Appendix 11: 2018 Groundwater Monitoring Report

E & Q Consulting

and Associates Limited

Environmental Chemists

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Spicer Construction Quarry Site

Report on
Water Monitoring Well Data

For

2018

Prepared by

W. James Frazee, M.Sc., P.Chem.
E & Q Consulting and Associated Limited
January 25, 2019

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Table of Content

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Sampling Locations

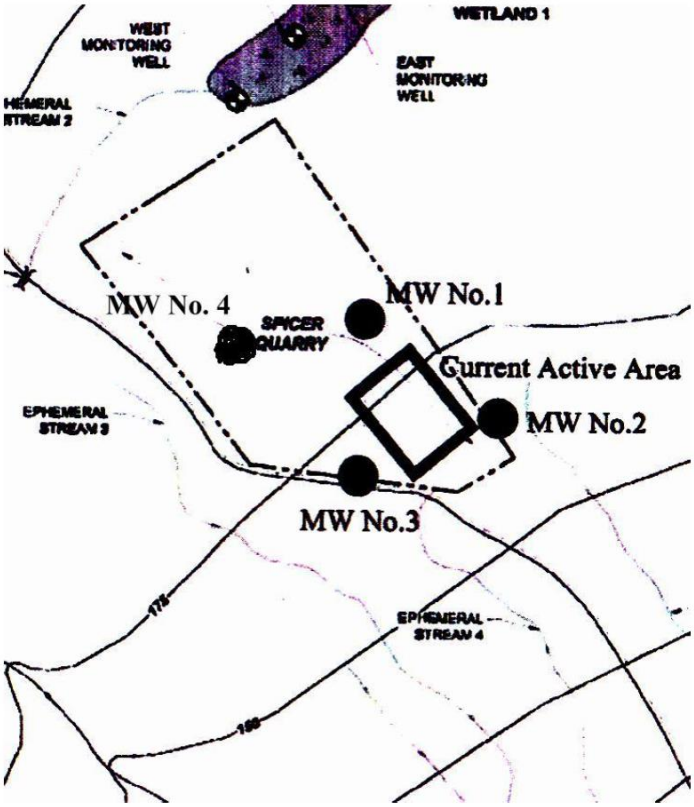
Monitoring Wells

The attached site map shows the locations of the wells around the site. The following are the GPS locations

Well #	Latitude	Longitude	Depth(m)
2	44.83432	65.37948	65.8
3	44.83400	65.38043	51.6
4	44.83465	65.3242	27.98

Well No. 1 was damaged in 2011 and replaced with Well No. 4.

Site Monitoring Wells as Modified in 2011



Sampling Procedures

Standard Sampling Procedures used by E & Q Consulting Limited for the Spicer Quarry Site are found in Appendix III.

Laboratory Results

Copies of the results sections of the AGAT Laboratory's official sample results for the summary period are attached in Appendix IV.

Summary Data Tables

Summary Data tables of sample results for the period are attached in Appendix I.

Graphical Representation of Well and Surface Water Data

Graphical analysis data is found in Appendix II.

Assessment of Results

Monitoring Wells

A blockage was found in well 3 has prevented sampling of that well.

Water Levels in Wells: The level of the ground water in all wells have been holding very steady. Well # 2 was droping but is now leveling off.

Wells # 2, 3 & 4: The water at this site has only moderate mineral levels as inticated by the conductivities. See Graph #2. The increasing trend in well # 2 continues. Graph #3 shows alkalinity levels and Graph #1 the pH in the wells. Alkalinity is following the same trend as condictivity. pH of both wells 2 and 4 are still following the same downward trend, but are in an acceptable range.

E.Coli bacteria levels found in previous years samples were absent again this year.

Conclusions and Recommendations

Monitoring Wells

There does not seem to be a lot of significant change in the character of the water in the two remaining wells. I understand that there are changes planned for the New Year, where wells 3 and 4 will be relocated. This will mean that present data for these wells will not be relevant for trend evaluation after the changes.

