CODRINGTON PIT
2014 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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January 26, 2015

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

Attention: Mr. Colin Evans
CBM Environment and Lands Manager

Re: Codrington Pit
2014 Monitoring Program Report
File 13-005-00

ResEnv Consulting Limited (ResEnv) is pleased to submit the 2014 Monitoring Program Report in accordance with the Site Plan 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.

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 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-lines 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. In accordance with the Site Plan the Baseline Monitoring Program was completed in 2013 and in 2014 the first year of the Performance Monitoring Program was completed. This report presents the monitoring results to the end of 2014.

Based on the findings presented in this report, groundwater elevations, depths, and quality showed no effects from the pit operations in 2014. Similarly, groundwater quality at the residential water wells continued to reflect natural conditions in 2014. No water well complaints were received from residents in 2014.

Surface water flow rates and quality also showed no effects from the pit operations in 2014.

As the 2014 groundwater and surface water conditions continued to reflect natural conditions with no effects from pit operations, it is recommended that the 2014 monitoring results be used to enhance the baseline database.

It is also recommended that local residents within 500 m of the pit should continue to be solicited for participation in the Performance Monitoring Program to achieve the target of six water wells. Groundwater and surface water monitoring and reporting should continue in 2015 as outlined in Section 6 of this report.

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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 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-lines 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. In accordance with the Site Plan the Baseline Monitoring Program was completed in 2013 and in 2014 the first year of the Performance Monitoring Program was completed. This report presents the monitoring results to the end of 2014.

2. METHODOLOGY

The following groundwater and surface water monitoring was completed during 2014 in accordance with the monitoring requirements of the Site Plan. Details are provided in Tables 1 through 3, and monitoring locations are shown in Figure 1.

- Quarterly manual groundwater level measurements were obtained for the on-site monitoring wells on April 15, June 17, September 15, and December 4, 2014. Manual groundwater elevations are presented in Table A-1 and Figure A-1, Appendix A. On the same monitoring dates the data were downloaded from the automated water level and temperature probe transducers that measure groundwater levels and temperatures within the monitoring wells at 6 hour intervals. These automated data are presented in Figures A-2 through A-15, Appendix A. Monitoring well BH05-2 was vandalized in October 2013 and was fixed in July 2014 during the first scheduled monitoring event after the snow melt.

- Semiannual sampling was completed for the on-site monitoring wells on April 15 and September 15, 2014. Chemical results are summarized in Table B-1, Appendix B. BH12-1 could not be sampled in April owing to the presence of bentonite in the well. The bentonite was subsequently removed, the monitoring well rehabilitated, and a sample collected in September. The April monitoring event for BH05-20 had to be postponed until June owing to flooding around the monitoring well. Parameters were analysed as required, except as follows:
    - Owing to the laboratory scan package, bismuth was not analyzed, but strontium and vanadium were added.

- Temperature and dissolved oxygen were not analyzed for groundwater from BH05-20 in June owing to equipment failure. Both parameters were obtained during the following September monitoring event.
- Phosphorus was analyzed in April, but was inadvertently omitted by the laboratory for the September monitoring event.

➢ Annual residential water well monitoring was completed on September 16, 2014, for [redacted]. Permission to sample the well could not be obtained from 130 Jameson Road although several attempts were made. Other wells selected for sampling after the baseline monitoring could not be sampled as permission was not granted. It is understood that requests for participation in the residential well monitoring program are/will be offered at public meetings associated with the pit. Groundwater levels are presented in Table A-2, Appendix A. Chemical results are provided in Tables B-2 through B-3, Appendix B. Analytes were the same as those for the on-site monitoring wells, with the addition of bacteria.

➢ Semiannual water level monitoring was completed for the three wells at the Codrington Fish Research Centre on April 16 and September 17, 2014. Results are provided in Table A-3, Appendix A. 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 April 15 and September 15, 2014. Chemical results and flow rates are provided in Table C-1, Appendix C. Watercourse characteristics were used to determine the surface water flow rates. Parameters were analysed as required, except as follows:

- Owing to the laboratory scan package, bismuth was not analyzed, but strontium and vanadium were added.
- Phosphorus was analyzed in September, but was inadvertently omitted by the laboratory for the April monitoring event.

