BORAL

BORAL CONSTRUCTION MATERIALS, LLC

QUARRY WATER MONITORING PLAN (QWMP)

QUARTERLY REPORT
1st Quarter 2013

Prepared For:

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1.0 INTRODUCTION

1.1 Background

Boral Construction Materials Oklahoma, LLC (BCM) operates a limestone quarry in Murray County roughly three (3) miles west-southwest of Davis, OK. The facility, referred to as the Davis Quarry or Roger/Chambless Mine, is permitted by the Oklahoma Department of Mines (ODM) (LE-1669). The quarry is an actively producing mine with a portion of the facility overlying the Arbuckle Simpson Aquifer, a sensitive sole source ground water basin. According to 82 O.S. §1020.2(C)(1), this facility meets the definition of an exempt mine. At this time, BCM does not hold any surface or ground water permits. A domestic ground water well is in use, but is exempt (per 82 O.S. §1020.3) from permitting and considered *de minimis*.

BCM adopted and implemented a plan to monitor the accumulation and disposition of water as required by 82 O.S. 1020.2(E)(1) and 785:30-15-4(a)(1). A Site Specific Water Management and Conservation Plan (SSWMCP) was originally submitted to the Oklahoma Water Resources Board (OWRB) on December 28, 2012. However, with the adoption of the final rules and subsequent changes, BCM has updated its plan from a SSWMCP to a Quarry Water Monitoring Plan (QWMP). Since January 1, 2013, BCM has maintained monitoring protocols and procedures in order to assess the accumulation and disposition of Pit Water[1].

This document is designed to fulfill the quarterly reporting requirement specified by 82 O.S. §1020.2. The reporting period covered by this document is first quarter 2013 (January through March). *Information contained within shall be considered preliminary, draft and subject to correction, modification, and/or change.*

1.2 Facility Layout

The location of the mine pit, processing facilities, settling and retention impoundments and ancillary activities are generally illustrated on Figures 1 & 2. Figure 2 also depicts the general flow paths for the facility. Refer to Figure 3 for a generalized depiction of flow at the mine.

Refer to Figure 2 for the approximate location of mine pit water collection areas (i.e., Quarry Sumps). Currently, water is pumped from two (2) sumps (North & South) within the quarry pit. The actual location and number of sumps is subject to change as needed for operating purposes.

There were no stream diversion points used during this reporting period and there were no stream discharges or ground water recharge purposefully designed for augmentation credit.

[1] Pit Water as defined by 785:30-15-2 means ground water trapped or collecting in a producing mine pit that emanates from a Sensitive Basin.

2.0 MONITORING & MEASUREMENT METHODOLOGY

BCM measured, modeled, or otherwise reasonably estimated ground water and surface water volumes entering the quarry pit sumps, along with the volume and disposition of water diverted from the sumps. As part of the QWMP, BCM has protocols to measure consumptive use, stream and ground water augmentation, precipitation, evaporation, hydrology data, and/or other sources and diversions of water (when applicable). Please note that the methods may change as needed or required. This section is a summary of various measurements and methods employed during this reporting period.

2.1 Definitions

For clarification purposes the following definitions were adopted by BCM and used throughout this document:

A. **Quarry Sump Water**[2]: Water captured or accumulated in a quarry pit sump, which may consist of ground water, surface water runoff, and/or precipitation from direct interception.
B. **Diverted Quarry Sump Water**: Water pumped out of the quarry pit sump(s).
C. **Pit Water**: Ground water further defined by 785:30-15-2
D. **Consumptive Use of Pit Water**: As defined by 82 O.S. §1020.2 (F)

2.2 Measuring Diverted Quarry Sump Water

Water that accumulates or collects in a quarry pit sump in excess quantities may be pumped to another pond or impoundment, used for dust suppression (e.g., water truck) or discharged off site. The amount of Diverted Quarry Sump Water is estimated by direct measurement and/or by calculation (e.g., operating hours of the pump multiplied by its rated capacity). Any equipment used is installed, calibrated and maintained according to manufacturer's recommendations and specifications.

During this reporting period, estimates were based on pumping hours (i.e., hours of operation) and a measured pumping rate in gallons per hour. The total volume diverted was calculated by multiplying pumping rate for each sump by the number of pumping hours. Daily pumping records were kept by facility staff to document the effort.