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Appendix I

2017 Tabulated Data

from

Spicer Construction Quarry Site

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Table 1 – Well # 2

Well # 2						
Parameter	Units	Drinking Water Guidelines	Jun-17	Jan-17	May-18	Nov-18
Inorganics						
Alkalinity	mg/L	No Value	196	196	210	
Ammonia	mg/L	No Value	0.05	2.12	0.13	
Arsenic	mg/L	0.006	<0.002	<0.002	<0.002	
Barium	mg/L	1	0.011	0.077	0.031	No
Boron	mg/L	5	0.006	0.021	0.009	
Cadmium	mg/L	0.005	<0.000017	0.000203	<0.00009	Sample
Calcium	mg/L	No Value	68.1	45.5	73.5	
Chloride	mg/L	<250 ***	6	6	5	
Chromium	mg/L	0.05	0.004	0.005	0.003	
Conductivity	uS/cm	No Value	411	398	420	
Copper	mg/L	<1 ***	<0.002	<0.002	<0.002	
Iron	mg/L	<0.3 ***	0.246	11.8	<0.050	
Lead	mg/L	0.01	<0.0005	<0.0005	<0.0005	
Magnesium	mg/L	No Value	5.6	5.8	5.5	
Manganese	mg/L	<0.05 ***	0.024	0.829	0.02	
Mercury *	mg/L	0.001	Not Required	0.000605	Not Required	
Nitrate	mg/L	45	1.22	1.28	0.95	
Nitrite	mg/L	No Value	<0.05	0.16	<0.05	
Total Kjeldahl Nitrogen	mg/L	No Value	Not Required	4.3	Not Required	
pH	mg/L	6.5 - 8.5	7.93	7.87	8.25	
Total Phosphorus	mg/L	No Value	Not Required	0.12	Not Required	
Potassium	mg/L	No Value	0.7	0.6	0.7	
Sodium	mg/L	<200 ***	7.5	16.8	7.7	
Suspended Solids	mg/L	No Value	15	23	7	
Total Dissolved Solids	mg/L	<500 ***	218	220	228	
Sulphate	mg/L	<500 ***	6	6	5	
Zinc	mg/L	<5 ***	<0.005	0.032	<0.005	
Volatile Organics						
Benzene *	µg/L	5	Not Required	<1	Not Required	
1,4 Dichlorobenzene *	µg/L	5	Not Required	<1	Not Required	
Dicloromethane *	µg/L	50	Not Required	<2	Not Required	
Toluene *	µg/L	24	Not Required	30	Not Required	
Vinyl Chloride *	µg/L	2	Not Required	<0.5	Not Required	
Other Organics						
BOD5	mg/L	No Value	Not Required	Not Required	Not Required	
COD	mg/L	No Value	4	12	3	
Dissolved Organic Carbon	mg/L	No Value	2.1	2.8	8.1	
Total Organic Carbon	mg/L	No Value	4	5.1	8.7	
Phenol	mg/L	No Value	Not Required	0.025	Not Required	
E. Coli.	mg/L	No Value	<1	<1	<1	
Field Parameters						
Water level below Well Head	cm	Not Applicable	4979	4,990	4897	
Temperature	deg C	<15 ***	12.1	7.9	8.9	
pH		6.5 - 8.5	7.4	7.4	7.5	
Conductivity	uS/cm	No Value	388	384	339	
		*** aesthetic objective				

