CODRINGTON PIT
2017 MONITORING PROGRAM REPORT

Prepared for:
St. Marys Cement Inc. (Canada)
55 Industrial Street
Toronto, Ontario
M4G 3W9

Project No. 13-005-00

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ResEnv Consulting Limited

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December 29, 2017

St. Marys Cement Inc. (Canada)
55 Industrial Street
Toronto, Ontario
M4G 3W9

Attention: Mr. Colin Evans
Director, Lands and Environment

Re: Codrington Pit
2017 Monitoring Program Report
File 13-005-00

ResEnv Consulting Limited (ResEnv) is pleased to submit the 2017 Monitoring Program Report in accordance with the Site Plan and Permit to Take Water Number 8025-A9NQBU (PTTW) for the Codrington Pit. A summary of the findings is presented in the executive summary at the front of the report. Details are provided in the report text and technical data are appended.

It is understood that St. Marys Cement Inc. (Canada) will report the 2017 water takings to the Ministry of the Environment and Climate Change prior to March 31, 2018, in accordance with PTTW.

Thank you for the opportunity to participate in this program. Please contact us if you have any questions.

Yours truly,
ResEnv Consulting Limited

Jason T. Balsdon, M.A.Sc., P.Eng.
Consulting Engineer

EXECUTIVE SUMMARY

St. Marys Cement Inc. (Canada), known locally as CBM Aggregates, owns and operates an above water table pit that is located east of the Village of Codrington, approximately 12 kilometres north of the Town of Brighton. This pit is identified as the Codrington Pit. The pit encompasses lands to the south of Ontario Hydro Power Line easement in Parts of Lots 32, 33, and 34, Concession 6, Township of Brighton.

The pit was licenced in accordance with its Site Plan on January 30, 2014, and obtained Permit to Take Water Number 8025-A9NQBU (PTTW) on June 14, 2016, that allows for surface water and groundwater taking for the purpose of pit operations, including material washing and dust control. In accordance with the Site Plan, the Baseline Monitoring Program was completed in 2013 and the Performance Monitoring Program was initiated in 2014. The monitoring in 2017 was also completed in accordance with the PTTW. This report presents the monitoring results to the end of 2017.

Based on the findings presented in this report groundwater elevations, depths, and quality showed no unacceptable effects from the pit operations in 2017. Similarly, groundwater quantity and quality at the residential water wells continued to reflect natural conditions in 2017. In addition, no formal water well complaints about pit operations were received from residents in 2017.

Surface water flow rates and quality also showed no effects from the pit operations in 2017.

Groundwater and surface water monitoring and reporting should continue in 2018 as outlined in Section 6 of this report.

It is understood that St. Marys Cement Inc. (Canada) will report the 2017 water takings to the Ministry of the Environment and Climate Change prior to March 31, 2018, in accordance with PTTW.

TABLE OF CONTENTS

Transmittal Letter
Executive Summary

1. INTRODUCTION 1
2. METHODOLOGY 1
3. HYDROGEOLOGIC SETTING 3
   - 3.1 Topographic and Physiographic Setting 3
   - 3.2 Geologic Setting 3
   - 3.3 Groundwater Setting 4
   - 3.4 Groundwater Use 5
   - 3.5 Surface Water 5
4. 2017 PIT OPERATION SUMMARY 6
   - 4.1 Complaints and Responses 6
5. MONITORING RESULTS 6
   - 5.1 Groundwater Elevations and Depths 6
   - 5.2 Groundwater Quality 9
   - 5.3 Surface Water Flow Rates 10
   - 5.4 Surface Water Quality 11
6. 2018 MONITORING PROGRAM 12
7. CONCLUSIONS AND RECOMMENDATIONS 12
8. REFERENCES 13

LIST OF TABLES

Table 1 Monitoring Program Summary
Table 2 Precipitation Summary

LIST OF FIGURES

Figure 1 Site Location Map
Figure 2 Site Status Sketch
Figure 3 2017 Water Quality – Trilinear Diagram

APPENDICES

Appendix A Permit To Take Water Number 8025-A9NQBU
Appendix B Hydrogeologic Details
Appendix C Groundwater Chemical Results
Appendix D Surface Water Data

1. INTRODUCTION

St. Marys Cement Inc. (Canada), known locally as CBM Aggregates, owns and operates an above water table pit that is located east of the Village of Codrington, approximately 12 kilometres (km) north of the Town of Brighton. This pit is identified as the Codrington Pit. The pit encompasses lands to the south of Ontario Hydro Power Line easement in Parts of Lots 32, 33, and 34, Concession 6, Township of Brighton. See the Site Location Map of Figure 1 for location details.

The pit was licenced in accordance with its Site Plan on January 30, 2014, and obtained Permit to Take Water Number 8025-A9NQBU (PTTW) on June 14, 2016, that allows for surface water and groundwater taking for the purpose of pit operations, including material washing and dust control. A copy of the PTTW is provided in Appendix A. In accordance with the Site Plan, the Baseline Monitoring Program was completed in 2013 and the Performance Monitoring Program was initiated in 2014. The monitoring in 2017 was also completed in accordance with the PTTW. This report presents the monitoring results to the end of 2017.

2. METHODOLOGY

The following groundwater and surface water monitoring was completed during 2017 in accordance with the monitoring requirements of the Site Plan and PTTW. Details are provided in Table 1 and monitoring locations are shown in Figures 1 and 2.

- Quarterly manual groundwater level measurements were obtained for the onsite monitoring wells on March 2, June 28, September 6, and December 5, 2017. Monitor construction details are provided in Table B-1 and manual groundwater elevations are presented in Table B-1 and Figure B-1, Appendix B. Water level data were also downloaded from the automated transducers that measure groundwater levels within the monitoring wells at 6 hour intervals. The water levels are presented in Figures B-2 through B-8, Appendix B.

- Semiannual sampling was completed for the onsite monitoring wells on March 2 and September 6, 2017. BH05-2, BH05-19, BH12-1, and BH12-2 had insufficient water at the time of the sampling event in March. Chemical results are summarized in Table C-1, Appendix C. Parameters were analysed as required, except owing to the laboratory scan package bismuth was not analyzed, but strontium and vanadium were added.

- Annual residential water well monitoring was completed as summarized below. Groundwater levels are presented in Table B-3, Appendix B. Chemical results are provided in Tables C-2 through C-6, Appendix C. Analytes were the same as those for the onsite monitoring wells, with the addition of bacteria.

ADDRESS	WATER LEVEL DATE	DATE SAMPLED	COMMENTS
[redacted]	September 6	September 6	
[redacted]	NA	NA	No access to well granted. Well removed from monitoring program.
[redacted]	NA	NA	No one home for two visits in September, and no response to telephone message.
[redacted]	September 6	September 6	
[redacted]	NA	NA	No access to well granted. Well removed from monitoring program.
[redacted]	September 6	September 6	
[redacted]	September 6	September 6	
[redacted]	September 6	September 6	

- Semiannual water level monitoring was completed for the three wells at the Codrington Fish Research Centre on March 6 and September 6, 2017. Results are provided in Table B-4, Appendix B. There is no access to Well 1 that is used for consumption purposes at the centre.

- Semiannual surface water monitoring at stations SWB and SWC was completed on March 2 and September 6, 2017. Chemical results and flow rates are provided in Table D-1, Appendix D. Watercourse characteristics were used to determine the surface water flow rates. Parameters were analysed as required, except owing to the laboratory scan package bismuth was not analyzed, but strontium and vanadium were added.

- Annual (field parameters) and semiannual (flow rates) surface water monitoring at springs FH-SW1 and FH-SW2 was completed on March 2 and September 6, 2017. Flow rates and chemical results for the required field parameters are presented in Table D-2, Appendix D. Watercourse characteristics were used to determine the surface water flow rates.

- Precipitation data from the local climatological station in Trenton or Belleville were documented for use in the assessment of water levels and flow rates. Data prior to each monitoring event are summarized in Table 2.

Laboratory chemical analyses were completed at AGAT Laboratories in Mississauga. Laboratory Certificates of Analysis are on file if required.

3. HYDROGEOLOGIC SETTING

3.1 TOPOGRAPHIC AND PHYSIOGRAPHIC SETTING

The pit is located on a hill, which is approximately 2.5 km wide in an east-west direction and slightly longer in the north-south direction. The hill has a flattened top and is approximately 50 metres (m) higher than the surrounding sand plain.

The maximum natural elevation on the pit is about 204 metres above sea level (m asl) in the western portion of the pit and the minimum elevation is about 180 m asl in the southeastern portion of the pit. A low-lying area at an elevation of about 181 m asl is located in the north-central portion of the pit and is identified to be a seasonal wetland/pond on the topographic mapping. The northern limit of the pit along the Ontario Hydro Power line easement varies between 180 to 195 m asl, and the southern limit varies between 180 and 195 m asl.

The pit is not in the Oak Ridges Moraine physiographic region or the Oak Ridges Moraine Conservation Plan Area (ORMCPA).

3.2 GEOLOGIC SETTING

The main finding of the extensive drilling and recent extraction operations on the pit is that there are substantial amounts of sand and gravelly sand in the subsurface and that a large amount of this material is above the water table. Based on a detailed interpretation of the subsurface findings the subsurface material encountered was grouped into three major units.

Unit 1
Unit 1 includes silt till and silty fine sand that are generally in the order of about 5 m to 8 m thick, but were detected to be at least 11.9 m to 16.8 m deep within the northwestern corner of the pit. This unit is prominent near surface within the northwestern portion of the site.

Unit 2
Unit 2 is the main sand and gravel unit present within the pit. The unit is prominent at surface or below Unit 1 in the southern and eastern portions of the pit. The material of Unit 2 is variable in texture and commonly ranges from fine to medium sand with gravel and cobbles (>50%). The gravel-rich areas appear as lenses or beds within the sand, and the gravel content is variable.

Unit 3
Unit 3 is generally fine to medium sand with an occasional lens of coarser material. The unit is present at depth beneath much of the pit and is generally regarded as marginal for use as aggregate

due to its fine-grained texture and lack of gravel. Unit 3 is transitional with Unit 2 and essentially represents the gravel-poor phase of the combined unit.

Boreholes and extraction near the low-lying area in the north-central portion of the site intersected a shallow silt unit (Unit 1) from 0.6 to 8.2 m below ground surface. This fine grained material tends to restrict the downward movement of water and as a result contains a perched water table.

3.3 GROUNDWATER SETTING

Groundwater levels within the deep monitoring wells on the pit fluctuate on a seasonal basis as a result of the infiltration of precipitation and snowmelt to the water table that will naturally vary between the fall, winter, and spring.

The unconfined groundwater table is inferred to be highest in elevation with the central portion of the pit below the area of high surface topography and where sand occurs near surface. Within the northwestern portion of the site, the fine grained surficial material (silt and silty fine sand) prevents the rapid infiltration of water to the water table and thus prevents the establishment of high water table levels. The direction of groundwater movement is outward from the groundwater high toward the north, south, east, and west. As expected, no groundwater seeps or springs were identified on the pit. The deep unconfined groundwater table is monitored at monitoring wells BH05-2, BH05-18, BH05-19, BH06-1, BH12-2, and BH12-2.

A seasonal perched groundwater table occurs within the wetland/pond area within the north-central portion of the pit. It is interpreted that the perched water table is formed as a result of the slow downward movement of groundwater through the underlying silt. The fine grained soil that contains the perched water table is underdrained by the deeper unconfined water table. Groundwater conditions for the perched water table are assessed based on observations at monitoring well BH05-20.

Based on the water table configuration and the surrounding low areas, it is inferred that vertical hydraulic gradients are downward and the pit is located in a groundwater recharge area.

Considering data to May 2008 and the interpreted groundwater table configuration (Jagger Hims Limited, 2009), the pit average base elevation will be about 177.1 m asl (175.6 m asl + 1.5 m) within the central portion of the pit and will vary along the pit perimeter. Updated groundwater elevations for monitoring wells BH12-1 and BH12-2 were also considered in the pit design. Pit base elevations considered the following data.

MONITOR DESIGNATION	MAXIMUM GROUNDWATER ELEVATION (m asl)	DATE	MINIMUM PIT BASE ELEVATION (m asl)
BH05-2	174.74	May 2008	176.3
BH05-18	167.03	April 2007	168.6
BH05-19	159.82	May 2008	161.3
BH06-1	175.62	May 2008	177.1
BH12-1	153.52	November 2012	155.0
BH12-2	173.09	November 2012	174.5

NOTE: 'm asl' indicates meters above sea level.

3.4 GROUNDWATER USE

Residential and stock use of groundwater around the pit occurs from both dug wells and drilled wells. Most wells on record with the Ministry of the Environment and Climate Change (MOECC) are drilled wells, but the results of local water well reconnaissance surveys indicate the presence of a number of dug wells. The dug wells obtain water from an unconfined aquifer, while the drilled wells obtain water from either an unconfined aquifer or deeper confined aquifers.

Eight (8) residential water wells were selected for ongoing monitoring around the pit in accordance with the Site Plan and the PTTW. Only residents at the following six (6) wells initially agreed to participate in the ongoing Performance Monitoring Program. Well locations are shown in Figure 1.

- [redacted]

In addition, water wells located over 1.5 km west of the pit at the Codrington Fish Research Centre are included in the Performance Monitoring Program. See Figure 1 for location details.

3.5 SURFACE WATER

On a regional basis, there are few surface watercourses located within 2 km of the pit. One watercourse is Cold Creek, which is about 1 km south of the pit and flows in an easterly direction. A tributary that contributes to Cold Creek originates within 500 m of the pit, as shown in Figure 1, and flows below Old Wooler Road. The status of this tributary is assessed by monitoring station SWC.

Tributaries of Marsh Creek are located north, west, and east of the pit as summarized below.

- About 1 km west of the pit a tributary flows in a northerly direction toward Murray Marsh, which is located about 2 km northeast of the pit. This tributary has a component of groundwater baseflow that is assessed at stations FH-SW1 and FH-SW2, which are located at the Codrington Fish Research Centre.
- Near the southeastern corner of the pit is a tributary of Marsh Creek. Station SWB allows for the ongoing assessment of groundwater baseflow into this watercourse.
- North of the pit are a number of groundwater seeps and springs that combine with runoff to contribute to surface water flow within tributaries that flow toward Marsh Creek.

4. 2017 PIT OPERATION SUMMARY

In 2017, operations at the pit included: the completion of the internal access roads, material extraction, ongoing construction of the Settling Pond, installation of a second pumping well near the Settling Pond, construction of a lined Water Storage Pond, and the collection of water in the Settling Pond and Water Storage Pond. There was no extraction below the water table. A site sketch showing the pit conditions in April 2017 (Google Earth) is provided as Figure 2.

Water within the Settling Pond and Water Storage Pond included surface water that originated from runoff and groundwater that was pumped from two pumping wells located near the Settling Pond in accordance with the PTTW. Material washing occurred in 2017.

4.1 COMPLAINTS AND RESPONSES

No formal complaints regarding pit operations were received in 2017.

5. MONITORING RESULTS

5.1 GROUNDWATER ELEVATIONS AND DEPTHS

Groundwater elevations presented in Figures B-1 through B-8, Appendix B, indicate peak levels during the spring and summer months of 2017 followed by a general decrease in groundwater elevations in the fall owing to the drier weather conditions. One exception is at BH05-19 where the groundwater elevations were similar for mid 2017 as a result of onsite pumping to supplement the ponds, which commenced in the spring of 2017 and ended in October. Deactivation of the pumping in October 2017 resulted in a notable increase in the water levels within BH05-19.

The effect of the dry weather conditions is most apparent at BH05-20 within the low-lying area where the perched water table elevation decreased temporarily to below the base of the monitoring well in late 2017. These low water level conditions also occurred during the latter half of 2016 and temporarily in late 2013.

Groundwater Trigger Elevations were established for the onsite monitoring wells based on groundwater elevations measured to the end of 2015. These Trigger Elevations represent the minimum groundwater elevations observed with no detectable effect by pit operations. Groundwater elevations that are detected below the Trigger Elevation will initiate a progressive data review process that includes:

1) assessing if the low groundwater elevation is a result of pit operations or if it is a natural occurrence related to climate conditions;
2) if the low elevation is related to pit operations, confirmatory water level measurements will be collected;
3) if the low elevations related to pit operations are confirmed, then mitigation measures will be implemented.

The Groundwater Trigger Elevations and the minimum manual elevations for 2017 are summarized in the following table.

MONITORING WELL DESIGNATION	GROUNDWATER TRIGGER ELEVATION (m ASL)	MINIMUM 2017 GROUNDWATER ELEVATION (m ASL)	ACCEPTABLE GROUNDWATER ELEVATION (Yes/No)
BH05-2	173.30	173.02	No
BH05-18	166.43	166.42	No
BH06-1	174.03	173.71	No
BH12-1	152.39	152.60	Yes
BH12-2	167.85	172.95	Yes

NOTES:
1) 'm ASL' indicates metres above sea level.
2) Original Groundwater Trigger Elevations updated with 2015 groundwater elevations owing to naturally low groundwater elevations in 2015.
3) BH05-19 and BH05-20 removed from Groundwater Trigger Elevation assessment owing to the commencement of onsite pumping in 2016. Both wells are to be decommissioned in accordance with the Site Plan.

The minimum groundwater elevations for 2017 satisfied the Groundwater Trigger Elevations, except at BH05-2, BH05-18, and BH06-1 in March. The pattern of decreasing groundwater elevations for these three monitoring wells, as shown in Figures B- 2, B-3, and B-6, Appendix B, shows a constant decrease through 2016 into early 2017 in response to the dry weather conditions that occurred in 2016. However, no notable change in groundwater elevations occurred at these three monitoring wells as a result of pumping in 2017. Therefore, pit operations had no detectable impact on groundwater elevations near the pit boundaries in 2017.

Groundwater Trigger Levels were also established for the residential water wells and the water wells located at the Codrington Fish Research Centre. The Groundwater Trigger Depths and the maximum depths for 2017 are summarized in the following table. It is noted that depths are used for the water wells since the geodetic elevations of the wells were not available.

MONITORING WELL DESIGNATION	GROUNDWATER TRIGGER DEPTH (m)	MAXIMUM 2016 GROUNDWATER DEPTH (m)	ACCEPTABLE GROUNDWATER DEPTH (Yes/No)
[redacted]	3.71*	3.71	Yes
[redacted]	7.1**	Not Available	-
[redacted]	2.89	Not Available	-
[redacted]	2.39	2.06	Yes
[redacted]	2.45*	1.05	Yes
[redacted]	3.56	3.5	Yes
CFRC – Well2	Flowing	Flowing	Yes
CFRC – Well 3	1.55	1.61	No
CFRC – Well 4	2.07	1.94	Yes

NOTES:
1) 'm' indicates metres.
2) '*' indicates used 2015 level as no baseline levels available.
3) '**' indicates used 2016 level as no baseline levels available.

Most water wells showed an increase in elevation from 2016 to 2017 and showed an elevation that is greater than the Groundwater Trigger Depth. The low groundwater elevation at Well 3 of the Codrington Fish Research Centre (CFRC) occurred at about 2 km from the pit, which is beyond the potential influence of the pit. In addition, CFRC - Well 4 showed an acceptable level. Therefore, pit operations had no detectable impact on groundwater elevations at residential water wells in 2017.

The Site Plan provides a Water Well Complaint process that details a mitigation process for complaints from residents about the quality or quality of water within their water well. This process will also be used if the monitoring program identifies an unacceptable pit effect to the well water.

In summary, there were no observed unacceptable effects on groundwater elevations or depths from operations at the pit in 2017, although some low water levels as a result of drier conditions in 2016 continued into 2017.

5.2 GROUNDWATER QUALITY

Groundwater Trigger Concentrations were established based on major ions as presented in the Trilinear diagram of Figure 3, as well as based on the Ontario Drinking Water Standards, Objectives, and Guidelines (2006) (ODWSOG) that are included in the chemical summary tables of Tables C-1 through C-6, Appendix C. Major ions include parameters that constitute a major proportion of the water quality, and include: alkalinity, chloride, sulphate, calcium, magnesium, potassium, and sodium.

The Trilinear diagram shows that groundwater obtained from the onsite monitoring wells and the residential water wells in 2017 is similar and plots in a similar location to baseline conditions on the diagram. A notable change in groundwater quality will result in a shift in the plotted location of a monitoring well or residential water well on the diagram. For example, [redacted] continues to show road salt effects.

Figure C-1 to C-3, Appendix B, provide time concentration graphs for total dissolved solids (TDS), nitrate, and total phosphorous to allow for an assessment of water quality changes with time. In general the 2017 concentrations for these three parameters are similar to baseline conditions. BH05-18 tends to show the highest nutrient concentrations (nitrate and total phosphorus), likely as a result of agricultural fertilizers.

The following table provides the Trigger Concentrations that are based on 75% of the ODWSOG.

PARAMETER	ODWSOG (mg/L)	TRIGGER CONCENTRATION (mg/L)
TDS	500	375
DOC	5.0	3.75
Sulphate	500	375
Chloride	250	188
Nitrate	10.0	7.5
Aluminum	0.1	0.075
Barium	1.0	0.75
Boron	5.0	3.75
Cadmium	0.005	0.0038
Chromium	0.05	0.038
Copper	1	0.75
Iron	0.3	0.225
Lead	0.01	0.075
Manganese	0.05	0.038
Sodium	200	150
Zinc	5	3.75

NOTE: 'mg/L' indicates milligrams per litre.

Nitrate exceeded the Trigger Concentration in groundwater at BH05-18 for both the March and September monitoring events. Hardness was excluded from the Trigger Concentrations as

groundwater in the area of the pit is naturally hard and typically exceeds the ODWSOG of 100 milligrams per litre (mg/L). For the onsite monitoring wells the level of turbidity also typically exceeds the ODWSOG as a result of the agitation of sediment within the monitoring wells during sampling.

The nitrate concentration in groundwater at BH05-18 exceeded the ODWSOG of 10 mg/L in March and September 2017. Groundwater at BH05-19 also showed elevated nitrate concentrations. Elevated nitrate concentrations have historically occurred during baseline conditions at both monitoring wells likely as a result of the application of agricultural fertilizers.

Bacteria was detected in each of the residential water wells at one time or another.

In summary, there were no observed negative effects on groundwater quality from operations at the pit in 2017.

