:

SNC-Lavalin Inc.

5657 Spring Garden Road, Suite 200

Halifax, NS, B3J 3R4

PH: (902) 492-4544

Bedford West Water Quality Monitoring	2018 Autumn Final Report	631477-0001-T-4E-REP-000-0013
2018/11/28	Halifax Regional Municipality	C01

EXECUTIVE SUMMARY

On October 17, 2018 SNC-Lavalin Inc. (SNCL) completed the Bedford West water quality monitoring program (2018 autumn event) on behalf of Halifax Regional Municipality (HRM). The sampling program consisted of collecting surface water samples from eleven (11) water quality stations. Field parameters were recorded and surface water samples were collected for laboratory analyses. The laboratory analysis included the following analysis: inorganics, calculated parameters, standard elements and microbiological.

The applicable water quality assessment standards included:

- Canadian Council of Ministers of the Environment (CCME) guidelines for the Protection of Aquatic Life Freshwater (PAL-F);
- Health Canada guidelines for Canadian Recreational Water Quality (2012, Third Edition); and
- Nova Scotia Environment (NSE) Environmental Quality Standards (EQS) for Surface Water, EQS for Contaminated Sites (NSE 2014) Table A2, Reference for Pathway Specific Standards for Surface Water – Fresh Water.

During the autumn monitoring event, five (5) monitoring stations reported concentrations that exceeded the Total Phosphorous (TP) management threshold criteria of 10 µg/L (equivalent to 0.01 mg/L) listed in the HRM RFP14-338. Based on the laboratory results reported in milligrams per litre (mg/L), the TP exceedances were as follows:

- HWY102-2: 0.014 mg/L (equivalent to 14 µg/L)
- LSD: 0.018 mg/L (equivalent to 18 µg/L)
- LU: 0.021 mg/L (equivalent to 21 µg/L)
- PML1: 0.012 mg/L (equivalent to 12 µg/L)
- PML2: 0.012 mg/L (equivalent to 12 µg/L)

In-Situ readings of parameters such as pH, dissolved oxygen, water temperature and conductivity were recorded at all eleven (11) stations:

- All eleven (11) stations, recorded In-Situ pH values well within the Health Canada Guideline for Recreational Water Quality range of 5.0 - 9.0 pH. However, pH values as stations KL2 (5.84 pH) and LSD (5.90 pH) were recorded outside CCME-PAL-F recommended range of 6.5 - 9.0.
- In-Situ dissolved oxygen concentrations were well within the CCME PAL-F recommended range of 5.5 - 9.5 mg/L for all stations, with the exception of LU: 9.79 mg/L

Bedford West Water Quality Monitoring	2018 Autumn Final Report	631477-0001-T-4E-REP-000-0013
2018/11/28	Halifax Regional Municipality	C01

- In-Situ water temperature was recorded between 9.3°C and 13.1°C.
- In-Situ water conductivity was recorded between 67.2 µs/cm to 384.4 µs/cm.

Secchi depth readings were collected at six (6) stations. Recorded values meet the Health Canada reference guideline of minimum of 1.2 meters (m): KL1 (2.1 m); KL2 (1.4 m); KL5 (3.01 m); PML-1 (2.4); and PML-2 (3.0 m).

The following parameters reported concentrations above the recommended Canadian Council of Ministers of the Environment Guidelines for the Protection of Aquatic Life - Freshwater (CCME-PAL-F, edition 2015) and/or the Nova Scotia Environment (NSE) Environmental Quality Standards (EQS) for Surface Water, EQS for Contaminated Sites (NSE 2014) and/or the Health Canada guidelines for Recreational Water Quality:

- Laboratory pH was reported at all eleven (11) stations well within Health Canada range of 5.0-9.0 for Recreational Water Quality. However, station KL2 (6.3 pH) was outside the CCME-PAL-F recommended range of 6.5-9.0 pH.
- Copper concentrations exceeded the NSE EQS and CCME-PAL-F limit of 2 µg/L at stations HWY-102-1 (3 µg/L) and LU (5.0 µg/L).
- Iron concentrations exceeded the NSE EQS and CCME-PAL-F limit of 300 µg/L at stations KL2 (336 µg/L) and HWY102-1 (403 µg/L)
- Zinc concentrations exceeded the NSE EQS and CCME-PAL-F limit of 30 µg/L at stations HWY102-2 (69 µg/L) and LU (38 µg/L)

In terms of microbiological analyses, E. Coli was not found in exceedance of the Health Canada Guideline of 400 CFU/100 mL, at any of the eleven (11) sampling locations.

There are no applicable Health Canada guidelines for Total Coliforms (TC) in recreational water; however, reported concentrations were above the laboratory RDL of 1 CFU/100mL at all eleven (11) stations. Reported TC concentrations ranged from 81 CFU/100ml to 8,000 CFU/100ml.

Bedford West Water Quality Monitoring	2018 Autumn Final Report	631477-0001-T-4E-REP-000-0013
2018/11/28	Halifax Regional Municipality	C01

TABLE OF CONTENTS

EXECUTIVE SUMMARY ii

1. INTRODUCTION 6

2. METHODOLOGY 8

3. APPLICABLE GUIDELINES 9

4. FIELD OBSERVATIONS 10

5. FIELD MEASUREMENTS 10

6. ANALYTICAL RESULTS 11

6.1 TOTAL PHOSPHOROUS 11

6.2 GENERAL CHEMISTRY 12

6.3 METALS 12

6.4 MICROBIOLOGICAL 12

7. STATISTICAL PRESENTATION 13

8. GRAPHS 18

9. CONCLUSIONS 18

TOTAL PHOSPHOROUS 18

FIELD MEASUREMENTS 19

GENERAL CHEMISTRY AND METALS 19

MICROBIOLOGICAL 19

10. LIMITATION 20

11. CLOSURE 20

12. REFERENCES 20

List of Tables

Table 1: Bedford West Water Quality Sampling Stations 6

Table 2: Analytical Parameter Groups 8

Table 3: Statistical Presentation of Key Water Quality Parameters 14

List of Drawing

Figure 1: Bedford West Water Quality Sampling Stations 7

Appendices

Appendix A Instrument Calibration Report

Appendix B Field Reports

Appendix C Site Photographs

Appendix D Summary Table Results

Table D1 – 2018 Autumn Results, Bedford West Water Quality Sampling Program

Table D2 - Historical Results, Bedford West Water Quality Sampling Program

Appendix E Laboratory Certificates of Analysis

Appendix F Graphs

Bedford West Water Quality Monitoring	2018 Autumn Final Report	631477-0001-T-4E-REP-000-0013
2018/11/28	Halifax Regional Municipality	C01

1. INTRODUCTION

SNC-Lavalin Inc. (SNCL) has prepared this report to provide Halifax Regional Municipality (HRM) with water quality data for eleven (11) surface water stations throughout the Bedford West development area.

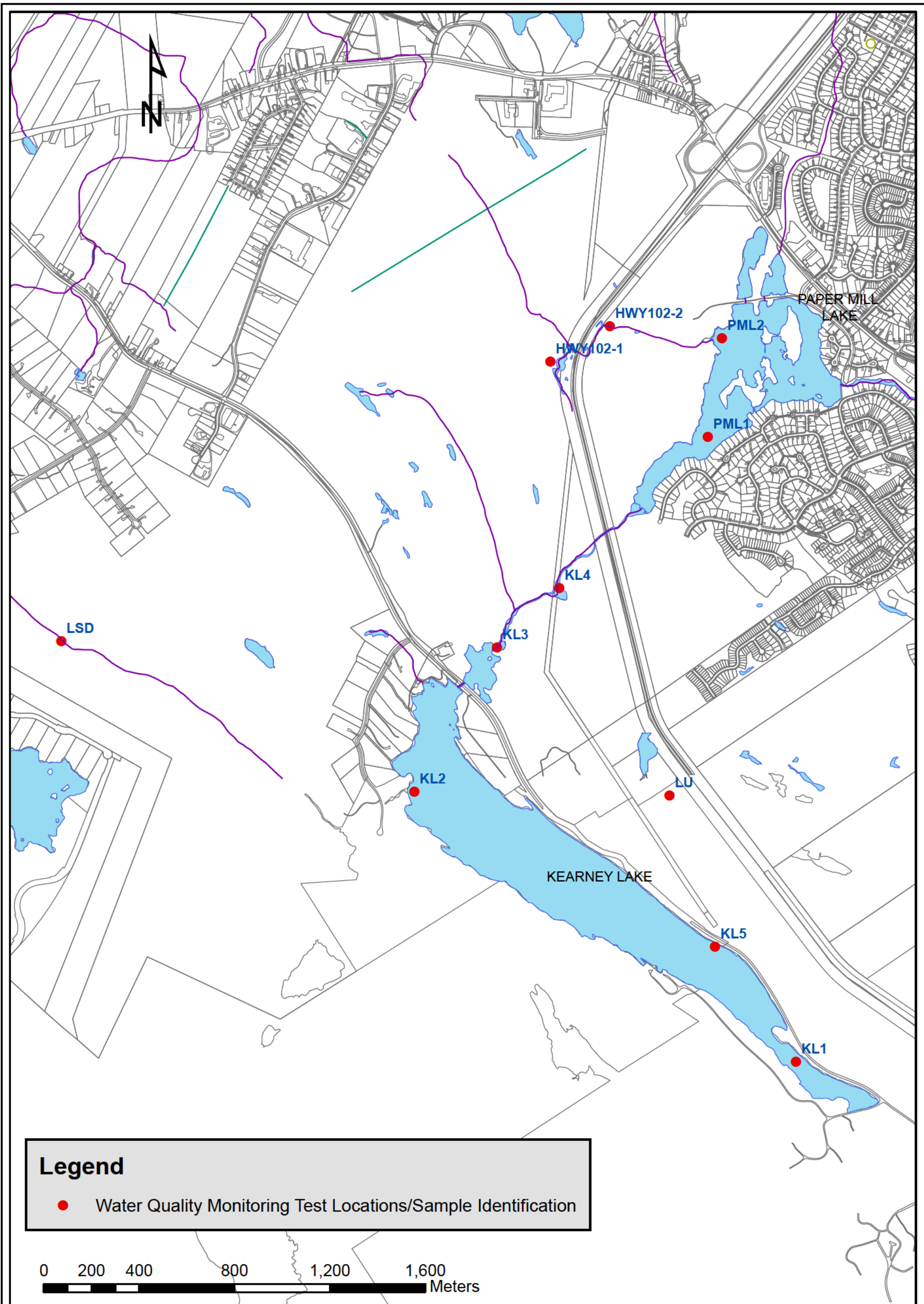
Water quality monitoring in the Bedford West development area has been ongoing since 2009. SNCL was retained by HRM to complete water quality monitoring programs each spring, summer and autumn since 2015. The results of the 2018 autumn monitoring program are detailed herein.

The overall purpose of the program is to conduct water quality sampling and testing prior to and during construction activities related to the Bedford West development in order to detect any impacts on and/or changes to water quality.

The 2018 autumn sampling stations are summarized in Table 1 and shown in Drawing 1.

Table 1: Bedford West Water Quality Sampling Stations

Water Course	Sample Location Name	Updated Coordinates (UTM NAD 83)	
		Easting	Northing
Kearney Lake	KL-1	20T445718E	4948496N
Kearney Lake	KL-2	20T0443859	4949738N
Kearney Run	KL-3	20T444390E	4950406N
Kearney Run	KL-4	20T444463E	4950571N
Kearney Lake	KL-5	20T4949142E	445280N
Creek Above Highway	HWY 102-1	20T444708E	4951644N
Creek Below Highway	HWY 102-2	20T444829E	4951778N
Lake Shore Drive	LSD	20T442583E	4950431N
Larry Uteck Off-Ramp	LU	20T444954E	4949891N
Paper Mill Lake	PML-1	20T445129E	4951154N
Paper Mill Lake	PML-2	20T445363E	4951740N



2. METHODOLOGY

The 2018 autumn water quality sampling event included the collection of Field Parameters (Group A) and surface water for laboratory analysis of:

- Inorganics (Group B);
- Calculated Parameters (Group C);
- Standard Elements/Metals (Group D); and
- Microbiological Analyses (Group E);

Table 2 below summarizes the water quality parameters measured in the field or analyzed by the laboratory.

Table 2: Analytical Parameter Groups

Field Parameters (A)	Inorganics (B)	Calculated Parameters (C)	Standard Metals (D)	Microbiological (E)
<ul style="list-style-type: none"> • pH • TDS • Dissolved Oxygen • Temperature • Secchi Depth • Conductance • Air Temperature • Cloud Cover • Incidental Wildlife Sightings 	<ul style="list-style-type: none"> • Total Alkalinity (as CaCO₃) • Dissolved Chloride • Colour • Total Kjeldahl Nitrogen • Nitrate + Nitrite • Nitrate • Nitrite • Nitrogen (as NH₄) • Total Organic Carbon • Orthophosphate (P) • pH • Low Total Phosphorus • Reactive Silica • Total Suspended Solids • Dissolved Sulphate • Turbidity • Conductivity 	<ul style="list-style-type: none"> • Anion Sum • Cation Sum • Ion Balance • Bicarbonate Alkalinity(as CaCO₃) • Carbonate Alkalinity (as CaCO₃) • Hardness • Total Dissolved Solids • Saturation pH (@4°C & 20°C) • Langelier Index (@4°C & 20°C) 	<ul style="list-style-type: none"> • Calcium • Copper • Iron • Magnesium • Manganese • Potassium • Sodium • Zinc 	<ul style="list-style-type: none"> • Chlorophyll A • E. coli • Most Probable Number (MPN) or CFU per 100 mL

All surface water samples, associated field parameters and secchi depth measurements were collected on October 17, 2018.

Field measurements of pH, dissolved oxygen, specific conductivity and water temperature were taken at

each station using an YSI Professional Plus multi meter probe (serial number 18G102273). The instrument was calibrated on October 14, 2018. The calibration certificate issued by the equipment provider is enclosed in Appendix A.

Site conditions (i.e. weather, air temperature, cloud cover, site accessibility and wildlife sightings) and field parameters for each sampling location were recorded on a field report sheet (See Appendix B, Field Reports). Each sample station was photographed during the sample event (See Appendix C, Site Photographs).

Surface water sampling followed SNCL’s Standard Operating Procedures (SOP) for surface water sampling. A new pair of nitrile gloves was used at each sample location. Water samples and field parameter readings were collected within a depth of ≤ 1.0 m below surface (if possible). It should be noted that samples were collected from the shore at nine (9) stations (KL1, KL2, KL3, KL4, KL5, HWY-102-1, HWY-102-2, LSD and LU) and from a boat at two (2) stations (PML-1 and PML-2) which require secchi depth readings.

Surface water samples were collected and placed in clean laboratory-supplied bottles and stored in a chilled container together with a chain of custody record for transport to the laboratory. Laboratory analysis was completed by AGAT Laboratories located in Dartmouth, Nova Scotia. AGAT is an accredited laboratory by the Standard Council of Canada (SCC), Canadian Association for Laboratory Accreditation (CALA), and ISO 9001:2015.

3. APPLICABLE GUIDELINES

For this water quality monitoring program, the Federal and Provincial water quality guidelines being used for the assessment of surface water quality results are as follows, the Canadian Council of Ministers of the Environment (CCME) Guidelines for the Protection of Aquatic Life – Freshwater (PAL-F) (Version 2015), the Health Canada (HC) guidelines for Canadian Recreational Water Quality (2012, Third Edition), and the Nova Scotia Environment (NSE) Environmental Quality Standards (EQS) for Contaminated Sites (NSE 2014) Table A2, Reference for Pathway Specific Standards for Surface Water ($\mu\text{g/L}$) for Fresh Water. These guidelines were used to determine whether a tested parameter was in exceedance. Exceedances may be an indication of water quality impairment or conditions that will eventually lead to impairment. A detail description of the guidelines is presented below:

CCME Guidelines

- The CCME PAL-F guidelines were used for parameters such as dissolved oxygen, pH (In-Situ and analytical), Chloride, Nitrate, Nitrite, Nitrogen, as well as for total metals such as Aluminum, Arsenic, Boron, Cadmium, Cooper, Iron, Lead, Molybdenum, Nickel, Selenium, Silver, Thallium, Uranium, and Zinc.
- There is no a CCME recommend value for Total Suspended Solids (TSS), however the following CCME narrative for TSS at high flow was applied “maximum increase of 25 mg/L from

Bedford West Water Quality Monitoring	2018 Autumn Final Report	631477-0001-T-4E-REP-000-0001
2018/11/28	Halifax Regional Municipality	C01

background levels at any time when background levels are between 25 and 250 mg/L should not increase more than 10% of background levels when background is ≥ 250 mg/L”.

- According to CCME, 10 $\mu\text{g/L}$ of total phosphorous is the threshold between oligotrophic and mesotrophic classifications. In the Canadian framework, a trigger range is a desired concentration range for phosphorus; if the upper limit of the range is exceeded, it indicates potential for environmental quality issues, which may trigger the need for further investigation. HRM defined a Total Phosphorous management threshold value of 10 $\mu\text{g/L}$ or 0.01 mg/L for this monitoring program.

HC Guidelines

- The HC guidelines for Canadian Recreational Water Quality was used for parameters such as secchi depth (i.e. visibility at a minimum depth of 1.2 metres), pH guideline of 5.0-9, turbidity (limit of 50 Nephelometric Turbidity Units), and E. coli (i.e. ≤ 400 E.Coli/100mL).

NSE Guidelines

- The NSE EQS were used for assessment of total metals such as Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Molybdenum, Nickel, Selenium, Silver, Strontium, Thallium, Uranium, Vanadium and Zinc.

4. FIELD OBSERVATIONS

The 2018 autumn site conditions were recorded for all eleven (11) surface water quality monitoring stations and are included in the field data sheets in Appendix B. Site condition observations include weather, cloud cover, air temperature, wildlife sightings and site accessibility.

In addition, site photographs are included in Appendix C.

5. FIELD MEASUREMENTS

Field parameters such as In-Situ pH, dissolved oxygen, water temperature, conductivity and secchi depth (where applicable) were recorded on field data sheets. Collected data is enclosed in Appendix B.

Field measurements are also tabulated in Appendix D: Table D1 - Autumn Results and Table D2 – historical Results.

In-Situ pH

All eleven (11) stations were within the 5.0 - 9.0 pH Health Canada range for Recreational Water Quality. However, pH values outside of the CCME-PAL-F recommended range of 6.5 - 9.0, were found at the following two (2) stations:

Bedford West Water Quality Monitoring	2018 Autumn Final Report	631477-0001-T-4E-REP-000-0001
2018/11/28	Halifax Regional Municipality	C01

- KL2: pH 5.8
- LSD: pH 5.9

Dissolved Oxygen

Dissolved oxygen concentrations were outside of the CCME PAL-F recommended range of 5.5-9.5 mg/L at one (1) station:

- LU: 9.8 mg/L

Water Temperature

There are no applicable Health Canada or NSE guidelines for recreation water temperature. Water temperature was recorded between 9.3°C and 13.1°C.