➢ Annual surface water monitoring at springs FH-SW1 and FH-SW2 was completed on April 16, 2014. Flow rates and chemical results for the required field parameters are presented in Table C-2, Appendix C. Watercourse characteristics were used to determine the surface water flow rates.

➢ Precipitation data from the local climatological station in Trenton were documented for use in the assessment of water levels and flow rates. Data prior to each monitoring event are summarized in Table 4.

It is noted that the scheduled March monitoring event was completed in April owing to the timing for approval to complete the 2014 monitoring program. This one month delay does not negatively affect the data as the influence of the spring thaw was monitored and the use of the automated water level and temperature probes at the on-site monitoring wells allowed for the collection of data throughout March.

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 kilometres (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 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 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 borehole results 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 some (20%) gravel to sand and gravel in approximately equal proportions. The gravel-rich areas appear as lenses or beds within the sand, and the gravel content is variable. The unit reaches a confirmed maximum thickness of 25 m in the south-central and eastern portions of the pit.

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 advanced 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	December 2012	155.0
BH12-2	173.09	December 2012	164.5

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 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.

Six (6) residential water wells were selected for ongoing monitoring around the pit based on the results of the baseline monitoring program as well as the type and depth of the water well. Only residents at the following three wells agreed to participate in the ongoing Performance Monitoring Program. Well locations are shown in Figure 1.

- 488 Old Wooler Road
- 232 Aranda Way
- 130 Jameson Road

In addition, water wells located over 1.5 km west of the pit at the Codrington Fish Research Centre granted permission to be 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.

- 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. Baseline Monitoring Program results for the seeps and springs for April 2013 are presented in Table C-3 and Figure C-1, Appendix C.

4. 2014 PIT OPERATION SUMMARY

In 2014, operations at the pit were related to the construction of infrastructure, including: construction of the pit access road and internal access roads, installation of a water well near the proposed scale house location, berming, and fencing. Some shallow material extraction occurred to provide material for the on-site infrastructure construction. No extraction occurred below the water table.

4.1 COMPLAINTS AND RESPONSES

No formal complaints regarding pit operations were received in 2014.

5. MONITORING RESULTS

5.1 GROUNDWATER ELEVATIONS AND DEPTHS

Groundwater Trigger Elevations were established for the on-site monitoring wells based on groundwater elevations measured to the end of 2013. These Trigger Elevations represent the minimum groundwater elevation observed. Groundwater elevations that are detected below the Trigger Elevation will initiate a data review progressive 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 elevations for 2014 are summarized in the following table.

MONITORING WELL DESIGNATION	GROUNDWATER TRIGGER ELEVATION (m ASL)	MINIMUM 2014 GROUNDWATER ELEVATION (m ASL)	ACCEPTABLE GROUNDWATER ELEVATION (Yes/No)
BH05-2	173.38	173.92	Yes
BH05-18	166.47	166.55	Yes
BH05-19	159.29	159.39	Yes
BH05-20	178.18	181.19	Yes
BH06-1	174.05	174.07	Yes
BH12-1	152.82	153.16*	Yes
BH12-2	167.85	170.38	Yes

NOTES:
1) 'm ASL' indicates metres above sea level.
2) '*' indicates minimum value based on pressure transducer result as manual measurement affected by bentonite.

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 2014 are summarized in the following table. It is noted that depths are used for the water wells since the geodetic elevation of the wells were not available.

MONITORING WELL DESIGNATION	GROUNDWATER TRIGGER DEPTH (m)	MAXIMUM 2014 GROUNDWATER DEPTH (m)	ACCEPTABLE GROUNDWATER DEPTH (Yes/No)
488 Old Wooler Road	2.89	2.8	Yes
232 Aranda Way	2.39	2.11	Yes
130 Jameson Road	3.56	Not Available	Yes
CFRC – Well2	Flowing	Flowing	Yes
CFRC – Well 3	1.55	1.46	Yes
CFRC – Well 4	2.07	1.97	Yes

NOTES:
1) 'm' indicates metres.

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 affect to the well water.

Based on the groundwater hydrographs presented in Figures A-1 through A-15, Appendix A, the groundwater levels in 2014 continued to show seasonal patterns of higher groundwater elevations during the late winter, spring, and early summer when snow melt occurs and/or precipitation is typically greatest. Lower groundwater elevations during the late summer, fall, and winter reflect the influence of less precipitation and more evapotranspiration.