5.3 SURFACE WATER FLOW RATES

Surface water flow rates show a notable difference between stations SWB and SWC as presented in Figure D-1, Appendix D. Station SWB is located right at the groundwater discharge point and thus the flow rates reflect local groundwater elevations. Seasonal patterns or influences from precipitation and overland flow are not apparent. As shown in the following table, the flow rates at SWB for 2017 were at low levels compared to historic baseline lows (2013 to 2015). As the pit operations have not affected groundwater levels near the pit boundaries, the low flow rates reflect the natural conditions.

STATION	TRIGGER FLOW RATES (2013 to 2015) (L/s)	2016 FLOW RATES (L/s)
SWB	0.2 – 1.67	0.1 – 0.2
SWC	<1 – 51.9	2.1 – 12.5
FH-SW1	2.3 – 7.4	2.2 – 4.8
FH-SW2	4.9 – 69.4	2.8 – 3.3

NOTES:
1) 'L/s' indicates litres per second.
2) Trigger Flow Rates include flow rates measured prior to pumping at the pit.

At station SWC the surface water flow rates show an influence from groundwater baseflow, precipitation, and overland flow. A seasonal pattern of flow rates is apparent with greater flow rates during the spring (March) and lower flow rates during the summer and fall (September). As shown in the table provided above, the flow rates at SWC for 2017 were within the flow rate range for baseline conditions.

At the Codrington Fish Research Centre, the flow rates at stations FH-SW1 and FH-SW2 also approximated historic lows as shown in Figure D-5, Appendix D. FH-SW1 is located right at a groundwater discharge point, whereas as FH-SW2 is located further from the spring source and shows an influence from groundwater baseflow, precipitation, and overland flow. As operations at the pit have not extracted below the water table, and local groundwater elevations and surface water flows have not been influenced by pit operations, the low flow rates at the Codrington Fish Research Centre are attributed to natural conditions.

5.4 SURFACE WATER QUALITY

Surface Water Trigger Concentrations were established based on major ions as presented in the Trilinear diagrams of Figure 3, as well as based on the Provincial Water Quality Objectives (1994 plus updates) (PWQO) that are included in the chemical summary tables of Tables D-1 and D-2, Appendix D.

The Trilinear diagrams show that the surface water quality is similar, and is similar to groundwater quality. A notable change in surface water quality will result in a shift in the plotted location of a station on the diagram.

Figures D-2 to D-4, Appendix D, provide time concentration graphs for total dissolved solids (TDS), nitrate, and total phosphorous to allow for an assessment of water quality changes with time. In general the 2017 concentrations for these three parameters are similar to baseline conditions, with surface water at station SWB generally showing lower concentrations than at station SWC.

The following table provides the Trigger Concentrations that are based on 75% of the PWQO.

PARAMETER	PWQO (µg/L)	TRIGGER CONCENTRATION (µg/L)
Ammonia (unionized)	0.02*	<0.02**
Aluminum	75	56
Beryllium	1100	825
Boron	200	150
Cadmium	0.5	0.375
Chromium	8.9	6.68
Cobalt	0.9	0.68
Copper	5	3.75
Iron	300	225
Lead	25.0	18.8
Molybdenum	40	30
Nickel	25	18.8
Phosphorus	30	22.5

PARAMETER	PWQO (µg/L)	TRIGGER CONCENTRATION (µg/L)
Silver	0.1	0.1**
Vanadium	6	4.5
Zinc	20	15

NOTES:

1) 'µg/L' indicates micrograms per litre.
2) '*' indicates value is milligrams per litre (mg/L).
3) '**' indicates Trigger Concentration is analytical method detection limit.

Surface water quality naturally satisfies the Trigger Concentrations and PWQO, except for total phosphorus (March) at station SWB and for iron (March and September) and total phosphorus (March) at station SWC. A second pattern of note is that parameter concentrations tend to be greater at station SWC compared to station SWB, likely as a result of the contribution of overland flow and its influence on soil erosion.

In summary the surface water quality shows no negative effects from the pit operations.

6. 2018 MONITORING PROGRAM

Based on the 2017 monitoring program findings, it is recommended that the Performance Monitoring Program detailed in the Site Plan and PTTW, and presented in Table 1, be continued in 2018. The 2018 Monitoring Program Report should be completed prior to March 31, 2019.

7. CONCLUSIONS AND RECOMMENDATIONS

Based on the findings presented in this report, we are pleased to provide the following conclusions.

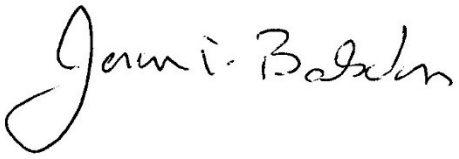
- Groundwater elevations, depths, and quality showed no unacceptable effects from the pit operations in 2017, but continued to show an influence from the dry weather conditions that occurred in 2016. Groundwater quality at the residential water wells continued to reflect natural conditions in 2017 and no formal water well complaints about pit operations were received from residents in 2017.

- Surface water flow rates and quality showed no effects from the pit operations in 2017, but were influenced by the dry weather conditions and some erosion of the watercourses.

The following recommendations are provided for consideration in 2018.

- Groundwater and surface water monitoring and reporting should continue in 2018 as outlined in Section 6 of this report.

Prepared by:
ResEnv Consulting Limited



Jason T. Balsdon, M.A.Sc., P.Eng.
Consulting Engineer

8. REFERENCES

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Ontario Ministry of the Environment (MOE), 2003, Revised June 2006.
Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines. PIBS 4449e01.

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Tables

TABLE 1
MONITORING PROGRAM SUMMARY
CODRINGTON PIT

MONITORING PROGRAM			
MONITORING LOCATIONS	**FREQUENCY**	**PARAMETERS**	**COMMENTS**
GROUNDWATER			
BH05-2, BH05-18, BH05-18, BH05-19, BH06-1, BH12-1 (formerly A), BH12-2 (formerly C)	Quarterly	Water Levels	BH05-19 and BH05-20 will be decommissioned during extraction.
	Semiannually	Field parameters, inorganics, metals	
	Annually if onsite fueling or fuel storage.	Petroleum Hydrocarbons	
Six (6) Residential Wells within 1 km*	Annually	Water Levels	Proposed residential wells include: 1 north of site, 1 east of site, and 4 along Old Wooler Road.
	Annually	Field parameters, inorganics, metals, microbiological.	
Fish Hatchery Wells (assume 2)	Semiannually	Water Levels	Where access is granted.
SURFACE WATER			
SWB, SWC	Semiannually	Flow Rates	Tributaries of Marsh Creek and Cold Creek.
	Semiannually	Field Parameters, Inorganics, Metals	
Fish Hatchery Springs	Semiannually	Flow Rates	Where access is granted.
	Annually	Field Parameters	

NOTES:

1) * denotes wells to be sampled will depend on access approval by landowner.

2) Quarterly indicates March, June, September, and December.

3) Annually indicates September.

4) Semiannually indicates March and September.

5) Field parameters include: pH, temperature, conductivity, turbidity, and dissolved oxygen.

6) Inorganics include: TDS, hardness, total ammonia, conductivity, DOC, orthophosphate, pH, sulphate, alkalinity, chloride, nitrite, and nitrate.

7) Metals include: aluminum, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, molybdenum, nickel, phosphorus, potassium, silver, sodium, strontium, vanadium, and zinc.

8) Petroleum Hydrocarbons include: BTEX and PH (F2 to F4).

9) Microbiological includes: background, total coliforms, E-Coli, and streptococci.

10) Precipitation conditions will be documented prior to sampling springs and undertaking sampling activities.

TABLE 2
PRECIPITATION SUMMARY
CODRINGTON PIT

DATE	PRECIPITATION (mm)
February 24	2.2
February 25	21.4
February 26	Trace
February 27	0
February 28	2.0
March 1	13.0
March 2	0.2

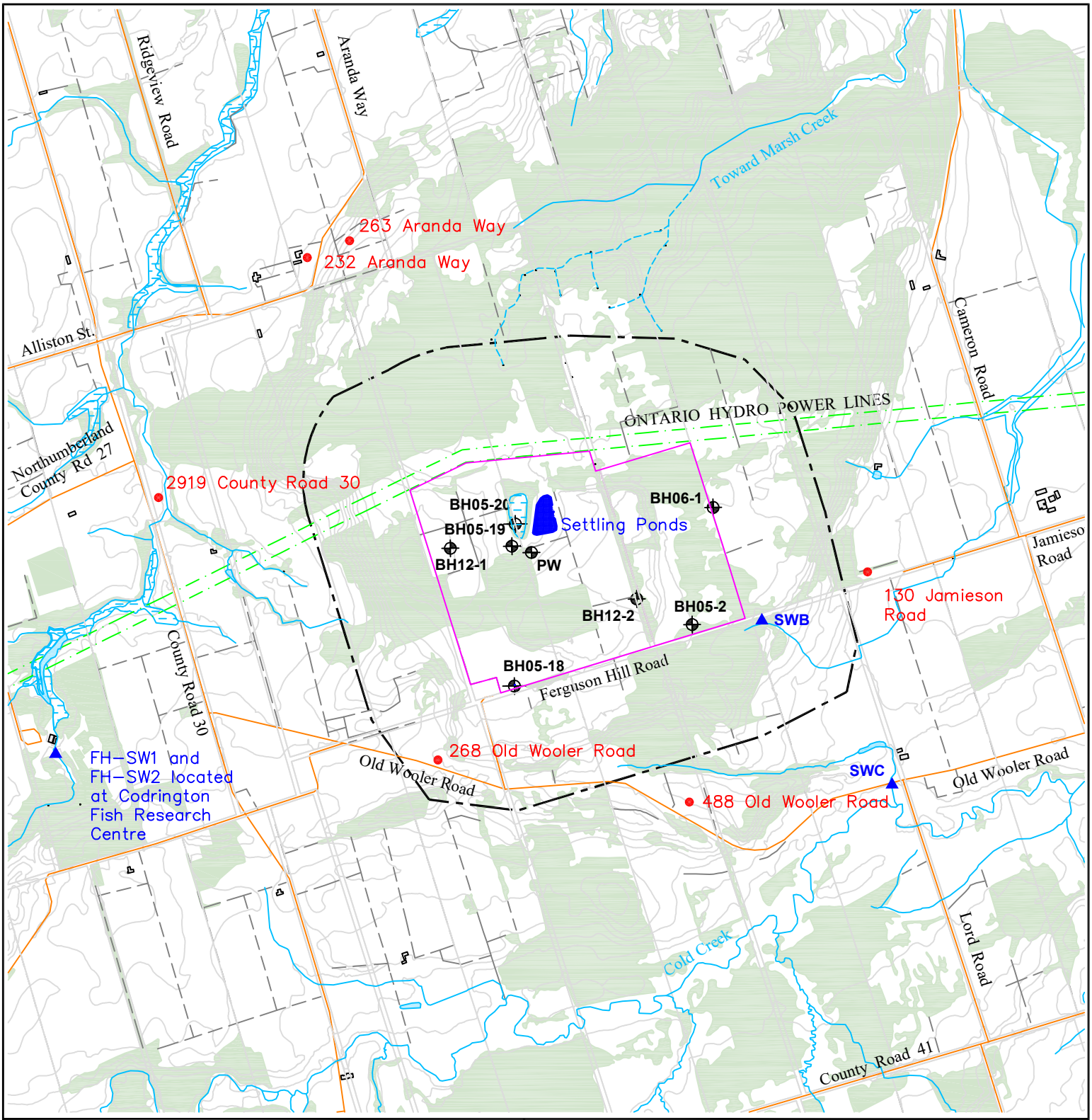
DATE	PRECIPITATION (mm)
June 22	13.6
June 23	40.1
June 24	0
June 25	Trace
June 26	12.9
June 27	3.0
June 28	0

DATE	PRECIPITATION (mm)
September 1	0
September 2	3.2
September 3	4.8
September 4	18.8
September 5	0
September 6	15.0
September 1	0

DATE	PRECIPITATION (mm)
November 29	Trace
November 30	3.8
December 1	0
December 2	0
December 3	0
December 4	9.0
December 5	3.0

NOTE: ‘mm’ indicates millimetres. Data from Trenton or Belleville.

Figures



LEGEND

- PIT LOCATION
- BH05-2 MONITORING WELL LOCATION AND DESIGNATION
- 500 m RADIUS FROM THE PIT
- APPROXIMATE LOCATION OF DOMESTIC WATER WELLS
- ▲ SWB SURFACE WATER STATION LOCATION AND DESIGNATION

250 0 250 m

MAP SOURCE:
OBM 1:10000 MAPPING, NAD 83, ZONE 18 AND HYDROGEOLOGICAL STUDY (GENIVAR, 2013).

SITE LOCATION MAP

2017 MONITORING PROGRAM REPORT - CODRINGTON PIT
for St. Marys Cement Inc. (Canada)

DATE: DECEMBER 2017	SCALE: 1:25000
PROJECT: 13-005-00	REF. NO.: F1-SP

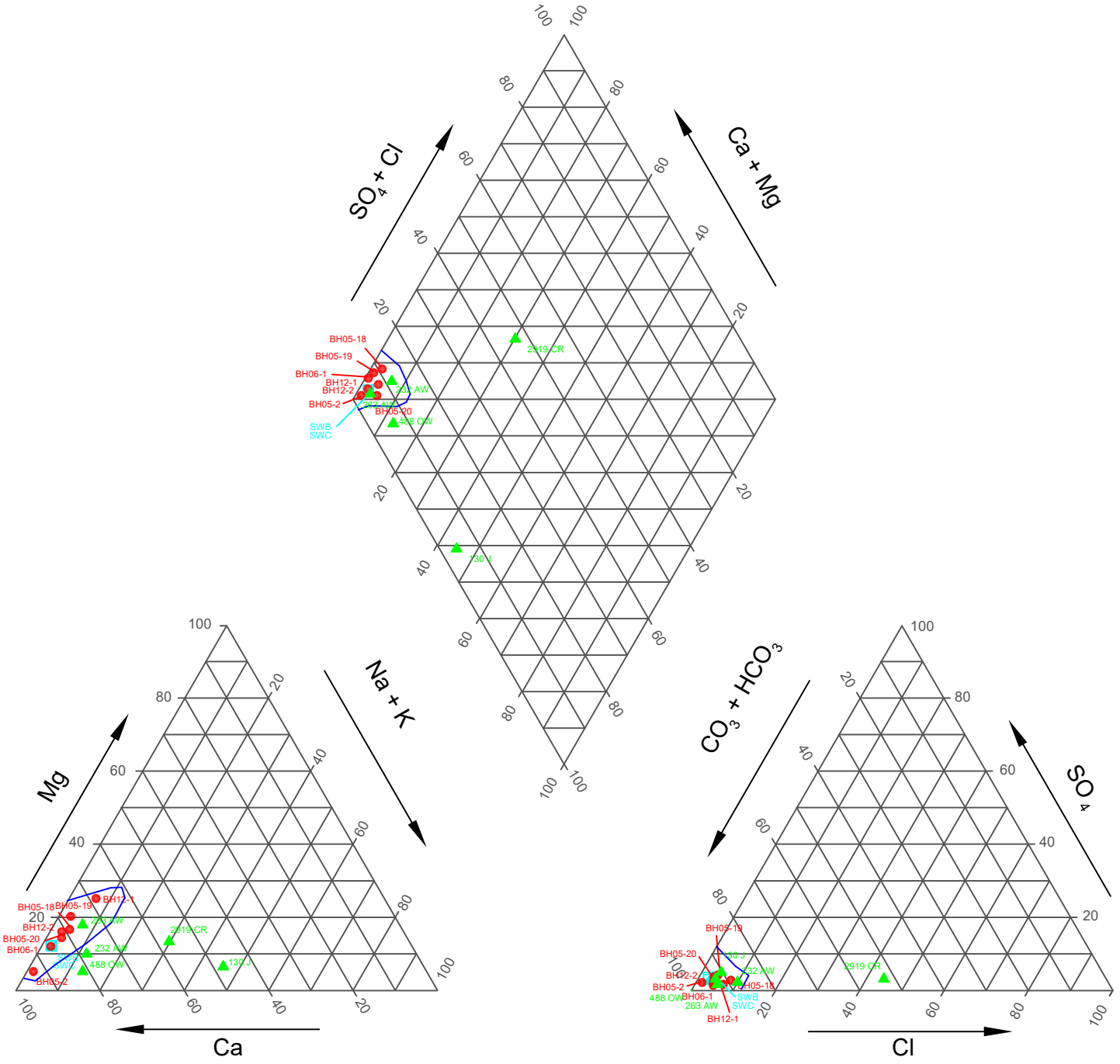
ResEnv Consulting Limited

FIGURE 1

Google Earth

miles 1

km 2



LEGEND

BASELINE GROUNDWATER AND SURFACE WATER QUALITY (PRE 2015)

MONITORING WELL

RESIDENTIAL WELL

SURFACE WATER

2017 WATER QUALITY - TRILINEAR DIAGRAM

2017 MONITORING PROGRAM REPORT
CODRINGTON PIT
For St. Marys Cement Inc. (Canada)

DATE: DECEMBER 2016	SCALE: AS SHOWN
PROJECT: 13-005-00	REF. NO.: F2

ResEnv Consulting Limited

FIGURE 3

Appendices

Appendix A

Permit To Take Water Number 8025-A9NQBU

PERMIT TO TAKE WATER

Surface and Ground Water
NUMBER 8025-A9NQBU

Pursuant to Section 34.1 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:

St. Marys Cement Inc. (Canada)
55 Industrial Street
Toronto, Ontario M4G 3W9
Canada

For the water taking from: Settling Pond Network
Pumping Well - PW
Pumping Well - PW2

Located at: Lot 33, Concession 6, Geographic Township of Murray
Brighton, County of Northumberland

For the purposes of this Permit, and the terms and conditions specified below, the following definitions apply:

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34.1, OWRA.

(b) "Provincial Officer" means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.

(c) "Ministry" means Ontario Ministry of the Environment and Climate Change.

(d) "District Office" means the Peterborough District Office.

(e) "Permit" means this Permit to Take Water No. 8025-A9NQBU including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA.

(f) "Permit Holder" means St. Marys Cement Inc. (Canada).

(g) "OWRA " means the *Ontario Water Resources Act,* R.S.O. 1990, c. O. 40, as amended.

You are hereby notified that this Permit is issued subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated February 20, 2016 and signed by Colin Evans, and all Schedules included in this Permit.

1.2 The Permit Holder shall ensure that any person authorized by the Permit Holder to take water under this Permit is provided with a copy of this Permit and shall take all reasonable measures to ensure that any such person complies with the conditions of this Permit.

1.3 Any person authorized by the Permit Holder to take water under this Permit shall comply with the conditions of this Permit.

1.4 This Permit is not transferable to another person.

1.5 This Permit provides the Permit Holder with permission to take water in accordance with the conditions of this Permit, up to the date of the expiry of this Permit. This Permit does not constitute a legal right, vested or otherwise, to a water allocation, and the issuance of this Permit does not guarantee that, upon its expiry, it will be renewed.

1.6 The Permit Holder shall keep this Permit available at all times at or near the site of the taking, and shall produce this Permit immediately for inspection by a Provincial Officer upon his or her request.

1.7 The Permit Holder shall report any changes of address to the Director within thirty days of any such change. The Permit Holder shall report any change of ownership of the property for which this Permit is issued within thirty days of any such change. A change in ownership in the property shall cause this Permit to be cancelled.

2. General Conditions and Interpretation

2.1 Inspections

The Permit Holder must forthwith, upon presentation of credentials, permit a Provincial Officer to carry out any and all inspections authorized by the OWRA, the *Environmental Protection Act* , R.S.O. 1990, the *Pesticides Act* , R.S.O. 1990, or the *Safe Drinking Water Act,* S. O. 2002.

2.2 Other Approvals

The issuance of, and compliance with this Permit, does not:

(a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the *Ontario Water Resources Act* , and the *Environmental Protection Act* , and any regulations made thereunder; or

(b) limit in any way any authority of the Ministry, a Director, or a Provincial Officer, including the authority to require certain steps be taken or to require the Permit Holder to furnish any further information related to this Permit.

2.3 Information

The receipt of any information by the Ministry, the failure of the Ministry to take any action or require any person to take any action in relation to the information, or the failure of a Provincial Officer to prosecute any person in relation to the information, shall not be construed as:

(a) an approval, waiver or justification by the Ministry of any act or omission of any person that contravenes this Permit or other legal requirement; or

(b) acceptance by the Ministry of the information's completeness or accuracy.

2.4 Rights of Action

The issuance of, and compliance with this Permit shall not be construed as precluding or limiting any legal claims or rights of action that any person, including the Crown in right of Ontario or any agency thereof, has or may have against the Permit Holder, its officers, employees, agents, and contractors.

2.5 Severability

The requirements of this Permit are severable. If any requirements of this Permit, or the application of any requirements of this Permit to any circumstance, is held invalid or unenforceable, the application of such requirements to other circumstances and the remainder of this Permit shall not be affected thereby.

2.6 Conflicts

Where there is a conflict between a provision of any submitted document referred to in this Permit, including its Schedules, and the conditions of this Permit, the conditions in this Permit shall take precedence.

3. Water Takings Authorized by This Permit

3.1 **Expiry**

This Permit expires on **June 10, 2026**. No water shall be taken under authority of this Permit after the expiry date.

3.2 Amounts of Taking Permitted

The Permit Holder shall only take water from the source, during the periods and at the rates and amounts of taking specified in Table A. Water takings are authorized only for the purposes specified in Table A.

Table A

	Source Name / Description:	Source: Type:	Taking Specific Purpose:	Taking Major Category:	Max. Taken per Minute (litres):	Max. Num. of Hrs Taken per Day:	Max. Taken per Day (litres):	Max. Num. of Days Taken per Year:	Zone/ Easting/ Northing:
1	Settling Pond Network	Pond Dugout	Aggregate Washing	Industrial	9,092	12	6,546,240	313	18 277983 4893013
2	Pumping Well - PW	Well Drilled	Aggregate Washing	Industrial	60	24	86,400	313	18 277897 4892840
3	Pumping Well - PW2	Well Drilled	Aggregate Washing	Industrial	60	24	86,400	313	18 277928 4892971
						Total Taking:	6,719,040		

4. Monitoring

4.1 The Permit Holder shall maintain a record of all water takings. This record shall include the dates and times of water takings and the total measured amounts of water taken per day for each day that water is taken under the authorization of this Permit. A separate record shall be maintained for each source. The Permit Holder shall keep all required records up to date and available at or near the site of the taking and shall produce the records immediately for inspection by a Provincial Officer upon his or her request.