Conductivity

There are no applicable Health Canada or NSE guidelines for recreation water conductivity. However, specific water conductivity was recorded between 67.2 µs/cm to 384.4 µs/cm.

Secchi Disk Depth

As per scope of work secchi depths were collected at five (5) monitoring stations. Secchi depth readings met the Health Canada reference guideline of minimum of 1.2 meters (m). Recorded values were as follows:

- KL1: 2.5 m
- KL2: 1.4 m
- KL5: 3.8 m
- PML-1: 2.9 m
- PML-2: 2.2 m

6. ANALYTICAL RESULTS

Analytical results of the 2018 autumn monitoring event and applicable/reference guidelines are tabulated in Table D1 and enclosed in Appendix D. In addition, historical water quality results from 2009 - 2018 are summarized in Table D2 and enclosed in Appendix D.

Laboratory certificates of analysis for the 2018 autumn event are located in Appendix E.

6.1 Total Phosphorous

Five (5) monitoring stations reported concentrations that exceeded the Total Phosphorous (TP) management threshold criteria of 10 µg/L (equivalent to 0.01 mg/L) listed in the HRM RFP14-338. Based

Bedford West Water Quality Monitoring	2018 Autumn Final Report	631477-0001-T-4E-REP-000-0001
2018/11/28	Halifax Regional Municipality	C01

on the laboratory results reported in milligrams per litre (mg/L), the TP exceedances were as follows:

- HWY102-2: 0.014 mg/L (equivalent to 14 µg/L)
- LSD: 0.018 mg/L (equivalent to 18 µg/L)
- LU: 0.021 mg/L (equivalent to 21 µg/L)
- PML1: 0.012 mg/L (equivalent to 12 µg/L)
- PML2: 0.012 mg/L (equivalent to 12 µg/L)

6.2 General Chemistry

For all inorganic parameters tested, only pH values were reported outside the applicable CCME PAL-F guidelines. No other exceedances were reported.

Laboratory pH

All eleven (11) stations reported pH values well within Health Canada range of 5.0-9.0 for Recreational Water Quality; however station KL2 (6.3 pH) was outside the CCME-PAL-F range of 6.5-9.0

6.3 Metals

The following metals were analyzed during the autumn monitoring event: Calcium, Copper, Iron, Magnesium, Manganese, Potassium, Sodium and Zinc. Exceedances were reported as follows:

Copper

Two (2) stations exceeded the NSE EQS guideline and CCME-PAL-F limit of 2 µg/L (based on hardness of <82 mg/L):

- HWY-102-1: 3 µg/L
- LU: 5.0 µg/L

Iron

Two (2) stations exceeded the NSE EQS guideline and CCME-PAL-F limit of 300 µg/L:

- KL2: 336 µg/L
- HWY102-1: 403 µg/L

Zinc

Two (2) stations exceeded the NSE EQS guideline and CCME-PAL-F limit of 30 µg/L:

- HWY102-2: 69 µg/L
- LU: 38 µg/L

6.4 Microbiological

There were no exceedances of the Heath Canada (HC) E.Coli Guideline of ≤ 400 CFU/100 mL.

Bedford West Water Quality Monitoring	2018 Autumn Final Report	631477-0001-T-4E-REP-000-0001
2018/11/28	Halifax Regional Municipality	C01

HC does not have a guideline for Total Coliform (TC) in regards to recreational water quality. All eleven (11) stations reported TC concentrations above the laboratory RDL of 1 CFU/100mL. Reported concentrations ranged from 81 CFU/100ml to 8,000 CFU/100ml.

7. STATISTICAL PRESENTATION

Statistics include water quality data from 2009 to October 2018 of all eleven (11) water quality monitoring stations. Table 3 provides the autumn seasonal statistics for the following six (6) key water quality parameters selected by HRM:

- Total phosphorus (mg/L),
- Dissolved chloride (mg/L),
- Laboratory measured pH
- Total suspended solids (mg/L),
- Conductivity ($\mu\text{S}/\text{cm}$) and
- Chlorophyll A ($\mu\text{g}/\text{L}$)

Where analytical results were found to be less than the laboratory Reportable Detection Limit (<RDL), the statistics (i.e. minimum, maximum, media and average) were calculated as half the laboratory reportable detection limit (1/2 RDL value) as a conservative approach.

It should be noted that number of decimal places presented for each listed parameter is based on the decimal places of the RDL and reported Laboratory certificate of analysis.

Table 3: Statistical Presentation of Key Water Quality Parameters for Autumn

KL-1	RDL	Seasonal Results	Historical Seasonal Minimum	Historical Seasonal Maximum	Historical Seasonal Median	Historical Seasonal Mean
Total Phosphorous (mg/L)	0.002	0.008	0.005	0.013	0.008	0.008
Chloride (mg/L)	1	55	33.0	64.0	52.5	51.4
Lab pH	N/A	7.07	6.4	7.1	6.8	6.8
Total Suspended Solids (mg/L)	5	<5	0.5	5.0	2.5	2.7
Conductivity (uS/cm)	1	215	140.0	250.0	222.5	213.2
Chlorophyll-A Acidification Method (µg/L)	0.05	1.63	0.8	2.1	1.3	1.4

KL-2	RDL	Seasonal Results	Historical Seasonal Minimum	Historical Seasonal Maximum	Historical Seasonal Median	Historical Seasonal Mean
Total Phosphorous (mg/L)	0.002	0.004	0.004	0.029	0.013	0.014
Chloride (mg/L)	1	11	10.0	48.0	13.0	18.5
Lab pH	N/A	6.27	6.1	6.9	6.3	6.3
Total Suspended Solids (mg/L)	5	<5	0.5	103.0	2.5	13.6
Conductivity (uS/cm)	1	70	54.0	212.0	71.5	91.7
Chlorophyll-A Acidification Method (µg/L)	0.05	0.75	0.1	2.0	0.4	0.6

KL-3	RDL	Seasonal Results	Historical Seasonal Minimum	Historical Seasonal Maximum	Historical Seasonal Median	Historical Seasonal Mean
Total Phosphorous (mg/L)	0.002	0.006	0.002	0.148	0.007	0.021
Chloride (mg/L)	1	46	37.0	60.0	47.5	49.7
Lab pH	N/A	7.10	6.4	7.1	6.9	6.8
Total Suspended Solids (mg/L)	5	<5	0.5	2.5	2.5	2.0
Conductivity (uS/cm)	1	232	160.0	247.0	218.0	212.4
Chlorophyll-A Acidification Method (µg/L)	0.05	1.28	0.5	2.3	1.2	1.2



KL-4	RDL	Seasonal Results	Historical Seasonal Minimum	Historical Seasonal Maximum	Historical Seasonal Median	Historical Seasonal Mean
Total Phosphorous (mg/L)	0.002	0.004	0.001	0.026	0.007	0.009
Chloride (mg/L)	1	47	37.0	60.0	48.5	50.1
Lab pH	N/A	7.13	6.5	7.1	6.9	6.9
Total Suspended Solids (mg/L)	5	<5	0.5	10.0	2.5	2.7
Conductivity (uS/cm)	1	231	160.0	250.0	224.0	214.4
Chlorophyll-A Acidification Method (µg/L)	0.05	1.12	0.4	2.2	1.0	1.0

KL-5	RDL	Seasonal Results	Historical Seasonal Minimum	Historical Seasonal Maximum	Historical Seasonal Median	Historical Seasonal Mean
Total Phosphorous (mg/L)	0.002	0.005	0.003	0.135	0.006	0.022
Chloride (mg/L)	1	47	37.0	60.0	47.5	49.5
Lab pH	N/A	7.47	6.5	7.5	6.9	6.9
Total Suspended Solids (mg/L)	5	<5	1.0	2.5	2.5	2.3
Conductivity (uS/cm)	1	286	160.0	286.0	214.5	218.8
Chlorophyll-A Acidification Method (µg/L)	0.05	1.68	0.6	2.7	1.2	1.4

HWY 102-1	RDL	Seasonal Results	Historical Seasonal Minimum	Historical Seasonal Maximum	Historical Seasonal Median	Historical Seasonal Mean
Total Phosphorous (mg/L)	0.002	0.010	0.002	0.031	0.011	0.014
Chloride (mg/L)	1	61	12.0	61.0	31.5	34.1
Lab pH	N/A	6.94	5.3	6.9	6.6	6.4
Total Suspended Solids (mg/L)	5	<5	0.5	2.5	2.5	2.1
Conductivity (uS/cm)	1	306	88.0	306.0	155.0	173.8
Chlorophyll-A Acidification Method (µg/L)	0.05	1.11	0.3	8.5	0.8	1.6



HWY 102-2	RDL	Seasonal Results	Historical Seasonal Minimum	Historical Seasonal Maximum	Historical Seasonal Median	Historical Seasonal Mean
Total Phosphorous (mg/L)	0.002	0.014	0.003	0.201	0.022	0.056
Chloride (mg/L)	1	30	17.0	92.0	46.5	49.7
Lab pH	N/A	7.07	5.5	7.1	6.3	6.3
Total Suspended Solids (mg/L)	5	<5	2.5	194.0	5.5	30.6
Conductivity (uS/cm)	1	208	94.0	366.0	201.0	217.6
Chlorophyll-A Acidification Method (µg/L)	0.05	0.53	0.3	48.2	1.2	10.9

LSD	RDL	Seasonal Results	Historical Seasonal Minimum	Historical Seasonal Maximum	Historical Seasonal Median	Historical Seasonal Mean
Total Phosphorous (mg/L)	0.002	0.018	0.003	0.095	0.015	0.028
Chloride (mg/L)	1	20	20.0	36.0	24.0	26.0
Lab pH	N/A	6.99	6.4	7.0	6.7	6.7
Total Suspended Solids (mg/L)	5	6	2.5	69.0	7.5	14.6
Conductivity (uS/cm)	1	123	105.0	171.0	124.0	126.3
Chlorophyll-A Acidification Method (µg/L)	0.05	0.60	0.1	5.1	1.0	1.7

LU	RDL	Seasonal Results	Historical Seasonal Minimum	Historical Seasonal Maximum	Historical Seasonal Median	Historical Seasonal Mean
Total Phosphorous (mg/L)	0.002	0.021	0.008	0.046	0.026	0.025
Chloride (mg/L)	1	74	34.0	258.0	83.0	102.0
Lab pH	N/A	7.29	6.4	7.3	7.0	6.9
Total Suspended Solids (mg/L)	5	<5	2.5	13.0	2.5	4.5
Conductivity (uS/cm)	1	422	190.0	840.0	408.0	443.0
Chlorophyll-A Acidification Method (µg/L)	0.05	2.39	0.1	4.9	1.9	2.0



PML-1	RDL	Seasonal Results	Historical Seasonal Minimum	Historical Seasonal Maximum	Historical Seasonal Median	Historical Seasonal Mean
Total Phosphorous (mg/L)	0.002	0.012	0.002	0.099	0.020	0.027
Chloride (mg/L)	1	47	18.0	59.0	47.5	45.1
Lab pH	N/A	7.16	6.6	7.2	6.8	6.8
Total Suspended Solids (mg/L)	5	<5	0.5	104.0	6.0	17.7
Conductivity (uS/cm)	1	232	100.0	248.0	216.5	198.2
Chlorophyll-A Acidification Method (µg/L)	0.05	1.12	0.1	5.1	1.0	2.0

PML-2	RDL	Seasonal Results	Historical Seasonal Minimum	Historical Seasonal Maximum	Historical Seasonal Median	Historical Seasonal Mean
Total Phosphorous (mg/L)	0.002	0.012	0.001	0.026	0.007	0.009
Chloride (mg/L)	1	43	34.0	64.0	50.0	50.9
Lab pH	N/A	7.05	6.6	7.1	6.8	6.9
Total Suspended Solids (mg/L)	5	<5	0.5	11.0	2.5	3.0
Conductivity (uS/cm)	1	227	150.0	277.0	227.0	221.9
Chlorophyll-A Acidification Method (µg/L)	0.05	1.78	0.3	2.0	1.3	1.1

8. GRAPHS

Graphs were completed for all eleven (11) water quality monitoring stations including water quality data collected from 2009 to October 2018. Appendix F presents seasonal and annual graphs that illustrate concentrations of the following six (6) key water quality parameters selected by HRM:

- Total phosphorus (mg/L),
- Dissolved chloride (mg/L),
- Laboratory measured pH
- Total suspended solids (mg/L),
- Conductivity ($\mu\text{S}/\text{cm}$) and
- Chlorophyll A ($\mu\text{g}/\text{L}$)

The graphs allow for comparison between water quality sampling stations and identification of concentration increases (i.e. above applicable CCME guidelines). As many parameters show seasonal concentration fluctuations, the water quality data was also graphed showing only the concentrations for a given season.

It should be noted that where results were found to be less than the laboratory Reportable Detection Limit (<RDL), they were graphed as half the reportable detection limit (1/2 RDL value) as a conservative approach.

9. CONCLUSIONS

The 2018 autumn water quality monitoring event included the collection of surface water samples at eleven (11) water quality sampling stations for the analysis of inorganics, calculated parameters, standard metals and microbiological analyses. Additionally, field parameters collected at each station included In-Situ pH, water temperature, dissolved oxygen, conductivity, Secchi depth (where applicable), air temperature, cloud cover and wildlife sightings.

Total Phosphorous

The following five (5) monitoring stations reported total phosphorous concentrations above the HRM management threshold criteria of 10 $\mu\text{g}/\text{L}$ (equivalent to 0.01 mg/L):

- HWY102-2: 0.014 mg/L (equivalent to 14 $\mu\text{g}/\text{L}$)
- LSD: 0.018 mg/L (equivalent to 18 $\mu\text{g}/\text{L}$)
- LU: 0.021 mg/L (equivalent to 21 $\mu\text{g}/\text{L}$)
- PML1: 0.012 mg/L (equivalent to 12 $\mu\text{g}/\text{L}$)
- PML2: 0.012 mg/L (equivalent to 12 $\mu\text{g}/\text{L}$)

Bedford West Water Quality Monitoring	2018 Autumn Final Report	631477-0001-T-4E-REP-000-0001
2018/11/28	Halifax Regional Municipality	C01

Field Measurements

- In-Situ pH values were well within the Health Canada Guideline for Recreational Water Quality of 5.0 - 9.0 pH for all eleven (11) of the stations. However, In-Situ pH values outside of the CCME-PAL-F recommended range of 6.5 - 9.0 were found at stations KL2 (5.84 pH) and LSD (5.90 pH).
- In-Situ dissolved oxygen concentrations were well within the CCME PAL-F recommended range of 5.5 - 9.5 mg/L for all stations, with the exception of LU: 9.79 mg/L
- In-Situ water temperature was recorded between 9.3°C and 13.1°C.
- In-Situ water conductivity was recorded between 67.2 µs/cm to 384.4 µs/cm.
- Secchi depth readings were collected at six (6) stations. Recorded values meet the Health Canada reference guideline of minimum of 1.2 meters (m): KL1 (2.1 m); KL2 (1.4 m); KL5 (3.01 m); PML-1 (2.4); and PML-2 (3.0 m).

General Chemistry and Metals

The following parameters reported concentrations above the recommended Canadian Council of Ministers of the Environment Guidelines for the Protection of Aquatic Life - Freshwater (CCME-PAL-F, edition 2015) and/or the Nova Scotia Environment (NSE) Environmental Quality Standards (EQS) for Surface Water, EQS for Contaminated Sites (NSE 2014):

- Laboratory pH was reported at all eleven (11) stations well within Health Canada range of 5.0-9.0 for Recreational Water Quality. However, station KL2 (6.3 pH) was outside the CCME-PAL-F recommended range of 6.5-9.0 pH.
- Copper concentrations exceeded the NSE EQS and CCME-PAL-F limit of 2 µg/L at stations HWY-102-1 (3 µg/L) and LU (5.0 µg/L).
- Iron concentrations exceeded the NSE EQS and CCME-PAL-F limit of 300 µg/L at stations KL2 (336 µg/L) and HWY102-1 (403 µg/L)
- Zinc concentrations exceeded the NSE EQS and CCME-PAL-F limit of 30 µg/L at stations HWY102-2 (69 µg/L) and LU (38 µg/L)

Microbiological

The Heath Canada guideline of ≤ 400 CFU/100 mL of E.Coli was met at all eleven (11) stations monitored during the 2018 autumn event.

There is no a guideline for Total Coliform (TC) in regards to recreational water quality. All monitoring stations reported TC concentrations above the Lab RDL of 1 CFU/100mL. Reported TC concentrations ranged from 81 CFU/100ml to 8,000 CFU/100ml.

Bedford West Water Quality Monitoring	2018 Autumn Final Report	631477-0001-T-4E-REP-000-0001
2018/11/28	Halifax Regional Municipality	C01

10. LIMITATION

Related to the Chlorophyll A analyses, the Welschmeyer Method completed by Dalhousie is not presented in this report due to laboratory's instrument failure. The Chlorophyll A results presented in this report are based only on Acidification Technique, which is what the laboratory of Dalhousie University is reliant on reporting.

11. CLOSURE

This report has been prepared and the work referred to in this report has been undertaken by SNC-Lavalin Inc (SNCL) for Halifax Regional Municipality (HRM), hereafter referred to as the "Client". It is intended for the sole and exclusive use of Halifax Regional Municipality. The report has been prepared in accordance with the Scope of Work and agreement between SNCL and the Client. Other than by the Client and as set out herein, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted without the express written permission of SNCL.

This report has been prepared in a manner generally accepted by professional consulting principles and practices for the same locality and under similar conditions. No other representations or warranties, expressed or implied, are made.

Opinions and recommendations contained in this report are based on conditions that existed at the time the services were performed and are intended only for the client, purposes, stations, time frames and project parameters as outlined in the Scope of Work and agreement between SNCL and the Client. The findings, observations, reported data and conclusions expressed are limited by the Scope of Work. SNCL is not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. SNCL does not warranty the accuracy of information provided by third party sources.

This report was prepared by Maria Gutierrez, BSc, MEM and Cally Baxter, BSc, EPt, and reviewed and approved by Michael Smith, AScT, B.Tech, EP.

12. REFERENCES

Canadian Environmental Quality Guidelines for the Protection of Aquatic Life, 2004, "Phosphorous: Canadian Guidance Framework for the Management of Freshwater Systems".

Canadian Council of Ministers of the Environment guidelines for the Protection of Aquatic Life Freshwater.

Health Canada guidelines for Canadian Recreational Water Quality, 2012, Third Edition.