One pattern of note is the greater groundwater elevation changes that occurs at monitoring well BH05-20, which is developed within the shallow silt below the low-lying area within the north-central portion of the pit. The groundwater elevations at this monitoring well reflect the elevation of the perched water table, and during some portions of the year the groundwater elevations reflect the elevation of the ponded water around the monitoring well. In 2012 the perched water table achieved a low elevation of almost 5 m below ground surface, whereas in 2014 the low elevation was only about 2 m below ground surface.

A comparison of groundwater elevations at BH05-20 (perched water table) to those at nearby BH05-19 (unconfined water table) indicates that the groundwater moves in a downward direction at this location and that water that ponds within the low-lying area continues to drain through the underlying fine grained soil into the deeper unconfined water table.

Temperature graphs for the groundwater at each of the deeper monitoring wells show the expected pattern of generally constant temperatures (7 ºC to 9 ºC) for groundwater. In contrast, within the perched water table at BH05-20 the groundwater temperature fluctuates over a greater range (6 ºC to 11 ºC) as the shallow groundwater is affected more by the ambient temperature of ponded water.

In summary, there were no observed effects on groundwater elevations or depths from operations at the pit in 2014.

5.2 GROUNDWATER QUALITY

Groundwater Trigger Concentrations were established based on major ions as presented in the Trilinear diagrams of Figures 2 and 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 B-1 through B-4, Appendix B. 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 diagrams show that groundwater obtained from the on-site monitoring wells and the residential water wells is similar and plots in a similar location on the diagrams. 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.

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 monitoring events in April and September, and manganese exceeded the Trigger Concentration in groundwater at BH12-2 and 488 Old Wooler Road.

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 on-site 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 concentrations in groundwater at BH05-18 exceeded the ODWSOG of 10 mg/L in April 2014, and continued to be elevated in September 2014. Groundwater at BH05-19 also showed elevated nitrate concentrations. Elevated nitrate concentrations can occur in agricultural areas as a result of the application of nitrogen-based fertilizers.

Periodic elevated manganese concentrations occurred in groundwater at BH12-2 and 488 Old Wooler Road. Manganese occurs naturally and is often a result of water turbidity. Elevated iron concentrations often occur with elevated manganese concentrations.

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

In summary, there were no observed effects on groundwater quality from operations at the pit in 2014. It is recommended that the 2014 water quality results be used as baseline conditions for future monitoring to improve the accuracy of future water quality assessments.

5.3 SURFACE WATER FLOW RATES

Surface water flow rates show a notable difference between stations SWB and SWC. 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 2014 were within the flow rate range for baseline conditions.

STATION	TRIGGER FLOW RATES (2013) (L/s)	2014 FLOW RATES (L/s)
SWB	0.35 – 1.67	1.0 – 1.3
SWC	<1 – 50	5.6 – 51.9
FH-SW1	3.2 – 7.2	2.9 – 7.4
FH-SW2	4.9 – 27.4	6.3 – 69.4

NOTE: ‘L/s’ indicates litres per second.

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 (April) and lower flow rates during the summer and fall. As shown in the table provided above, the flow rates at SWC for 2014 were within or exceeded the flow rate range for baseline conditions.

At the Codrington Fish Research Centre, the flow rates at stations FH-SW1 and FH-SW2 also show a notable difference. 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. Only the flow rate at FH-SW1 showed a slight decrease in 2014 relative to baseline conditions. However, as operations at the pit had not extracted below the water table and local groundwater elevations and surface water flow had not been influence by pit operations, the slight decrease in flow rate at FH-SW1 is attributed to natural conditions. It is recommended that the baseline Trigger Flow Rates be updated with the 2014 flow rates.

5.4 SURFACE WATER QUALITY

Surface Water Trigger Concentrations were established based on major ions as presented in the Trilinear diagrams of Figures 2 and 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 C-1 and C-2, Appendix C.

The Trilinear diagrams show that the surface water quality is similar, and is similar to groundwater quality, except at station FH-SW1, which shows a slightly greater chloride and sulphate composition. A notable change in surface water quality will result in a shift in the plotted location of a station on the diagram.