4.2 The total amounts of water taken shall be measured using a flow meter and totalizer.

4.3 The "Performance Monitoring Program" shall be undertaken as described in the application for this Permit however the following two changes shall also be incorporated into the program:

1) The domestic wells at 230 Old Wooler Road and 22 Ferguson Hill Road shall be explicitly added to the monitoring program and the frequency of water level measurement shall be quarterly at these wells (with the permission of the well owner); and,

2) Groundwater trigger depths shall be determined for the domestic wells at 230 Old Wooler Road and 22 Ferguson Hill Road. This information shall be determined prior to any water taking at pumping wells PW or PW2. These domestic wells shall be added to the overall monitoring, assessment and contingency programs described in the application for this Permit.

If the domestic well owners that are part of the "Performance Monitoring Program" for the site do not provide access for monitoring of their well(s), this information shall be

provided to the Director in writing within 60 days of the refusal to provide access.

4.4 The Permit Holder shall retain a qualified person to prepare and submit a report to the MOECC on an annual basis prior to March 31 of each year: The report shall include (but not be limited to) the following items:

- an analysis of the monitoring results and daily water takings; and,
- provide conclusions and make recommendations based on the monitoring results.

5. Impacts of the Water Taking

5.1 Notification

The Permit Holder shall immediately notify the local District Office of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint. The Permit Holder shall immediately notify the local District Office if the taking of water is observed to have any significant impact on the surrounding waters. After hours, calls shall be directed to the Ministry's Spills Action Centre at 1-800-268-6060.

5.2 For Surface-Water Takings

The taking of water (including the taking of water into storage and the subsequent or simultaneous withdrawal from storage) shall be carried out in such a manner that streamflow is not stopped and is not reduced to a rate that will cause interference with downstream uses of water or with the natural functions of the stream.

For Groundwater Takings

If the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of so doing, or shall reduce the rate and amount of taking to prevent or alleviate the observed negative impact. Pending permanent restoration of the affected supplies, the Permit Holder shall provide, to those affected, temporary water supplies adequate to meet their normal requirements, or shall compensate such persons for their reasonable costs of doing so.

If permanent interference is caused by the water taking, the Permit Holder shall restore the water supplies of those permanently affected.

5.3 Prevention of Adverse Effects:

The Permit Holder shall ensure the taking of water under authority of this Permit does not result in an adverse effect on area waters.

5.4 Prevention of Structural Adverse Effects:

The Permit Holder shall take all measures necessary to prevent damage to buildings, bridges,

structures, roads and/or railway lines that may be impacted either directly or indirectly by this taking.

6. Director May Amend Permit

The Director may amend this Permit by letter requiring the Permit Holder to suspend or reduce the taking to an amount or threshold specified by the Director in the letter. The suspension or reduction in taking shall be effective immediately and may be revoked at any time upon notification by the Director. This condition does not affect your right to appeal the suspension or reduction in taking to the Environmental Review Tribunal under the *Ontario Water Resources Act* , Section 100 (4).

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is included to ensure that the conditions in this Permit are complied with and can be enforced.

2. Condition 2 is included to clarify the legal interpretation of aspects of this Permit.

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written notice served upon me, the Environmental Review Tribunal and the Environmental Commissioner, ***Environmental Bill of Rights****, R.S.O. 1993, Chapter 28, within 15 days after receipt of this Notice, require a hearing by the Tribunal. The Environmental Commissioner will place notice of your appeal on the Environmental Registry. Section 101 of the Ontario Water Resources Act, as amended provides that the Notice requiring a hearing shall state:*

1. The portions of the Permit or each term or condition in the Permit in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

In addition to these legal requirements, the Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Permit to Take Water number;
6. The date of the Permit to Take Water;
7. The name of the Director;
8. The municipality within which the works are located;

This notice must be served upon:

The Secretary
Environmental Review Tribunal
655 Bay Street, 15th Floor
Toronto ON
M5G 1E5
Fax: (416) 326-5370
Email:
ERTTribunalsecretary@ontario.ca

AND

The Environmental Commissioner
1075 Bay Street
6th Floor, Suite 605
Toronto, Ontario M5S 2W5

AND

The Director, Section 34.1,
Ministry of the Environment and Climate Change
1259 Gardiners Rd, PO Box 22032
Kingston, ON
K7P 3J6

Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal:

by Telephone at	by Fax at	by e-mail at
(416) 212-6349	(416) 326-5370	www.ert.gov.on.ca
Toll Free 1(866) 448-2248	Toll Free 1(844) 213-3474	

This instrument is subject to Section 38 of the ***Environmental Bill of Rights*** *that allows residents of Ontario to seek leave to appeal the decision on this instrument. Residents of Ontario may seek to appeal for 15 days from the date this decision is placed on the Environmental Registry. By accessing the Environmental Registry, you can determine when the leave to appeal period ends.*

Dated at Toronto this 14th day of June, 2016.

Greg Faaren
Director, Section 34.1
Ontario Water Resources Act , R.S.O. 1990

Schedule A

This Schedule "A" forms part of Permit To Take Water 8025-A9NQBU, dated June 14, 2016.

The following tables and figures of the Technical Support Document should be attached in the PTTW as Schedule A:

- Table 1 - Monitoring Program Summary, Codrington Pit;
- Table 6 - Groundwater Level Triggers, Codrington Pit;
- Table 7 - Surface Water Flow Triggers, Codrington Pit;
- Table 8 - Groundwater Quality Triggers, Codrington Pit;
- Table 9 - Surface Water Quality Triggers, Codrington Pit;
- Figure 9 - Surface Water Flow Assessment Process;
- Figure 10 - Water Quality Assessment Process; and,
- Figure 11 - Water Well Complaint Resolution Process.

Appendix B

Hydrogeologic Details

- Monitor Construction Details – Table B-1
- Groundwater Elevations – Table B-2
- Groundwater Hydrographs – Figures B-1 to B-8
- Residential Groundwater Levels – Water Wells - Table B-3
- Groundwater Elevations – Codrington Fish Research Centre - Table B-4

TABLE B-1
MONITOR CONSTRUCTION DETAILS
CODRINGTON PIT

Monitor Designation	Screen Depth		Filter Pack		Seal	
	Top	Bottom	Top	Bottom	Top	Bottom
	m bgl	m bgl	m bgl	m bgl	m bgl	m bgl
BH05-2	9.2	12.2	9.2	12.2	0	0.9
BH05-18	25.9	29.0	25.6	28.9	0	25.6
BH05-19	25.3	28.4	24.7	28.4	0	24.7
BH05-20	3.0	4.6	2.7	4.6	0	2.7
BH06-1	8.6	10.1	8.4	10.3	0	8.4
BH12-1 (Location A)	45.6	51.7	45.5	51.7	44.5	45.5
					0	16.5
BH12-2 (Location C)	30.3	36.4	29.6	36.4	0	29.6

NOTE:

"m bgl" indicates metres below ground level.

TABLE B-2
GROUNDWATER ELEVATIONS
CODRINGTON PIT

	BH05-2	BH05-18	BH05-19	BH05-20	BH06-1	BH12-1	BH12-2	CFRC- Well2	CFRC- Well3	CFRC- Well4
Measuring Point	185.72	191.53	185.43	183.59	183.41	204.62	206.39	ND	ND	ND
Ground Elevation	184.78	190.96	184.98	182.81	182.61	203.93	205.47	ND	ND	ND
07-Oct-05	173.87	166.76	159.52	<178.11						
20-Oct-05	173.87	166.74	159.53	<178.11						
26-Oct-05	173.84	166.69	159.49	<178.11						
31-Jan-06	173.60	166.53	159.45	182.04						
23-Mar-06	173.95	166.49	159.38	182.39						
30-Mar-06	173.96	166.52	159.41	182.36	174.77					
21-Apr-06	174.03	166.60	159.44	182.23	174.86					
04-Dec-06	174.04	166.74	159.39	182.54	174.93					
09-Apr-07	174.31	167.03	159.58	182.54	175.13					
09-May-08	174.74	166.78	159.82	182.71	175.62					
24-Mar-10	173.71	166.47			174.67					
18-Aug-11	174.55	167.03			175.12					
16-Nov-12	173.44	166.53	159.74	179.86	174.14					
23-Nov-12						153.52	173.09			
07-Dec-12	173.41	166.54	159.71	178.97	174.10	153.64*	172.74			
11-Apr-13	173.76	167.07	159.40	Ponded	174.53	152.82	173.38	Flowing	1.4	1.94
04-Jul-13	174.21	167.00	159.54	182.54	175.03	152.9	173.90	Flowing	1.4	1.95
19-Sep-13	174.00	166.72	159.62	179.17	174.76	153.42*	173.97	Flowing	1.52	2.06
18-Oct-13							173.87			
04-Dec-13	Damaged	166.79	159.56	181.58	174.40	153.34*	173.69	Flowing	1.55	2.07
15-Apr-14	173.55	166.97	159.4	Ponded	174.57	155.34	173.33	Flowing	1.26	1.82
17-Jun-14	174.56	167.09	159.61	182.82	175.47	152.62	174.20			
15-Sep-14	174.30	166.95	159.82	181.72	175.14	155.21	173.36			
17-Sep-14								Flowing	1.46	1.97
04-Dec-14	173.93	166.76	159.79	181.76	174.73	154.86	174.02			
31-Mar-15	173.67	166.58	159.8	182.53	174.33	154.39	173.87			
01-Apr-15								Flowing	1.50	2.03
03-Jun-15	173.84	166.62	159.89	181.81	174.64	152.86	173.63			
21-Sep-15	173.52	166.51	159.62	180.41	174.28	152.84	173.46	Flowing	1.55	2.07
08-Nov-15	173.41	166.45	159.51	181.97	174.10	152.78	173.33			
11-Dec-15	173.30	166.43	159.48	181.88	174.03	152.87	173.24			
16-Mar-16	173.43	166.81	159.37	182.73	174.20	152.82	173.15	Flowing	1.41	1.94
17-Jun-16	173.83	166.78	159.29	181.11	174.64	152.78	173.58			
27-Sep-16	173.47	166.71	159.10	<178.11	174.22	152.82	173.45	Flowing	1.62	2.04
01-Dec-16	173.25	166.59	159.10	<178.11	173.96	152.78	173.22			
02-Mar-17	173.02	166.42	158.93	182.50	173.71	152.6	172.95	Flowing	1.61	1.94
28-Jun-17	174.10	166.73	158.99	Ponded	175.00	152.67	173.64			
06-Sep-17	173.99	166.94	158.99	179.62	174.83	152.78	173.90	Flowing	1.44	1.95
05-Dec-17	173.65	166.83	159.32	182.16	174.43	152.89	173.70			

NOTES:

1) "m asl" indicates metres above sea level.
2) "*" denotes water level based on pressure transducer owing to manual measurement interference by bentonite on well pipe sides.
3) CFRC indicates Codrington Fish Research Centre. No elevation survey of wells, thus depths below top of casing are provided.
4) Blank indicates water level not measured.