Nova Scotia Environment, Notification of Contamination Protocol, Table 3 Tier 1 EQS for Surface Water, Revision July 2013

Bedford West Water Quality Monitoring	2018 Autumn Final Report	631477-0001-T-4E-REP-000-0001
2018/11/28	Halifax Regional Municipality	C01

Appendix A

Instrument Calibration Report

Open Road Environmental Limited

YSI Professional Plus

Serial Number 18G102273 (Quattro)

Calibration Certificate

3 Point Calibration pH (4.00, 7.00, 10.00)	Calibration solution	Specific Conductivity 12880 $\mu\text{S}/\text{cm}$	DO 100% @22.0 Deg.C
pH 4.00 pass 155.9mV	Lot#S180501018 Exp. May-20	pass	pass
pH 7.00 pass 30.2mV	Lot#S180315008 Exp. Mar-20		
pH 10.00 pass -167.4mV	Lot#S180104003 Exp. Jul-19		

October 14, 2018

Original signed

Ghislain Pitre, CET

Appendix B

Field Reports

Appendix B – Field Report Autumn 2018

Project:	Water Quality Monitoring - Bedford West	Sub-Area(s): 2, 3, 4, 5
Client:	Halifax Regional Municipality	
Site: Kearney Lake	Site ID: KL1	
Watercourse: Kearney Lake	Location: Kearney Lake Road	
Monitoring Well <input type="checkbox"/> Pumping Well <input type="checkbox"/> Surface Water <input checked="" type="checkbox"/> Spring/Seep <input type="checkbox"/> Discharge Pipe <input type="checkbox"/> Other:		
GPS Coordinates:	20T 0445718E, 4948496N (UTM, NAD83)	
SNC Field Personnel:	Maria Gutierrez / Cally Baxter	

Site Conditions

Weather:	Partially Cloudy
Air Temperature:	5°C
Cloud Cover :	>90%
Wildlife Sightings:	None
Site Accessibility: Yes, Accessible	Off Kearney Lake Road
Site Access Detail:	Sample taken off the end of dock at Kearney Lake beach. Parked in public parking of Hamshaw Dr. and walked down to beach area.

Field Parameter Data

	Remarks
Date (d.m.y):	17/10/18
Time (hh:mm):	9 am
Sample Depth (m):	< 1m
pH:	6.84
Dissolved Oxygen (mg/L):	8.61
Secchi Depth (m):	2.5m
Water Temperature (degrees Celsius):	12.8°C
Conductivity (µs/cm):	253.7

Additional Comments / Notes

N/A

Appendix B – Field Report Autumn 2018

Project:	Water Quality Monitoring - Bedford West	Sub-Area(s): 2, 3, 4, 5
Client:	Halifax Regional Municipality	
Site: Kearney Lake	Site ID: KL2	
Watercourse: Kearney Lake	Location: Kearney Lake Road	
Monitoring Well <input type="checkbox"/> Pumping Well <input type="checkbox"/> Surface Water <input checked="" type="checkbox"/> Spring/Seep <input type="checkbox"/> Discharge Pipe <input type="checkbox"/> Other:		
GPS Coordinates:	20T 0443942E, 4949803N (UTM, NAD83)	
SNC Field Personnel:	Maria Gutierrez / Cally Baxter	

Site Conditions

Weather:	Partially Cloudy
Air Temperature:	5°C
Cloud Cover:	30%
Wildlife Sightings:	None
Site Accessibility: Yes, Accessible	Off Colin's Rd.
Site Access Detail:	Sample taken on the lake side of the culvert between residential buildings 20 and 28. Walked down rock to left of culvert. Note: Sample when standing downstream of bottle.

Field Parameter Data

	Remarks
Date (d.m.y):	17/10/18
Time (hh:mm):	10 am
Sample Depth (m):	~ 0.5 m
pH:	5.84
Dissolved Oxygen (mg/L):	7.54
Secchi Depth (m):	1.4
Water Temperature (degrees Celsius):	10.3
Conductivity (µs/cm):	67.2

Additional Comments / Notes

<ul style="list-style-type: none"> > Water level is high, stream moving fast.

Appendix B – Field Report Autumn 2018

Project:	Water Quality Monitoring - Bedford West	Sub-Area(s): 2, 3, 4, 5
Client:	Halifax Regional Municipality	
Site: Kearney Lake Run	Site ID: KL3	
Watercourse: Kearney Lake Run	Location: Kearney Lake Road	
Monitoring Well <input type="checkbox"/> Pumping Well <input type="checkbox"/> Surface Water <input checked="" type="checkbox"/> Spring/Seep <input type="checkbox"/> Discharge Pipe <input type="checkbox"/> Other:		
GPS Coordinates:	20T 0444390E, 4950406N (UTM, NAD83)	
SNC Field Personnel:	Maria Gutierrez / Cally Baxter	

Site Conditions

Weather:	Partly cloudy
Air Temperature:	9°C
Cloud Cover:	80%
Wildlife Sightings:	None
Site Accessibility: Yes, Accessible	Off walking trail from Amesbury Gate Rd.
Site Access Detail:	Access to site is via a walking path clearly evident off of Amesbury Gate Rd. (off Larry Uteck Blvd.) roughly 205m down road on left. Walk down path, follow gravel walkway down hill and take sample at the low point facing the dam. Look for large rock outcrop on right.

Field Parameter Data

	Remarks
Date (d.m.y):	17/10/18
Time (hh:mm):	11:30 am
Sample Depth (m):	~ 0.25 m
pH:	6.64
Dissolved Oxygen (mg/L):	8.64
Secchi Depth (m):	N/A
Water Temperature (degrees Celsius):	12.4°C
Conductivity (µs/cm):	209.8

Additional Comments / Notes

<ul style="list-style-type: none"> > Water level is high, fast moving water over dam.

Appendix B – Field Report Autumn 2018

Project:	Water Quality Monitoring - Bedford West	Sub-Area(s): 2, 3, 4, 5
Client:	Halifax Regional Municipality	
Site: Kearney Lake Run	Site ID: KL4	
Watercourse: Kearney Lake Run	Location: Kearney Lake Road	
Monitoring Well <input type="checkbox"/> Pumping Well <input type="checkbox"/> Surface Water <input checked="" type="checkbox"/> Spring/Seep <input type="checkbox"/> Discharge Pipe <input type="checkbox"/> Other:		
GPS Coordinates:	20T 0444463E, 4950571N (UTM, NAD83)	
SNC Field Personnel:	Maria Gutierrez / Cally Baxter	

Site Conditions

Weather:	Partly cloudy
Air Temperature:	9°C
Cloud Cover:	80%
Wildlife Sightings:	Squirrels
Site Accessibility: Yes, Accessible	Via the extended road at the end of Weybridge Ln.
Site Access Detail:	At Weybridge, go to end of extended road on right and walk and take sample above the rocky area at the base of the wider, slow moving section of the river.

Field Parameter Data

	Remarks
Date (d.m.y):	17/10/18
Time (hh:mm):	11:45 am
Sample Depth (m):	0.5 m
pH:	6.91
Dissolved Oxygen (mg/L):	8.46
Secchi Depth (m):	N/A
Water Temperature (degrees Celsius):	12.7°C
Conductivity (µs/cm):	210.6

Additional Comments / Notes

N/A

Appendix B – Field Report Autumn 2018

Project:	Water Quality Monitoring - Bedford West	Sub-Area(s): 9
Client:	Halifax Regional Municipality	
Site: Kearney Lake	Site ID: KL5	
Watercourse: Kearney Lake	Location: Kearney Lake Road	
Monitoring Well <input type="checkbox"/> Pumping Well <input type="checkbox"/> Surface Water <input checked="" type="checkbox"/> Spring/Seep <input type="checkbox"/> Discharge Pipe <input type="checkbox"/> Other:		
GPS Coordinates:	20T 4949142E, 445280N (UTM, NAD83)	
SNC Field Personnel:	Maria Gutierrez / Cally Baxter	

Site Conditions

Weather:	Partly cloudy
Air Temperature:	5°C
Cloud Cover:	30%
Wildlife Sightings:	No
Site Accessibility: Yes, Accessible	Along Kearney Lake Road
Site Access Detail:	Easily accessible, sample location is directly off the Kearney Lake Road on a rocky outcrop supporting a power line pole (two pole structure). Slow truck down carefully, turn hazard lights on. Samples were taken on left front of outcrop facing lake.

Field Parameter Data

	Remarks
Date (d.m.y):	17/10/18
Time (hh:mm):	9:30 am
Sample Depth (m):	<1m
pH:	6.67
Dissolved Oxygen (mg/L):	7.58 mg/L
Secchi Depth (m):	3.77
Water Temperature (degrees Celsius):	13.1°C
Conductivity (µs/cm):	236.4

Additional Comments / Notes

N/A

Appendix B – Field Report Autumn 2018

Project:	Water Quality Monitoring - Bedford West	Sub-Area(s): 2, 3, 4, 5
Client:	Halifax Regional Municipality	
Site: Highway 102	Site ID: HWY 102-1	
Watercourse: Marsh area	Location: Highway 102, south of exit 3	
Monitoring Well <input type="checkbox"/> Pumping Well <input type="checkbox"/> Surface Water <input checked="" type="checkbox"/> Spring/Seep <input type="checkbox"/> Discharge Pipe <input type="checkbox"/> Other:		
GPS Coordinates:	20T 0444708E, 4951644N (UTM, NAD83)	
SNC Field Personnel:	Maria Gutierrez / Cally Baxter	

Site Conditions

Weather:	Light rain
Air Temperature:	10°C
Cloud Cover:	100%
Wildlife Sightings:	None
Site Accessibility: Yes, Accessible	Off Highway 102 Park before guardrail.
Site Access Detail:	Carefully slow truck down while pulling off highway 102. Park truck with hazard lights on before the start of the guardrail. Walk along outside of guardrail (for approximately 150m). Site is on right fed by a swampy bog area. Samples were taken in front of culvert. There is a concrete pad to step on to take samples. Sample while standing downstream.

Field Parameter Data

	Remarks
Date (d.m.y):	17/10/18
Time (hh:mm):	3:40 pm
Sample Depth (m):	< 1m
pH:	6.70
Dissolved Oxygen (mg/L):	6.06
Secchi Depth (m):	N/A
Water Temperature (degrees Celsius):	10.6
Conductivity (µs/cm):	189.4

Additional Comments / Notes

N/A

Appendix B – Field Report Autumn 2018

Project:	Water Quality Monitoring - Bedford West	Sub-Area(s): 2, 3, 4, 5
Client:	Halifax Regional Municipality	
Site: Highway 102	Site ID: HWY 102-2	
Watercourse: Marsh area	Location: HWY 102, south of exit 3	
Monitoring Well <input type="checkbox"/> Pumping Well <input type="checkbox"/> Surface Water <input checked="" type="checkbox"/> Spring/Seep <input type="checkbox"/> Discharge Pipe <input type="checkbox"/> Other:		
GPS Coordinates:	20T 0444829E, 4951778N (UTM, NAD83)	
SNC Field Personnel:	Maria Gutierrez / Cally Baxter	

Site Conditions

Weather:	Cloudy
Air Temperature:	10°C
Cloud Cover:	90%
Wildlife Sightings:	None.
Site Accessibility: Yes, Accessible	Off Highway 102 (Small gravel drive way- *Back in)
Site Access Detail:	Travel along Highway 102 toward Bedford NS. Site is on right easily to identify based on swamp/bog. Carefully slow truck down with hazard lights flashing. There is a small driveway to park truck. Pull a head of driveway and when lanes are clear back truck down into spot. Take samples in water body in front of culvert.

Field Parameter Data

	Remarks
Date (d.m.y)	17/10/18
Time (hh:mm):	1:40 pm
Sample Depth (m):	0.25
pH:	7.24
Dissolved Oxygen (mg/L):	5.62
Secchi Depth (m):	N/A
Water Temperature (degrees Celsius):	10.6°C
Conductivity (µs/cm):	246.4

Additional Comments / Notes

N/A

Appendix B – Field Report Autumn 2018

Project:	Water Quality Monitoring - Bedford West	Sub-Area(s): 2, 3, 4, 5
Client:	Halifax Regional Municipality	
Site: Lake Shore Drive	Site ID: LSD	
Watercourse: Marsh @ Lakeshore Dr.	Location: Kingswood Subdivision	
Monitoring Well <input type="checkbox"/> Pumping Well <input type="checkbox"/> Surface Water <input checked="" type="checkbox"/> Spring/Seep <input type="checkbox"/> Discharge Pipe <input type="checkbox"/> Other:		
GPS Coordinates:	20T 0442583E, 4950431N (UTM, NAD83)	
SNC Field Personnel:	Maria Gutierrez / Cally Baxter	

Site Conditions

Weather:	Partly Cloudy
Air Temperature:	9°C
Cloud Cover:	50%
Wildlife Sightings:	Frogs
Site Accessibility: Yes, Accessible	Via Lakeshore Drive in Kingswood Subdivision
Site Access Detail:	Take Kingswood Drive off Hammonds Plains Road. Travel down to Diana Drive on left go to end and take a left on Lakeshore drive. Travel approximately 1.0 km. There will be a clearing on left down to power lines. Drive truck (4X4) down until larger clearing is reached and park. Continue (walk) down hill to ATV pathway on left. Follow pathway for approximately 250m. Sample location is on right (river with a lot of vegetation throughout)

Field Parameter Data

	Remarks
Date (d.m.y):	17/10/18
Time (hh:mm):	10:50 am
Sample Depth (m):	~0.25
pH:	5.90
Dissolved Oxygen (mg/L):	7.24
Secchi Depth (m):	N/A
Water Temperature (degrees Celsius):	9.3°C
Conductivity (µs/cm):	108.1

Additional Comments / Notes

N/A

Appendix B – Field Report Autumn 2018

Project:	Water Quality Monitoring - Bedford West	Sub-Area(s): 9
Client:	Halifax Regional Municipality	
Site: Larry Uteck Blvd.	Site ID: LU	
Watercourse: Pond	Location: Larry Uteck off-ramp	
Monitoring Well <input type="checkbox"/> Pumping Well <input type="checkbox"/> Surface Water <input checked="" type="checkbox"/> Spring/Seep <input type="checkbox"/> Discharge Pipe <input type="checkbox"/> Other:		
GPS Coordinates:	20T 0444954E, 4949891N (UTM, NAD83)	
SNC Field Personnel:	Maria Gutierrez / Cally Baxter	

Site Conditions

Weather:	Cloudy
Air Temperature:	10 °C
Cloud Cover:	>90%
Wildlife Sightings:	None
Site Accessibility: Yes, Accessible	From Larry Uteck Road
Site Access Detail:	Take Larry Uteck off ramp and continue down Larry Uteck Blvd. for approximately 320m. Park truck safely on grassy clearing on left. Sample location is at shore line of lake across road. Take walking pathway to wooded area and travel approximately 80m to lake shore. Avoid walking through the bog area on right.

Field Parameter Data

	Remarks
Date (d.m.y):	17/10/18
Time (hh:mm):	12:25 pm
Sample Depth (m):	< 1m
pH:	7.09
Dissolved Oxygen (mg/L):	9.79
Secchi Depth (m):	N/A
Water Temperature (degrees Celsius):	12.4°C
Conductivity (µs/cm):	384.4

Additional Comments / Notes

> Strong/Bad odour

Appendix B – Field Report Autumn 2018

Project:	Water Quality Monitoring - Bedford West	Sub-Area(s): 2, 3, 4, 5
Client:	Halifax Regional Municipality	
Site: Paper Mill Lake	Site ID: PML1	
Watercourse: Paper Mill Lake	Location: Moirs Mill Subdivision	
Monitoring Well <input type="checkbox"/> Pumping Well <input type="checkbox"/> Surface Water <input checked="" type="checkbox"/> Spring/Seep <input type="checkbox"/> Discharge Pipe <input type="checkbox"/> Other:		
GPS Coordinates:	20T 0445129E, 4951154N (UTM, NAD83)	
SNC Field Personnel:	Maria Gutierrez / Cally Baxter	

Site Conditions

Weather:	Overcast
Air Temperature:	11°C
Cloud Cover:	100%
Wildlife Sightings:	Birds
Site Accessibility: Yes, Accessible	Travel down Ahmadi Cr. approximately 340m (around second bend in road). Park truck in front of Halifax Water station and carefully walk down rock wall on left. At the bottom locate the small stream and continue along the left and side facing lake. Sample location is a small clearing to the left at the mouth of the river.

Field Parameter Data

	Remarks
Date (d.m.y):	17/10/18
Time (hh:mm):	2:45 pm
Sample Depth (m):	0.5m
pH:	7.19
Dissolved Oxygen (mg/L):	8.36
Secchi Depth (m):	2.9
Water Temperature (degrees Celsius):	12.3°C
Conductivity (µs/cm):	208.1

Additional Comments / Notes

<ul style="list-style-type: none"> > Potentially seek a new access point as this one is challenging with the boat.
--

Appendix B – Field Report Autumn 2018

Project:	Water Quality Monitoring - Bedford West	Sub-Area(s): 2, 3, 4, 5
Client:	Halifax Regional Municipality	
Site: Paper Mill Lake	Site ID: PML2	
Watercourse: Paper Mill Lake	Location: Moirs Mill Subdivision	
Monitoring Well <input type="checkbox"/> Pumping Well <input type="checkbox"/> Surface Water <input checked="" type="checkbox"/> Spring/Seep <input type="checkbox"/> Discharge Pipe <input type="checkbox"/> Other:		
GPS Coordinates:	20T 0445363E, 4951740N (UTM, NAD83)	
SNC Field Personnel:	Maria Gutierrez / Cally Baxter	

Site Conditions

Weather:	Cloudy
Air Temperature:	11°C
Cloud Cover:	100%
Wildlife Sightings:	None
Site Accessibility: Yes, Accessible	Via Lake Dr., off Hammonds Plains Rd.
Site Access Detail:	Follow pathway along lake bank to small clearing, use GPS to find exact sample location. Travel over small ridge to reach lake and sample at edge.

Field Parameter Data

	Remarks
Date (d.m.y):	17/10/18
Time (hh:mm):	2:15 pm
Sample Depth (m):	<1m
pH:	7
Dissolved Oxygen (mg/L):	8.70
Secchi Depth (m):	2.2
Water Temperature (degrees Celsius):	12.2
Conductivity (µs/cm):	297.3

Additional Comments / Notes

> N/A

Appendix C

Site Photographs



Photo 1: KL1 Kearney Lake Sample Location



Photo 2: KL2 Kearney Lake Sample Location.