Table 2 – Well # 3

Well # 3						
Parameter	Units	Drinking Water Guidelines	Jun-17	Jan-17	May-18	Nov-18
Inorganics						
Alkalinity	mg/L	No Value	Well	Well	Pump	Well
Ammonia	mg/L	No Value				
Arsenic	mg/L	0.006	Blocked	Blocked	Broken	Blocked
Barium	mg/L	1				
Boron	mg/L	5	No	No	No	No
Cadmium	mg/L	0.005				
Calcium	mg/L	No Value	Sample	Sample	Sample	Sample
Chloride	mg/L	<250 ***				
Chromium	mg/L	0.05				
Conductivity	uS/cm	No Value				
Copper	mg/L	<1 ***				
Iron	mg/L	<0.3 ***				
Lead	mg/L	0.01				
Magnesium	mg/L	No Value				
Manganese	mg/L	<0.05 ***				
Mercury *	mg/L	0.001				
Nitrate	mg/L	45				
Nitrite	mg/L	No Value				
Total Kjeldahl Nitrogen	mg/L	No Value				
pH	mg/L	6.5 - 8.5				
Total Phosphorus	mg/L	No Value				
Potassium	mg/L	No Value				
Sodium	mg/L	<200 ***				
Suspended Solids	mg/L	No Value				
Total Dissolved Solids	mg/L	<500 ***				
Sulphate	mg/L	<500 ***				
Zinc	mg/L	<5 ***				
Volatile Organics						
Benzene *	µg/L	5				
1,4 Dichlorobenzene *	µg/L	5				
Dicloromethane *	µg/L	50				
Toluene *	µg/L	24				
Vinyl Chloride *	µg/L	2				
Other Organics						
BOD5	mg/L	No Value				
COD	mg/L	No Value				
Dissolved Organic Carbon	mg/L	No Value				
Total Organic Carbon	mg/L	No Value				
Phenol	mg/L	No Value				
E. Coli.	mg/L	No Value				
Field Parameters						
Water level below Well Head	cm	Not Applicable				
Temperature	deg C	<15 ***				
pH		6.5 - 8.5				
Conductivity	uS/cm	No Value				
		*** aesthetic objective				

Table 3 – Well # 4

Well # 4						
Parameter	Units	Drinking Water Guidelines	Jun-17	Nov-17	May-18	Nov-18
Inorganics						
Alkalinity	mg/L	No Value	132	164	150	No
Ammonia	mg/L	No Value	0.2	0.16	0.16	
Arsenic	mg/L	0.006	<0.002	<0.002	<0.002	Sample
Barium	mg/L	1	0.03	0.051	0.076	
Boron	mg/L	5	0.012	0.013	0.021	
Cadmium	mg/L	0.005	<0.000017	0.000089	<0.00009	
Calcium	mg/L	No Value	36	65.5	43.2	
Chloride	mg/L	<250 ***	4	4	4	
Chromium	mg/L	0.05	0.002	0.005	0.003	
Conductivity	uS/cm	No Value	268	307	294	
Copper	mg/L	<1 ***	0.003	<0.002	0.008	
Iron	mg/L	<0.3 ***	0.373	0.106	1.99	
Lead	mg/L	0.01	<0.0005	<0.0005	<0.0005	
Magnesium	mg/L	No Value	5.3	5	6.1	
Manganese	mg/L	<0.05 ***	0.286	0.121	0.659	
Mercury *	mg/L	0.001	Not Required	0.000041	Not Required	
Nitrate	mg/L	45	<0.05	<0.05	0.06	
Nitrite	mg/L	No Value	<0.05	<0.05	<0.05	
Total Kjeldahl Nitrogen	mg/L	No Value	Not Required	0.7	Not Required	
pH	mg/L	6.5 - 8.5	7.74	7.58	8.15	
Total Phosphorus	mg/L	No Value	Not Required	0.07	Not Required	
Potassium	mg/L	No Value	0.5	1.1	0.8	
Sodium	mg/L	<200 ***	10.4	7.5	9.7	
Suspended Solids	mg/L	No Value	<5	88	<5	
Total Dissolved Solids	mg/L	<500 ***	136	182	157	
Sulphate	mg/L	<500 ***	<2	<2	<2	
Zinc	mg/L	<5 ***	0.006	<0.005	0.017	
Volatile Organics						
Benzene *	µg/L	5	Not Required	<1	Not Required	
1,4 Dichlorobenzene *	µg/L	5	Not Required	<1	Not Required	
Dicloromethane *	µg/L	50	Not Required	<2	Not Required	
Toluene *	µg/L	24	Not Required	<2	Not Required	
Vinyl Chloride *	µg/L	2	Not Required	<0.5	Not Required	
Other Organics						
BOD5	mg/L	No Value	Not Required	Not Required	Not Required	
COD	mg/L	No Value	10	16	13	
Dissolved Organic Carbon	mg/L	No Value	5.2	4.5	9.4	
Total Organic Carbon	mg/L	No Value	6.2	5.3	9.5	
Phenol	mg/L	No Value	Not Required	<0.001	Not Required	
E. Coli.	mg/L	No Value	<1	<1	<1	
Field Parameters						
Water level below Well Head	cm	Not Applicable	168	200	204	
Temperature	deg C	<15 ***	10.6	9.5	8.3	
pH		6.5 - 8.5	7.15	7.05	6.9	
Conductivity	uS/cm	No Value	254	353	233	
		*** aesthetic objective				