FIGURE B-1
GROUNDWATER ELEVATIONS

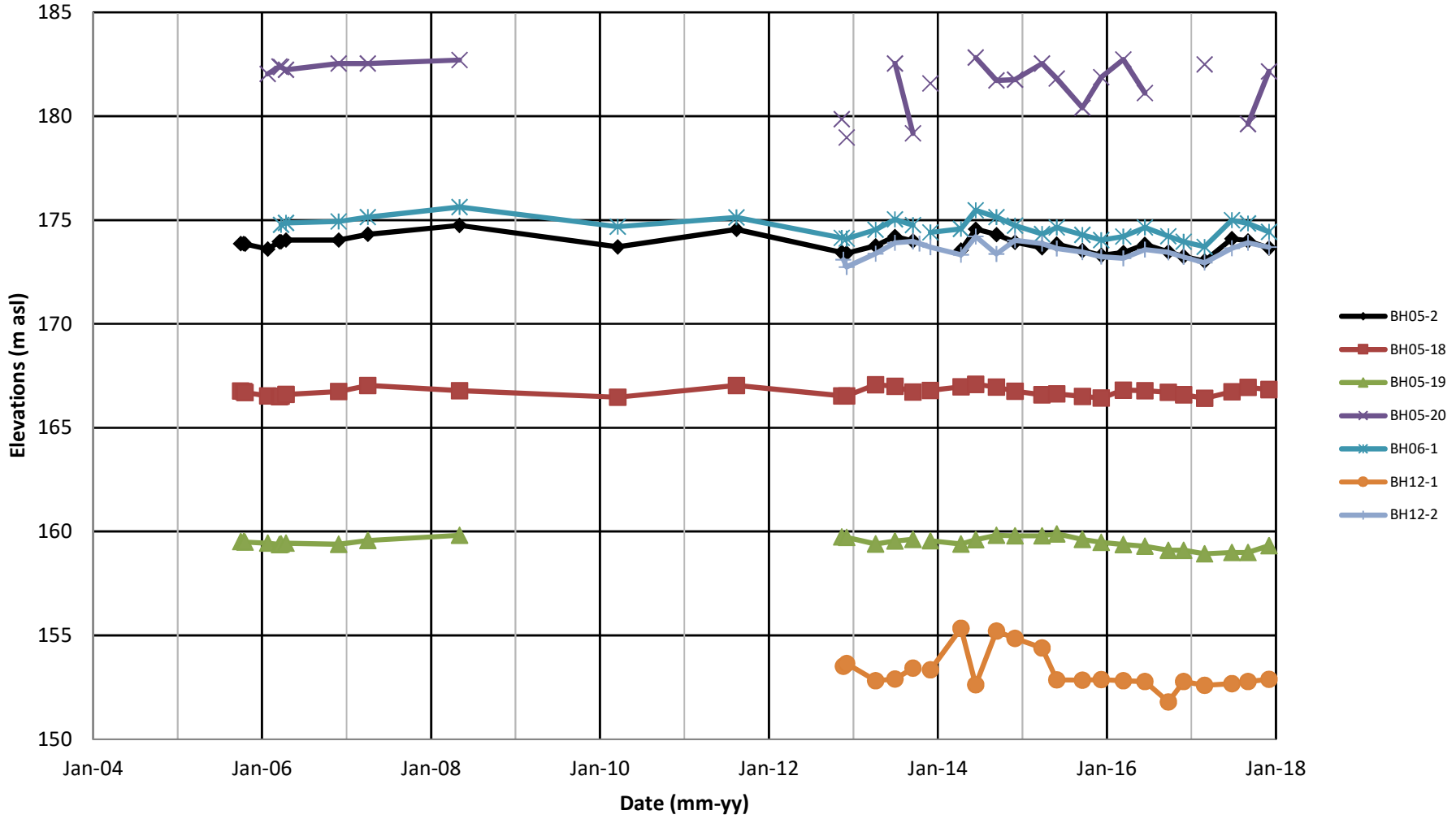


Figure B-2
BH05-2: Groundwater Elevation

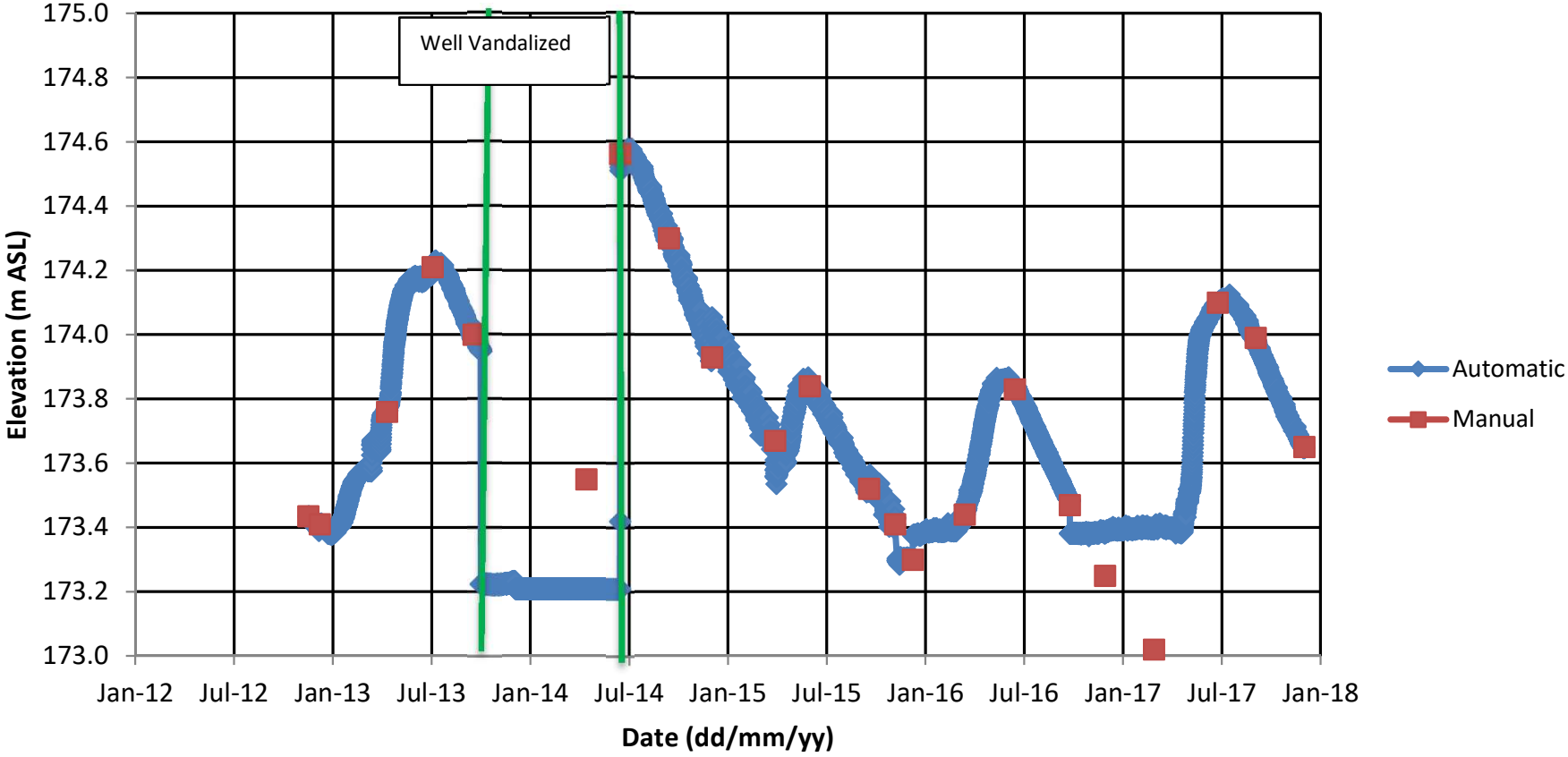


Figure B-3
BH05-18: Groundwater Elevation

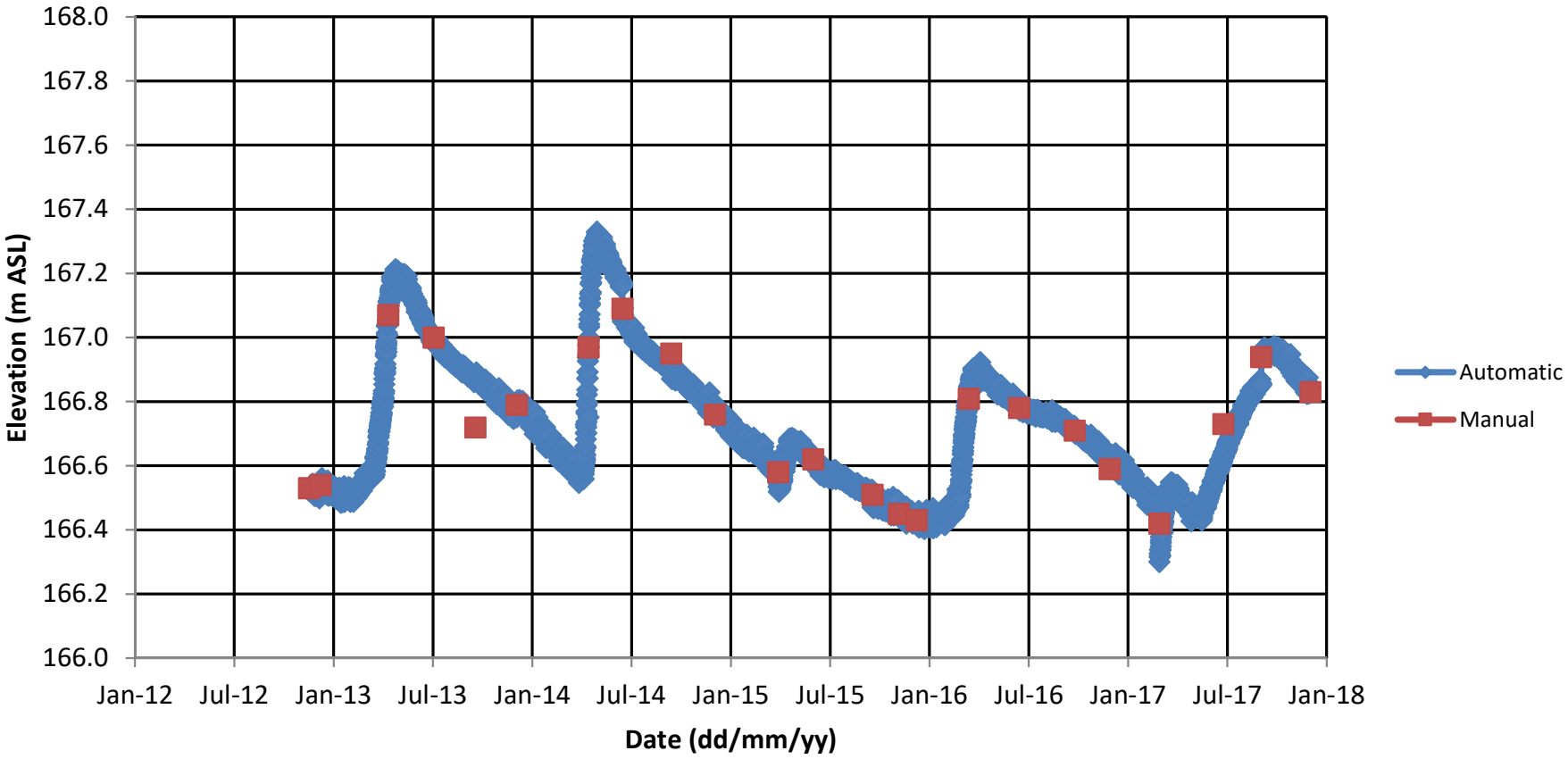


Figure B-4
BH05-19: Groundwater Elevation

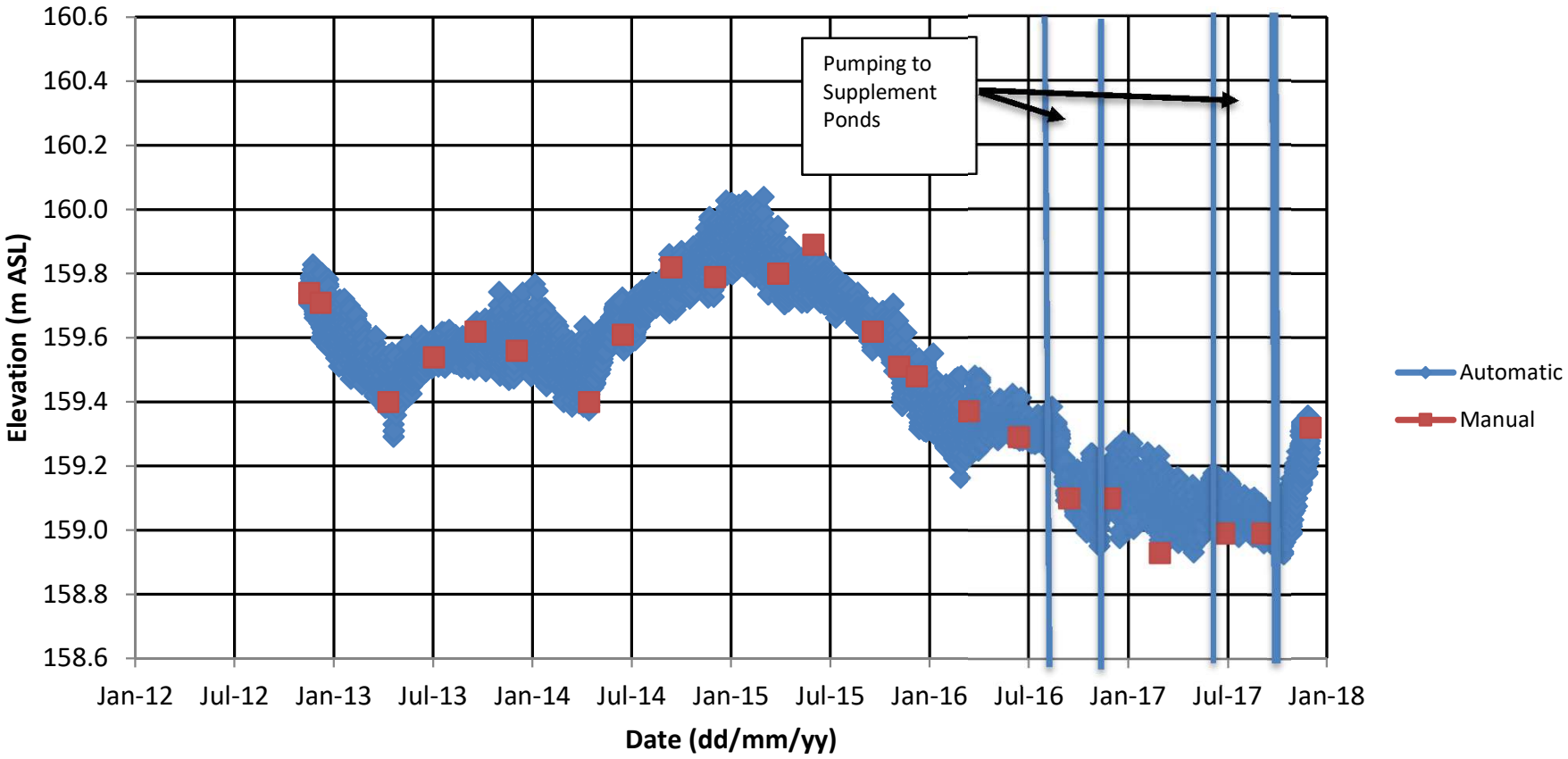


Figure B-5
BH05-20: Groundwater Elevation

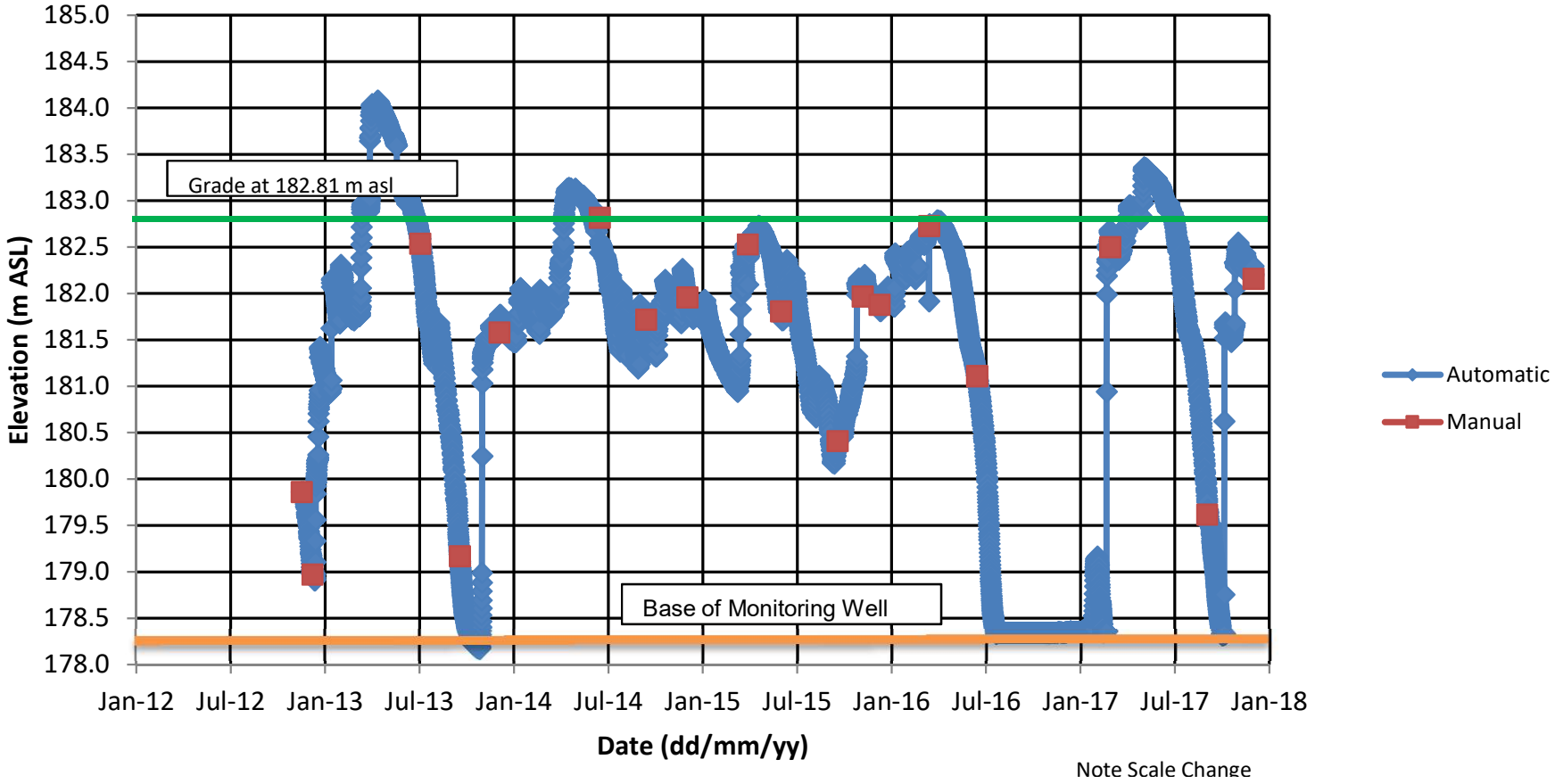


Figure B-6
BH06-1: Groundwater Elevation

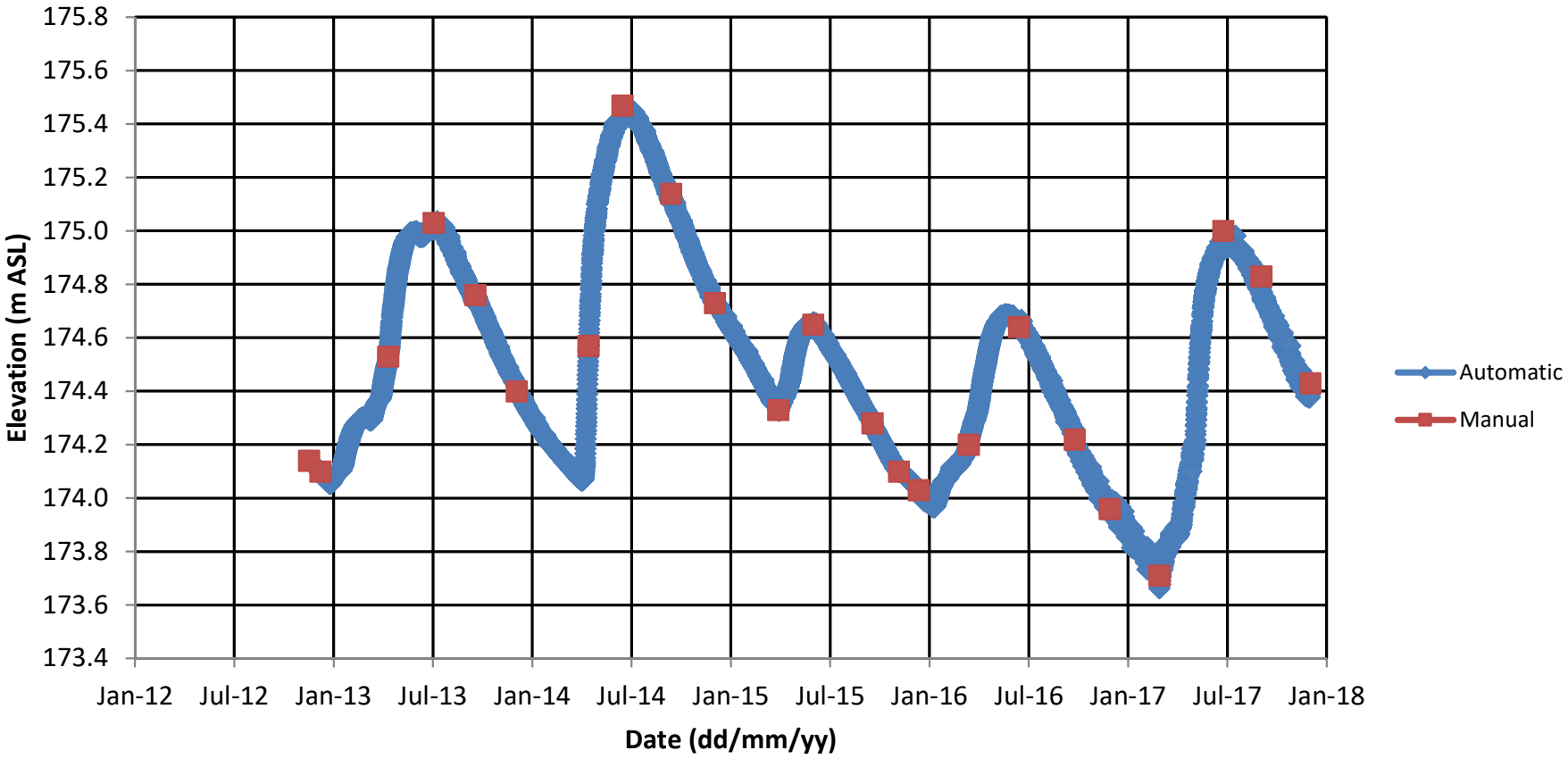


Figure B-7
BH12-1: Groundwater Elevation

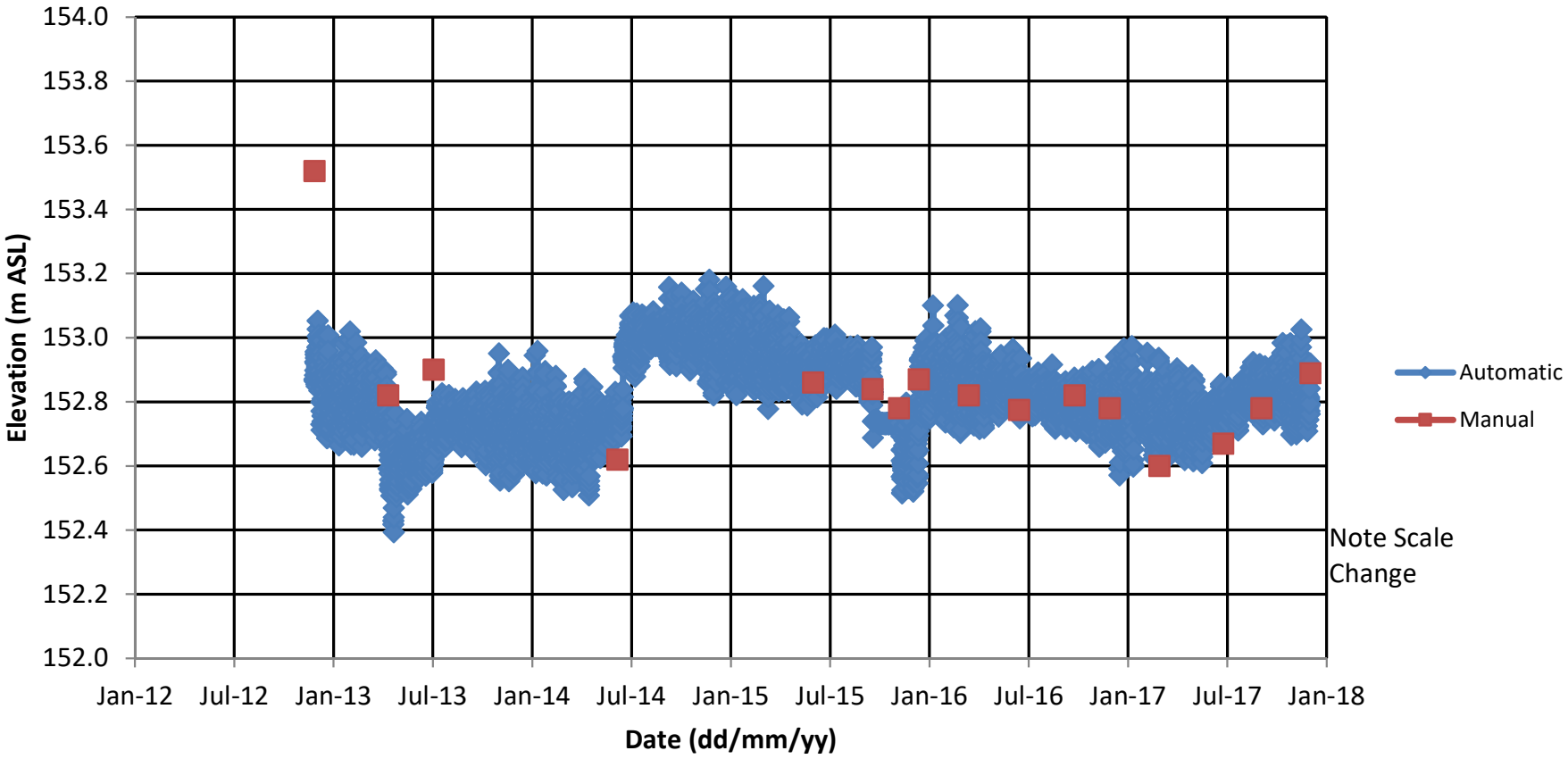


Figure B-8
BH12-2: Groundwater Elevation

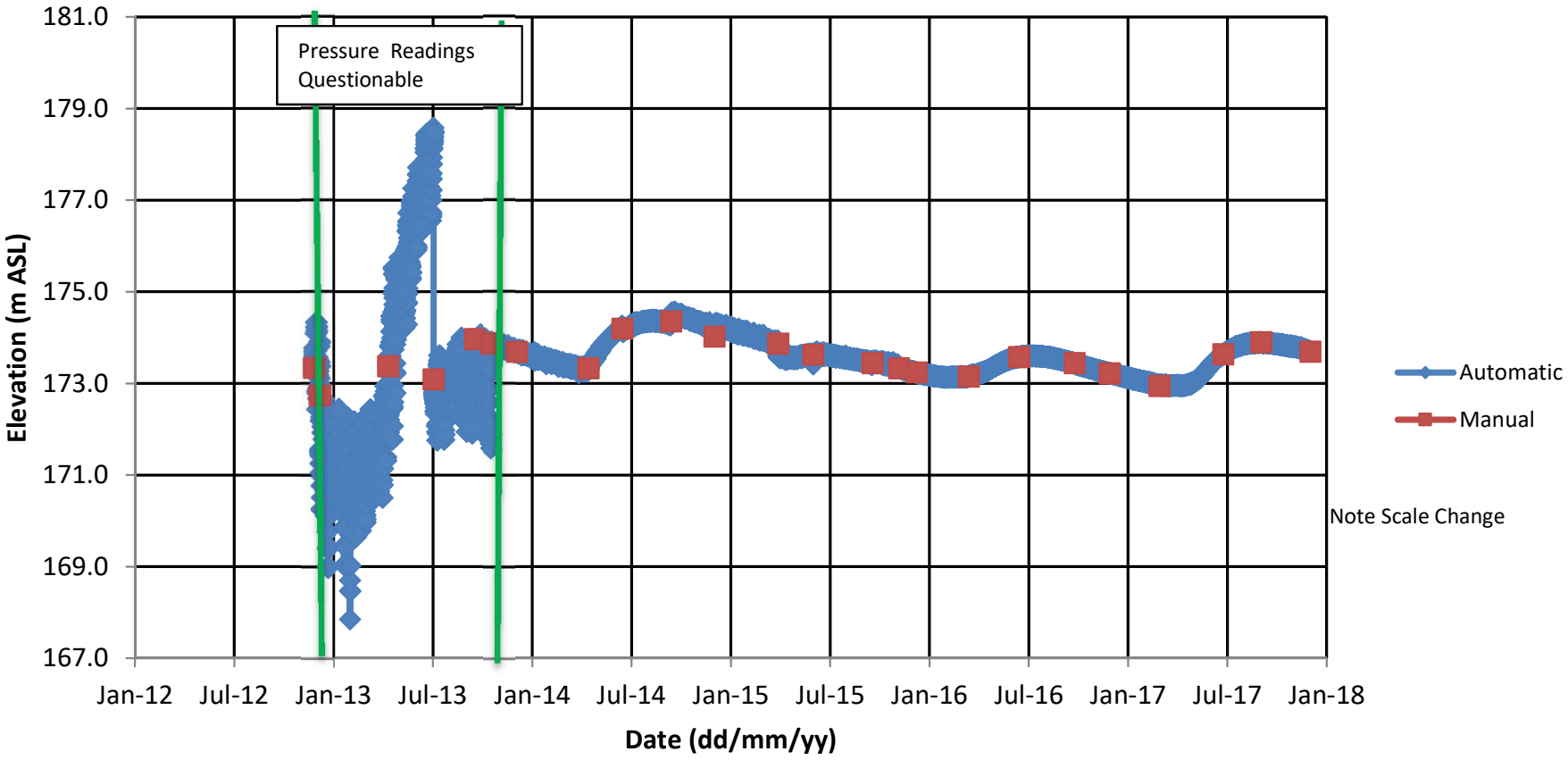


TABLE B-3
RESIDENTIAL GROUNDWATER LEVELS - WATER WELLS
CODRINGTON PIT

LOCATION	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
TYPE OF WELL	Drilled	Dug	Drilled	Dug	Dug/Drilled	Dug	Dug	Dug	Drilled	Drilled	Drilled	Drilled
DATE											No Access	
26-Jul-11	No Access					No Access			No Access	12.38		2.14
29-Jul-11												
18-Aug-11		1.81	No Access				4.73					
19-Aug-11								No Access				
28-Sep-11					No Access							
10-Apr-03												NP
11-Apr-13								NP				
12-Apr-13												
13-Apr-13												
15-Apr-13												
04-Jul-13												
05-Jul-13												
19-Sep-13												
20-Sep-13												
04-Dec-13												
07-Dec-13												
16-Sep-14												
03-Jun-15				3.71								
21-Sep-15				3.52								
11-Dec-15				3.49								
22-Mar-16				3.27		7.1						
20-Sep-16												
27-Sep-16				3.91		No Response						
06-Sep-17				3.71		No Response						

TABLE B-3
RESIDENTIAL GROUNDWATER LEVELS - WATER WELLS
CODRINGTON PIT

LOCATION	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
TYPE OF WELL	Drilled	Dug	Dug	Drilled	Drilled	Dug	Dug	Dug	Drilled	Dug	Dug	Dug
DATE												
26-Jul-11		2.74	1.4	9.79								
29-Jul-11					NA							
18-Aug-11	No Access					3.23	3.14		No Access	2.14		
19-Aug-11												3.47
28-Sep-11								No Access				
10-Apr-03												
11-Apr-13		NA										
12-Apr-13			NP									
13-Apr-13												0.99
15-Apr-13		NA										
04-Jul-13										1.31		NA
05-Jul-13		2.73										
19-Sep-13		2.89										3.56
20-Sep-13										2.39		
04-Dec-13										1.64		
07-Dec-13		2.79										
16-Sep-14		2.8								2.11		NA
03-Jun-15											1.68	
21-Sep-15										2.3	2.45	3.48
11-Dec-15											1.46	
22-Mar-16		No Response									1.36	
20-Sep-16											3.94 - Hauled	
27-Sep-16		No Response								3.09	3.23 - Hauled	Hauled Water
06-Sep-17		2.8								2.06	1.05	3.15

NOTES:

1) Groundwater levels in metres below top of well casing.
2) NA indicates not available owing to resident not home.
3) NP indicates no permission granted to access well and request for removal from monitoring program.

TABLE B-4
GROUNDWATER ELEVATIONS - CODRINGTON FISH RESEARCH CENTRE
CODRINGTON PIT

	CFRC- Well2	CFRC- Well3	CFRC- Well4
Measuring Point	ND	ND	ND
Ground Elevation	ND	ND	ND
11-Apr-13	Flowing	1.4	1.94
04-Jul-13	Flowing	1.4	1.95
19-Sep-13	Flowing	1.52	2.06
04-Dec-13	Flowing	1.55	2.07
16-Apr-14	Flowing	1.26	1.82
17-Sep-14	Flowing	1.46	1.97
01-Apr-15	Flowing	1.50	2.03
21-Sep-15	Flowing	1.55	2.07
16-Mar-16	Flowing	1.41	1.94
27-Sep-16	Flowing	1.62	2.04
06-Mar-17	Flowing	1.61	1.94
06-Sep-17	Flowing	1.44	1.95

NOTES:
1) Groundwater elevations are presented in metres below top of casing.
2) CFRC indicates Codrington Fish Research Centre. No elevation survey of wells, thus depths below top of casing are provided.