Photo 3: L3 Kearney Lake Sample Location



Photo 4: KL4 Kearney Lake Sample Location



Photo 5: KL5 Kearney Lake Sample Location



Photo 6: HWY 102-1 Sample Location



Photo 7: HWY102-2 Sample Location



Photo 8: LSD Lake Shore Drive Sample Location



Photo 9: LU Larry Uteck Sample Location



Photo 10: PML-1 Paper Mill Lake Sample Location



Photo 11: PML-2 Paper Mill Lake Sample Location

Appendix D

Summary Table Results (Seasonal and Historical)

TABLE D1: 2018 Autumn Results, Bedford West Water Quality Sampling Program

Tested Parameters		RDL	NSE ESQs for Surface Water (Reference)	Health Canada Guideline for Recreational Water Quality (Reference)	CCME Guideline PAL-F (Applied)	KL1	KL2	KL3	KL4	KL5	HWY-102-1	HWY-102-2	LSD	LU	PML-1	PML-2
Sampling Date						2018/10/17	2018/10/17	2018/10/17	2018/10/17	2018/10/17	2018/10/17	2018/10/17	2018/10/17	2018/10/17	2018/10/17	2018/10/17
Sampling Time						9:00 AM	10:00 AM	11:30 AM	11:45 AM	9:30 AM	15:40 00 PM	14:15 PM	10:50 AM	12:25 PM	14:45 PM	14:15 PM
Field Data (in Situ)																
Secchi Depth	Meters	--	--	minimum of 1.2	--	2.5	1.4	N/A	N/A	3.8	N/A	N/A	N/A	N/A	2.9	2.2
Water Temp	Celsius	--	--	--	--	12.8	10.3	12.4	12.7	13.1	10.6	10.6	9.3	12.4	12.3	12.2
Dissolved Oxygen	mg/L	--	--	5.5 - 9.5	--	8.6	7.5	8.6	8.5	7.6	6.1	5.6	7.2	9.8	8.4	8.7
pH	pH	--	--	5.0-9.0	6.5 - 9.0	6.8	5.8	6.6	6.9	6.67	6.7	7.2	5.9	7.1	7.2	7.0
Specific Conductance (µS/cm)	uS/cm	--	--	--	--	253.7	67.2	209.8	210.6	236.4	189.4	246.4	108.1	384.4	208.1	297.3
Inorganic Parameters																
Alkalinity	mg/L	5	--	--	--	7.0	<5	7.0	8.0	26.0	12.0	13.0	9.0	13.0	8.0	8.0
Chloride	mg/L	1	--	--	120	55.0	11.0	46.0	47.0	47.0	61.0	30.0	20.0	74.0	47.0	43.0
True Color	TCU	5	--	--	--	18.0	123.0	27.0	16.0	12.0	68.0	85.0	65.0	24.0	31.0	21.0
Nitrate + Nitrite as N	mg/L	0.05	--	--	--	0.2	<0.05	0.1	0.1	0.4	0.2	0.8	0.1	1.3	0.2	0.2
Nitrate as N	mg/L	0.05	--	--	13	0.2	<0.05	0.1	0.1	0.4	0.2	0.8	0.1	1.3	0.2	0.2
Nitrite as N	mg/L	0.05	--	--	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ammonia as N	mg/L	0.03	--	--	18	0.1	0.1	0.03	0.03	0.05	<0.03	0.06	<0.03	<0.03	<0.03	0.05
Total Kjeldahl Nitrogen as N	mg/L	0.4	--	--	--	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Total Organic Carbon	mg/L	0.5	--	--	--	4.0	14.0	4.0	4.0	3.0	7.0	8.0	8.0	5.0	4.0	4.0
Ortho-Phosphate as P	mg/L	0.01	--	--	--	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
pH				5.0-9.0	6.5 - 9.0	7.1	6.3	7.1	7.1	7.5	6.9	7.1	7.0	7.3	7.2	7.1
Calcium	mg/L	0.1	--	--	--	6.9	2.9	8.4	7.7	7.6	9.9	16.5	3.5	14.9	8.4	7.7
Magnesium	mg/L	0.1	--	--	--	1.3	0.8	1.4	1.3	1.2	1.8	1.9	0.9	2.1	1.4	1.3
Total Phosphorus	mg/L	0.002	--	--	0.01	0.008	0.004	0.006	0.004	0.005	0.010	0.014	0.018	0.021	0.012	0.012
Potassium	mg/L	0.1	--	--	--	0.8	0.6	1.1	1.0	0.9	1.4	1.7	0.8	2.3	1.1	1.1
Sodium	mg/L	0.1	--	--	--	31.7	11.8	39.9	40.6	41.7	47.9	29.4	15.4	69.9	39.2	39.6
Reactive Silica as SiO2	mg/L	0.5	--	--	--	1.7	3.6	1.9	2.0	3.4	4.6	4.6	3.3	4.7	2.3	2.3
Total Suspended Solids	mg/L	5	--	--	Comment 1	<5	<5	<5	<5	<5	<5	<5	6.0	<5	<5	<5
Sulphate	mg/L	2	--	--	--	9.0	3.0	7.0	8.0	11.0	11.0	16.0	5.0	24.0	9.0	8.0
Turbidity	NTU	0.1	--	50	--	2.1	1.1	1.2	1.7	0.7	3.2	1.1	2.5	4.5	2.1	1.2
Conductivity	umho/cm	1	--	--	--	215.0	70.0	232.0	231.0	286.0	306.0	208.0	123.0	422.0	232.0	227.0
Calculated Parameters																
Anion Sum	me/L	--	--	--	--	1.9	0.4	1.6	1.7	2.1	2.2	1.5	0.9	2.9	1.7	1.6
Bicarb. Alkalinity (as CaCO3)	mg/L	5	--	--	--	7.0	<5	<5	8.0	26.0	12.0	13.0	9.0	13.0	8.0	8.0
Calculated TDS	mg/L	1	--	--	--	110.0	31.0	109.0	111.0	127.0	142.0	107.0	52.0	201.0	112.0	107.0
Carb. Alkalinity (as CaCO3)	mg/L	10	--	--	--	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cation sum	me/L	--	--	--	--	1.9	0.8	2.3	2.3	2.3	2.8	2.3	1.0	4.1	2.3	2.3
Hardness	mg/L	--	--	--	--	22.6	10.5	26.7	24.6	23.9	32.1	49.0	12.4	45.9	26.7	24.6
% Difference/ Ion Balance (NS)	%	--	--	--	--	0.4	36.7	18.4	16.2	5.0	12.1	21.8	6.6	15.9	14.9	18.7
Langelier Index (@20C)	NA	--	--	--	--	-2.8	-4.1	-2.7	-2.7	-1.8	-2.6	-2.2	-3.1	-2.0	-2.6	-2.8
Langelier Index (@ 4C)	NA	--	--	--	--	-3.2	-4.4	-3.0	-3.0	-2.2	-2.9	-2.5	-3.4	-2.4	-2.9	-3.1
Saturation pH (@ 20C)	NA	--	--	--	--	9.9	10.4	9.8	9.8	9.3	9.5	9.3	10.1	9.3	9.8	9.8
Saturation pH (@ 4C)	NA	--	--	--	--	10.2	10.7	10.1	10.1	9.6	9.9	9.6	10.4	9.7	10.1	10.1
Metals (ICP-MS)																
Total Aluminum	ug/L	5	5	--	100 ug/L (based on pH)	--	--	--	--	--	--	--	--	--	--	--
Total Antimony	ug/L	2	20	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Arsenic	ug/L	2	5.0	--	5	--	--	--	--	--	--	--	--	--	--	--
Total Barium	ug/L	5	1000	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Beryllium	ug/L	2	5.3	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Bismuth	ug/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Boron	ug/L	5	1200	--	1500	--	--	--	--	--	--	--	--	--	--	--
Total Cadmium	ug/L	0.09	0.01	--	0.09	--	--	--	--	--	--	--	--	--	--	--
Total Chromium	ug/L	1	--	--	1	--	--	--	--	--	--	--	--	--	--	--
Total Cobalt	ug/L	1	10	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Copper	ug/L	1	2	--	2 ug/L (based on hardness)	2.0	1.0	1.0	1.0	1.0	3.0	2.0	1.0	5.0	1.0	2.0
Total Iron	ug/L	50	300	--	300	142.0	336.0	<50	78.0	<50	403.0	93.0	164.0	206.0	82.0	165.0
Total Lead	ug/L	0.5	1	--	1 ug/L (base on hardness)	--	--	--	--	--	--	--	--	--	--	--
Total Manganese	ug/L	2	820	--	--	28.0	29.0	22.0	43.0	14.0	71.0	10.0	58.0	40.0	22.0	74.0
Total Molybdenum	ug/L	2	73	--	73	--	--	--	--	--	--	--	--	--	--	--
Total Nickel	ug/L	2	25	--	25 ug/L (base on hardness)	--	--	--	--	--	--	--	--	--	--	--
Total Selenium	ug/L	1	1.0	--	1	--	--	--	--	--	--	--	--	--	--	--
Total Silver	ug/L	0.1	0.1	--	0.25	--	--	--	--	--	--	--	--	--	--	--
Total Strontium	ug/L	5	21000	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Thallium	ug/L	0.1	0.8	--	0.8	--	--	--	--	--	--	--	--	--	--	--
Total Tin	ug/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Titanium	ug/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Uranium	ug/L	0.1	300	--	15	--	--	--	--	--	--	--	--	--	--	--
Total Vanadium	ug/L	2	6	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Zinc	ug/L	5	30	--	30	19.0	20.0	<5	7.0	7.0	12.0	69.0	<5	38.0	<5	6.0

Tested Parameters		RDL	NSE ESQs for Surface Water (Reference)	Health Canada Guideline for Recreational Water Quality (Reference)	CCME Guideline PAL-F (Applied)	KL1	KL2	KL3	KL4	KL5	HWY-102-1	HWY-102-2	LSD	LU	PML-1	PML-2
Microbiological Parameters																
Total Coliforms	CFU/100 mL	1 to 10	--	--	--	157.0	140.0	5,020.0	8,000.0	6,000.0	370.0	81.0	2,380.0	330.0	4,000.0	3,030.0
E. Coli	CFU/100 mL	1 to 10	--	400	--	61.0	50.0	20.0	12.0	11.0	2.0	3.0	20.0	30.0	13.0	30.0
Chlorophyll A - Acidification Method	ug/L	0.05	--	--	--	1.6	0.7	1.3	1.1	1.7	1.1	0.5	0.6	2.4	1.1	1.8
Chlorophyll A - Welschmeyer Method	ug/L	0.05	--	--	--	*	*	*	*	*	*	*	*	*	*	*

(*) Chlorophyll A - Welschmeyer Method not completed due to laboratory's instrument failure.

RDL = Reported Detection Limit (represents most recent sampling event)

" -- " = no guideline available / no parameter tested.

NDOGT- No Data Overgrown With Target

Nova Scotia Environmental Quality Standards (EQS) for Contaminated Sites (NSE 2014) Table A2 Reference for Pathway Specific Standards for Surface Water (ug/L) - Fresh Water

Health Canada Guidelines for Canadian

CCME PAL-F Canadian Council of Ministers of the Environment Guidelines for the Protection of Aquatic Life - Freshwater (Updated 2015)

CCME Phosphorus Trigger Range (Applied) of 0.01 mg/L

CCME PAL-F Guidelines for Aluminum, Lead, Copper and Nickel vary based on reported pH and water hardness.

CCME PAL-F Guideline for Ammonia-N vary base on water pH and Temperature. The value is converted to mg/L total ammonia-N by multiplying by 0.8224

Comment 1: CCME PAL-F reference values between 25-250 mg/L, and >250 mg/L.

Bold and Black Shaded Concentration exceeds CCME FWAL applicable guideline.

Underlined and Black Shaded Concentration exceeds NSE EQS Contaminated Sites Regulations and/or Health Canada Guideline for Recreational Water Quality (Reference Guidelines)

TABLE D2 Historical Data - Bedford West Water Quality Sampling Program

Table with columns for Tested Parameters, Units, RDL (2017), NSE ESQs for Surface Water (Reference), Health Canada Guideline for Recreational Water Quality (Reference), CCME Guideline PAL-F (Applied), HRM Phosphorus Trigger Range (Applied), and a grid of data points for Kamee Lake from 2009/06/26 to 2018/10/17. The data grid includes various chemical and biological parameters such as Temperature, Dissolved Oxygen, pH, Conductivity, and heavy metals.

Notes:

N/A - Not Applicable; NC - Not Collected; RDL - Report Ind Detect on L m (1 sp essent most essent sampl ng event); -- = no gu del ne avable / Not Tested; CCME PAL-F: Canad an Council of M n ste s of the Env onment Gu del nes fo the P ote ct on of Aqat L fe - F eshwa e (updated 2011); CCME PAL-F Gu del nes fo Alum num, Lead, Coppe and Ni cet va y based on rpo ted pH and wa e ha dness (CCME PAL-F calculat on equat on); The gest gu del ne va e fo each espect ve element ange wa always used; Comment 1: CCME PAL-F etc etc values between 25-150 mg/L and >150 mg/L; Health Canada Gu del nes fo Canad an Rec eat onal Wa e Qual ty - D aft (September 2009); Nova Scot a Env onmental Qual ty Standa ds (EQS) fo Contam nated S tes (NSE 2014) Table A2 Refe ence fo Pathway Spec f Standa ds fo Su face Wa e (ug/L) - F esh Wa e; (*) Chlo ophyll A - Wetlichmeyer Method not completed due to labo ato y s nst ument fa lu e.

Black shaded = P essent Result - Pa amete concent at on exceeds CCME FWAL Gu del ne.

Dark shaded = P essent Result - Pa amete concent at on exceeds NSE EQS Contam nated S tes Regulat on and/o Health Canada Gu del ne fo Rec eat onal Wa e Qual ty.

Blue shaded = Past Result - Pa amete concent at on exceeds CCME FWAL Gu del ne and/o NSE EQS Contam nated S tes Regulat on and/o Health Canada Gu del ne fo Rec eat onal Wa e Qual ty.

TABLE D2 Historical Data - Bedford West Water Quality Sampling Program

Table with columns for Tested Parameters, Units, RDL (2017), NSE EQS for Surface Water (Reference), Health Canada Guideline for Recreational Water Quality (Reference), CCME Guideline PAL-F (Applied), HRM Phosphorus Trigger Range (Applied), and a grid of data points for various parameters across multiple dates from 2009/06/29 to 2018/08/17. Parameters include Dissolved Oxygen, pH, Conductance, Ammonia, Nitrate, Nitrite, Phosphate, Sulphate, Chloride, Fluoride, Total Solids, and various metals and nutrients.

Notes:
N/A - Not Applicable; NC - Not Calculable; NCT - Not Collected; RDL - Result detected on L m (1 eq events most recent sampling event); -- = no data received / Not Tested.
CCME PAL-F Guideline for Ammonia, Lead, Copper, and Nitrate is based on reported pH and water hardness (CCME PAL-F calculation on equivalent ions). The guideline value for each respective element range was always used.
**CCME PAL-F Guideline for TSS maximum concentration of 25 mg/L on background levels at any time when background levels are below 25 and 250 mg/L.
Health Canada Guideline for Canadian Recreational Water Quality - D (September 2009) (Reference)
Nova Scotia Environmental Quality Standards (EQS) (CCME 2014) Table A2 Reference Standards for Surface Water (ug/L) - Fresh Water

Legend:
Black and black shaded: P event Result - Parameter concentration at or exceeds CCME FWAL Guideline.
Blue and black shaded: P event Result - Parameter concentration at or exceeds NSE EQS Contaminated Sites Regulation and/or Health Canada Guideline for Recreational Water Quality.
Blue shaded: Past Result - Parameter concentration at or exceeds CCME FWAL Guideline and/or NSE EQS Contaminated Sites Regulation and/or Health Canada Guideline for Recreational Water Quality.

TABLE D2 Historical Data - Bedford West Water Quality Sampling Program

Table with columns for Tested Parameters, Units, RDL (2017), NSE EQs for Surface Water (Reference), Health Canada Guideline for Recreational Water Quality (Reference), CCME Guideline PAL-F (Applied), HRM Phosphorus Trigger Range (Applied), and a grid of sampling dates from 2009/06/29 to 2018/08/17. Rows include various chemical and physical parameters like pH, Dissolved Oxygen, Ammonia, and Metals.

Notes:
N/A - Not Applicable; NC - Not Calculable; NCC - Not Collected;
RDL - Report Detect Level on Lm (1 eq events most, except sampling event);
-- = no go del ne ava lable / Not Tested.
CCME PAL-F Guideline for Ammonium, Lead, Copper and Nitrate by water hardness (CCME PAL-F calculated on equivalent ions). The first guideline value for each respective element range was always used.
*CCME PAL-F nitrate for TSS: maximum nitrate of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L.
Health Canada Guideline for Ammonia: Rec. eat onal Water Quality - D-1 (September 2009) (Referenced).
Nova Scotia Environmental Quality Standards for Surface Water (Environmental Quality Standards (EQS) for Contaminated Sites (NSEQ) Table A2 Reference)

Legend for result shading:
Bold (black shaded) = Pass Result - Parameter concentration does not exceed CCME FWAL guideline.
Bold (red/black shaded) = Pass Result - Parameter concentration does not exceed NSEQ Contaminated Sites Regulation and/or Health Canada guideline for Rec. eat onal Water Quality.
Blue shaded = Pass Result - Parameter concentration does not exceed CCME FWAL guideline and/or NSEQ Contaminated Sites Regulation and/or Health Canada guideline for Rec. eat onal Water Quality.

TABLE D2 - Historical Data - Bedford West Water Quality Sampling Program

Table with columns for Tested Parameters, Units, RDL (2017), NSE ESQs for Surface Water (Reference), Health Canada Guidelines for Recreational Water Quality (Reference), CCME Guideline PAL-F (Applied), HRM Phosphorus Trigger Range (Applied), and a grid of data points for various dates from 2011 to 2021. The table is divided into sections: FIELD DATA, INORGANICS, Calculated Parameters, and MICROBIOLOGICAL.

Notes:
N/A - Not Applicable
NC - Not Collected
RDL - Report Not Detected on Minimum of 40 samples
-- = no data available / Not Tested
CCME PAL-F - Canadian Council of Ministers of the Environment Quality Guidelines for the Protection of Aquatic Life - Freshwater (updated 2011)
CCME PAL-F Guideline for Alkalinity, Lead, Copper and Nitrate is based on reported pH and water hardness (CCME PAL-F calculation on report only). The highest guideline value for each respective element range was always used.
**CCME PAL-F no nitrate for TSS maximum concentration of 25 mg/L on background levels at any time when background level is above 25 and 250 mg/L.
Health Canada Guideline for Canadian Recreational Water Quality - DRAFT September 2009 (Reference)
Nova Scotia Environmental Quality Standards for Surface Water (Environmental Quality Standards (EQS) Contaminated Sites (NSEQ 2014) Table A2 Reference for Surface Water (ug/L) - Freshwater

Legend:
Bold (black shaded) = Past Result - Parameter concentration at or exceeds CCME FWAL Guideline.
Blue (black shaded) = Past Result - Parameter concentration at or exceeds NSE EQS Contaminated Sites Regulations and/or Health Canada Guideline for Recreational Water Quality.
Blue shaded = Past Result - Parameter concentration at or exceeds CCME FWAL Guideline and/or NSE EQS Contaminated Sites Regulations and/or Health Canada Guideline for Recreational Water Quality.