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Appendix II

2017 Graphical Data

from

Spicer Construction Quarry Site

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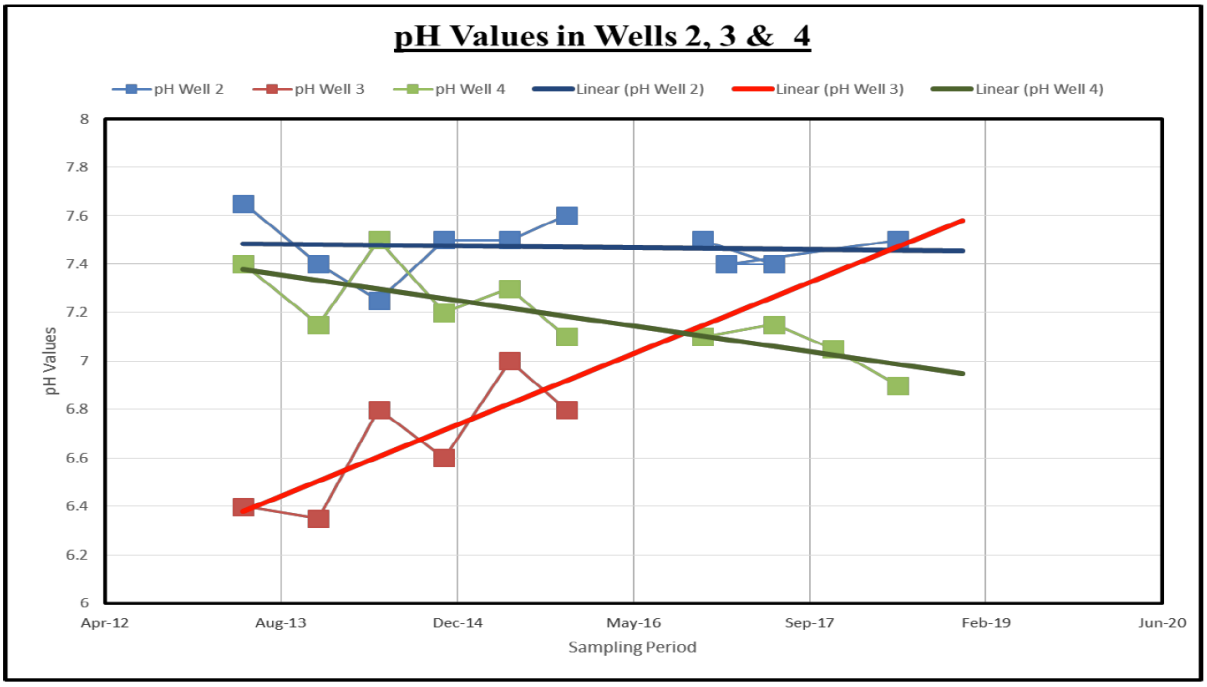
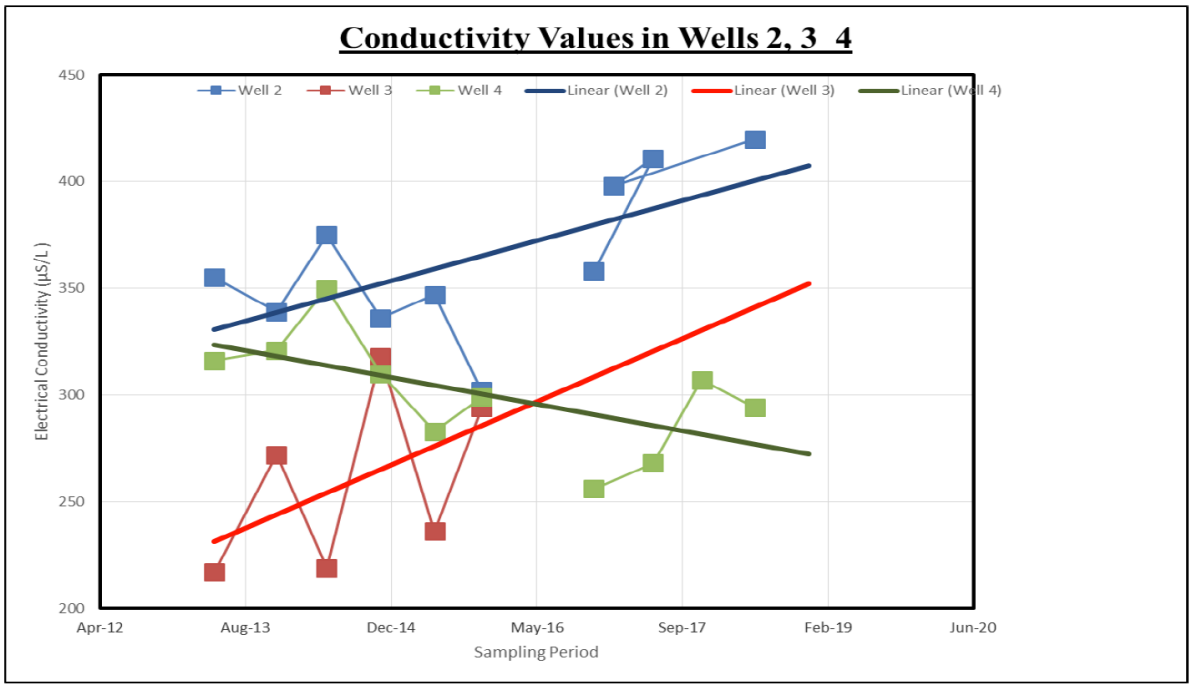
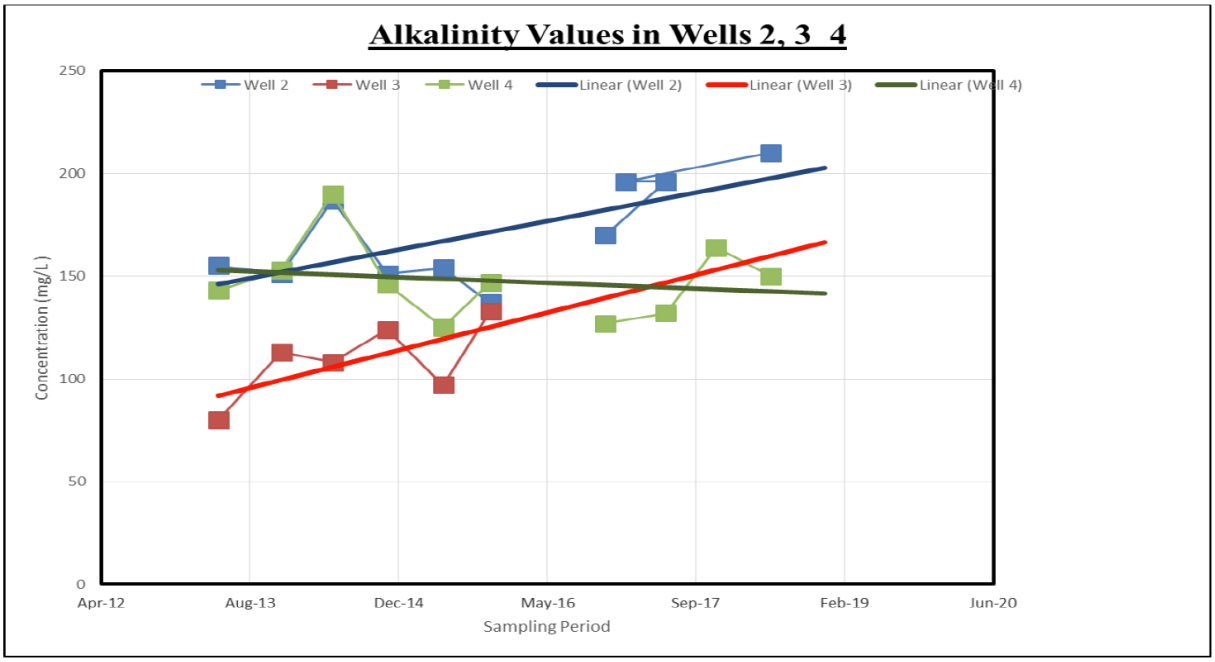
Graph #1 pH in Wells 2, 3 &4