2.3 Measuring & Calculating Quarry Sump Water Components

The Pit Water (i.e., ground water) volume is determined based on the measurement or reasonable estimation of the Diverted Quarry Sump Water plus any calculated evaporation loses from the wetted surface of the sump. In order to determine what portion of the Quarry Sump Water is actual ground water (i.e., Pit Water), the various components need to be calculated. Measurement of each component is discussed below.

A. **Evaporation Component**: The volume of Quarry Sump Water lost via evaporation is calculated by monitoring evaporation and measuring the wetted surface area of the sumps. At this time there are two (2) sumps in the quarry area (North Sump & South Sump). The average surface area was field-determined for each. Evaporation data was obtained from the Sulphur, OK

[2] This definition is different than OAC 785:30-15-2 "pit water", but more accurately describes the water entering the mine quarry pit system.

Mesonet station per Appendix C of OAC 785:30-15 (draft dated 2/1/2013) (http://www.mesonet.org). The volume was calculated by multiplying the sump surface area by the amount/depth of evaporation.

B. **Surface Water Component**: The surface water fraction of the Quarry Sump Water is estimated by calculating runoff using accepted engineering models and/or calculations (per Appendix "C" of OAC 785:30-15, draft dated 2/1/2013). At this time, the SCS model is used to predict storm event runoff and what portion accumulates in the sumps. The model is adjusted for the actual drainage basin characteristics (e.g., surface area, disturbance, antecedent moisture conditions, soil group (when applicable), designated land use, and growing season, etc.). The quarry sump watershed was delineated via USGS 1:24,000 topographic maps and field verification. The watershed was broken into groups based on landuse and assigned appropriate NRCS curves numbers. The calculation method followed Corbitt, R. A. "Standard Handbook of Environmental Engineering", McGraw-Hill, 1989 and Adsero, C.M, "UDOT Research Report No. UT-08.26", Brigham Young University, 2008.

   Contributing storm values were measured on site with a rain gauge and/or obtained from the Sulphur, OK Mesonet station (per Appendix "C" of OAC 785:30-15 draft dated 2/1/2013) (http://www.mesonet.org).

C. **Direct Interception Component:** The precipitation fraction of Quarry Sump Water is measured by determining the amount of water that is contributed by direct interception into the quarry sumps. The average surface area was determined. Precipitation is measured on site with a rain gauge and/or obtained from the Sulphur, OK Mesonet station (per Appendix "C" of OAC 785:30-15 draft dated 2/1/2013) (http://www.mesonet.org). The volume is calculated by multiplying the sump surface area by the amount/depth of precipitation.

D. **Ground Water Component**: The ground water or Pit Water[3] fraction is estimated by subtracting the total volume of Diverted Quarry Sump Water plus sump evaporation losses from the sum of direct interception and surface water runoff.

2.4 Measuring Consumptive Use of Pit Water

If applicable, the fraction of Pit Water (i.e. ground water) consumptively used will be calculated. The amount of water consumptively used will be determined based on the defined consumptive uses (82 O.S. §1020.2 (F)) and the guidance provided in OAC 785:30-15 (draft dated 2/1/2013).

During this monitoring period no pit water was consumptively used; consequently, this section is not applicable.

2.5 Measuring Water Diverted From a Stream or Pond

During this monitoring period no water was diverted from a stream or pond; consequently, this section is not applicable.

[3] As defined by 785:30-15-2

2.6 Measuring Ground Water Pumped From Water Wells

During this monitoring period, water was not pumped from a ground water well other than for domestic purposes. The ground water well associated with the facility's scale house/office is an exempt well per 82 O.S. §1020.3.

2.7 Measuring Pit Water Discharged to a Stream

During this monitoring period no Pit Water was discharged to a stream or pond; consequently, this section is not applicable.

2.8 Measuring Water Recharged to the Aquifer

During this monitoring period no Pit Water was used to recharge the aquifer for augmentation purposes; consequently, this section is not applicable.

2.9 Precipitation at the Mine Site

Contributing storm values were measured on site with a rain gauge and/or obtained from the Sulphur, OK Mesonet station (per Appendix "C" of OAC 785:30-15 draft dated 2/1/2013) (http://www.mesonet.org). (Other Mesonet sites may be used to better estimate precipitation when applicable or necessary.)