HRM Water Quality Monitoring Program Results

TABLE D2: Historical Data - Bedford West Water Quality Sampling Program

Table with columns for Tested Parameters, Units, RDL (2017), NSE ESCs for Surface Water (Reference), Health Canada Guideline for Recreational Water Quality (Reference), CCME Guideline PAL-F (Applied), HRM Phosphorus Trigger Range (Applied), and Lake Shore Drive. Rows include Sample Sites, Sampling Date, Field Data (Secchi Depth, Water Temp, Dissolved Oxygen, pH, Specific Conductance), Inorganics (Total Alkalinity, Dissolved Chloride, Colour, Nitrate, Nitrite, Nitrogen, Total Kjeldahl Nitrogen, Total Organic Carbon, Orthophosphate, pH, Total Calcium, Total Magnesium, Total Phosphorus, Total Potassium, Total Sodium, Reactive Silica, Total Suspended Solids, Dissolved Sulphate, Turbidity, Conductivity), Calculated Parameters (Anion Sum, Bicarb. Alkalinity, Calculated TDS, Carb. Alkalinity, Cation Sum, Hardness, Ion Balance, Langelier Index, Saturation pH), Metals (ICP-MS) (Total Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Molybdenum, Nickel, Selenium, Silver, Strontium, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc), and Microbiological (Total Coliform, E. coli, Chlorophyll A). Values are provided for dates from 2009/06/29 to 2018/10/17.

Notes:
N/A - Not Applicable; NC - Not Calculable; NCC Not Collected;
RD - Repetitive Detect on 1 or more parameters;
-- no gu del ne val table / Not Tested;
CCME PAL-F Guideline for M n e s of the Env. onment Gu del ne fo the P oject on of Aquat c l f e - F eshwa (updated 2011);
CCME PAL-F Gu del ne fo Alum num, Lead, Coppe, and N icke l va y based on epo ted pH and wa te ha dness (CCME PAL-F calculat on equat ons). The la ge st gu del ne val ue fo each es pect ve element ange was always used.
**CCME PAL-F ma at we fo TSS max mum nc ease of 25 mg/L from bakg qund levels at any t me when bakg qund levels a e between 25 and 250 mg/L.
Health Canada Gu del ne fo Canad an Rec eat onal Wa te Quality - O tfr (September 2009)
Nova Scot a Env onmental Qual ty Standa ds (EQS) fo Contam nated S tes (NSE 2014) Table A2 Refe ence fo Pathway Spec c Standa ds fo Su face Wa te (ug/L) - F esh Wa te

bold (black shaded) = P esent Result - Pa amete concent at on exceeds CCME FWAL Gu del ne;
bold (blue shaded) = P esent Result - Pa amete concent at on exceeds CCME FWAL Gu del ne and/o NSE ESC Contam nated S tes Regulat ons and/o Health Canada Gu del ne fo Rec eat onal Wa te Quality;
blue shaded = Past Result - Pa amete concent at on exceeds CCME FWAL Gu del ne and/o NSE ESC Contam nated S tes Regulat ons and/o Health Canada Gu del ne fo Rec eat onal Wa te Quality

Appendix E

Laboratory Certificate of Analysis

CLIENT NAME: SNC Lavalin Inc.
5657 SPRING GARDEN RD, SUITE 200
HALIFAX , NS B3J3R4
(902) 492-4544

ATTENTION TO: Mike Smith

PROJECT: 631477

AGAT WORK ORDER: 18X398281

MICROBIOLOGY ANALYSIS REVIEWED BY: Jason Coughtrey, Inorganics Supervisor

WATER ANALYSIS REVIEWED BY: Jason Coughtrey, Inorganics Supervisor

DATE REPORTED: Nov 06, 2018

PAGES (INCLUDING COVER): 11

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (902) 468-8718

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.



Certificate of Analysis

AGAT WORK ORDER: 18X398281

PROJECT: 631477

11 Morris Drive, Unit 122
 Dartmouth, Nova Scotia
 CANADA B3B 1M2
 TEL (902)468-8718
 FAX (902)468-8924
<http://www.aga labs.com>

CLIENT NAME: SNC Lavalin Inc.

ATTENTION TO: Mike Smith

SAMPLING SITE:

SAMPLED BY:

Total Coliforms and E.coli Membrane Filtration

DATE RECEIVED: 2018-10-17

DATE REPORTED: 2018-11-06

		SAMPLE DESCRIPTION: KL1				KL2		KL3		KL4		KL5		HWY-102-1	
		SAMPLE TYPE: Water				Water		Water		Water		Water		Water	
		DATE SAMPLED: 2018-10-17				2018-10-17		2018-10-17		2018-10-17		2018-10-17		2018-10-17	
Parameter	Unit	G / S	RDL	9631332	RDL	9631337	9631338	RDL	9631339	9631340	9631341				
Total Coliforms (MF)	CFU/100 mL		1	157	10	140	5020	10	8000	6000	370				
E. Coli (MF)	CFU/100 mL		1	61	10	50	20	1	12	11	2				
		SAMPLE DESCRIPTION: HWY-102-2				LSD		LU		PML-1		PML-2			
		SAMPLE TYPE: Water				Water		Water		Water		Water			
		DATE SAMPLED: 2018-10-17				2018-10-17		2018-10-17		2018-10-17		2018-10-17			
Parameter	Unit	G / S	RDL	9631342	RDL	9631343	9631344	RDL	9631345	RDL	9631346				
Total Coliforms (MF)	CFU/100 mL		1	81	10	2380	330	10	4000	10	3030				
E. Coli (MF)	CFU/100 mL		1	3	10	20	30	1	13	10	30				

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Canadian Drinking Water Quality - updated 2017-05
 Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Analysis performed at AGAT Halifax (unless marked by *)

Certified By:

Original signed



Certificate of Analysis

AGAT WORK ORDER: 18X398281

PROJECT: 631477

11 Morris Drive, Unit 122
 Dartmouth, Nova Scotia
 CANADA B3B 1M2
 TEL (902)468-8718
 FAX (902)468-8924
<http://www.aga labs.com>

CLIENT NAME: SNC Lavalin Inc.

ATTENTION TO: Mike Smith

SAMPLING SITE:

SAMPLED BY:

SNC-Lavalin Bedford West Custom Inorganics Package

DATE RECEIVED: 2018-10-17

DATE REPORTED: 2018-11-06

Parameter	Unit	SAMPLE DESCRIPTION:		KL1	KL2	KL3	KL4	KL5	HWY-102-1	HWY-102-2	LSD
		G / S	RDL	Water	Water	Water	Water	Water	Water	Water	Water
		DATE SAMPLED:		2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17
				9631332	9631337	9631338	9631339	9631340	9631341	9631342	9631343
Alkalinity	mg/L	5	7	<5	7	8	26	12	13	9	
Chloride	mg/L	1	55	11	46	47	47	61	30	20	
True Color	TCU	5	18	123	27	16	12	68	85	65	
Nitrate + Nitrite as N	mg/L	0.05	0.21	<0.05	0.13	0.13	0.42	0.19	0.76	0.10	
Nitrate as N	mg/L	0.05	0.21	<0.05	0.13	0.13	0.42	0.19	0.76	0.10	
Nitrite as N	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Ammonia as N	mg/L	0.03	0.05	0.05	0.03	0.03	0.05	<0.03	0.06	<0.03	
Ortho-Phosphate as P	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
pH			7.07	6.27	7.10	7.13	7.47	6.94	7.07	6.99	
Total Calcium	mg/L	0.1	6.9	2.9	8.4	7.7	7.6	9.9	16.5	3.5	
Total Magnesium	mg/L	0.1	1.3	0.8	1.4	1.3	1.2	1.8	1.9	0.9	
Total Phosphorus	mg/L	0.002	0.008	0.004	0.006	0.004	0.005	0.010	0.014	0.018	
Total Potassium	mg/L	0.1	0.8	0.6	1.1	1.0	0.9	1.4	1.7	0.8	
Total Sodium	mg/L	0.1	31.7	11.8	39.9	40.6	41.7	47.9	29.4	15.4	
Reactive Silica as SiO2	mg/L	0.5	1.7	3.6	1.9	2.0	3.4	4.6	4.6	3.3	
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5	<5	<5	6	
Sulphate	mg/L	2	9	3	7	8	11	11	16	5	
Turbidity	NTU	0.1	2.1	1.1	1.2	1.7	0.7	3.2	1.1	2.5	
Electrical Conductivity	umho/cm	1	215	70	232	231	286	306	208	123	
Anion Sum	me/L		1.89	0.37	1.59	1.66	2.10	2.20	1.49	0.86	
Bicarb. Alkalinity (as CaCO3)	mg/L	5	7	<5	<5	8	26	12	13	9	
Calculated TDS	mg/L	1	110	31	109	111	127	142	107	52	
Carb. Alkalinity (as CaCO3)	mg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	
Cation sum	me/L		1.88	0.80	2.31	2.30	2.33	2.81	2.33	0.98	
Hardness	mg/L		22.6	10.5	26.7	24.6	23.9	32.1	49.0	12.4	
% Difference/ Ion Balance	%		0.4	36.7	18.4	16.2	5.0	12.1	21.8	6.6	
Langelier Index (@20C)	NA		-2.84	-4.11	-2.72	-2.67	-1.83	-2.59	-2.19	-3.07	
Langelier Index (@ 4C)	NA		-3.16	-4.43	-3.04	-2.99	-2.15	-2.91	-2.51	-3.39	
Saturation pH (@ 20C)	NA		9.91	10.4	9.82	9.80	9.30	9.53	9.26	10.1	
Saturation pH (@ 4C)	NA		10.2	10.7	10.1	10.1	9.62	9.85	9.58	10.4	

Original signed

Certified By:



Certificate of Analysis

AGAT WORK ORDER: 18X398281

PROJECT: 631477

11 Morris Drive, Unit 122
 Dartmouth, Nova Scotia
 CANADA B3B 1M2
 TEL (902)468-8718
 FAX (902)468-8924
<http://www.aga labs.com>

CLIENT NAME: SNC Lavalin Inc.

ATTENTION TO: Mike Smith

SAMPLING SITE:

SAMPLED BY:

SNC-Lavalin Bedford West Custom Inorganics Package

DATE RECEIVED: 2018-10-17

DATE REPORTED: 2018-11-06

Parameter	Unit	SAMPLE DESCRIPTION:		KL1	KL2	KL3	KL4	KL5	HWY-102-1	HWY-102-2	LSD
		SAMPLE TYPE:		Water	Water	Water	Water	Water	Water	Water	Water
		DATE SAMPLED:		2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17
		G / S	RDL	9631332	9631337	9631338	9631339	9631340	9631341	9631342	9631343
Total Copper	ug/L	1	2	1	1	1	1	1	3	2	1
Total Iron	ug/L	50	142	336	<50	78	<50	403	93	164	
Total Manganese	ug/L	2	28	29	22	43	14	71	10	58	
Total Zinc	ug/L	5	19	20	<5	7	7	12	69	<5	
Chlorophyll A - Acidification Method	ug/L	0.05	1.63	0.746	1.28	1.12	1.68	1.11	0.526	0.600	
Total Kjeldahl Nitrogen as N	mg/L	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	

Original signed

Certified By: _____



Certificate of Analysis

AGAT WORK ORDER: 18X398281

PROJECT: 631477

11 Morris Drive, Unit 122
 Dartmouth, Nova Scotia
 CANADA B3B 1M2
 TEL (902)468-8718
 FAX (902)468-8924
<http://www.aga labs.com>

CLIENT NAME: SNC Lavalin Inc.

ATTENTION TO: Mike Smith

SAMPLING SITE:

SAMPLED BY:

SNC-Lavalin Bedford West Custom Inorganics Package

DATE RECEIVED: 2018-10-17

DATE REPORTED: 2018-11-06

Parameter	Unit	SAMPLE DESCRIPTION:		LU	PML-1	PML-2
		G / S	RDL	Water	Water	Water
		DATE SAMPLED:		2018-10-17	2018-10-17	2018-10-17
				9631344	9631345	9631346
Alkalinity	mg/L		5	13	8	8
Chloride	mg/L		1	74	47	43
True Color	TCU		5	24	31	21
Nitrate + Nitrite as N	mg/L		0.05	1.26	0.24	0.20
Nitrate as N	mg/L		0.05	1.26	0.24	0.20
Nitrite as N	mg/L		0.05	<0.05	<0.05	<0.05
Ammonia as N	mg/L		0.03	<0.03	<0.03	0.05
Ortho-Phosphate as P	mg/L		0.01	<0.01	<0.01	<0.01
pH				7.29	7.16	7.05
Total Calcium	mg/L		0.1	14.9	8.4	7.7
Total Magnesium	mg/L		0.1	2.1	1.4	1.3
Total Phosphorus	mg/L		0.002	0.021	0.012	0.012
Total Potassium	mg/L		0.1	2.3	1.1	1.1
Total Sodium	mg/L		0.1	69.9	39.2	39.6
Reactive Silica as SiO2	mg/L		0.5	4.7	2.3	2.3
Total Suspended Solids	mg/L		5	<5	<5	<5
Sulphate	mg/L		2	24	9	8
Turbidity	NTU		0.1	4.5	2.1	1.2
Electrical Conductivity	umho/cm		1	422	232	227
Anion Sum	me/L			2.94	1.69	1.55
Bicarb. Alkalinity (as CaCO3)	mg/L		5	13	8	8
Calculated TDS	mg/L		1	201	112	107
Carb. Alkalinity (as CaCO3)	mg/L		10	<10	<10	<10
Cation sum	me/L			4.05	2.28	2.27
Hardness	mg/L			45.9	26.7	24.6
% Difference/ Ion Balance	%			15.9	14.9	18.7
Langelier Index (@20C)	NA			-2.04	-2.60	-2.75
Langelier Index (@ 4C)	NA			-2.36	-2.92	-3.07
Saturation pH (@ 20C)	NA			9.33	9.76	9.80
Saturation pH (@ 4C)	NA			9.65	10.1	10.1

Original signed

Certified By:



Certificate of Analysis

AGAT WORK ORDER: 18X398281

PROJECT: 631477

11 Morris Drive, Unit 122
 Dartmouth, Nova Scotia
 CANADA B3B 1M2
 TEL (902)468-8718
 FAX (902)468-8924
<http://www.aga labs.com>

CLIENT NAME: SNC Lavalin Inc.

ATTENTION TO: Mike Smith

SAMPLING SITE:

SAMPLED BY:

SNC-Lavalin Bedford West Custom Inorganics Package

DATE RECEIVED: 2018-10-17

DATE REPORTED: 2018-11-06

Parameter	Unit	SAMPLE DESCRIPTION:		LU	PML-1	PML-2
		G / S	RDL	9631344	9631345	9631346
Total Copper	ug/L		1	5	1	2
Total Iron	ug/L		50	206	82	165
Total Manganese	ug/L		2	40	22	74
Total Zinc	ug/L		5	38	<5	6
Chlorophyll A - Acidification Method	ug/L		0.05	2.39	1.12	1.78
Total Kjeldahl Nitrogen as N	mg/L		0.4	<0.4	<0.4	<0.4

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9631332 Total Phosphorus was analysed at AGAT Mississauga.
 Chlorophyll A was analysed by a sub-contracted laboratory.

9631337-9631339 Total Phosphorus was analysed at AGAT Mississauga.
 Chlorophyll A was analysed by a sub-contracted laboratory.
 Ion Balance is biased high, contributing parameters have been confirmed.

9631340 Total Phosphorus was analysed at AGAT Mississauga.
 Chlorophyll A was analysed by a sub-contracted laboratory.

9631341-9631342 Total Phosphorus was analysed at AGAT Mississauga.
 Chlorophyll A was analysed by a sub-contracted laboratory.
 Ion Balance is biased high, contributing parameters have been confirmed.

9631343 Total Phosphorus was analysed at AGAT Mississauga.
 Chlorophyll A was analysed by a sub-contracted laboratory.

9631344-9631346 Total Phosphorus was analysed at AGAT Mississauga.
 Chlorophyll A was analysed by a sub-contracted laboratory.
 Ion Balance is biased high, contributing parameters have been confirmed.

Analysis performed at AGAT Halifax (unless marked by *)

Original signed

Certified By:



Certificate of Analysis

AGAT WORK ORDER: 18X398281

PROJECT: 631477

11 Morris Drive, Unit 122
Dartmouth, Nova Scotia
CANADA B3B 1M2
TEL (902)468-8718
FAX (902)468-8924
<http://www.aga labs.com>

CLIENT NAME: SNC Lavalin Inc.

ATTENTION TO: Mike Smith

SAMPLING SITE:

SAMPLED BY:

TKN / Low Level TP (Water)

DATE RECEIVED: 2018-10-17

DATE REPORTED: 2018-11-06

Parameter	Unit	SAMPLE DESCRIPTION:		KL1	KL2	KL3	KL4	KL5	HWY-102-1	HWY-102-2	LSD
		G / S	RDL	Water	Water	Water	Water	Water	Water	Water	Water
		DATE SAMPLED:		2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17
Total Kjeldahl Nitrogen	mg/L		0.10	0.14	0.29	0.15	<0.10	0.12	0.25	0.28	0.30
Total Phosphorus	mg/L		0.002	0.008	0.004	0.006	0.004	0.005	0.010	0.014	0.018
Parameter	Unit	SAMPLE DESCRIPTION:		LU	PML-1	PML-2					
		G / S	RDL	Water	Water	Water					
		DATE SAMPLED:		2018-10-17	2018-10-17	2018-10-17					
Total Kjeldahl Nitrogen	mg/L		0.10	0.38	0.17	0.18					
Total Phosphorus	mg/L		0.002	0.021	0.012	0.012					

Comments: RDL - Reported Detection Limit, G / S - Guideline / Standard

Original signed

Certified By: _____



Certificate of Analysis

AGAT WORK ORDER: 18X398281

PROJECT: 631477

11 Morris Drive, Unit 122
 Dartmouth, Nova Scotia
 CANADA B3B 1M2
 TEL (902)468-8718
 FAX (902)468-8924
<http://www.aga labs.com>

CLIENT NAME: SNC Lavalin Inc.