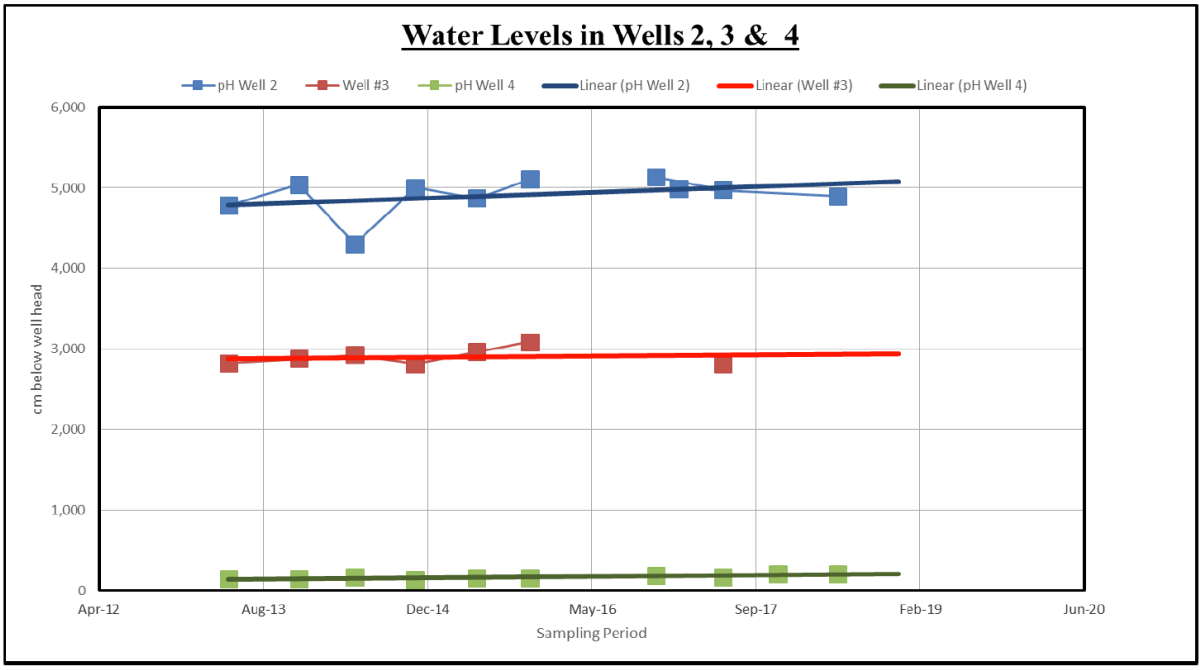
Graph #2 Conductivity in Wells 2, 3 &4



Graph #3 Alkalinity in Wells 2, 3 &4



Graph #4 Water levels in Wells 2, 3 &4



Appendix III

SOP for Sampling Procedure and Handling

at

Spicer Construction Quarry Site

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E & Q Consulting
and Associates Limited
Environmental Chemists
1725 White Rock Road, White Rock, N.S., Canada B4P 2R1
Phone: (902)542-4309 Cell: (902)680-0129
Email: jfrazee@accesswave.ca Website: members.accesscable.net/~eandq/

Sampling Procedure

Equipment

- Sample Bottles (2 to 4 Litre Volume)
- Submersible Sampling Pump 10 L/min flow (Equipped with 7.5 metre hose and attached measuring tape)
- Calibrated Thermometer (readable to 0.1 °C)
- Dissolved Oxygen Meter (read as % Saturation)
- Deionized Rinse Water
- Heron Dipper-T Water Level Meter

Pre Trip Procedure

1. All Sample bottles are washed with dish washing detergent and rinsed with first tap water and then deionized water.
2. Sample pump is cleaned and rinsed
3. Thermometer calibration is checked
4. D.O. Meter is checked for proper operation

Sampling Procedure - Monitoring Wells

1. The well top is opened
2. The water level meter is lowered until the light indicated water level is reached. The level is recorded.
3. The Sampling pump is rinsed with deionized water and shaken to remove excess water.
4. The pump is lowered into the well to the point where it is heard to touch the water
5. The pump is then lowered to with in 1 to 2 metres of the well bottom and started.
6. The pump is allowed to run for at least 5 min to purge the well. If the water contains significant sediment after 5 min, the purging procedure continues until sediment levels significantly decrease (if possible).