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

PARAMETER	PWQO (µg/L)	TRIGGER CONCENTRATION (µg/L)
Phosphorus	30	22.5
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 and periodically for iron near the pit at stations SWB and SWC, and for zinc at station FH-SW1. 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 effects for the pit. It is recommended that the 2014 water quality results be used as baseline conditions for future monitoring to improve the accuracy of future water quality assessments.

6. 2015 MONITORING PROGRAM

Based on the 2014 monitoring program findings, it is recommended that the Performance Monitoring Program detailed in the Site Plan, and presented in Tables 1 through 3, be continued in 2015. The 2015 Monitoring Program Report should be completed prior to March 31, 2016.

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 effects from the pit operations in 2014. Similarly, groundwater quality at the residential water wells continued to reflect natural conditions in 2014. No water well complaints were received from residents in 2014.

- Surface water flow rates and quality showed no effects from the pit operations in 2014.

The following recommendations are provided for consideration in 2015.

- As the 2014 groundwater and surface water conditions continued to reflect natural conditions with no effects from pit operations, it is recommended that the 2014 monitoring results be used to enhance the baseline database.

- Local residents within 500 m of the pit should continue to be solicited for participation in the Performance Monitoring Program to achieve the target of six water wells.

- Groundwater and surface water monitoring and reporting should continue in 2015 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

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

Ontario Ministry of the Environment and Energy (MOEE), 1994 and updates.
Water Management Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy. ISBN 0-7778-8473-9 rev, PIBS 3303B.

Tables

TABLE 1
MONITORING PROGRAM SUMMARY
CODRINGTON PIT

BASELINE 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)	Monthly for 1 year	Water Levels	A' and 'C' are new wells to be installed across the water table. 'A' will be installed at least 1 year prior to extraction.
Six (6) Residential Wells within 1 km*	Quarterly for 1 year	Water Levels	Proposed residential wells include: 1 north of site, 1 east of site, and 4 along Old Wooler Road.
	Twice (July and April/May) for baseline	Field parameters, inorganics, metals, microbiological.	One event already completed in July 2011 to present low water level information. Second event to be completed during spring (April/May) for high water level information.
Fish Hatchery Wells (assume 2)	Quarterly for 1 year	Water Levels	Where access is granted and if no historic data are available.
SURFACE WATER			
SWB, SWC	Quarterly for 1 year	Flow Rates	Tributaries Marsh Creek and Cold Creek. Characterize springs at SWB and SWC, including cross-sections.
	Quarterly for 1 year	Field Parameters, Inorganics, Metals	
Study Area Springs	1 Event	Flow Rates, Field Parameters	Characterize springs, including cross-sections.
Fish Hatchery Springs (assume 2)	Quarterly for 1 year	Flow Rates	Where access is granted and if no historic data are available. The springs will be characterized, including cross sections.
	Quarterly for 1 year	Field Parameters	

NOTES:
1) * denotes see Table 2 for list of residential wells. Focus is on shallow dug wells. Final wells to be sampled will depend on access approval by landowner.
2) Quarterly indicates March, June, September, December.
3) See Table 3 for parameter list.
4) Establish trigger mechanisms for water levels/flows and quality after one year of baseline monitoring.
5) Precipitation conditions will be documented prior to sampling springs and undertaking sampling activities.

PROPOSED 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 (assume 2)	Semiannually	Flow Rates	Where access is granted.
	Annually	Field Parameters	

NOTES:
1) * denotes see Table 2 for list of residential wells. Focus is on shallow dug wells. Final 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) See Table 3 for parameter list.
6) Proposed monitoring program may be revised based on results of one year of baseline monitoring.
7) Precipitation conditions will be documented prior to sampling springs and undertaking sampling activities.