ATTENTION TO: Mike Smith

SAMPLING SITE:

SAMPLED BY:

Water Analysis - TOC

DATE RECEIVED: 2018-10-17

DATE REPORTED: 2018-11-06

Parameter	Unit	SAMPLE DESCRIPTION:		KL1	KL2	KL3	KL4	KL5	HWY-102-1	HWY-102-2	LSD
		G / S	RDL	Water	Water	Water	Water	Water	Water	Water	Water
		DATE SAMPLED:		2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17	2018-10-17
Total Organic Carbon	mg/L	1	4	14	4	4	3	7	8	8	
		SAMPLE DESCRIPTION:		LU	PML-1	PML-2					
		SAMPLE TYPE:		Water	Water	Water					
		DATE SAMPLED:		2018-10-17	2018-10-17	2018-10-17					
Total Organic Carbon	mg/L	1	5	4	4						

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By:

Original signed

Quality Assurance

 CLIENT NAME: SNC Lavalin Inc.
 PROJECT: 631477
 SAMPLING SITE:

 AGAT WORK ORDER: 18X398281
 ATTENTION TO: Mike Smith
 SAMPLED BY:

Water Analysis															
RPT Date: Nov 06, 2018			DUPLICATE				Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE		MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Measured Value		Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

SNC-Lavalin Bedford West Custom Inorganics Package

Chloride	9631332	9631332	55	56	0.5%	< 1	93%	80%	120%	NA	80%	120%	NA	80%	120%
True Color	9631332	9631332	18	19	NA	< 5	105%	80%	120%	NA			NA		
Nitrate as N	9631332	9631332	0.21	0.19	NA	< 0.05	92%	80%	120%	NA	80%	120%	88%	80%	120%
Nitrite as N	9631332	9631332	<0.05	<0.05	NA	< 0.05	99%	80%	120%	NA	80%	120%	92%	80%	120%
Ammonia as N	1	9631099	<0.03	<0.03	NA	< 0.03	87%	80%	120%		80%	120%	85%	80%	120%
Ortho-Phosphate as P	1	9606059	<0.01	<0.01	NA	< 0.01	90%	80%	120%		80%	120%	94%	80%	120%
Total Calcium	9631448		7.0	7.2	2.9%	< 0.1	106%	80%	120%	108%	80%	120%	NA	70%	130%
Total Magnesium	9631448		3.5	3.7	4.2%	< 0.1	108%	80%	120%	104%	80%	120%	NA	80%	120%
Total Phosphorus	2		NA	NA	NA	< 0.002	93%	90%	110%	102%	90%	110%	NA	80%	120%
Total Potassium	9631448		2.3	2.4	6%	< 0.1	95%	80%	120%	98%	80%	120%	NA	70%	130%
Total Sodium	9631448		3.3	3.4	2%	< 0.1	111%	80%	120%	108%	80%	120%	NA	70%	130%
Reactive Silica as SiO2	1	9606059	4.0	3.9	2.5%	< 0.5	100%	80%	120%		80%	120%	83%	80%	120%
Total Suspended Solids	9631332	9631332	<5	<5	NA	< 5	98%	80%	120%	NA			104%	80%	120%
Sulphate	9631332	9631332	9	9	NA	< 2	112%	80%	120%	NA	80%	120%	102%	80%	120%
Turbidity	9631332	9631332	2.1	1.9	11.6%	< 0.1	105%	80%	120%	NA			NA		
Total Copper	9631448		7	7	2.2%	< 1	113%	80%	120%	111%	80%	120%	101%	70%	130%
Total Iron	9631448		58	56	NA	< 50	113%	80%	120%	110%	80%	120%	96%	70%	130%
Total Manganese	9631448		<2	<2	NA	< 2	113%	80%	120%	112%	80%	120%	101%	70%	130%
Total Zinc	9631448		8	8	NA	< 5	100%	80%	120%	99%	80%	120%	101%	70%	130%

Comments: If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

TKN / Low Level TP (Water)

Total Kjeldahl Nitrogen	9631332	9631332	0.14	0.18	NA	< 0.10	92%	80%	120%	94%	80%	120%	90%	70%	130%
Total Phosphorus	9636464		0.007	0.007	NA	< 0.002	93%	90%	110%	102%	90%	110%	100%	80%	120%

Water Analysis - TOC

Total Organic Carbon	9631309		<1	<1	NA	< 1	101%	80%	120%	95%	80%	120%	108%	80%	120%
----------------------	---------	--	----	----	----	-----	------	-----	------	-----	-----	------	------	-----	------

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

Water Analysis - TOC

Total Organic Carbon	9669305		<1	<1	NA	< 1	104%	80%	120%	110%	80%	120%	117%	80%	120%
----------------------	---------	--	----	----	----	-----	------	-----	------	------	-----	------	------	-----	------

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

Certified By:

 Original signed

Method Summary

CLIENT NAME: SNC Lavalin Inc.

AGAT WORK ORDER: 18X398281

PROJECT: 631477

ATTENTION TO: Mike Smith

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Microbiology Analysis			
Total Coliforms (MF)	MIC-121-7002	Sm 9222 H	MF/INCUBATOR
E. Coli (MF)	MIC-121-7002	SM 9222 H	MF/INCUBATOR
Water Analysis			
A kalinity	INOR-121-6001	SM 2320 B	
Chloride	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
True Color	INOR-121-6014	SM 2120 C	NEPHELOMETER
Nitrate + Nitrite as N	INORG-121-6005	SM 4110 B	CALCULATION
Nitrate as N	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Ammonia as N	INOR-121-6047	SM 4500-NH3 G	COLORIMETER
Ortho-Phosphate as P	INOR-121-6012	SM 4110 B	COLORIMETER
pH	INOR-121-6001	SM 4500 H+B	PC TITRATE
Total Calcium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Magnesium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Phosphorus	INOR-93-1022	SM 4500-P B & E	SPECTROPHOTOMETER
Total Potassium	MET121-6104 & MET-121-6105	SM 3125	ICP-MS
Total Sodium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Reactive Silica as SiO ₂	INOR-121-6027	SM 4110 B	COLORIMETER
Total Suspended Solids	INOR-121-6024, 6025	SM 2540C, D	GRAVIMETRIC
Sulphate	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Turbidity	INOR-121-6022	SM 2130 B	NEPHELOMETER
Electrical Conductivity	INOR-121-6001	SM 2510 B	PC TITRATE
Anion Sum	CALCULATION	SM 1030E	CALCULATION
Bicarb. A kalinity (as CaCO ₃)	INORG-121-6001	SM 2320 B	PC TITRATE
Calculated TDS		SM 1030E	CALCULATION
Carb. Alkalinity (as CaCO ₃)	INORG-121-6001	SM 2320 B	PC TITRATE
Cation sum	CALCULATION	SM 1030E	CALCULATION
Hardness	CALCULATION	SM 2340B	CALCULATION
% Difference/ Ion Balance	CALCULATION	SM 1030E	CALCULATION
Langelier Index (@20C)	CALCULATION	CALCULATION	CALCULATION
Langelier Index (@ 4C)	CALCULATION	CALCULATION	CALCULATION
Saturation pH (@ 20C)	CALCULATION	CALCULATION	CALCULATION
Saturation pH (@ 4C)	CALCULATION	CALCULATION	CALCULATION
Total Copper	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Iron	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Manganese	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Zinc	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Chlorophyll A - Acidification Method	Subcontracted	Subcontracted	
Total Kjeldahl Nitrogen as N	INOR-121-6020	SM 4500 NORG D	COLORIMETER
Total Kjeldahl Nitrogen	INOR-93-6048	Qu kChem 10-107-06-2-I & SM 4500-Norg D	LACHAT FIA
Total Phosphorus	INOR-93-6022	SM 4500-P B & E	SPECTROPHOTOMETER
Total Organic Carbon	INST 0170	SM 5310 B	COMBUSTION

Unit 122 - 11 Morris Dr.
Dartmouth, Nova Scotia
B3B 1M2
http://webearth.agatlabs.com

Phone: 902-468-8718
Fax: 902-468-8924
www.agatlabs.com

Laboratory use Only

Arrival Condition: Good Poor (complete 'notes')
Arrival Temperature: 12.7, 12.8, 13.1
AGAT Job Number: 18X398231
Notes:

Drinking Water Sample (y/n): _____ Reg. No. _____

Waterworks Number: _____

Report To:
Company: SNC Lavalin
Contact: Maria Gutierrez
Address: 5657 Spring Garden Road
Halifax, NS B3J 3R4
Phone: 902-492-4544 FAX:
Cell: 902-483-4059
AGAT Quotation:
Client Project #: 631477

Invoice to: Same (Y/N) - Circle
Company: SNC Lavalin
Contact: payables@sncclavalin.com
Address:
Phone: _____ Fax: _____
PO#/Credit Card #:

Report Information
1. Name: Maria Gutierrez
Email: Maria.Gutierrez@sncclavalin.com
2. Name: Mike Smith
Email: Michael.Smith@sncclavalin.com

Regulatory Requirements (Check):
 List Guidelines on Report Do Not List Guidelines on Report
 PIRI Site Info (check all that apply):
 Teir 1 Res. Pot. Coarse
 Teir 2 Com N/Pot. Fine
 Gas Fuel Lube
 CCME CDWQ
 Ind NSDFOSP
 Com HRM 101
 Res/P Storm Water
 Ag HRM 101
 FWAL Waste Water
 Sediment HEALTH CANADA
 Other RECREATIONAL WATER

Report Format
 Single PDF sample per page
 Multiple PDF samples per page
 Excel Format Included

Turnaround Time (TAT) Business Days
Regular TAT: 5 - 7 days
Rush TAT: 1 day 2 days
 3 - 4 days
Date Required: _____
Time Required: _____

SAMPLE IDENTIFICATION	DATE / TIME SAMPLED	SAMPLE MATRIX	# OF CONTAINERS	COMMENTS - Site/Sample Info, Sample Containment	Field Filtered/ Preserved	Standard Water Analysis	Metals (Spring Quarterly Only)	(circle-Total, Diss or Available)	Mercury	TKN	pH	TSS	TP- Low Level 0.002mg/L- Mississauga	Arlons	Total Phosphorus	Phenols	TPH/BTEX (PIR) Teir 1	TPH/BTEX-Fractionation Teir 2	VOC	THM	PAH	Chlorophyll A (Sub to DAL)	E. coli by CFU	Hazardous (Y/N)	Lab Sample #
KL1	Oct 17/18	water	7			X		T		X		X	X									X	X		
KL2	"	water	7			X		T		X		X	X									X	X		
KL3	"	water	7			X		T		X		X	X									X	X		
KL4	"	water	7			X		T		X		X	X									X	X		
KL5	"	water	7			X		T		X		X	X									X	X		
HWY-102-1	"	water	7			X		T		X		X	X									X	X		
HWY-102-2	"	water	7			X		T		X		X	X									X	X		
LSD	"	water	7			X		T		X		X	X									X	X		
LU	"	water	7			X		T		X		X	X									X	X		
PML-1	"	water	7			X		T		X		X	X									X	X		
PML-2	"	water	7			X		T		X		X	X									X	X		

Sample Relinquished By (print name & sign) Original signed	Date/Time Oct 17/18	Samples Received By (print name and sign) Sam Murphy	Date/Time 4:30 PM	Special Instructions
Sample Relinquished By (print name & sign)	Date/Time	Samples Received By (print name and sign) Original signed	Date/Time 10/17/18	SNC Bedford West Package

Appendix F

Graphs (Seasonal and Historical)

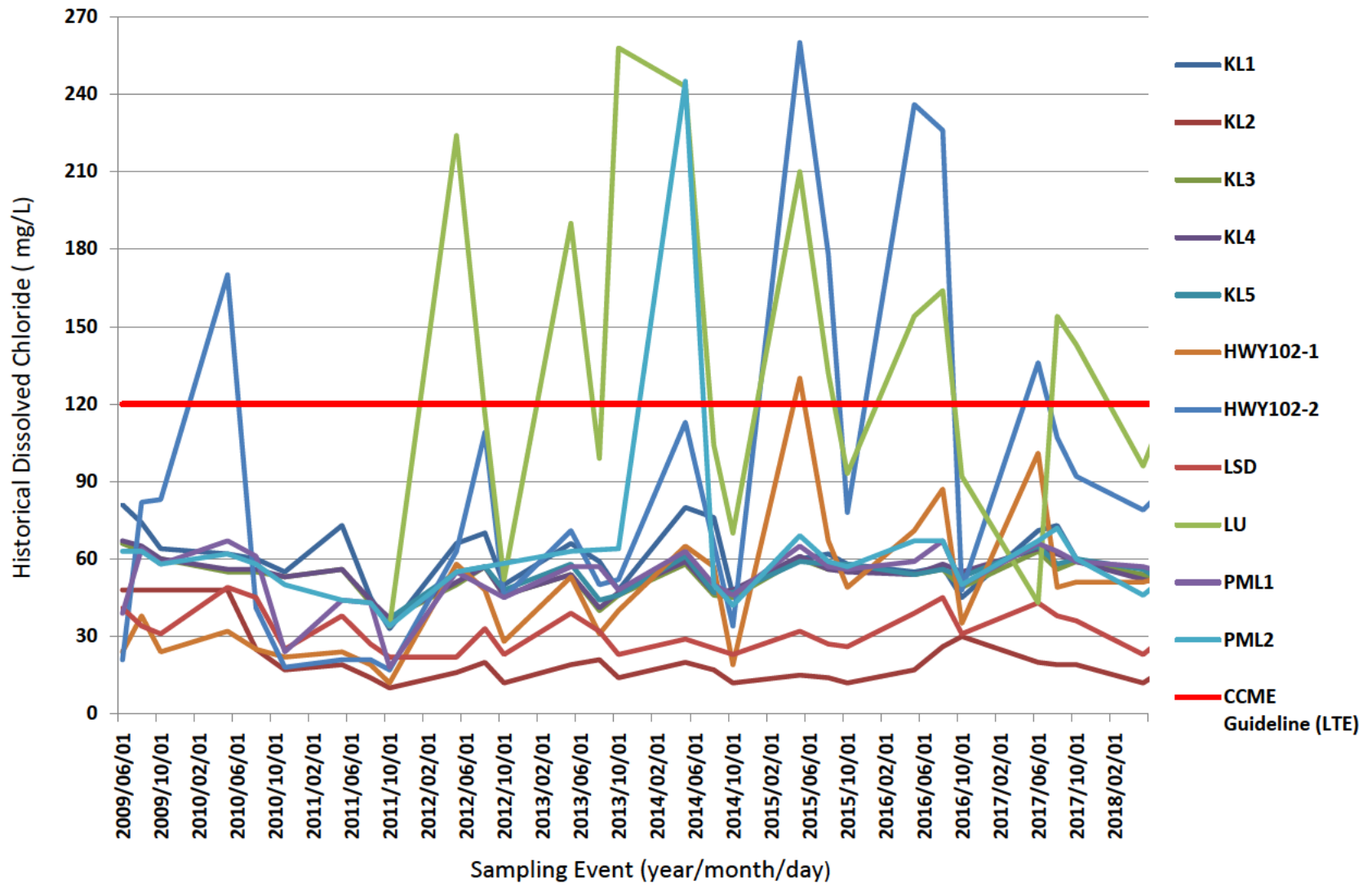


Figure 1 - Historical Dissolved Chloride Concentrations for Water Quality Monitoring Program.

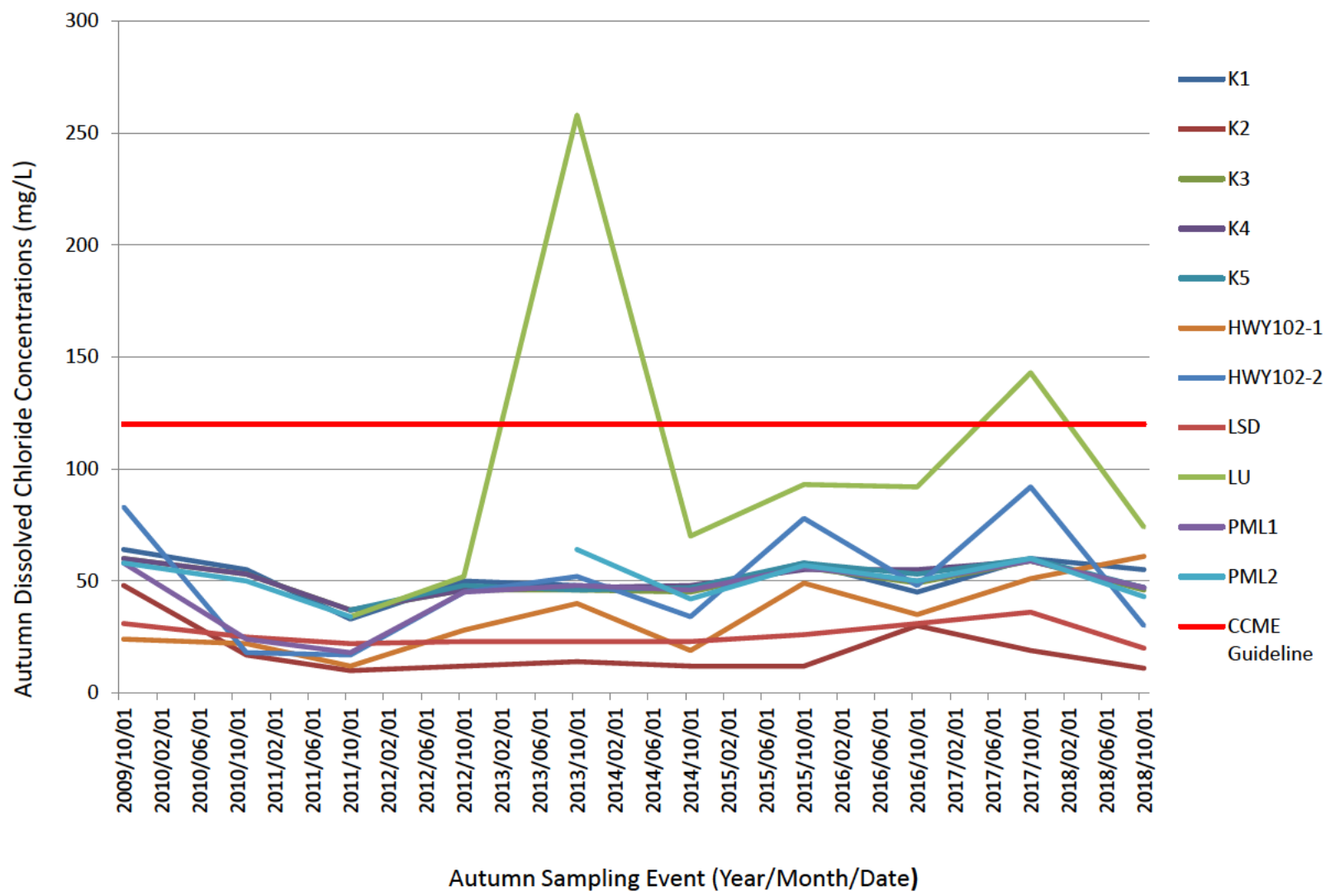


Figure 2 – Seasonal Dissolved Chloride Concentrations for Water Quality Monitoring Program.