7. A sample is then collected from the water flowing out of the sampling pump hose. A small amount of water is first collected and the emptied as a rinse. A volume of 2 to 4 Litres is collected.
8. Samples are secured for transport back to E & Q Consulting Limited=s facility.

Sample preparation at E & Q Consulting Limited's Facility

1. pH and conductivity of each sample is measured by (a) first calibration of the meters against standards and (b) removing a 100 mL portion of each sample and reading and recording the results.
2. Note- It is not recommended that pH be measured at the sampling location as it is potentially subjected to many errors, such as temperature, probe fowling, probe damage and calibration solution contamination and it is very unlikely that pH readings will change over short periods of time, even one day. Conductivity can be measured at the sample site but there is no advantage in doing so as the sample conductivity is very unlikely to be subject to any changes over short or even long periods of time.
3. All monitoring well samples are allowed to set for at least 24 hours, to allow for any sediment to settle. The samples are stored at 4 ºC.
4. Samples are then transferred into the appropriate bottles for laboratory analysis and preserved as required.
5. After sediments have settled, clear samples are decanted into bottles for transport to laboratory. All samples are transported to laboratory as soon as possible after preparation. If sample shipment is delayed, for any reason. i.e. such as a weekend. The samples are stored at 4 ºC.

Appendix IV

AGAT Laboratories 2017 Result Reports

for

Spicer Construction Quarry Site

AGAT Laboratories

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

CLIENT NAME: E & Q CONSULTING & ASSOCIATES LTD
1725 WHITE ROCK RD, RR#1
WOLFVILLE, NS B4P2R1
(902) 542-4309

ATTENTION TO: JIM FRAZEE

PROJECT: Spicers

AGAT WORK ORDER: 17X226139

MICROBIOLOGY ANALYSIS REVIEWED BY: Laura Baker, Inorganics Data Reporter

WATER ANALYSIS REVIEWED BY: Laura Baker, Inorganics Data Reporter

DATE REPORTED: Jun 20, 2017

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.

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 17X226139

PROJECT: Spicers

CLIENT NAME: E & Q CONSULTING & ASSOCIATES LTD

ATTENTION TO: JIM FRAZEE

SAMPLING SITE:

SAMPLED BY:

Fecal Coliforms by Membrane Filtration

DATE RECEIVED: 2017-06-14

DATE REPORTED: 2017-06-20

			SAMPLE DESCRIPTION:	EQ1709	EQ1711
			SAMPLE TYPE:	Water	Water
			DATE SAMPLED:	2017-06-13	2017-06-13
Parameter	Unit	G / S	RDL	8468959	8468996
Fecal Coliforms	CFU/100 mL		1	<1	<1

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

Certified By: Laura Bale

AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 17X226139

PROJECT: Spicers

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

CLIENT NAME: E & Q CONSULTING & ASSOCIATES LTD

SAMPLING SITE:

ATTENTION TO: JIM FRAZEE

SAMPLED BY:

DOC,COD,TSS

DATE RECEIVED: 2017-06-14

DATE REPORTED: 2017-06-20

		SAMPLE DESCRIPTION:		EQ1709	EQ1711
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		2017-06-13	2017-06-13
Parameter	Unit	G / S	RDL	8468959	8468996
Chemical Oxygen Demand	mg/L		3	4	10
Dissolved Organic Carbon	mg/L		0.5	2.1	5.2
Total Suspended Solids	mg/L		5	15	<5

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

Certified By: Laura Bala

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 17X226139

PROJECT: Spicers

CLIENT NAME: E & Q CONSULTING & ASSOCIATES LTD

ATTENTION TO: JIM FRAZEE

SAMPLING SITE:

SAMPLED BY:

Standard Water Analysis + Dissolved Metals

DATE RECEIVED: 2017-06-14

DATE REPORTED: 2017-06-20

		SAMPLE DESCRIPTION:		EQ1709	EQ1711
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		2017-06-13	2017-06-13
Parameter	Unit	G / S	RDL	8468959	8468996
pH				7.93	7.74
Reactive Silica as SiO2	mg/L		0.5	14.5	13.6
Chloride	mg/L		1	6	4
Fluoride	mg/L		0.12	<0.12	<0.12
Sulphate	mg/L		2	6	<2
Alkalinity	mg/L		5	196	132
True Color	TCU		5	<5	12
Turbidity	NTU		0.1	11.6	3.9
Electrical Conductivity	umho/cm		1	411	268
Nitrate + Nitrite as N	mg/L		0.05	1.22	<0.05
Nitrate as N	mg/L		0.05	1.22	<0.05
Nitrite as N	mg/L		0.05	<0.05	<0.05
Ammonia as N	mg/L		0.03	0.05	0.20
Total Organic Carbon	mg/L		0.5	4.0	6.2
Ortho-Phosphate as P	mg/L		0.01	<0.01	<0.01
Dissolved Sodium	mg/L		0.1	7.5	10.4
Dissolved Potassium	mg/L		0.1	0.7	0.5
Dissolved Calcium	mg/L		0.1	68.1	36.0
Dissolved Magnesium	mg/L		0.1	5.6	5.3
Bicarb. Alkalinity (as CaCO3)	mg/L		5	196	132
Carb. Alkalinity (as CaCO3)	mg/L		10	<10	<10
Hydroxide	mg/L		5	<5	<5
Calculated TDS	mg/L		1	218	136
Hardness	mg/L			193	112
Langelier Index (@20C)	NA			0.43	-0.18
Langelier Index (@ 4C)	NA			0.11	-0.50
Saturation pH (@ 20C)	NA			7.50	7.92
Saturation pH (@ 4C)	NA			7.82	8.24
Anion Sum	me/L			4.30	2.75
Cation sum	me/L			4.25	2.74

Certified By: Laura Baker

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 17X226139

PROJECT: Spicers

CLIENT NAME: E & Q CONSULTING & ASSOCIATES LTD

ATTENTION TO: JIM FRAZEE

SAMPLING SITE:

SAMPLED BY:

Standard Water Analysis + Dissolved Metals

DATE RECEIVED: 2017-06-14

DATE REPORTED: 2017-06-20

		SAMPLE DESCRIPTION:		EQ1709	EQ1711
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		2017-06-13	2017-06-13
Parameter	Unit	G / S	RDL	8468959	8468996
% Difference/ Ion Balance (NS)	%			0.6	0.2
Dissolved Aluminum	ug/L		5	278	28
Dissolved Antimony	ug/L		2	<2	<2
Dissolved Arsenic	ug/L		2	<2	<2
Dissolved Barium	ug/L		5	11	30
Dissolved Beryllium	ug/L		2	<2	<2
Dissolved Bismuth	ug/L		2	<2	<2
Dissolved Boron	ug/L		5	6	12
Dissolved Cadmium	ug/L		0.017	<0.017	<0.017
Dissolved Chromium	ug/L		1	4	2
Dissolved Cobalt	ug/L		1	<1	<1
Dissolved Copper	ug/L		2	<2	3
Dissolved Iron	ug/L		50	246	373
Dissolved Lead	ug/L		0.5	<0.5	<0.5
Dissolved Manganese	ug/L		2	24	286
Dissolved Molybdenum	ug/L		2	<2	<2
Dissolved Nickel	ug/L		2	3	<2
Phosphorous	mg/L		0.02	<0.02	<0.02
Dissolved Selenium	ug/L		1	2	<1
Dissolved Silver	ug/L		0.1	<0.1	<0.1
Dissolved Strontium	ug/L		5	68	142
Dissolved Thallium	ug/L		0.1	<0.1	<0.1
Dissolved Tin	ug/L		2	<2	<2
Dissolved Titanium	ug/L		2	8	2
Dissolved Uranium	ug/L		0.1	1.0	0.4
Dissolved Vanadium	ug/L		2	2	<2
Dissolved Zinc	ug/L		5	<5	6

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

8468959-8468996 Metals analysis completed on a filtered sample.

Certified By: Launa Bahr