TABLE 2
RESIDENTIAL WATER WELL LOCATION SUMMARY
CODRINGTON PIT

#	ADDRESS	RESIDENTIAL WELL DETAILS				MONITORING WELL
		WELL TYPE	APPROXIMATE DATE CONSTRUCTED	APPROXIMATE DEPTH (m)	APPROXIMATE WELL DIAMETER (m)	
1	[redacted]	drilled	NA	NA	NA	
2	[redacted]	dug	1930	7	1	
3	[redacted]	drilled	NA	NA	NA	
4	[redacted]	dug/drilled	2007	60	0.9/0.1	
5	[redacted]	dug	2010	NA	NA	
6	[redacted]	dug	2010	6	1	
7	[redacted]	dug	100 years ago	NA	NA	Yes
8	[redacted]	drilled	25 years ago	NA	NA	
9	[redacted]	drilled	2009	NA	0.1	
10	[redacted]	drilled	1975	25	NA	
11	[redacted]	drilled	2004	4.48*	0.1	Yes
12	[redacted]	drilled	NA	NA	NA	
13	[redacted]	dug	1988	4	1	Yes
14	[redacted]	dug	40 years ago	2.5	1	Yes
15	[redacted]	drilled	2002/2003	16	0.1	
16	[redacted]	drilled	1975	NA	NA	
17	[redacted]	dug	1972	6	1	
18	[redacted]	dug	NA	10	1	
19	[redacted]	dug	NA	6	1	
20	[redacted]	dug	20 years ago	6	1	Yes
21	[redacted]	drilled	1992	50	0.1	
22	[redacted]	dug	100 years Ago	6	1	Yes

NOTES:
1) 'm' indicates metres.

TABLE 3
PARAMETERS FOR ANALYSIS
CODRINGTON PIT

PARAMETERS	UNITS	PARAMETERS	UNITS
Field Parameters		**Metals**	
pH	pH	. Aluminum (Al)	µg/L
Temperature	t^{0}C	. Barium (Ba)	µg/L
Conductivity	(µS/cm)	. Beryllium (Be)	µg/L
Dissolved Oxygen	mg/L	. Bismuth (Bi)	µg/L
Turbidity	NTU	. Boron (B)	µg/L
		. Cadmium (Cd)	µg/L
Inorganics		. Calcium (Ca)	µg/L
Total Ammonia-N	mg/L	. Chromium (Cr)	µg/L
Conductivity	uS/cm	. Cobalt (Co)	µg/L
Dissolved Organic Carbon	mg/L	. Copper (Cu)	µg/L
Orthophosphate (P)	mg/L	. Iron (Fe)	µg/L
pH	pH	. Lead (Pb)	µg/L
Dissolved Sulphate (SO4)	mg/L	. Magnesium (Mg)	µg/L
Alkalinity (Total as CaCO3)	mg/L	. Manganese (Mn)	µg/L
Dissolved Chloride (Cl)	mg/L	. Molybdenum (Mo)	µg/L
Nitrite (N)	mg/L	. Nickel (Ni)	µg/L
Nitrate (N)	mg/L	. Phosphorus (P)	µg/L
Nitrate + Nitrite	mg/L	. Potassium (K)	µg/L
TDS	mg/L	. Silver (Ag)	µg/L
Hardness	mg/L	. Sodium (Na)	µg/L
		. Zinc (Zn)	µg/L
Microbiological			
Background	CFU/100mL		
Total Coliforms	CFU/100mL		
Escherichia coli	CFU/100mL		
Faecal Streptococci	CFU/100mL		
Heterotrophic PlateCount	CFU/100mL		

C:\Users\Jason\Documents\ResEnv\Projects\13-005-00\Codrington\Tech\Monitoring Program\Revised Program\[Table 3.xlsx]Parameters

TABLE 4
PRECIPITATION SUMMARY
CODRINGTON PIT

DATE	PRECIPITATION (mm)
April 10	1.2
April 11	0
April 12	13.4
April 13	0
April 14	10.3
April 15	3.2
April 16	0