Appendix C

Groundwater Chemical Results

- Groundwater Quality – General Chemistry - Table C-1
- Time-Concentration Graphs – Figures C-1 to C-3
- Residential Groundwater Quality – Tables C-2 to C-6

TABLE C-1
GROUNDWATER QUALITY - GENERAL CHEMISTRY
CODRINGTON PIT

PARAMETERS	UNITS	ODWQO	MONITORING DATES						
			BH05-2	BH05-2	BH05-2	BH05-2	BH05-2	BH05-2	BH05-2
DATE			15-Apr-14	15-Sep-14	31-Mar-15	21-Sep-15	16-Mar-16	27-Sep-16	6-Sep-17
Field Parameters									
pH	pH	6.5 - 8.5	7.65	7.35	8.4	7.16	7.54	6.98	7.09
Temperature	^{0}C	15	3.8	9.2	5.7	10.8	7.1	9.4	11.5
Conductivity	(µS/cm)		422	397	430	420	481	346	345
Dissolved Oxygen	mg/L		10.86	9.3	10.4	11.9	11.5	10.5	8.97
Turbidity	NTU	5	**>200**	**>200**	**>200**	**>200**	**232**	**>200**	**278**
Inorganics									
TDS	mg/L	500	236	250	212	238	250	230	200
Hardness (CaCO3)	mg/L	80 - 100	**209**	**250**	**226**	**239**	**256**	**233**	**209**
Total Ammonia-N	mg/L		0.49	<0.02	0.08	<0.02	<0.02	<0.02	<0.02
Ammonia (unionized)	mg/L		<0.2	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Conductivity	uS/cm		398	471	429	422	458	439	402
Dissolved Organic Carbon	mg/L	5.0	1.5	1	1.9	1.5	0.8	1.2	1.8
Orthophosphate (P)	mg/L		<0.10	<0.10	<0.20	<0.10	<0.10	<0.10	0.2
pH	pH	6.5 - 8.5	8.13	8.05	8.01	8.03	8.07	7.92	8.22
Sulphate (SO4)	mg/L	500	2.84	3.35	3.78	2.19	2.48	2.28	4.03
Alkalinity (Total as CaCO3)	mg/L		191	228	224	223	253	227	219
Chloride (Cl)	mg/L	250	1	1.13	1.24	0.94	1.17	0.94	1.16
Nitrite (N)	mg/L	1.0	<0.05	<0.05	<0.10	<0.05	<0.05	<0.05	<0.10
Nitrate (N)	mg/L	10.0	0.08	0.07	0.15	0.06	0.08	0.22	0.1
Nitrate + Nitrite	mg/L	10.0	0.08	0.07	0.15	<0.07	0.08	0.22	0.1
Metals									
Aluminum (Al)	mg/L	0.1	<0.004	<0.004	0.004	0.004	0.009	0.006	0.004
Barium (Ba)	mg/L	1.0	0.022	0.032	0.028	0.026	0.027	0.028	0.026
Beryllium (Be)	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron (B)	mg/L	5.0	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.005	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	0.001
Calcium (Ca)	mg/L		78.5	91.8	84.3	89.6	96.3	87	77
Chromium (Cr)	mg/L	0.05	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cobalt (Co)	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper (Cu)	mg/L	1	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Iron (Fe)	mg/L	0.3	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead (Pb)	mg/L	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Magnesium (Mg)	mg/L		3.27	4.95	3.79	3.65	3.75	3.72	3.95
Manganese (Mn)	mg/L	0.05	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Molybdenum (Mo)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Nickel (Ni)	mg/L		<0.003	<0.003	<0.003	0.004	<0.003	<0.003	<0.003
Phosphorus (P)	mg/L		0.04		0.98	0.44	0.39	0.73	0.36
Potassium (K)	mg/L		0.47	0.69	0.53	0.67	0.56	0.56	0.6
Silver (Ag)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Sodium (Na)	mg/L	200/20	0.81	0.96	0.94	0.75	0.91	0.85	0.83
Strontium (Sr)	mg/L		0.107	0.134	0.113	0.108	0.117	0.119	0.102
Vanadium (V)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Zinc (Zn)	mg/L	5	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	0.007

NOTES:

1. OWDWO indicates Ontario Drinking Water Objectives (2006).
2. Bolding and shading denotes concentration exceeds ODWQO.
3. mg/L indicates milligrams per litre.
4. Blank denotes no ODWQO or parameter not tested..
5. '*' indicates value based on lab value.

TABLE C-1
GROUNDWATER QUALITY - GENERAL CHEMISTRY
CODRINGTON PIT

PARAMETERS	UNITS	ODWQO	MONITORING DATES							
			BH05-18	BH05-18	BH05-18	BH05-18	BH05-18	BH05-18	BH05-18	BH05-18
DATE			15-Apr-14	15-Sep-14	31-Mar-15	21-Sep-15	16-Mar-16	27-Sep-16	2-Mar-17	6-Sep-17
Field Parameters										
pH	pH	6.5 - 8.5	7.74	7.83	7.62	7.07	7.7	7.65	7.85	6.5
Temperature	^{0}C	15	6	10.4	6.4	10.1	8.4	11	6.6	104
Conductivity	(µS/cm)		450	381	426	382	473	374	432	399
Dissolved Oxygen	mg/L		10.32	9.1	11.0	10.6	10.7	8.98	EF	9.76
Turbidity	NTU	5	**>200**	**>200**	**>200**	**>200**	**>200**	**194**	**367**	**>800**
Inorganics										
TDS	mg/L	500	280	254	232	276	244	290	252	286
Hardness (CaCO3)	mg/L	80 - 100	**201**	**218**	**208**	**247**	**228**	**226**	**225**	**225**
Total Ammonia-N	mg/L		0.33	0.04	0.2	<0.02	<0.02	<0.02	<0.02	<0.02
Ammonia (unionized)	mg/L		<0.2	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Conductivity	uS/cm		451	435	420	445	450	473	484	485
Dissolved Organic Carbon	mg/L	5.0	1.1	0.8	1.3	1.2	0.7	2.4	1	1.3
Orthophosphate (P)	mg/L		<0.10	<0.10	<0.20	<0.10	<0.10	<0.10	<0.10	<0.20
pH	pH	6.5 - 8.5	8.16	8.08	8.07	8.02	7.9	7.92	8.1	8.1
Sulphate (SO4)	mg/L	500	4.3	5.02	4.69	4.6	4.85	4.27	4.75	4.48
Alkalinity (Total as CaCO3)	mg/L		158	163	170	171	179	176	170	172
Chloride (Cl)	mg/L	250	8.1	7.81	7.24	8.25	8.74	8.99	11.5	12.7
Nitrite (N)	mg/L	1.0	<0.05	<0.05	<0.10	<0.05	<0.05	<0.05	<0.05	<0.10
Nitrate (N)	mg/L	10.0	**10.8**	9.39	9.26	**12**	**15.5**	**15.2**	**16.6**	**15.4**
Nitrate + Nitrite	mg/L	10.0	**10.8**	9.39	9.26	**12**	**15.5**	**15.2**	**16.6**	**15.4**
Metals										
Aluminum (Al)	mg/L	0.1	<0.004	0.004	<0.004	<0.004	0.008	0.004	0.007	0.008
Barium (Ba)	mg/L	1.0	0.051	0.056	0.054	0.064	0.058	0.061	0.058	0.067
Beryllium (Be)	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron (B)	mg/L	5.0	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.005	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium (Ca)	mg/L		64.6	71.9	66.7	82.8	74.1	73.8	72.1	72.9
Chromium (Cr)	mg/L	0.05	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cobalt (Co)	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper (Cu)	mg/L	1	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Iron (Fe)	mg/L	0.3	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead (Pb)	mg/L	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Magnesium (Mg)	mg/L		9.66	9.36	10	9.82	10.4	10.1	11	10.5
Manganese (Mn)	mg/L	0.05	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Molybdenum (Mo)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	<0.002
Nickel (Ni)	mg/L		<0.003	<0.003	<0.003	0.003	<0.003	<0.003	<0.003	<0.003
Phosphorus (P)	mg/L		0.04		2.7	2.37	2.11	0.08	0.08	0.84
Potassium (K)	mg/L		0.73	0.8	0.69	1.12	0.74	0.78	0.76	0.87
Silver (Ag)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Sodium (Na)	mg/L	200/20	2.13	2.52	2.31	2.57	2.87	2.88	2.41	2.69
Strontium (Sr)	mg/L		0.123	0.132	0.113	0.117	0.121	0.133	0.131	0.136
Vanadium (V)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Zinc (Zn)	mg/L	5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	<0.005

NOTES:

1. OWDWO indicates Ontario Drinking Water Objectives (2006).
2. Bolding and shading denotes concentration exceeds ODWQO.
3. mg/L indicates milligrams per litre.
4. Blank denotes no ODWQO or parameter not tested..
5. '*' indicates value based on lab value.

TABLE C-1
GROUNDWATER QUALITY - GENERAL CHEMISTRY
CODRINGTON PIT

PARAMETERS	UNITS	ODWQO	MONITORING DATES						
			BH05-19	BH05-19	BH05-19	BH05-19	BH05-19	BH05-19	BH05-19
DATE			15-Apr-14	15-Sep-14	31-Mar-15	21-Sep-15	16-Mar-16	27-Sep-16	6-Sep-17
Field Parameters									
pH	pH	6.5 - 8.5	7.82	6.7	7.96	7.37	7.45	7.45	7.92
Temperature	^{0}C	15	5.4	12.6	9.6	18	8.8	8.8	12
Conductivity	(µS/cm)		465	406	484	393	474	474	371
Dissolved Oxygen	mg/L		11.21	10.2	10.5	8.5	10.9	10.9	8.87
Turbidity	NTU	5	**>200**	**>200**	**>200**	**>200**	**>200**	**>200**	1.67
Inorganics									
TDS	mg/L	500	274	290	232	256	250	242	242
Hardness (CaCO3)	mg/L	80 - 100	**208**	**236**	**236**	**250**	**240**	**243**	**227**
Total Ammonia-N	mg/L		0.06	0.06	0.26	<0.02	<0.02	<0.02	<0.02
Ammonia (unionized)	mg/L		<0.2	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Conductivity	uS/cm		453	452	467	431	448	463	464
Dissolved Organic Carbon	mg/L	5.0	1	2	1.4	2.1	0.9	<0.5	0.6
Orthophosphate (P)	mg/L		<0.10	<0.10	<0.20	<0.10	<0.10	<0.10	<0.20
pH	pH	6.5 - 8.5	8.08	8.12	8.02	8.06	8.03	8.06	8.17
Sulphate (SO4)	mg/L	500	6.98	6.82	6.33	6.51	7.67	6.43	6.41
Alkalinity (Total as CaCO3)	mg/L		190	196	217	202	222	215	222
Chloride (Cl)	mg/L	250	2.93	2.53	3.29	2.71	5.13	3.4	4.05
Nitrite (N)	mg/L	1.0	<0.05	<0.05	<0.10	<0.05	<0.05	<0.05	<0.10
Nitrate (N)	mg/L	10.0	5.52	4.91	6.01	4	6.48	4.88	3.93
Nitrate + Nitrite	mg/L	10.0	5.52	4.91	6.01	4	6.48	4.88	3.93
Metals									
Aluminum (Al)	mg/L	0.1	<0.004	<0.004	<0.004	0.011	0.059	0.007	0.004
Barium (Ba)	mg/L	1.0	0.067	0.066	0.068	0.074	0.069	0.097	0.098
Beryllium (Be)	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron (B)	mg/L	5.0	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.005	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium (Ca)	mg/L		63.9	74.5	74.4	81.3	76.1	77.6	71.6
Chromium (Cr)	mg/L	0.05	0.011	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cobalt (Co)	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper (Cu)	mg/L	1	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Iron (Fe)	mg/L	0.3	<0.010	<0.010	<0.010	<0.010	0.053	<0.010	<0.010
Lead (Pb)	mg/L	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Magnesium (Mg)	mg/L		11.8	12.1	12.3	11.5	12.1	12	11.7
Manganese (Mn)	mg/L	0.05	<0.002	<0.002	<0.002	<0.002	0.007	<0.002	<0.002
Molybdenum (Mo)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Nickel (Ni)	mg/L		0.004	<0.003	<0.003	0.003	<0.003	<0.003	<0.003
Phosphorus (P)	mg/L		0.66		<0.05	0.08	<0.05	<0.05	<0.05
Potassium (K)	mg/L		0.75	0.94	0.88	1.18	0.88	0.83	0.77
Silver (Ag)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Sodium (Na)	mg/L	200/20	1.96	1.96	1.91	2.18	2.2	1.83	1.88
Strontium (Sr)	mg/L		0.146	0.149	0.134	0.137	0.146	0.137	0.138
Vanadium (V)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Zinc (Zn)	mg/L	5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES:

1. OWDWO indicates Ontario Drinking Water Objectives (2006).
2. Bolding and shading denotes concentration exceeds ODWQO.
3. mg/L indicates milligrams per litre.
4. Blank denotes no ODWQO or parameter not tested..
5. '*' indicates value based on lab value.

TABLE C-1
GROUNDWATER QUALITY - GENERAL CHEMISTRY
CODRINGTON PIT

PARAMETERS	UNITS	ODWQO	MONITORING DATES							
			BH05-20	BH05-20	BH05-20	BH05-20	BH05-20	BH05-20	BH05-20	BH05-20
DATE			17-Jun-14	15-Sep-14	31-Mar-15	21-Sep-15	16-Mar-16	27-Sep-16	2-Mar-17	6-Sep-17
Field Parameters										
pH	pH	6.5 - 8.5	7.78*	7.5	8.28	7	7.81	DRY	7.39	7.43
Temperature	^{0}C	15		13.1	6.5	11.8	6.7		6.2	13.9
Conductivity	(µS/cm)		542*	494	598	510	588		572	495
Dissolved Oxygen	mg/L			7	3.8	5.34	4		EF	3.74
Turbidity	NTU	5	**>200**	**>200**	**>200**	**>200**	**136**		**54.8**	**590**
Inorganics										
TDS	mg/L	500	336	314	316	332	312		328	322
Hardness (CaCO3)	mg/L	80 - 100	**247**	**294**	**297**	**335**	**321**		**242**	**305**
Total Ammonia-N	mg/L		0.29	<0.02	0.03	<0.02	<0.02		<0.02	<0.02
Ammonia (unionized)	mg/L		<0.02	<0.02	<0.02	<0.02	<0.02		<0.02	<0.02
Conductivity	uS/cm		542	546	596	589	568		639	608
Dissolved Organic Carbon	mg/L	5.0	2.5	1.4	1	0.9	0.7		1.3	0.9
Orthophosphate (P)	mg/L		<0.10	<0.10	<0.20	<0.10	<0.20		<0.50	<0.20
pH	pH	6.5 - 8.5	7.78	8.22	7.94	7.94	8.09		8.15	8.13
Sulphate (SO4)	mg/L	500	8.12	8.18	7.46	7	6.79		22.4	5.63
Alkalinity (Total as CaCO3)	mg/L		292	261	305	297	313		316	323
Chloride (Cl)	mg/L	250	2.84	3.14	4.36	4.17	5.78		8.74	7.55
Nitrite (N)	mg/L	1.0	<0.05	<0.05	<0.10	<0.05	<0.10		<0.25	<0.10
Nitrate (N)	mg/L	10.0	<0.05	<0.05	<0.10	<0.05	<0.10		<0.25	<0.10
Nitrate + Nitrite	mg/L	10.0	<0.07	<0.07	<0.07	<0.07	<0.07		<0.07	<0.07
Metals										
Aluminum (Al)	mg/L	0.1	<0.004	0.013	<0.004	<0.004	0.006		0.006	<0.004
Barium (Ba)	mg/L	1.0	0.017	0.019	0.016	0.017	0.016		0.023	0.031
Beryllium (Be)	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001
Boron (B)	mg/L	5.0	<0.010	<0.010	<0.010	<0.010	<0.010		<0.010	<0.010
Cadmium (Cd)	mg/L	0.005	<0.002	<0.002	<0.001	<0.001	<0.001		<0.001	<0.001
Calcium (Ca)	mg/L		81.5	99.6	100	115	110		79.9	103
Chromium (Cr)	mg/L	0.05	<0.003	<0.003	<0.003	<0.003	<0.003		<0.003	<0.003
Cobalt (Co)	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001
Copper (Cu)	mg/L	1	<0.003	<0.003	<0.003	<0.003	<0.003		<0.003	<0.003
Iron (Fe)	mg/L	0.3	<0.010	<0.010	<0.010	<0.010	<0.010		<0.010	<0.010
Lead (Pb)	mg/L	0.01	<0.002	<0.002	<0.002	<0.002	<0.002		<0.002	<0.002
Magnesium (Mg)	mg/L		10.5	11	11.4	11.6	11.2		10.4	11.5
Manganese (Mn)	mg/L	0.05	<0.002	0.022	0.003	<0.002	<0.002		<0.002	0.002
Molybdenum (Mo)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002		0.002	<0.002
Nickel (Ni)	mg/L		<0.003	<0.003	<0.003	0.005	<0.003		<0.003	<0.003
Phosphorus (P)	mg/L				0.43	1.13	0.19		0.08	0.29
Potassium (K)	mg/L		0.45	0.51	0.38	1.19	0.39		0.72	0.52
Silver (Ag)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002		<0.002	<0.002
Sodium (Na)	mg/L	200/20	4.56	5.17	6.23	5.94	5.65		46.1	6.25
Strontium (Sr)	mg/L		0.175	0.197	0.173	0.167	0.16		0.179	0.192
Vanadium (V)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002		<0.002	<0.002
Zinc (Zn)	mg/L	5	<0.005	<0.005	<0.005	<0.005	0.005		<0.005	<0.005

NOTES:

1. OWDWO indicates Ontario Drinking Water Objectives (2006).
2. Bolding and shading denotes concentration exceeds ODWQO.
3. mg/L indicates milligrams per litre.
4. Blank denotes no ODWQO or parameter not tested..
5. '*' indicates value based on lab value.

TABLE C-1
GROUNDWATER QUALITY - GENERAL CHEMISTRY
CODRINGTON PIT

PARAMETERS	UNITS	ODWQO	MONITORING DATES							
			BH06-1	BH06-1	BH06-1	BH06-1	BH06-1	BH06-1	BH06-1	BH06-1
DATE			15-Apr-14	15-Sep-14	31-Mar-15	21-Sep-15	16-Mar-16	27-Sep-16	2-Mar-17	6-Sep-17
Field Parameters										
pH	pH	6.5 - 8.5	7.71	7.63	7.81	7.28	7.48	7.31	7.86	**6.49**
Temperature	^{0}C	15	6.6	9	7.6	8.9	8.2	10	7	**16**
Conductivity	(µS/cm)		477	414	523	434	471	391	462	399
Dissolved Oxygen	mg/L		9.92	9	10.3	8.85	10.6	9.3	EF	9.6
Turbidity	NTU	5	**>200**	**>200**	**>200**	**158**	**150**	**>200**	**400**	**729**
Inorganics										
TDS	mg/L	500	306	272	242	266	240	252	276	252
Hardness (CaCO3)	mg/L	80 - 100	**233**	**235**	**259**	**272**	**256**	**264**	**255**	**242**
Total Ammonia-N	mg/L		0.94	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Ammonia (unionized)	mg/L		<0.2	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Conductivity	uS/cm		449	430	489	495	453	487	488	473
Dissolved Organic Carbon	mg/L	5.0	1.1	0.7	1.2	0.7	0.8	0.7	0.8	0.8
Orthophosphate (P)	mg/L		<0.10	<0.10	<0.20	<0.10	<0.10	<0.10	<0.10	<0.20
pH	pH	6.5 - 8.5	8.06	8.19	7.98	8.02	8.02	8.03	8.13	8.09
Sulphate (SO4)	mg/L	500	7.73	7.84	9.05	8.14	8.46	7.59	8.86	5.9
Alkalinity (Total as CaCO3)	mg/L		216	203	255	252	257	251	257	253
Chloride (Cl)	mg/L	250	1.2	1.37	1.68	1.32	1.35	1.22	1.34	1.22
Nitrite (N)	mg/L	1.0	<0.05	<0.05	<0.10	<0.05	<0.05	<0.05	<0.05	<0.10
Nitrate (N)	mg/L	10.0	0.08	<0.05	<0.10	0.05	0.14	0.12	0.09	<0.10
Nitrate + Nitrite	mg/L	10.0	0.08	<0.07	<0.07	<0.07	0.14	0.12	0.09	<0.07
Metals										
Aluminum (Al)	mg/L	0.1	<0.004	<0.004	<0.004	<0.004	<0.004	0.006	0.007	0.008
Barium (Ba)	mg/L	1.0	0.029	0.029	0.032	0.031	0.028	0.031	0.032	0.032
Beryllium (Be)	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron (B)	mg/L	5.0	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.005	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium (Ca)	mg/L		81.8	81.6	90.5	96.5	90.2	93.2	88.4	84.9
Chromium (Cr)	mg/L	0.05	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cobalt (Co)	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper (Cu)	mg/L	1	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Iron (Fe)	mg/L	0.3	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.023	<0.010
Lead (Pb)	mg/L	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Magnesium (Mg)	mg/L		7.08	7.69	7.99	7.61	7.47	7.58	8.33	7.37
Manganese (Mn)	mg/L	0.05	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Molybdenum (Mo)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	<0.002
Nickel (Ni)	mg/L		<0.003	<0.003	<0.003	0.005	<0.003	<0.003	<0.003	<0.003
Phosphorus (P)	mg/L		0.35		0.66	0.12	0.2	<0.05	0.44	0.37
Potassium (K)	mg/L		0.58	0.63	0.63	0.8	0.61	0.67	0.76	0.67
Silver (Ag)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Sodium (Na)	mg/L	200/20	1.56	1.46	1.68	1.76	1.55	1.55	1.62	1.36
Strontium (Sr)	mg/L		0.15	0.156	0.149	0.14	0.129	0.14	0.149	0.14
Vanadium (V)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Zinc (Zn)	mg/L	5	<0.005	<0.005	<0.005	<0.005	<0.005	0.009	0.008	<0.005

NOTES:

1. OWDWO indicates Ontario Drinking Water Objectives (2006).
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3. mg/L indicates milligrams per litre.
4. Blank denotes no ODWQO or parameter not tested..
5. '*' indicates value based on lab value.