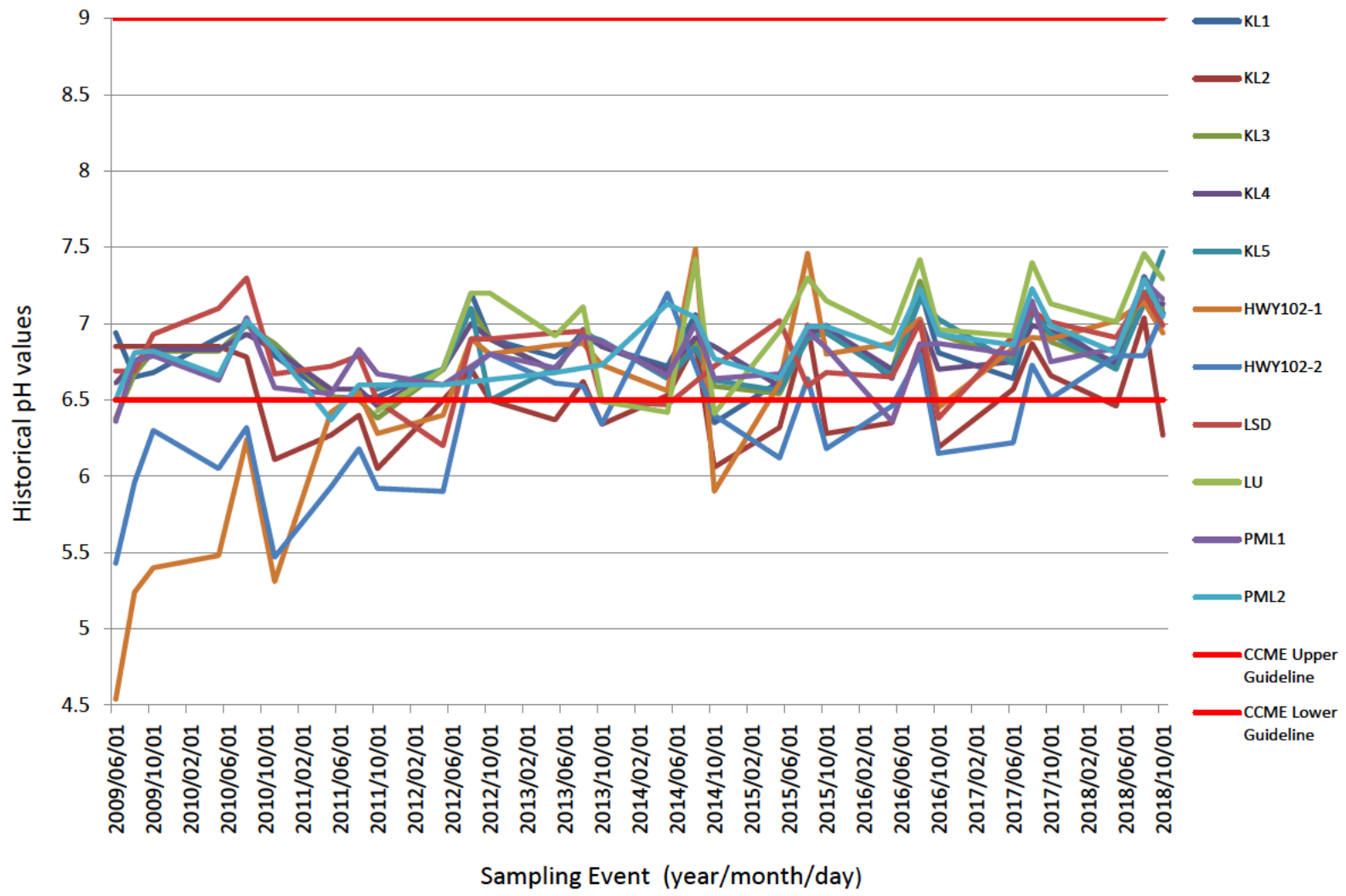


Figure 3 –Historical pH Measurements for Water Quality Monitoring Program

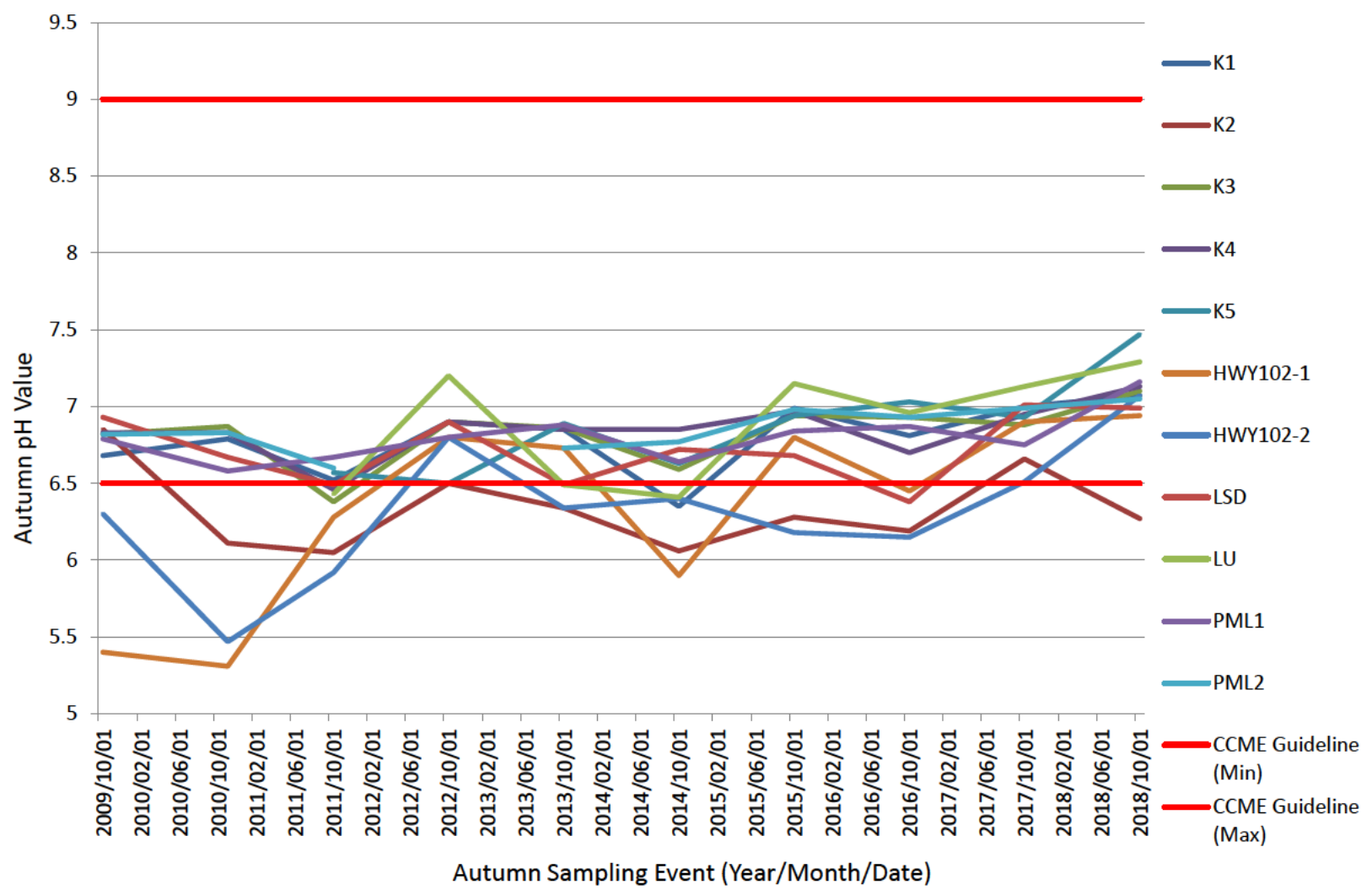


Figure 4 – Seasonal pH Measurements for Water Quality Monitoring Program.

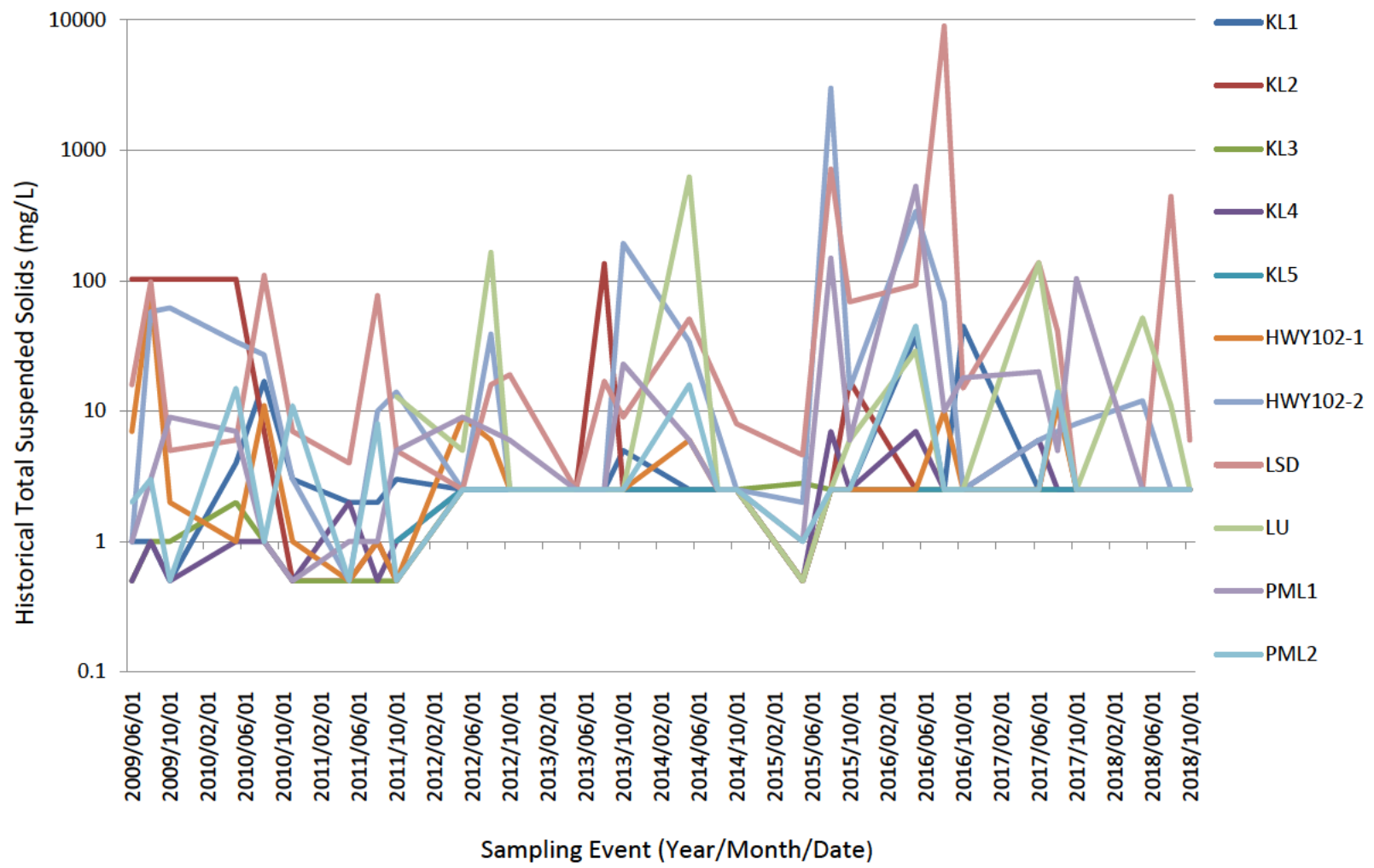


Figure 5 – Historical Total Suspended Solids Concentrations for Water Quality Monitoring Program.

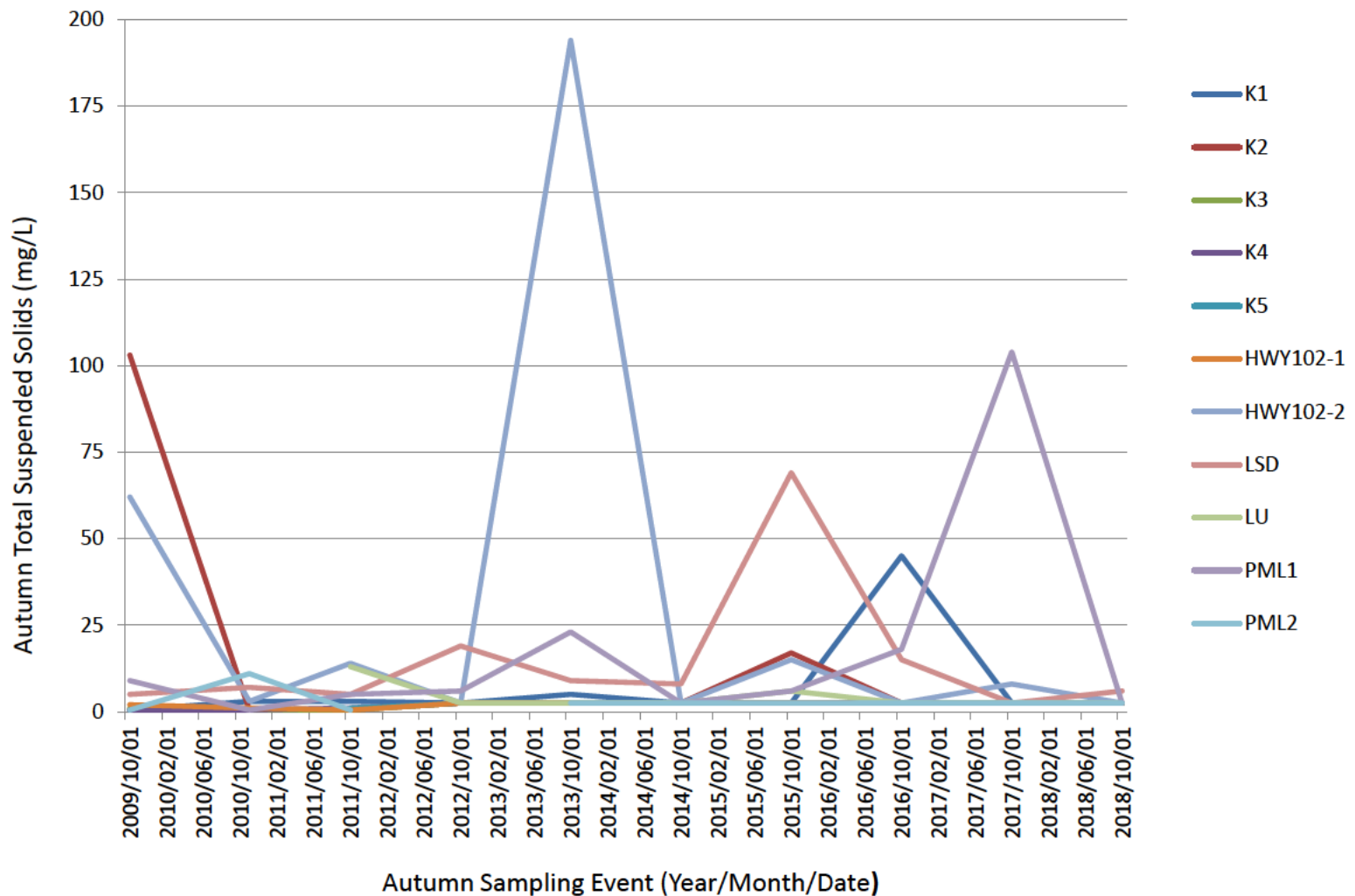


Figure 6 – Seasonal Total Suspended Solids Concentrations for Water Quality Monitoring Program.

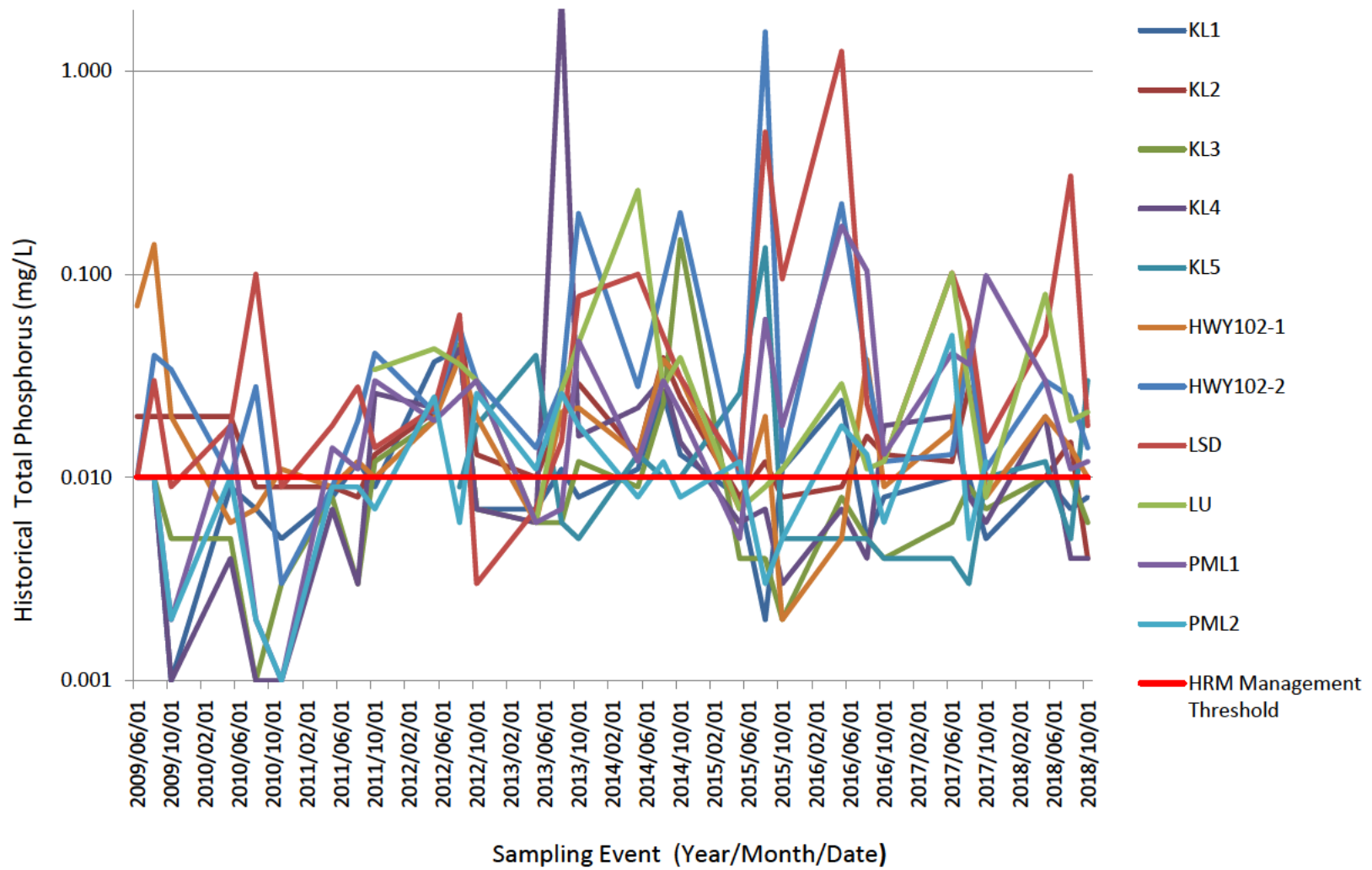


Figure 7 – Historical Total Phosphorus Concentrations for Water Quality Monitoring Program.