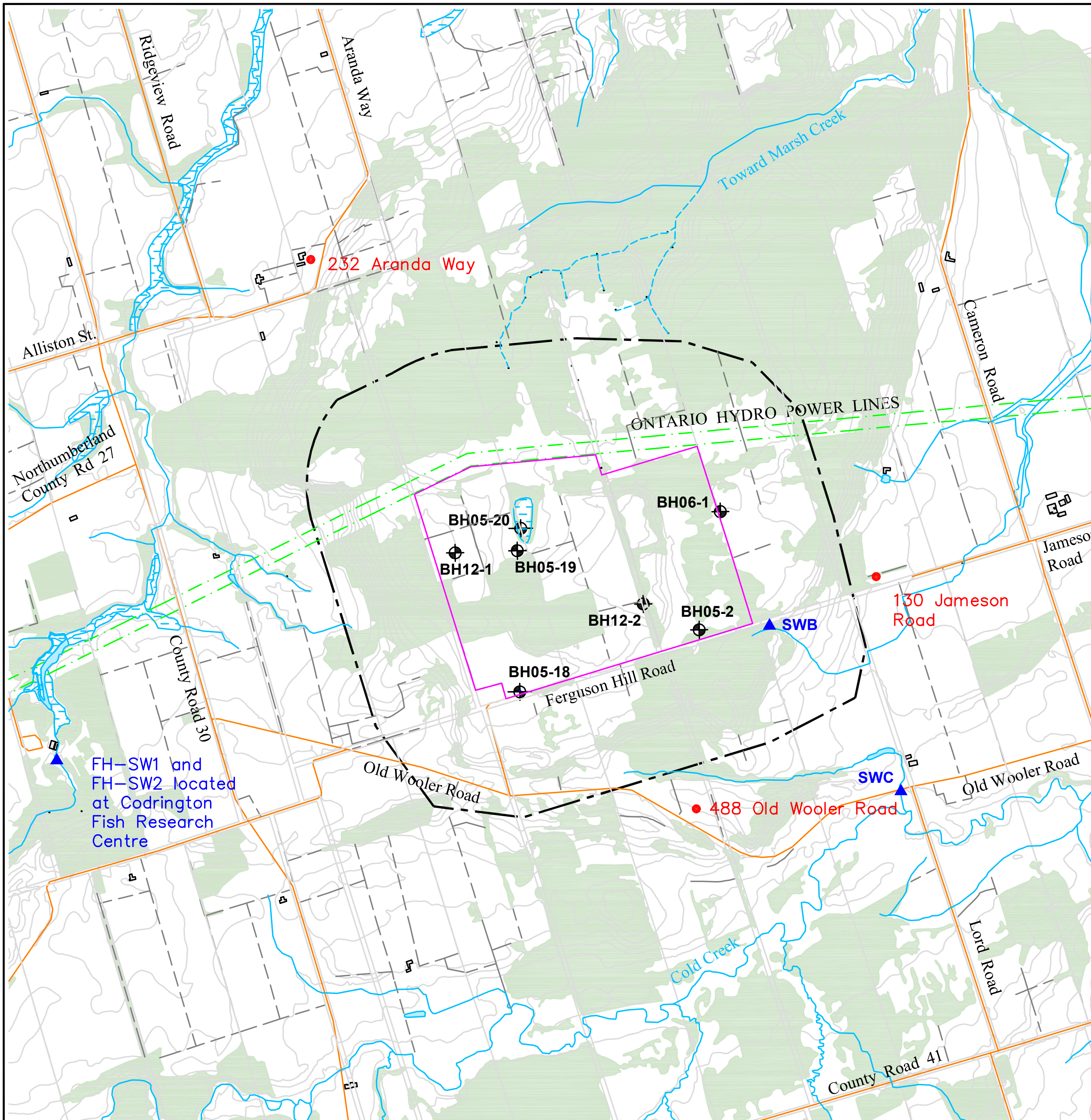
DATE	PRECIPITATION (mm)
June 12	15.2
June 13	1.2
June 14	0
June 15	0
June 16	4.8
June 17	13.0
June 18	0

DATE	PRECIPITATION (mm)
September 10	8.0
September 11	6.4
September 12	0
September 13	3.8
September 14	0
September 15	0.6
September 16	Trace

DATE	PRECIPITATION (mm)
November 28	Trace
November 29	0
November 30	Trace
December 1	Trace
December 2	4.8
December 3	1.8
December 4	Trace