TABLE C-1
GROUNDWATER QUALITY - GENERAL CHEMISTRY
CODRINGTON PIT

PARAMETERS	UNITS	ODWQO	MONITORING DATES				
			BH12-1	BH12-1	BH12-1	BH12-1	BH12-1
DATE			15-Sep-14	31-Mar-15	21-Sep-15	27-Sep-16	6-Sep-17
Field Parameters							
pH	pH	6.5 - 8.5	7.83	8.6	7.92	7.51	8.1
Temperature	^{0}C	15	12.3	10	12.9	11.4	14.4
Conductivity	(µS/cm)		471	532	460	4211	415
Dissolved Oxygen	mg/L		7.2	9.1	10.7	8.8	7.33
Turbidity	NTU	5	**>200**	**>200**	**>200**	**>200**	**>800**
Inorganics							
TDS	mg/L	500	294	258	294	284	270
Hardness (CaCO3)	mg/L	80 - 100	**266**	**242**	**233**	**261**	**256**
Total Ammonia-N	mg/L		0.1	0.14	<0.10	0.02	0.05
Ammonia (unionized)	mg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Conductivity	uS/cm		557	505	514	525	523
Dissolved Organic Carbon	mg/L	5.0	2	2.5	1.7	2.6	1.5
Orthophosphate (P)	mg/L		<0.10	<0.20	<0.10	<0.10	<0.20
pH	pH	6.5 - 8.5	8.18	8.07	8.15	8.03	8.12
Sulphate (SO4)	mg/L	500	20.3	15.9	17	16	17.4
Alkalinity (Total as CaCO3)	mg/L		245	241	241	255	269
Chloride (Cl)	mg/L	250	4.34	4.34	3.62	2.99	3.65
Nitrite (N)	mg/L	1.0	<0.05	<0.10	<0.05	<0.05	<0.10
Nitrate (N)	mg/L	10.0	1.65	1.96	1.54	1.5	1.28
Nitrate + Nitrite	mg/L	10.0	1.65	1.96	1.54	1.5	1.28
Metals							
Aluminum (Al)	mg/L	0.1	0.005	**0.291**	0.059	<0.004	0.01
Barium (Ba)	mg/L	1.0	0.07	0.089	0.094	0.107	0.109
Beryllium (Be)	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Boron (B)	mg/L	5.0	0.019	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.005	<0.002	<0.001	<0.001	<0.001	<0.001
Calcium (Ca)	mg/L		75.3	69.1	66	76.8	74.7
Chromium (Cr)	mg/L	0.05	<0.003	<0.003	<0.003	<0.003	<0.003
Cobalt (Co)	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Copper (Cu)	mg/L	1	<0.003	<0.003	<0.003	0.004	0.007
Iron (Fe)	mg/L	0.3	<0.010	0.217	0.015	<0.010	<0.010
Lead (Pb)	mg/L	0.01	<0.002	<0.002	<0.002	<0.002	<0.002
Magnesium (Mg)	mg/L		18.9	16.8	16.5	16.8	16.8
Manganese (Mn)	mg/L	0.05	<0.002	0.036	0.028	0.005	0.003
Molybdenum (Mo)	mg/L		0.003	<0.002	<0.002	<0.002	<0.002
Nickel (Ni)	mg/L		<0.003	<0.003	0.004	<0.003	<0.003
Phosphorus (P)	mg/L			1.77	4.08	1.99	2.07
Potassium (K)	mg/L		3.21	2.17	2.32	1.55	2.28
Silver (Ag)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002
Sodium (Na)	mg/L	200/20	11.8	10.4	13	6.25	8.43
Strontium (Sr)	mg/L		0.812	0.396	0.294	0.291	0.317
Vanadium (V)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002
Zinc (Zn)	mg/L	5	0.257	0.025	0.04	1.12	0.105

NOTES:

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2. Bolding and shading denotes concentration exceeds ODWQO.
3. mg/L indicates milligrams per litre.
4. Blank denotes no ODWQO or parameter not tested..
5. '*' indicates value based on lab value.

TABLE C-1
GROUNDWATER QUALITY - GENERAL CHEMISTRY
CODRINGTON PIT

PARAMETERS	UNITS	ODWQO	MONITORING DATES						
			BH12-2	BH12-2	BH12-2	BH12-2	BH12-2	BH12-2	BH12-2
DATE			15-Apr-14	15-Sep-14	31-Mar-15	21-Sep-15	16-Mar-16	27-Sep-16	6-Sep-17
Field Parameters									
pH	pH	6.5 - 8.5	7.77	7.48	8.2	7.4	7.77	7.77	6.7
Temperature	^{0}C	15	6.7	9.3	9.3	9.9	8.3	8.3	11.2
Conductivity	(µS/cm)		445	390	440	388	440	440	360
Dissolved Oxygen	mg/L		10.01	8.8	10.4	9.37	9.9	9.9	9.89
Turbidity	NTU	5	**>200**	**>200**	**>200**	**>200**	**311**	**311**	**>800**
Inorganics									
TDS	mg/L	500	264	256	228	230	226	250	222
Hardness (CaCO3)	mg/L	80 - 100	**224**	**257**	**233**	**194**	**240**	**238**	**228**
Total Ammonia-N	mg/L		0.27	<0.02	0.03	<0.02	<0.02	<0.02	<0.02
Ammonia (unionized)	mg/L		<0.2	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Conductivity	uS/cm		442	459	451	432	429	453	449
Dissolved Organic Carbon	mg/L	5.0	2.2	0.7	3.5	1.6	0.9	1.2	0.9
Orthophosphate (P)	mg/L		<0.10	<0.10	<0.20	<0.10	<0.10	<0.10	<0.20
pH	pH	6.5 - 8.5	8.04	8.14	8.03	8.04	8.02	8.04	8.13
Sulphate (SO4)	mg/L	500	7.94	8.07	8.07	7.54	7.66	6.84	6.83
Alkalinity (Total as CaCO3)	mg/L		209	216	226	217	232	224	235
Chloride (Cl)	mg/L	250	1.89	2.27	2.77	1.6	1.45	2.09	2.59
Nitrite (N)	mg/L	1.0	<0.05	<0.05	<0.10	<0.05	<0.05	<0.05	<0.10
Nitrate (N)	mg/L	10.0	0.36	0.74	0.86	0.41	0.33	1.06	1.42
Nitrate + Nitrite	mg/L	10.0	0.36	0.74	0.86	0.41	0.33	1.06	1.42
Metals									
Aluminum (Al)	mg/L	0.1	<0.004	<0.004	0.034	<0.004	0.006	0.005	0.006
Barium (Ba)	mg/L	1.0	0.186	0.087	0.084	0.08	0.084	0.089	0.087
Beryllium (Be)	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron (B)	mg/L	5.0	<0.010	<0.010	<0.010	<0.010	0.018	<0.010	<0.010
Cadmium (Cd)	mg/L	0.005	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium (Ca)	mg/L		74	86.6	76.3	61.9	79.7	79.3	75.7
Chromium (Cr)	mg/L	0.05	0.013	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cobalt (Co)	mg/L		0.007	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper (Cu)	mg/L	1	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Iron (Fe)	mg/L	0.3	0.189	<0.010	0.038	<0.010	<0.010	<0.010	<0.010
Lead (Pb)	mg/L	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Magnesium (Mg)	mg/L		9.44	9.92	10.2	9.5	9.93	9.82	9.56
Manganese (Mn)	mg/L	0.05	**0.95**	<0.002	0.004	<0.002	<0.002	<0.002	<0.002
Molybdenum (Mo)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Nickel (Ni)	mg/L		0.016	<0.003	<0.003	0.004	<0.003	<0.003	<0.003
Phosphorus (P)	mg/L		1.07		0.8	0.72	0.38	0.17	0.99
Potassium (K)	mg/L		0.89	1.14	0.88	0.86	0.85	0.89	0.91
Silver (Ag)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Sodium (Na)	mg/L	200/20	1.81	1.77	1.75	1.77	1.73	1.61	1.63
Strontium (Sr)	mg/L		1.02	0.147	0.139	0.125	0.121	0.144	0.135
Vanadium (V)	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Zinc (Zn)	mg/L	5	0.012	<0.005	0.009	<0.005	0.006	<0.005	<0.005

NOTES:

1. OWDWO indicates Ontario Drinking Water Objectives (2006).
2. Bolding and shading denotes concentration exceeds ODWQO.
3. mg/L indicates milligrams per litre.
4. Blank denotes no ODWQO or parameter not tested..
5. '*' indicates value based on lab value.

FIGURE C-1
TDS CONCENTRATIONS VS TIME

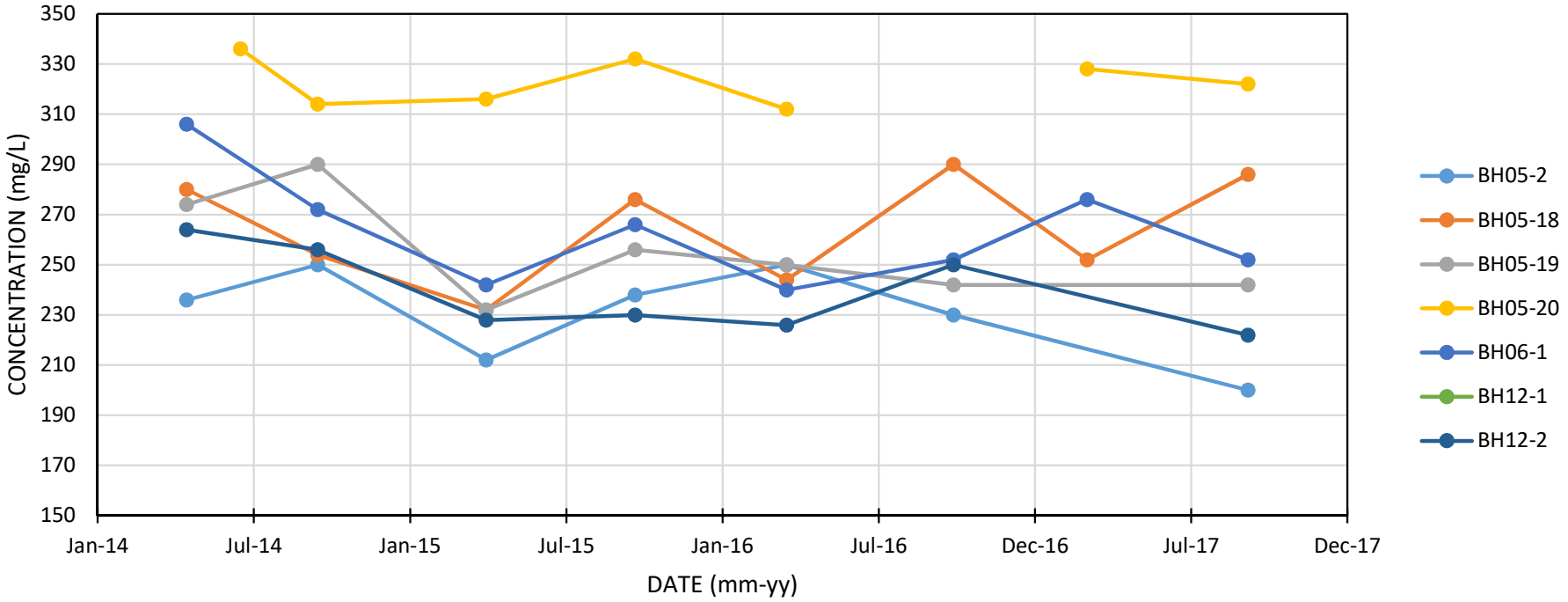

FIGURE C-2
NITRATE CONCENTRATIONS VS TIME

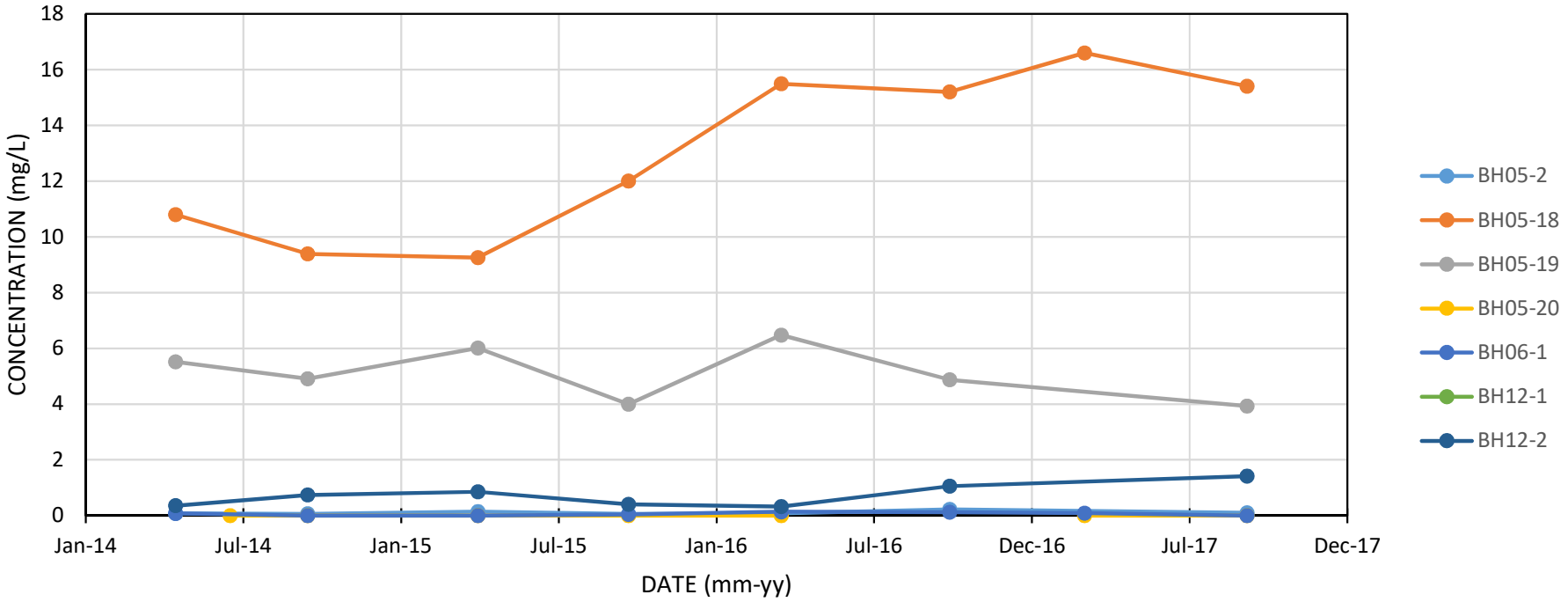

FIGURE C-3
TOTAL PHOSPHORUS CONCENTRATIONS VS TIME

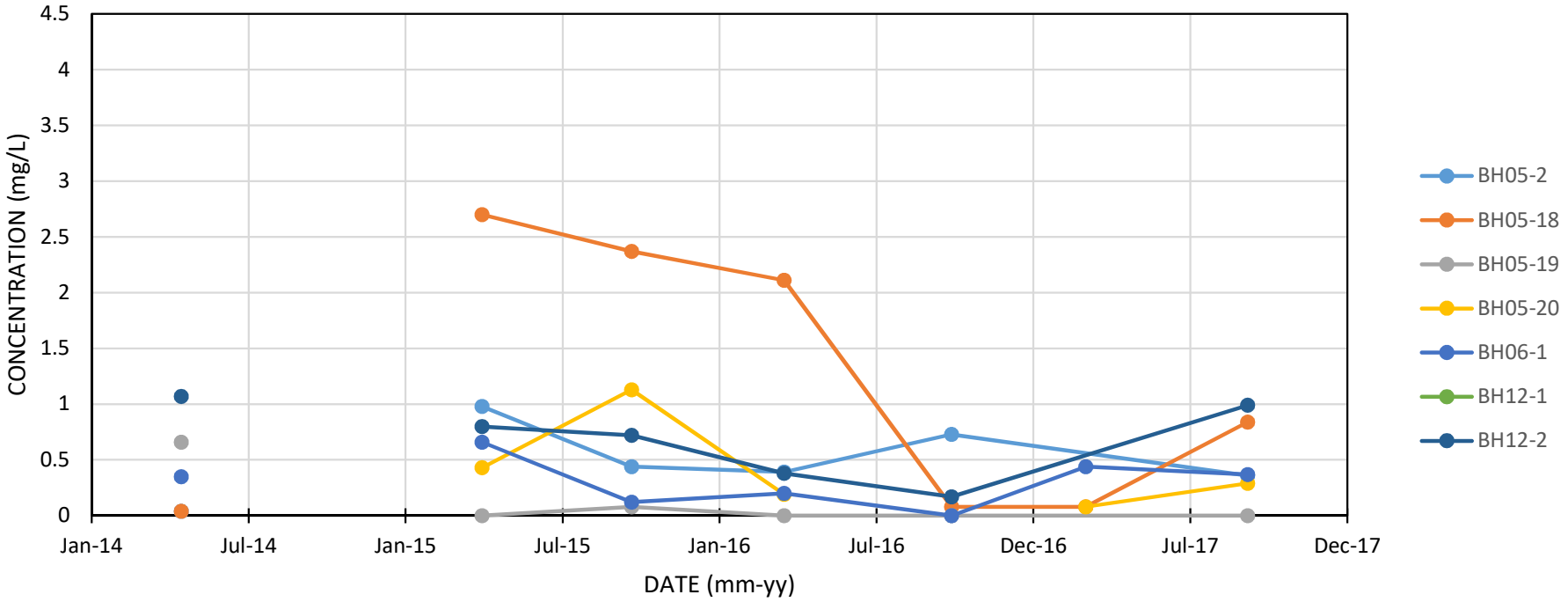

TABLE C-2
RESIDENTIAL GROUNDWATER QUALITY -[redacted]
CODRINGTON PIT

PARAMETERS MEASURED	UNITS	ODWSOG	[redacted]			
DATE			**26-Jul-11**	**05-Jul-13**	**16-Sep-14**	**06-Sep-17**
TDS	mg/L	500 (AO)	285	252	336	258
Hardness (CaCO3)	mg/L	80 - 100 (AO)	**270**	**249**	**304**	**256**
Total Ammonia-N	mg/L		0.32	0.21	<0.02	<0.02
Conductivity	umho/cm		517	496	561	566
Dissolved Organic Carbon	mg/L	5 (AO)	1.8	1.6	1.8	2
Orthophosphate (P)	mg/L		<0.01	<0.50	<0.20	<0.10
pH	pH	6.5 - 8.5 (OG)	7.87	8.49	8.11	8.08
Sulphate (SO4)	mg/L	500 (AO)	5	3.5	5.63	5.8
Alkalinity (Total as CaCO3)	mg/L	30 - 500 (OG)	262	258	280	288
Chloride (Cl)	mg/L	250 (AO)	5	3.22	8.17	9.47
Nitrite (N)	mg/L	1.0 (*)	<0.01	<0.25	<0.10	<0.05
Nitrate (N)	mg/L	10.0 (*)	0.7	<0.25	1.6	<0.05
Nitrate + Nitrite	mg/L		0.7	<0.07	1.6	<0.07
Microbiological						
Total Coliforms	CFU/100mL	NOT DETECTED	**>2000**	0	ND	**16**
Fecal Streptococcus	CFU/100mL			<1	ND	<1
Heterotrophic Plate Count	CFU/1mL			0	55	ND
Coliform Background Count	CFU/100mL			0	ND	22
Escherichia coli	CFU/100mL	NOT DETECTED	**7 (1)**	0	ND	ND
Metals						
Aluminum (Al)	µg/L	100 (OG)	15	<4	<4	7
Barium (Ba)	µg/L	1,000 (MAC)*	43	32	45	37
Beryllium (Be)	µg/L		<0.5	<1	<1	<1
Boron (B)	µg/L	5,000 (IMAC)	17	<10	11	<1
Cadmium (Cd)	µg/L	5 (MAC)*	<0.1	<2	<2	<1
Calcium (Ca)	µg/L		99,000	92,400	113,000	96000
Chromium (Cr)	µg/L	50 (MAC)*	<5	<3	<3	<3
Cobalt (Co)	µg/L		<0.5	<1	<1	<1
Copper (Cu)	µg/L	1,000 (AO)	<1	15	11	<3
Iron (Fe)	µg/L	300 (AO)	<100	91	<10	**555**
Lead (Pb)	µg/L	10 (MAC)*	<0.5	<2	<2	<2
Magnesium (Mg)	µg/L		4,700	4,330	5,350	3890
Manganese (Mn)	µg/L	50 (AO)	23	**60**	2	**101**
Molybdenum (Mo)	µg/L		<0.5	<2	<2	<2
Nickel (Ni)	µg/L		<1	<3	<3	<3
Phosphorus (P)	µg/L		<100	<50		<50
Potassium (K)	µg/L		<200	260	260	240
Silver (Ag)	µg/L		<0.1	<2	<2	<2
Sodium (Na)	µg/L	(**)	2,800	2,350	4,080	18000
Strontium (Sr)	µg/L		170	176	183	160
Vanadium (V)	µg/L		<0.5	<2	<2	<2
Zinc (Zn)	µg/L	5,000 (AO)	<5	7	20	<5

NOTES:

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2. (*) denotes health related drinking water standard.
3. OG denotes the Operational Guidelines.
4. AO denotes Aesthetic Objective.
5. Bolding and shading denotes concentration exceeds ODWSOG.
6. mg/L indicates milligrams per litre. ug/L indicates micrograms per litre.
7. Blank denotes no ODWSOG has been set yet.
8. CFU/100ml denotes number of colony forming units per 100 millilitres of water.
9. "<" denotes less than detection limit (not detected).