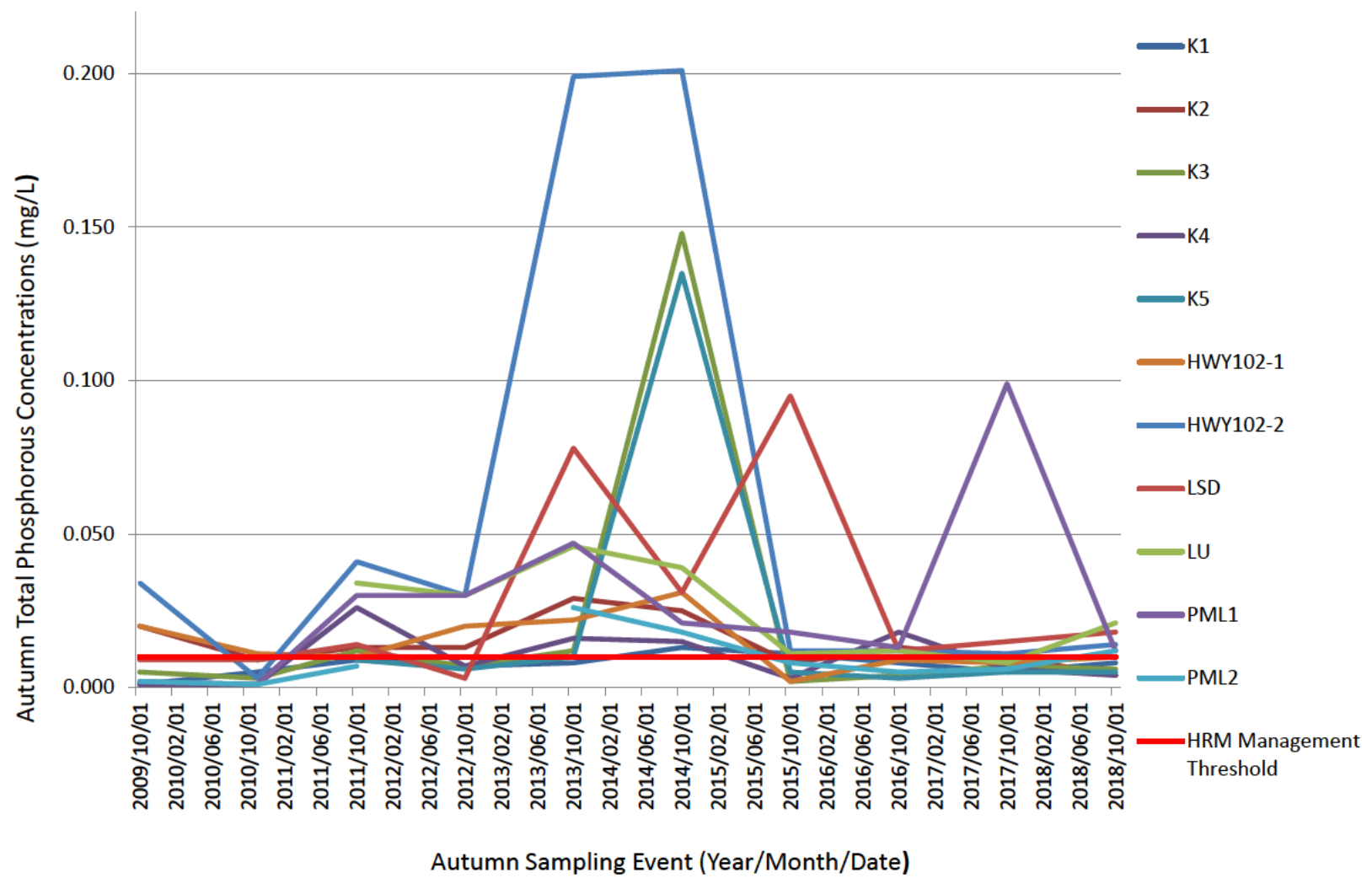


Figure 8 – Seasonal Total Phosphorus Concentrations for Water Quality Monitoring Program.

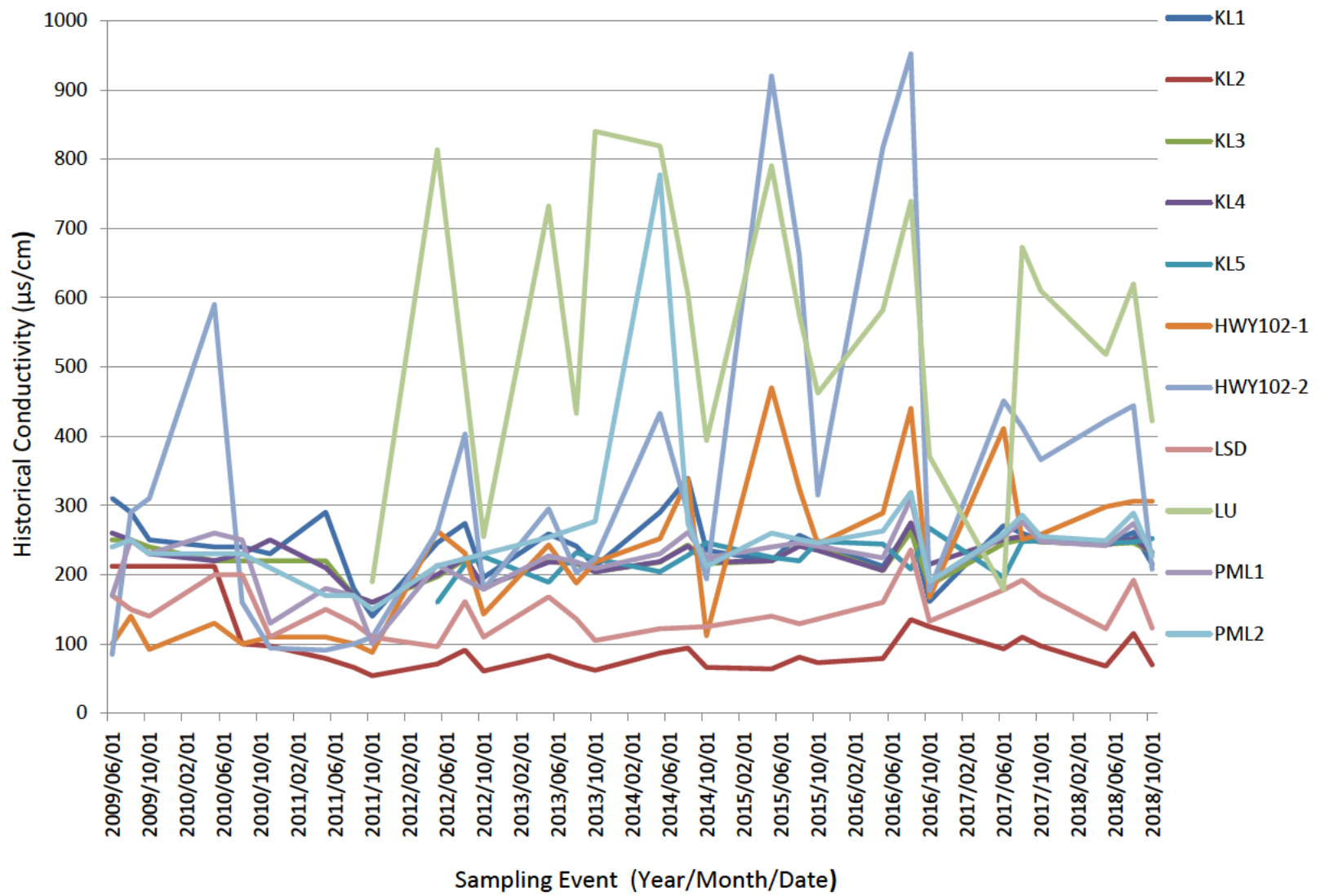


Figure 9 – Historical Measurement of Conductivity for Water Quality Monitoring Program.

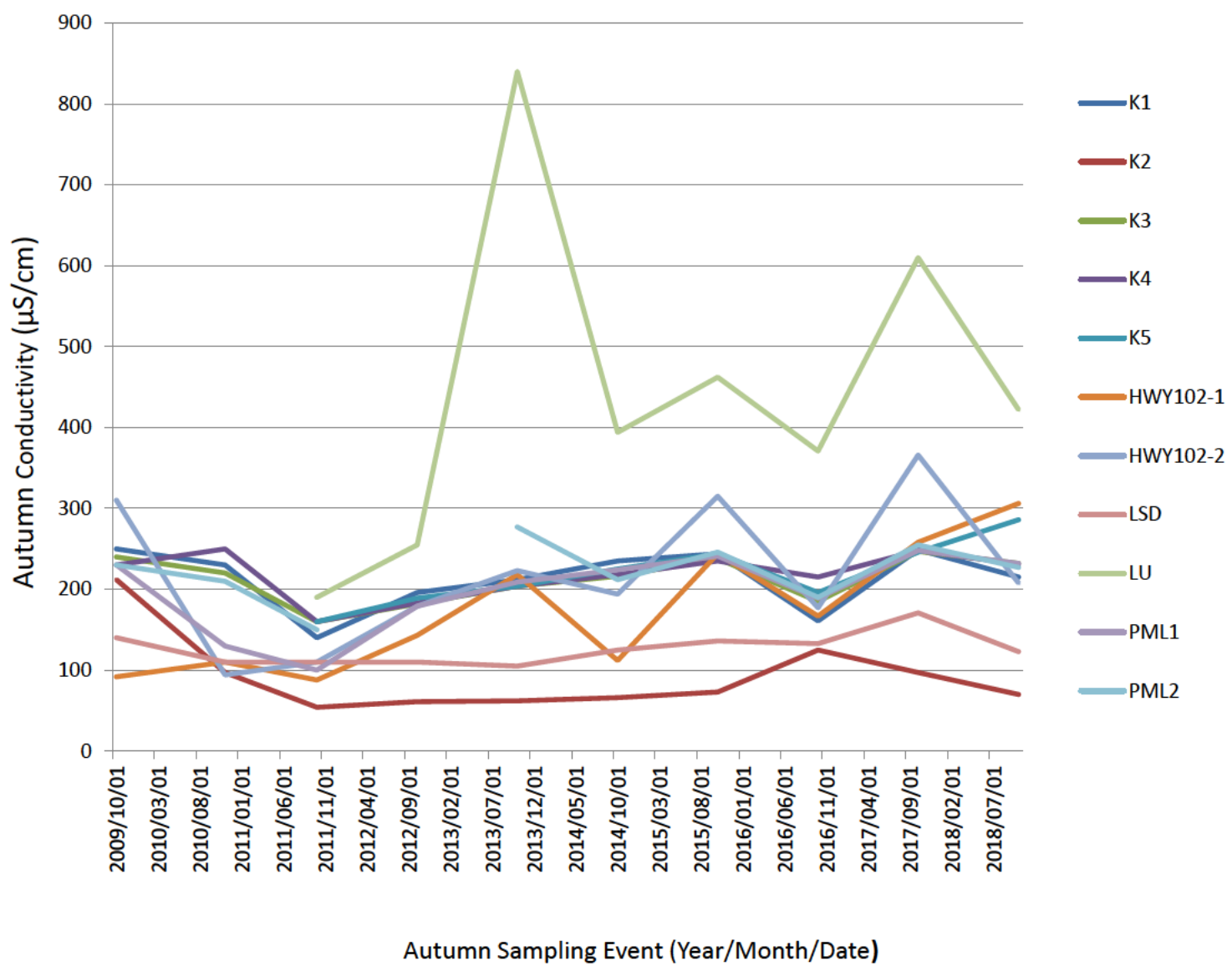


Figure 10 – Seasonal Conductivity Measurements for Water Quality Monitoring Program.

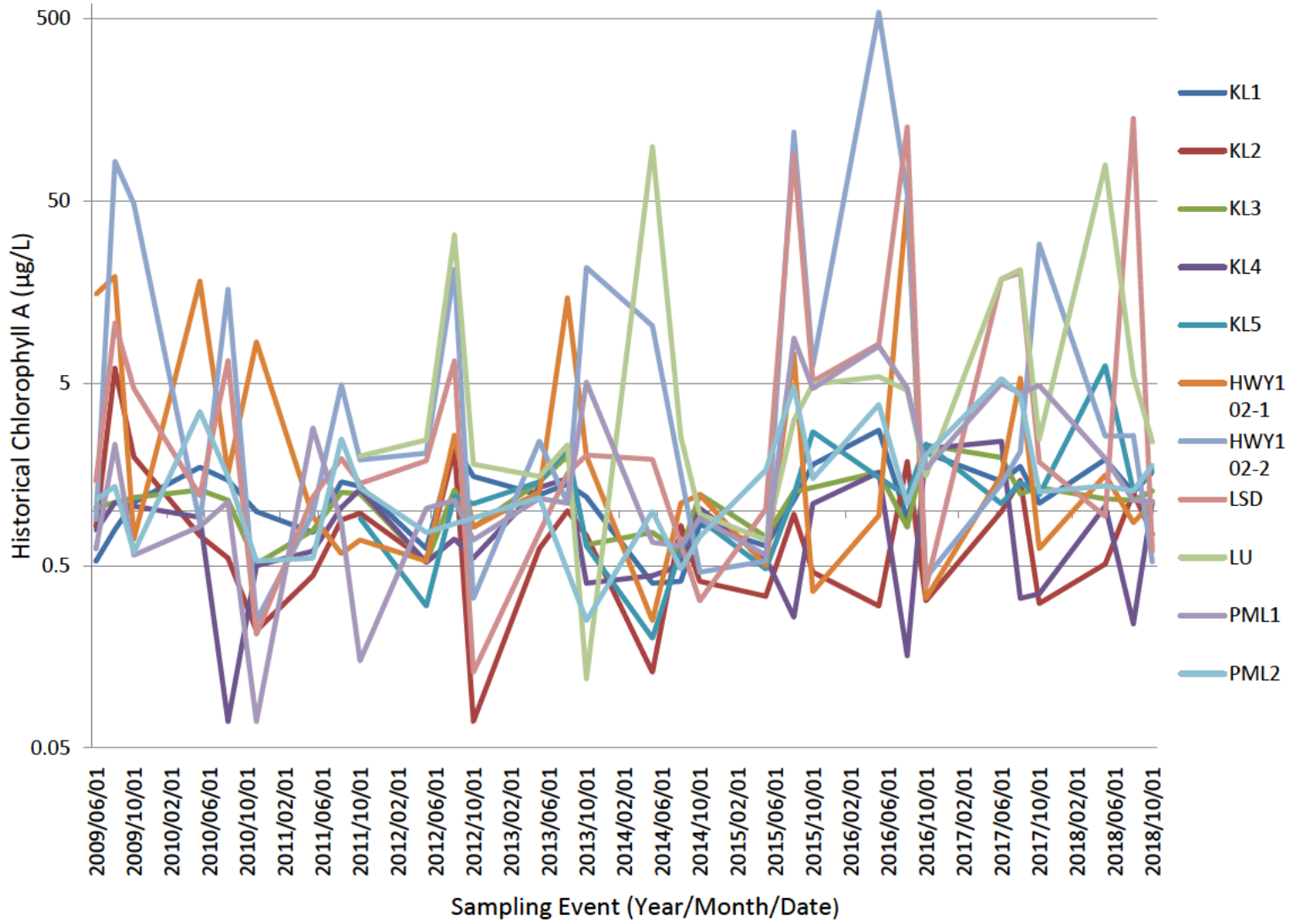


Figure 11 – Historical Chlorophyll A Concentrations for Water Quality Monitoring Program.

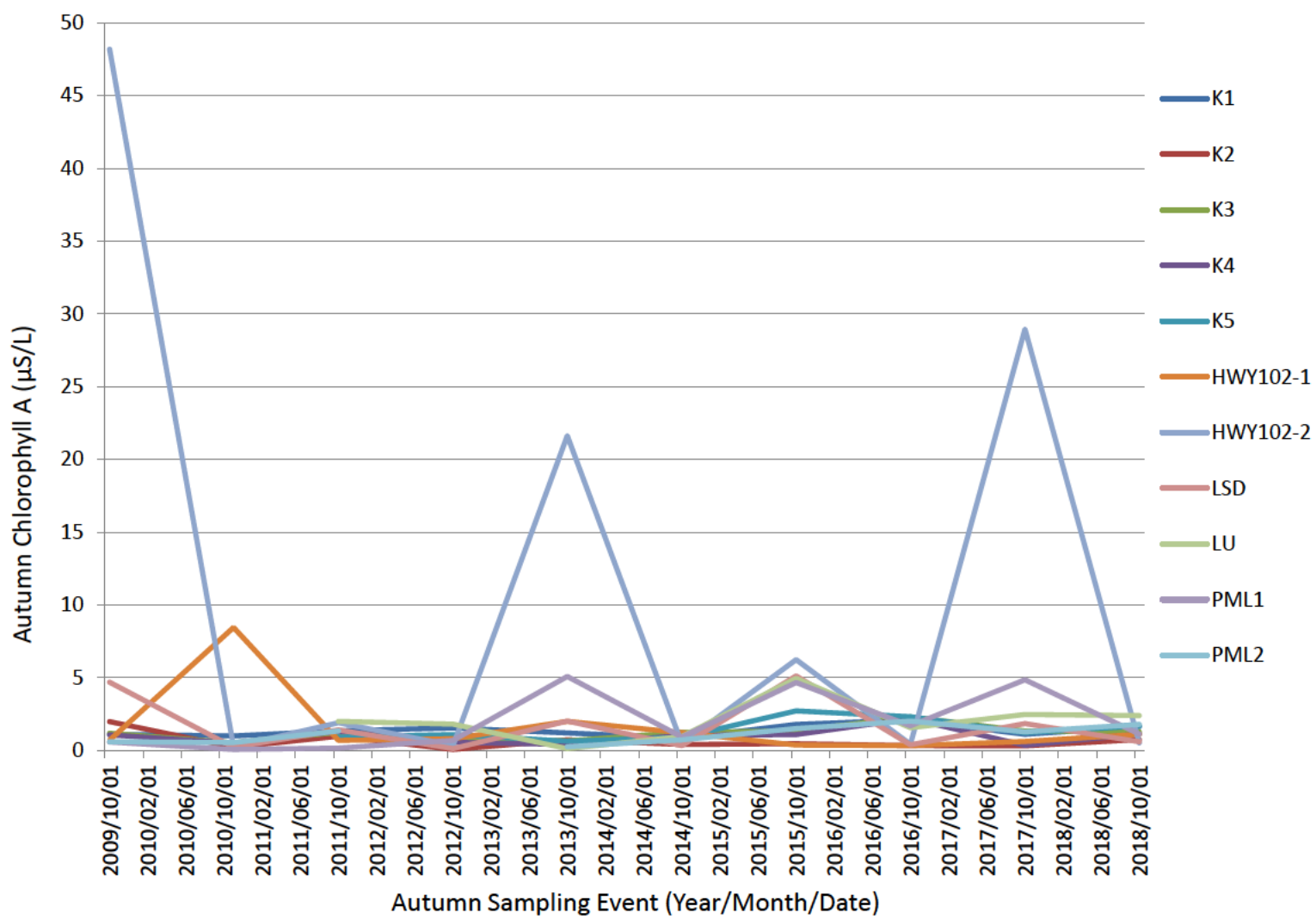


Figure 12 – Seasonal Chlorophyll A Concentrations for Water Quality Monitoring Program.



SNC • LAVALIN

5657 Spring Garden Road, Suite 200 Park Lane Terraces
Halifax, Nova Scotia B3J 3R4
1.902.492-4544 - 1.902.492.4540