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

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

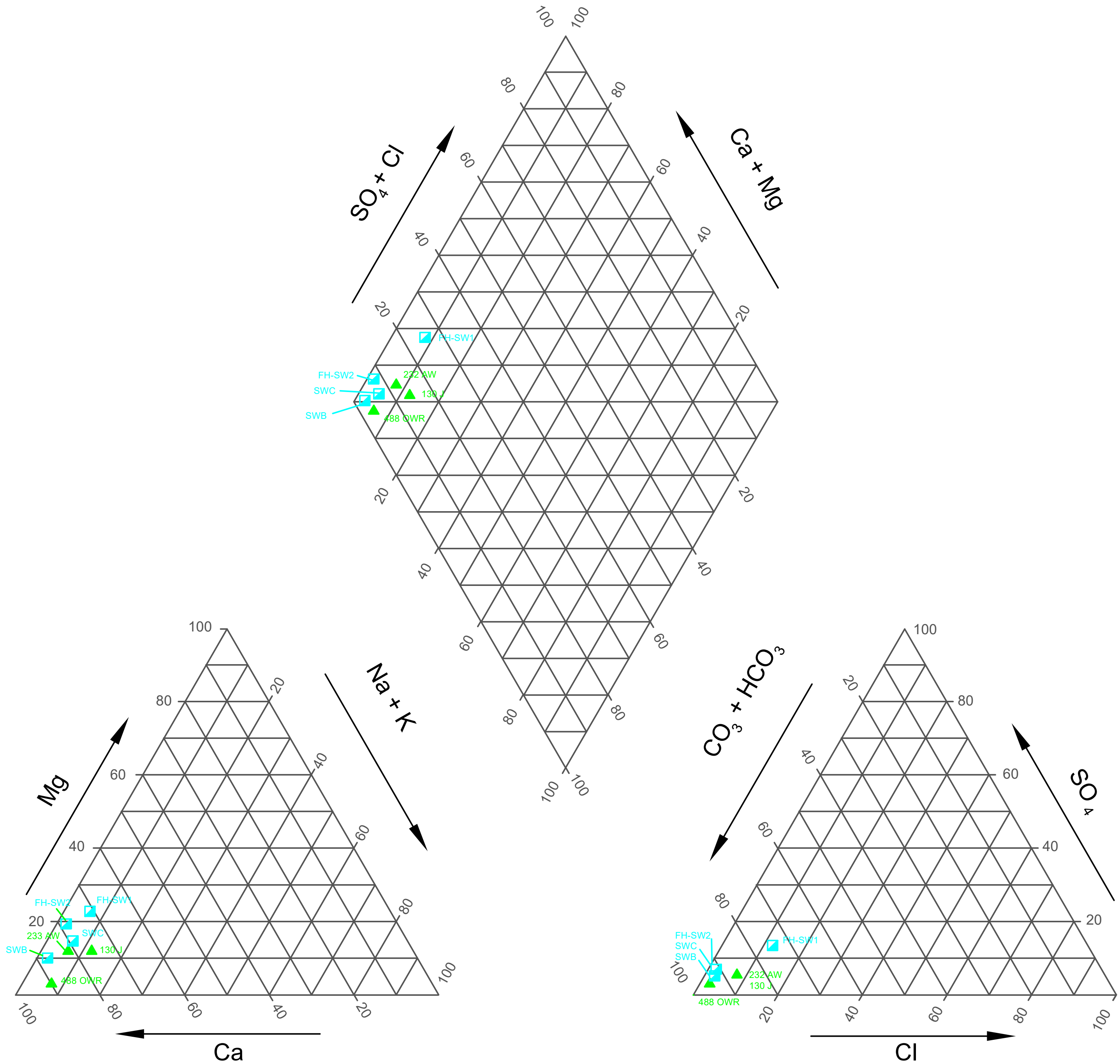
MAP SOURCE:
OBM 1:10000 MAPPING, NAD 83, ZONE 18 AND HYDROGEOLOGICAL STUDY (GENIVAR, 2013).