TABLE C-3
RESIDENTIAL GROUNDWATER QUALITY - [redacted]
CODRINGTON PIT

PARAMETERS MEASURED	UNITS	ODWSOG	[redacted]					
DATE			**18-Aug-11**	**04-Jul-13**	**16-Sep-14**	**21-Sep-15**	**26-Sep-16**	**06-Sep-17**
TDS	mg/L	500 (AO)	314	330	308	322	306	234
Hardness (CaCO3)	mg/L	80 - 100 (AO)	**280**	**294**	**285**	**314**	**266**	**264**
Total Ammonia-N	mg/L		<0.05	0.23	0.04	<0.02	<0.02	<0.02
Conductivity	umho/cm		556	627	563	639	573	571
Dissolved Organic Carbon	mg/L	5 (AO)	1.1	1.7	1.1	1.2	1.1	1.5
Orthophosphate (P)	mg/L		0.01	<0.50	<0.20	<0.50	<0.50	<0.10
pH	pH	6.5 - 8.5 (OG)	7.87	8.27	8.13	7.89	8.06	8.06
Sulphate (SO4)	mg/L	500 (AO)	8	8.7	7.6	7.85	8.12	5.98
Alkalinity (Total as CaCO3)	mg/L	30 - 500 (OG)	264	292	270	288	267	282
Chloride (Cl)	mg/L	250 (AO)	16	15.2	18	18.6	14.3	17.9
Nitrite (N)	mg/L	1.0 (*)	<0.01	<0.25	<0.10	<0.25	<0.25	<0.05
Nitrate (N)	mg/L	10.0 (*)	0.1	1.18	<0.10	<0.25	<0.25	<0.05
Nitrate + Nitrite	mg/L		0.1	1.18	<0.07	<0.07	<0.35	<0.07
Microbiological								
Total Coliforms	CFU/100mL	NOT DETECTED	**30**	**128**	ND	**Overgrowth**	**37**	1900
Fecal Streptococcus/Enterococci	CFU/100mL			<1	ND	<1	11	79
Heterotrophic Plate Count	CFU/1mL			90	710	ND	405	410
Coliform Background Count	CFU/100mL			34	ND	ND	185	5600
Escherichia coli	CFU/100mL	NOT DETECTED	0	0	ND	ND	**2**	ND
Metals								
Aluminum (Al)	µg/L	100 (OG)	6	<4	<4	5	6	<4
Barium (Ba)	µg/L	1,000 (MAC)*	43	51	41	56	48	45
Beryllium (Be)	µg/L		<0.5	<1	<1	<1	<1	<1
Boron (B)	µg/L	5,000 (IMAC)	11	15	16	13	11	14
Cadmium (Cd)	µg/L	5 (MAC)*	<0.1	<2	<2	<1	<1	<1
Calcium (Ca)	µg/L		100,000	104,000	101,000	112000	94000	93800
Chromium (Cr)	µg/L	50 (MAC)*	<5	<1	<3	<3	<3	<3
Cobalt (Co)	µg/L		<0.5	<1	<1	<1	<1	<1
Copper (Cu)	µg/L	1,000 (AO)	7	48	8	18	50	11
Iron (Fe)	µg/L	300 (AO)	<100	<10	<10	10	<10	<2
Lead (Pb)	µg/L	10 (MAC)*	1.2	<2	<2	<2	<2	<2
Magnesium (Mg)	µg/L		7,200	8,300	8,060	8340	7710	7270
Manganese (Mn)	µg/L	50 (AO)	7	<2	18	5	<2	2
Molybdenum (Mo)	µg/L		<0.5	<2	<2	<2	<2	<2
Nickel (Ni)	µg/L		<1	<3	<3	<3	<3	<3
Phosphorus (P)	µg/L		<100	<50		<0.05	<50	<50
Potassium (K)	µg/L		2,600	2,500	2,460	2450	2090	2150
Silver (Ag)	µg/L		<0.1	<2	<2	<2	<2	<2
Sodium (Na)	µg/L	(**)	10,000	8,590	10,700	10900	11100	14100
Strontium (Sr)	µg/L		230	305	271	323	312	242
Vanadium (V)	µg/L		<0.5	<2	<2	<2	<2	<2
Zinc (Zn)	µg/L	5,000 (AO)	280	449	379	226	168	235

NOTES:

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2. (*) denotes health related drinking water standard.
3. OG denotes the Operational Guidelines.
4. AO denotes Aesthetic Objective.
5. Bolding and shading denotes concentration exceeds ODWSOG.
6. mg/L indicates milligrams per litre. ug/L indicates micrograms per litre.
7. Blank denotes no ODWSOG has been set yet.
8. CFU/100ml denotes number of colony forming units per 100 millilitres of water.
9. "<" denotes less than detection limit (not detected).

TABLE C-4
RESIDENTIAL GROUNDWATER QUALITY -[redacted]
CODRINGTON PIT

PARAMETERS MEASURED	UNITS	ODWSOG	[redacted]	
DATE			**21-Sep-15**	**06-Sep-17**
TDS	mg/L	500 (AO)	410	254
Hardness (CaCO3)	mg/L	80 - 100 (AO)	**428**	**280**
Total Ammonia-N	mg/L		<0.02	<0.02
Conductivity	umho/cm		774	563
Dissolved Organic Carbon	mg/L	5 (AO)	2.3	1.2
Orthophosphate (P)	mg/L		<0.50	<0.10
pH	pH	6.5 - 8.5 (OG)	7.95	8.19
Sulphate (SO4)	mg/L	500 (AO)	4.98	14.3
Alkalinity (Total as CaCO3)	mg/L	30 - 500 (OG)	402	296
Chloride (Cl)	mg/L	250 (AO)	1.95	1.5
Nitrite (N)	mg/L	1.0 (*)	<0.25	<0.05
Nitrate (N)	mg/L	10.0 (*)	<0.25	<0.05
Nitrate + Nitrite	mg/L		<0.07	<0.07
Microbiological				
Total Coliforms	CFU/100mL	NOT DETECTED	**85**	ND
Fecal Streptococcus/Enterococci	CFU/100mL		<1	1
Heterotrophic Plate Count	CFU/1mL		70	445
Coliform Background Count	CFU/100mL		45	58
Escherichia coli	CFU/100mL	NOT DETECTED	ND	ND
Metals				
Aluminum (Al)	µg/L	100 (OG)	7	6
Barium (Ba)	µg/L	1,000 (MAC)*	60	170
Beryllium (Be)	µg/L		<1	<1
Boron (B)	µg/L	5,000 (IMAC)	14	10
Cadmium (Cd)	µg/L	5 (MAC)*	<1	<1
Calcium (Ca)	µg/L		154000	90400
Chromium (Cr)	µg/L	50 (MAC)*	<3	<3
Cobalt (Co)	µg/L		<1	<1
Copper (Cu)	µg/L	1,000 (AO)	11	3
Iron (Fe)	µg/L	300 (AO)	**493**	23
Lead (Pb)	µg/L	10 (MAC)*	3	<2
Magnesium (Mg)	µg/L		10600	13200
Manganese (Mn)	µg/L	50 (AO)	**167**	**139**
Molybdenum (Mo)	µg/L		<2	<2
Nickel (Ni)	µg/L		<3	<3
Phosphorus (P)	µg/L		<0.05	<50
Potassium (K)	µg/L		1550	7660
Silver (Ag)	µg/L		<2	<2
Sodium (Na)	µg/L	(**)	3840	3710
Strontium (Sr)	µg/L		342	369
Vanadium (V)	µg/L		<2	<2
Zinc (Zn)	µg/L	5,000 (AO)	46	7

NOTES:

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3. OG denotes the Operational Guidelines.
4. AO denotes Aesthetic Objective.
5. Bolding and shading denotes concentration exceeds ODWSOG.
6. mg/L indicates milligrams per litre. ug/L indicates micrograms per litre.
7. Blank denotes no ODWSOG has been set yet.
8. CFU/100ml denotes number of colony forming units per 100 millilitres of water.
9. "<" denotes less than detection limit (not detected).

TABLE C-5
RESIDENTIAL GROUNDWATER QUALITY -[redacted]
CODRINGTON PIT

PARAMETERS MEASURED	UNITS	ODWSOG	[redacted]		
DATE			**21-Sep-15**	**27-Sep-16**	**06-Sep-17**
TDS	mg/L	500 (AO)	480	474	470
Hardness (CaCO3)	mg/L	80 - 100 (AO)	**342**	**326**	**321**
Total Ammonia-N	mg/L		<0.02	<0.02	<0.02
Conductivity	umho/cm		977	899	981
Dissolved Organic Carbon	mg/L	5 (AO)	1.1	1.1	1.1
Orthophosphate (P)	mg/L		<0.50	<0.50	<0.50
pH	pH	6.5 - 8.5 (OG)	7.82	8.06	8.02
Sulphate (SO4)	mg/L	500 (AO)	17	10.1	14.1
Alkalinity (Total as CaCO3)	mg/L	30 - 500 (OG)	297	316	301
Chloride (Cl)	mg/L	250 (AO)	116	93.3	138
Nitrite (N)	mg/L	1.0 (*)	<0.25	<0.25	<0.25
Nitrate (N)	mg/L	10.0 (*)	0.78	<0.25	1.08
Nitrate + Nitrite	mg/L		0.78	<0.35	1.08
Microbiological					
Total Coliforms	CFU/100mL	NOT DETECTED	**102**	**1**	**600**
Fecal Streptococcus/enterococci	CFU/100mL		<1	<1	<1
Heterotrophic Plate Count	CFU/1mL		840	10	65
Coliform Background Count	CFU/100mL		ND	13	2000
Escherichia coli	CFU/100mL	NOT DETECTED	ND	ND	ND
Metals					
Aluminum (Al)	µg/L	100 (OG)	57	9	<4
Barium (Ba)	µg/L	1,000 (MAC)*	127	120	100
Beryllium (Be)	µg/L		<1	<1	<1
Boron (B)	µg/L	5,000 (IMAC)	36	30	34
Cadmium (Cd)	µg/L	5 (MAC)*	<1	<1	<1
Calcium (Ca)	µg/L		113000	108000	105000
Chromium (Cr)	µg/L	50 (MAC)*	5	<3	<3
Cobalt (Co)	µg/L		<1	<1	<1
Copper (Cu)	µg/L	1,000 (AO)	620	59	205
Iron (Fe)	µg/L	300 (AO)	132	92	<2
Lead (Pb)	µg/L	10 (MAC)*	2	<2	<2
Magnesium (Mg)	µg/L		14600	13600	14200
Manganese (Mn)	µg/L	50 (AO)	6	23	<2
Molybdenum (Mo)	µg/L		<2	<2	<2
Nickel (Ni)	µg/L		<3	<3	<3
Phosphorus (P)	µg/L		<0.05	<50	<50
Potassium (K)	µg/L		1580	2590	1370
Silver (Ag)	µg/L		<2	<2	<2
Sodium (Na)	µg/L	(**)	69800	56700	65800
Strontium (Sr)	µg/L		293	277	239
Vanadium (V)	µg/L		2	<2	<2
Zinc (Zn)	µg/L	5,000 (AO)	62	12	49

NOTES:

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4. AO denotes Aesthetic Objective.
5. Bolding and shading denotes concentration exceeds ODWSOG.
6. mg/L indicates milligrams per litre. ug/L indicates micrograms per litre.
7. Blank denotes no ODWSOG has been set yet.
8. CFU/100ml denotes number of colony forming units per 100 millilitres of water.
9. "<" denotes less than detection limit (not detected).

TABLE C-6
RESIDENTIAL GROUNDWATER QUALITY - [redacted]
CODRINGTON PIT

PARAMETERS MEASURED	UNITS	ODWSOG	[redacted]			
			18-Aug-11	11-Apr-13	21-Sep-15	06-Sep-17
TDS	mg/L	500 (AO)	357	300	356	246
Hardness (CaCO3)	mg/L	80 - 100 (AO)	**300**	**272**	**340**	**267**
Total Ammonia-N	mg/L		0.06	0.09	<0.02	0.07
Conductivity	umho/cm		628	566	670	561
Dissolved Organic Carbon	mg/L	5 (AO)	0.9	1.2	1.1	1.8
Orthophosphate (P)	mg/L		<0.01	<0.10	<0.50	<0.10
pH	pH	6.5 - 8.5 (OG)	7.78	8.24	7.96	8.08
Dissolved Sulphate (SO4)	mg/L	500 (AO)	12	6.57	11.7	7.67
Alkalinity (Total as CaCO3)	mg/L	30 - 500 (OG)	299	269	308	286
Dissolved Chloride (Cl)	mg/L	250 (AO)	16	8.94	10	12.4
Nitrite (N)	mg/L	1.0 (*)	<0.01	<0.05	<0.25	<0.05
Nitrate (N)	mg/L	10.0 (*)	0.4	0.14	2.99	0.19
Nitrate + Nitrite	mg/L	10.0 (*)	0.4	0.14	2.99	0.19
Microbiological						
Total Coliforms	CFU/100mL	NOT DETECTED	**100 (1)**	**27**	**Overgrowth**	**1000**
Fecal Streptococcus/Enterococci	CFU/100mL			3	9	>80
Heterotrophic Plate Count	CFU/1mL			340	1230	305
Coliform Background Count	CFU/100mL			ND	ND	19700
Escherichia coli	CFU/100mL	NOT DETECTED	0 (1)	ND	ND	ND
Metals						
Aluminum (Al)	µg/L	100 (OG)	<5	5	6	6
Barium (Ba)	µg/L	1,000 (MAC)*	0.058	0.044	0.065	43
Beryllium (Be)	µg/L		<0.5	<1	<1	<1
Boron (B)	µg/L	5,000 (IMAC)	28	35	37	21
Cadmium (Cd)	µg/L	5 (MAC)*	<0.1	<2	<1	<1
Calcium (Ca)	µg/L		110000	97700	120000	96000
Chromium (Cr)	µg/L	50 (MAC)*	<5	<3	<3	<3
Cobalt (Co)	µg/L		<0.5	<1	<1	<1
Copper (Cu)	µg/L	1,000 (AO)	27	560	33	<3
Iron (Fe)	µg/L	300 (AO)	<100	51	<10	<2
Lead (Pb)	µg/L	10 (MAC)*	0.7	<2	<2	<2
Magnesium (Mg)	µg/L		9400	6910	9770	6710
Manganese (Mn)	µg/L	50 (AO)*	<2	<2	<2	<2
Molybdenum (Mo)	µg/L		<0.5	<2	<2	<2
Nickel (Ni)	µg/L		<1	<3	<3	<3
Phosphorus (P)	µg/L		<100	<50	<50	<50
Potassium (K)	µg/L		1300	890	1470	970
Silver (Ag)	µg/L		<0.1	<2	<2	<2
Sodium (Na)	µg/L	(**)	17000	9710	123000	10500
Strontium (Sr)	µg/L		270	228	312	194
Vanadium (V)	µg/L		1.1	<2	<2	<2
Zinc (Zn)	µg/L	5,000 (AO)	10	18	9	<5

NOTES:

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5. Bolding and shading denotes concentration exceeds ODWSOG.
6. mg/L denotes milligrams per litre.
7. Blank denotes no ODWSOG has been set yet.
8. CFU/100ml denotes number of colony forming units per 100 millilitres of water.
9. "<" denotes less than detection limit (not detected).

Appendix D

Surface Water Data

- Surface Water Quality – General Chemistry – Table D-1
- Surface Water Flow Rates – Figure D-1
- Time-Concentration Graphs – Figures D-2 to D-4
- Surface Water Quality – Codrington Fish Research Centre – Table D-2
- Surface Water Flow Rates – Codrington Fish Research Centre – Figure D-5

TABLE D-1
SURFACE WATER QUALITY - GENERAL CHEMISTRY
CODRINGTON PIT

PARAMETERS	UNITS	PWQO	SAMPLING STATIONS												
			Pond North of Pit	SWB	SWB	SWB	SWB	SWB	SWB	SWB	SWB	SWB	SWB	SWB	SWB
DATE			**19-Aug-11**	**11-Apr-13**	**4-Jul-13**	**19-Sep-13**	**4-Dec-13**	**15-Apr-14**	**16-Sep-14**	**31-Mar-15**	**21-Sep-15**	**16-Mar-16**	**27-Sep-16**	**02-Mar-17**	**06-Sep-17**
Field Parameters															
pH	pH	6.5 - 8.5	8.22	7.75	EF	7.91	8.54	8.23	7.79	**8.91**	7.41	7.35	**6.22**	8.25	6.76
Temperature	t^0C		21.6	5.6	11	11	6.5	5.7	10	1.9	11.1	5.6	10.7	4.3	12.8
Conductivity	(µS/cm)		2287	407	415	346	437	429	376	223	369	436	338	385	351
Dissolved Oxygen	mg/L			10	12.31	9.8*	11.4	12.2		10.1	9.6	11.4	10.2	EF	8.43
Turbidity	NTU			4.09	<1	1.9*	4.1	7.3		31.3	10.8	1.75	5.62	4	15
Flow Rate	L/s			0.35	1.67	0.87	1.13	1.3	1	0.7	0.2	0.1	0.3	0.1	0.2
Inorganics															
TDS	mg/L		165	238	220	232	232	266		108	216	216	232	198	242
Hardness (CaCO3)	mg/L		140	233	218	232	232	218		111	228	238	215	228	221
Total Ammonia-N	mg/L		<0.05	0.063	0.143	<0.02	<0.02	0.13		0.06	<0.02	<0.02	<0.02	<0.02	<0.02
Ammonia (unionized)	mg/L	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Conductivity	umho/cm		321	454	443	439	440	447		229	428	420	427	449	438
Dissolved Organic Carbon	mg/L		4.2	0.9	1	1.2	1.4	2.5		10.9	0.9	1.3	1.1	1.2	1.2
Orthophosphate (P)	mg/L		<0.01	<0.100	<0.100	<0.10	<0.10	<0.10		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
pH	pH	6.5 - 8.5	8.16	8.04	8.41	7.78	8.28	8.3		8.08	8.22	8.1	8.2	8.32	8.07
Sulphate (SO4)	mg/L		5	6.24	5.2	4.73	5.07	5.36		2.48	4.61	5.33	4.02	5.09	3.99
Alkalinity (Total as CaCO3)	mg/L		169	222	230	250	239	219		111	219	232	220	224	237
Chloride (Cl)	mg/L		<1	1.02	0.967	0.99	1.02	1.06		1.18	0.96	1.1	0.86	0.92	1.06
Nitrite (N)	mg/L		<0.01	<0.050	<0.050	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrate (N)	mg/L		<0.1	0.104	0.082	0.08	0.08	0.16		0.38	0.05	0.12	0.07	0.09	0.06
Nitrate + Nitrite	mg/L		<0.1	0.104	0.082	0.08	0.08	0.16		0.38	<0.07	0.12	0.07	0.09	<0.07
Metals															
Aluminum (Al)	µg/L	75	**110**	4.2	14	10	<4	22		12	<4	<4	<4	6	5
Barium (Ba)	µg/L		33	69.1	57.1	62	64	51		25	66	63	68	59	70
Beryllium (Be)	µg/L	1100	<0.5	<2.0	<2.0	<1	<1	<1		<1	<1	<1	<1	<1	<1
Boron (B)	µg/L	200	<10	<10	<10	<10	13	<10		10	<10	<10	16	<10	<10
Cadmium (Cd)	µg/L	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<1	<0.1	<0.1	<0.1	<1
Calcium (Ca)	µg/L		49000	81700	76600	81800	81100	77300		39700	80500	84200	75800	79800	77300
Chromium (Cr)	µg/L	8.9	<5	<3.0	<3.0	<3	<3	<3		<3	<3	<3	<3	<3	<3
Cobalt (Co)	µg/L	0.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<1
Copper (Cu)	µg/L	5	<1	<2.0	<2.0	<2	<2	<2		1	<2	<2	<2	<2	<3
Iron (Fe)	µg/L	300	160	<10	28	<10	230	<10		170	10	4	70	73	86
Lead (Pb)	µg/L	25.0	<0.5	<1.0	<1.0	<1	1	<1		<1	<1	<1	<1	<1	<2
Magnesium (Mg)	µg/L		4700	6960	6430	6790	1050	6170		2880	6600	6850	6300	7010	6690
Manganese (Mn)	µg/L		23	3.9	13.7	15	40	6		29	11	11	21	10	19
Molybdenum (Mo)	µg/L	40	0.5	<2.0	<2.0	<2	<2	<2		<2	<2	<2	<2	<1	<2
Nickel (Ni)	µg/L	25	<1	<3.0	<3.0	<3	<3	<3		<3	<3	<3	<3	<3	<3
Phosphorus (P)	µg/L	30	<100	**36**	**48**	<20	**80**	30		**44**	<10	4	20	**40**	<2
Potassium (K)	µg/L		950	1130	1030	1110	1200	1240		4820	1190	1110	1090	1100	1100
Silver (Ag)	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<50
Sodium (Na)	µg/L		1100	1130	1070	1210	1150	1010		950	1190	1140	1110	1080	1150
Strontium (Sr)	µg/L		92	132	115	117	127	125		61	125	129	126	125	127
Vanadium (V)	µg/L	6	1.7	<2.0	<2.0	<2	<2	<2		<2	<2	<2	<2	<2	<2
Zinc (Zn)	µg/L	20	<5	<5.0	7	6	8	<5		<5	5	6	7	8	7

NOTES:

1. PWQO indicates Provincial Water Quality Objectives (1994 plus updates).
2. Bolding and shading denotes concentration exceeds PWQO.
3. mg/L indicates milligrams per litre; µg/L denotes microgram per litre.
4. Blank denotes no PWQO or parameter not tested..
5. EF indicates equipment failure.

TABLE D-1
SURFACE WATER QUALITY - GENERAL CHEMISTRY
CODRINGTON PIT

PARAMETERS	UNITS	PWQO	SAMPLING STATIONS											
			SWC	SWC	SWC	SWC	SWC	SWC	SWC	SWC	SWC	SWC	SWC	SWC
DATE			11-Apr-13	4-Jul-13	19-Sep-13	4-Dec-13	15-Apr-14	16-Sep-14	31-Mar-15	21-Sep-15	16-Mar-16	27-Sep-16	02-Mar-17	9-Sep-17
Field Parameters														
pH	pH	6.5 - 8.5	8.33	EF	8.02	8.42	7.79	8.02	7.63	7.84	7.33		8.23	7.06
Temperature	t^0C		3.6	22.6	17.2	3.1	6	14.1	1.4	16.4	4.3		2.4	15
Conductivity	(µS/cm)		370	355	316	452	420	329	365	327	524		385	336
Dissolved Oxygen	mg/L		9.8	9.49	9.5*	11.6	9.9		9.9	8.0	11.9		EF	8.22
Turbidity	NTU		17.9	1.4	8.8*	6.4	16.6		25.2	9.0	4.5		18.1	2.7
Flow Rate	L/s		50	2.8	<1	10.5	51.9	5.6	12.8	1	14.7	DRY	12.5	2.1
Inorganics														
TDS	mg/L		234	198	220	246	280	280	196	196	266		244	230
Hardness (CaCO3)	mg/L		190	178	172	242	197	197	173	193	257		190	203
Total Ammonia-N	mg/L		0.047	0.275	<0.02	0.03	0.82	0.82	0.6	<0.02	<0.02		0.54	<0.02
Ammonia (unionized)	mg/L	0.02	<0.02	<0;02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		<0.02	<0.02
Conductivity	umho/cm		412	372	335	458	452	452	368	371	486		430	404
Dissolved Organic Carbon	mg/L		6.7	4.2	4.2	2.8	11.4	11.4	13.1	6.9	4.5		20.6	5.6
Orthophosphate (P)	mg/L		<0.100	<0.100	0.22	<0.10	0.51	0.51	0.19	<0.10	<0.10		0.26	<0.10
pH	pH	6.5 - 8.5	7.87	8.34	7.78	8.28	8.17	8.17	8.12	8.26	8.14		8.11	8.36
Sulphate (SO4)	mg/L		7.15	4.35	5.94	7.84	6.97	6.97	6.55	6.39	9.61		10	3.3
Alkalinity (Total as CaCO3)	mg/L		176	189	185	231	197	197	173	184	240		190	218
Chloride (Cl)	mg/L		8.36	1.84	1.52	1.88	9.95	9.95	5.26	1.36	12.1		10.5	2.19
Nitrite (N)	mg/L		<0.050	<0.050	<0.05	<0.05	0.08	0.08	<0.05	<0.05	<0.05		0.09	<0.05
Nitrate (N)	mg/L		2.08	<0.050	0.16	0.09	0.58	0.58	0.26	<0.05	1.08		0.59	<0.05
Nitrate + Nitrite	mg/L		2.08	<0.070	0.16	0.09	0.66	0.66	0.26	<0.07	1.08		0.68	<0.07
Metals														
Aluminum (Al)	µg/L	75	10.4	15.5	13	<4	13	13	28	<4	9		6	<4
Barium (Ba)	µg/L		43.9	38.7	62	53	32	32	56	57	52		48	57
Beryllium (Be)	µg/L	1100	<2.0	<2.0	<1	<1	<1	<1	<1	<1	<1		<1	<1
Boron (B)	µg/L	200	<10	<10	<10	<10	<10	<10	<10	<10	<10		<10	<10
Cadmium (Cd)	µg/L	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1		<0.1	<1
Calcium (Ca)	µg/L		64400	58400	56300	82000	67500	67500	57800	64100	86400		63900	66600
Chromium (Cr)	µg/L	8.9	<3.0	<3.0	<3	<3	3	3	<3	<3	<3		<3	<3
Cobalt (Co)	µg/L	0.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<1
Copper (Cu)	µg/L	5	<2.0	<2.0	<2	<2	<2	<2	2	<2	<2		<2	<3
Iron (Fe)	µg/L	300	240	**372**	**630**	140	200	200	**450**	270	160		226	**345**
Lead (Pb)	µg/L	25.0	<1.0	<1.0	<1	<1	<1	<1	<1	<1	<1		<1	<2
Magnesium (Mg)	µg/L		6990	7770	7530	9070	6980	6980	6950	8100	9900		7440	9000
Manganese (Mn)	µg/L		20	65.7	98	46	39	39	49	44	30		35	76
Molybdenum (Mo)	µg/L	40	<2.0	<2.0	<2	<2	<2	<2	<2	<2	<2		<1	<2
Nickel (Ni)	µg/L	25	<3.0	<3.0	<3	<3	<3	<3	<3	<3	<3		<3	<3
Phosphorus (P)	µg/L	30	**267**	**70**	**80**	**40**	**270**	**270**	**720**	**60**	**130**		**490**	<2
Potassium (K)	µg/L		6190	<500	960	910	6190	6190	9730	1330	2990		12200	1490
Silver (Ag)	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<50
Sodium (Na)	µg/L		3900	1930	1970	1980	4460	4460	2730	1940	5170		3880	2450
Strontium (Sr)	µg/L		120	124	127	130	131	131	98	129	164		122	138
Vanadium (V)	µg/L	6	<2.0	<2.0	<2	<2	<2	<2	<2	<2	<2		<2	<2
Zinc (Zn)	µg/L	20	6.7	<5.0	<5	<5	5	5	5	7	7		8	<5

NOTES:

1. PWQO indicates Provincial Water Quality Objectives (1994 plus updates).
2. Bolding and shading denotes concentration exceeds PWQO.
3. mg/L indicates milligrams per litre; µg/L denotes microgram per litre.
4. Blank denotes no PWQO or parameter not tested..
5. EF indicates equipment failure.

FIGURE D-1
SURFACE WATER FLOW RATES

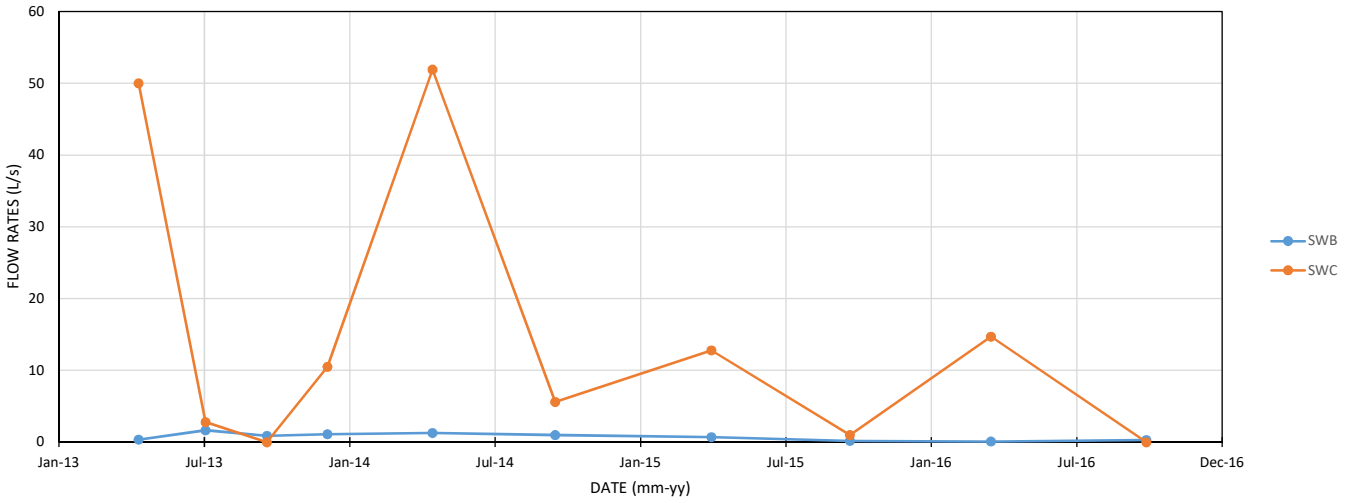

FIGURE D-2
TDS CONCENTRATIONS VS TIME

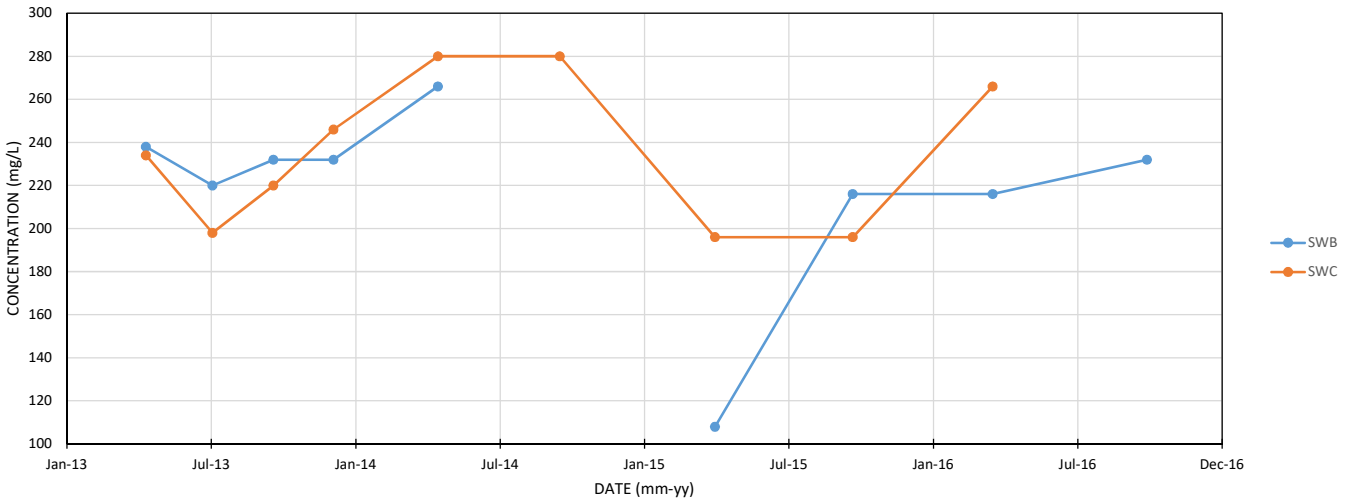

FIGURE D-3
NITRATE CONCENTRATIONS VS TIME

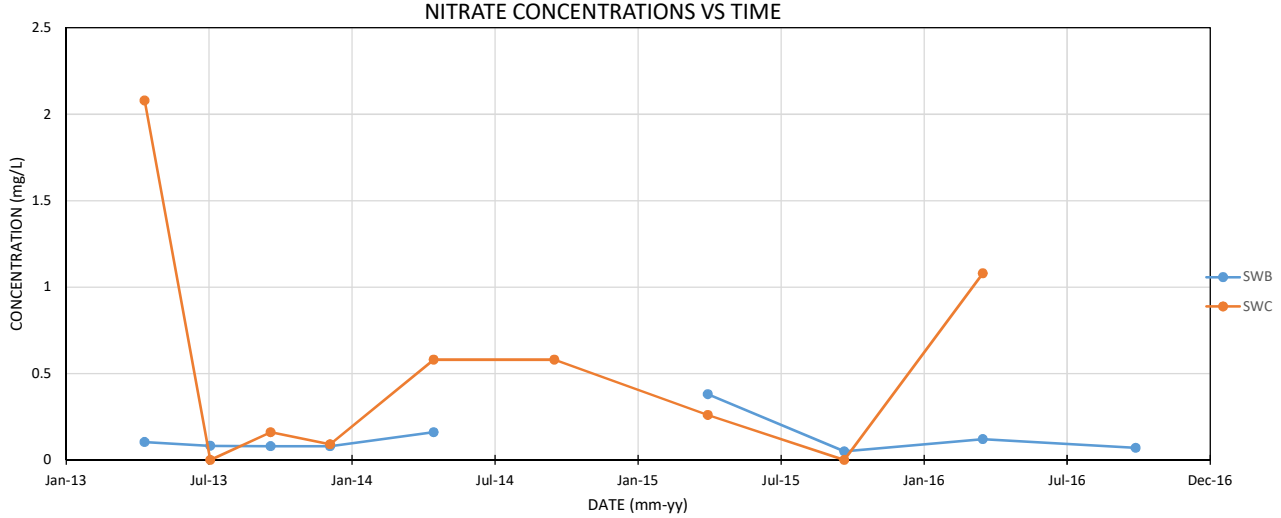

FIGURE D-4
TOTAL PHOSPHORUS CONCENTRATIONS VS TIME

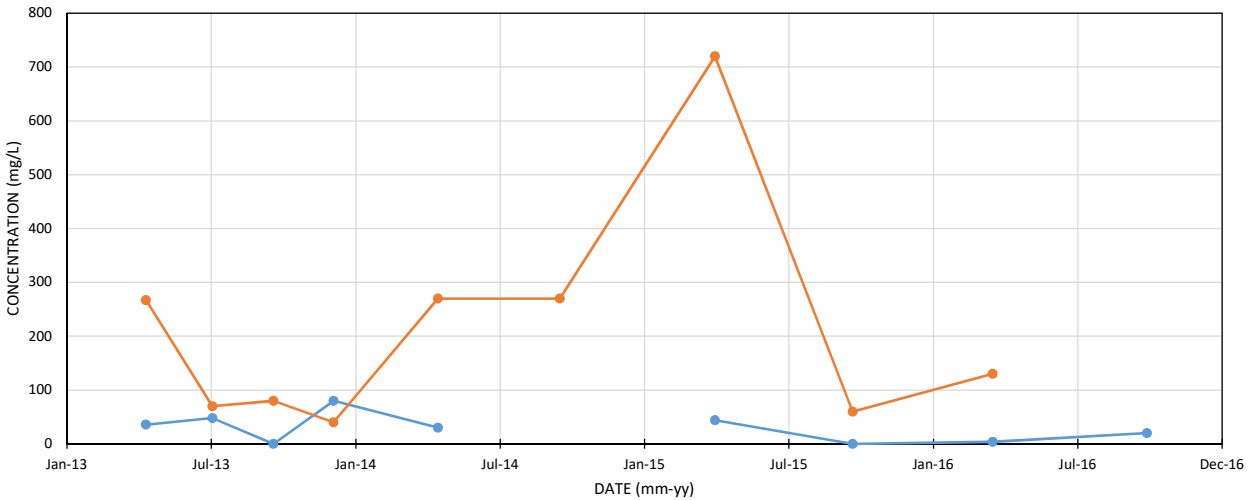

TABLE D-2
SURFACE WATER QUALITY - CODRINGTON FISH RESEARCH CENTRE
CODRINGTON PIT

PARAMETERS	UNITS	PWQO	SAMPLING STATIONS												
			Fish Hatchery Head Pond	FH-SW1	FH-SW1	FH-SW1	FH-SW1	FH-SW1	FH-SW1	FH-SW1	FH-SW1	FH-SW1	FH-SW1	FH-SW1	FH-SW1
DATE			**28-Sep-11**	**15-Apr-13**	**4-Jul-13**	**19-Sep-13**	**4-Dec-13**	**16-Apr-14**	**17-Sep-14**	**1-Apr-15**	**21-Sep-15**	**16-Mar-16**	**27-Sep-16**	**2-Mar-17**	**6-Sep-17**
Field Parameters															
pH	pH	6.5 - 8.5	7.92	7.54	EF	6.9	7.55	7.78	7.54	8.36	7.19	7.5	7.57	9.02	7.6
Temperature	t^0C		11.1	8.5	9.6	9.7	7.9	8.3	9	8.6	8.5	8.6	8.5	3.8	9.6
Conductivity	(µS/cm)		507	475	576	483	613	600	531	610	524	614	483	470	380
Dissolved Oxygen	mg/L			6.3	5.88	9.7*	4.7	4.69	4.72	5	4.88	EF	4.8	EF	10.81
Turbidity	NTU			1	<1	<0.5*	0.31	4.8	4.5	4	6.24	5.32	6.2	0.9	4.29
Flow Rate	L/s				3.2	3.9	7.2	7.4	2.9	6.8	2.3	3.9	2.4	4.8	2.2
Inorganics															
TDS	mg/L		302		332	350	316								
Hardness (CaCO3)	mg/L		260		273	318	298								
Total Ammonia-N	mg/L		<0.05		<0.020	<0.02	<0.02								
Ammonia (unionized)	mg/L	0.02	<0.02		<0.02	<0.02	<0.02								
Conductivity	umho/cm		524		612	621	625								
Dissolved Organic Carbon	mg/L		1		1	0.9	<0.5								
Orthophosphate (P)	mg/L		<0.01		<0.100	<0.20	<0.20								
pH	pH	6.5 - 8.5	8.15		8.41	7.76	8.22								
Sulphate (SO4)	mg/L		17		20.8	20.0	20.6								
Alkalinity (Total as CaCO3)	mg/L		241		249	271	253								
Chloride (Cl)	mg/L		12		30	27.9	27.8								
Nitrite (N)	mg/L		<0.01		<0.050	<0.10	<0.10								
Nitrate (N)	mg/L		2.6		1.5	1.54	1.36								
Nitrate + Nitrite	mg/L		2.6		1.5	1.54	1.36								
Metals															
Aluminum (Al)	µg/L	75	5		11.6	9	<4								
Barium (Ba)	µg/L		110		134	142	135								
Beryllium (Be)	µg/L	1100	<0.5		<2.0	<1	<1								
Boron (B)	µg/L	200	11		14	<10	10								
Cadmium (Cd)	µg/L	0.5	<0.1		<0.1	<0.1	<0.1								
Calcium (Ca)	µg/L		81000		83100	98200	91300								
Chromium (Cr)	µg/L	8.9	<5		<3.0	<3	<3								
Cobalt (Co)	µg/L	0.9	<0.5		<0.5	<0.5	<0.5								
Copper (Cu)	µg/L	5	<1		<2.0	<2	<2								
Iron (Fe)	µg/L	300	<100		<10	<10	<10								
Lead (Pb)	µg/L	25.0	<0.5		<1.0	<1	<1								
Magnesium (Mg)	µg/L		13000		15900	17600	17000								
Manganese (Mn)	µg/L		9		<2.0	3	<2								
Molybdenum (Mo)	µg/L	40	<0.5		<2.0	<2	<2								
Nickel (Ni)	µg/L	25	<1		<3.0	<3	<3								
Phosphorus (P)	µg/L	30	<100		<20	<20	20								
Potassium (K)	µg/L		1300		1530	1590	1620								
Silver (Ag)	µg/L	0.1	<0.1		<0.1	<0.1	<0.1								
Sodium (Na)	µg/L		5700		10500	11900	11100								
Strontium (Sr)	µg/L		190		293	316	301								
Vanadium (V)	µg/L	6	<0.5		<2.0	<2	<2								
Zinc (Zn)	µg/L	20	<5		<5.0	**57**	<5								

NOTES:

1. PWQO indicates Provincial Water Quality Objectives (1994 plus updates).
2. Bolding and shading denotes concentration exceeds PWQO.
3. mg/L indicates milligrams per litre; µg/L denotes microgram per litre.
4. Blank denotes no PWQO or parameter not tested..
5. EF indicates equipment failure.

TABLE D-2
SURFACE WATER QUALITY - CODRINGTON FISH RESEARCH CENTRE
CODRINGTON PIT

PARAMETERS	UNITS	PWQO	SAMPLING STATIONS											
			FH-SW2	FH-SW2	FH-SW2	FH-SW2	FH-SW2	FH-SW2	FH-SW2	FH-SW2	FH-SW2	FH-SW2	FH-SW2	FH-SW2
DATE			15-Apr-13	4-Jul-13	19-Sep-13	4-Dec-13	16-Apr-14	17-Sep-14	1-Apr-15	21-Sep-15	16-Mar-16	27-Sep-16	2-Mar-17	6-Sep-17
Field Parameters														
pH	pH	6.5 - 8.5	7.89	EF	8.02	8.06	8.2	8.11	9.1	7.75	7.89		8.62	6.76
Temperature	t^0C		6	12.4	10	4	3.7	8.4	1.6	8.4	5.6		8.6	8.8
Conductivity	(µS/cm)		411	462	383	525	373	417	442	404	423		589	472
Dissolved Oxygen	mg/L		10.2	12.58	9.9*	10.5	12.55	11.85	12	11.62	EF		EF	4047
Turbidity	NTU		2.6	<1	<0.5*	0.86	3.8	3	4	5.33	4.2		0.34	4.1
Flow Rate	L/s		27.4	12.6	4.9	6.9	69.4	6.3	36.9	6.4	15.4	DRY	2.8	3.3
Inorganics														
TDS	mg/L			242	280	266								
Hardness (CaCO3)	mg/L			247	261	259								
Total Ammonia-N	mg/L			0.102	<0.02	<0.02								
Ammonia (unionized)	mg/L	0.02		<0.02	<0.02	<0.02								
Conductivity	umho/cm			491	490	499								
Dissolved Organic Carbon	mg/L			1.2	1.4	1.3								
Orthophosphate (P)	mg/L			<0.100	<0.10	<0.20								
pH	pH	6.5 - 8.5		8.53	7.98	8.31								
Sulphate (SO4)	mg/L			13.8	14.0	13.5								
Alkalinity (Total as CaCO3)	mg/L			244	261	242								
Chloride (Cl)	mg/L			3.3	3.63	3.42								
Nitrite (N)	mg/L			<0.050	<0.05	<0.10								
Nitrate (N)	mg/L			0.964	1.08	0.84								
Nitrate + Nitrite	mg/L			0.964	1.08	0.84								
Metals														
Aluminum (Al)	µg/L	75		13.2	10	<4								
Barium (Ba)	µg/L			79.6	87	76								
Beryllium (Be)	µg/L	1100		<2.0	<1	<1								
Boron (B)	µg/L	200		<10	<10	<10								
Cadmium (Cd)	µg/L	0.5		<0.1	<0.1	<0.1								
Calcium (Ca)	µg/L			79300	84100	83800								
Chromium (Cr)	µg/L	8.9		<3.0	<3	<3								
Cobalt (Co)	µg/L	0.9		<0.5	<0.5	<0.5								
Copper (Cu)	µg/L	5		<2.0	<2	<2								
Iron (Fe)	µg/L	300		<10	<10	<10								
Lead (Pb)	µg/L	25.0		<1.0	<1	<1								
Magnesium (Mg)	µg/L			11800	12400	12200								
Manganese (Mn)	µg/L			11.1	3.0	10								
Molybdenum (Mo)	µg/L	40		<2.0	<2	<2								
Nickel (Ni)	µg/L	25		<3.0	<3	<3								
Phosphorus (P)	µg/L	30		<20	<20	<20								
Potassium (K)	µg/L			1110	1130	1140								
Silver (Ag)	µg/L	0.1		<0.1	<0.1	<0.1								
Sodium (Na)	µg/L			2390	2480	2500								
Strontium (Sr)	µg/L			168	167	167								
Vanadium (V)	µg/L	6		<2.0	<2	<2								
Zinc (Zn)	µg/L	20		<5.0	<5	<5								

NOTES:

1. PWQO indicates Provincial Water Quality Objectives (1994 plus updates).
2. Bolding and shading denotes concentration exceeds PWQO.
3. mg/L indicates milligrams per litre; µg/L denotes microgram per litre.
4. Blank denotes no PWQO or parameter not tested..
5. EF indicates equipment failure.

FIGURE D-5
SURFACE WATER FLOW RATES - Codrington Fish Research Centre