SITE LOCATION MAP

2014 MONITORING PROGRAM REPORT - CODRINGTON PIT
for St. Marys Cement Inc. (Canada)

DATE: JANUARY 2015	SCALE: 1:25000
PROJECT: 13-005-00	REF. NO.: F1-SP

ResEnv Consulting Limited FIGURE 1



LEGEND

- MONITORING WELL
- RESIDENTIAL WELL
- SURFACE WATER

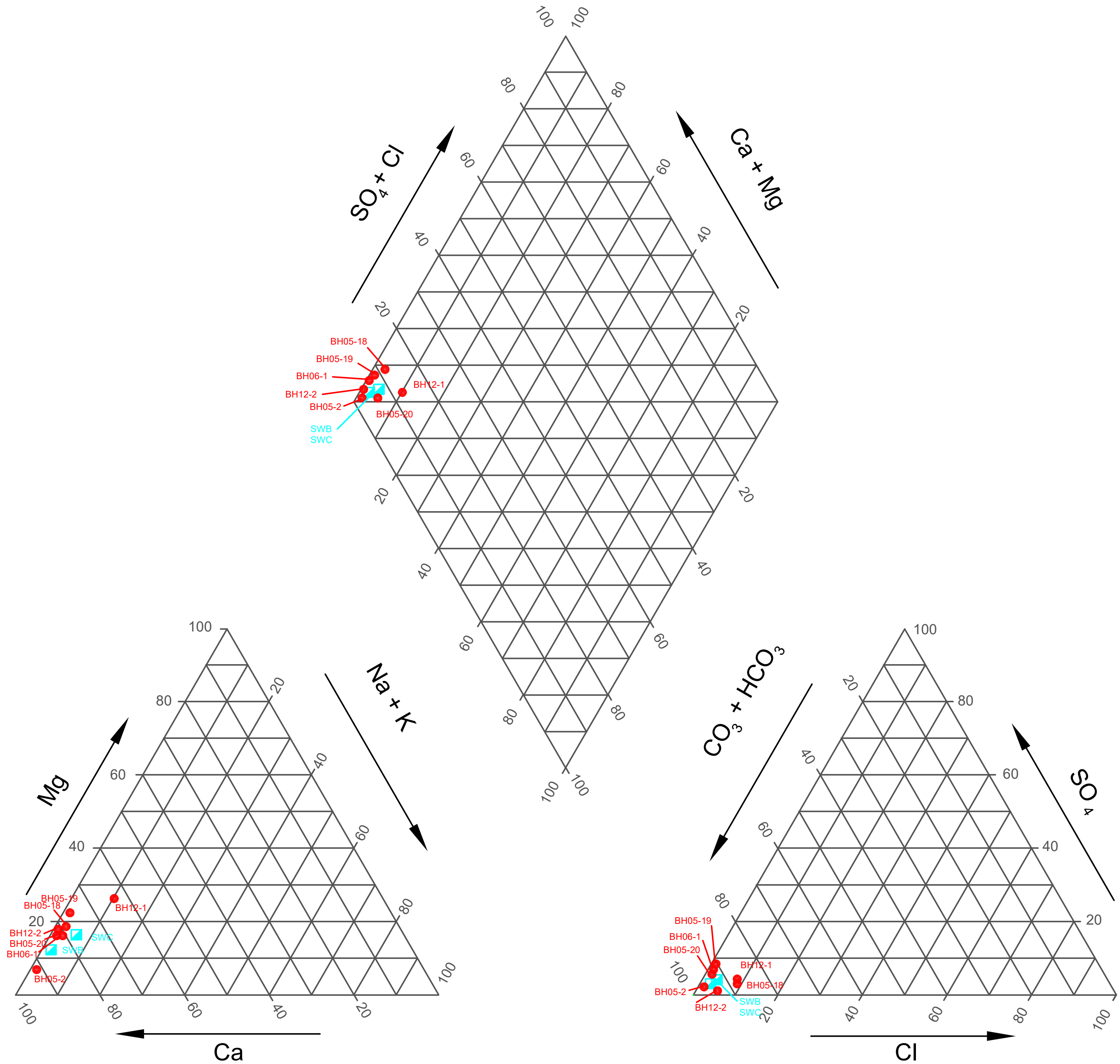
BASELINE WATER QUALITY - TRILINEAR DIAGRAM

2014 MONITORING PROGRAM REPORT
CODRINGTON PIT
For St. Marys Cement Inc. (Canada)

DATE: JANUARY 2015	SCALE: AS SHOWN
PROJECT: 13-005-00	REF. NO.: F1 - Baseline

ResEnv Consulting Limited

FIGURE 2



LEGEND

- MONITORING WELL
- RESIDENTIAL WELL
- SURFACE WATER

2014 WATER QUALITY - TRILINEAR DIAGRAM

2014 MONITORING PROGRAM REPORT
CODRINGTON PIT
For St. Marys Cement Inc. (Canada)

DATE: JANUARY 2015	SCALE: AS SHOWN
PROJECT: 13-005-00	REF. NO.: F1 - Baseline

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FIGURE 3