2.10 Evaporation From All Surface Water

During this monitoring period no Pit Water was encountered; consequently, this section is not applicable.

When applicable, evaporation from other surface water ponds and impoundments that receive Pit Water (i.e., groundwater) would be calculated following the guidelines developed by the OWRB (per Appendix C of OAC 785:30-15 draft dated 2/1/2013). The calculation would be similar to that used for the quarry sumps described above.

2.11 Water Obtained from Other Sources

During this monitoring period, BCM did not obtain water from other sources. However, BCM reserves the right to pursue and obtain water from any and all legally permissible sources.

3.0 RESULTS & DISCUSSION

Results of the quarterly monitoring effort are summarized below.

3.1 Diverted Quarry Sump Water Volumes

As mention above, there were two (2) sumps in use during this quarter—North & South. The total volume diverted was calculated in millions of gallons (MG) and acre-feet (ac-ft) from facility pumping records. The monthly amounts diverted from the sumps is listed in Table 3-1.

Table 3-1: North & South Sump Diversion Summary

1st Quarter		SUMP DIVERSIONS	
2013		North & South Totals	
		Monthly Total	Monthly Total
January		3.036	0.989
February		4.748	1.547
March		4.161	1.356
April		0.000	0.000
May		0.000	0.000
June		0.000	0.000
July		0.000	0.000
August		0.000	0.000
September		0.000	0.000
October		0.000	0.000
November		0.000	0.000
December		0.000	0.000
TOTALS		11.95	3.892
		ac-ft	MG

3.2 Quarry Sump Water Component Volumes

A. **Evaporation Component**: The volume of Quarry Sump Water lost via evaporation was estimated using Mesonet data. Lake evaporation was calculated by multiplying the Mesonet pan evaporation by 0.7. Evaporation was calculated for both sumps and listed in Table 3-2.

Table 3-2: Sump Evaporation Summary

1st Quarter 2013		SUMP EVAPORATION	
	Lake Evap	North & South Sumps	
		Monthly Total	Monthly Total
January	1.76	0.058	0.019
February	2.35	0.077	0.025
March	4.10	0.134	0.044
April		0.000	0.000
May		0.000	0.000
June		0.000	0.000
July		0.000	0.000
August		0.000	0.000
September		0.000	0.000
October		0.000	0.000
November		0.000	0.000
December		0.000	0.000
TOTALS	8.21	0.27	0.088
	inches	ac-ft	MG

B. **Surface Water Runoff Volumes**: Rainfall data was entered into the equation and the surface water fraction of the Quarry Sump Water was estimated by calculating runoff using the SCS model as described above. Resulting runoff is reported in Table 3-3.

C. **Direct Interception (Precipitation) Volume:** Direct interception was calculated by multiplying the rainfall depth by the sump surface area and converting to MG and ac-ft. Storm water runoff and direct interception are summarized Table 3-3.

Table 3-3: Surface Water Runoff and Direct Interception Volume Summary

1st Quarter		SURFACE WATER RUNOFF & INTERCEPTION	
2013	Precip	Quarry Area Watershed plus North & South Sumps	
		Monthly Total	Monthly Total
January	1.75	4.151	1.353
February	4.13	14.353	4.677
March	0.40	0.506	0.165
April		0.000	0.000
May		0.000	0.000
June		0.000	0.000
July		0.000	0.000
August		0.000	0.000
September		0.000	0.000
October		0.000	0.000
November		0.000	0.000
December		0.000	0.000
TOTALS	6.28	19.01	6.194
	Inches	ac-ft	MG

D. **Pit Water Volume**: As presented above, the Pit Water[4] fraction of the Quarry Sump Water is determined by subtracting the sum of sump evaporation plus sump diversion from the sum of direct interception plus surface water runoff. (Refer to Table 3-4 and Equation 3-1.) If the net balance is positive then more storm water entered the sumps than was evaporated and/or pumped out. If the balance is negative, then more water was evaporated and/or pumped out than entered via storm water. A negative value may indicate ground water inflows. Refer to Table 3-4.

Equation 3-1: Pit Water Volume Determination:

$$(\text{Interception} + \text{Runoff}) - (\text{Sump Evaporation} + \text{Sump Diversion}) = \text{Pit Water Volume}$$

Where: A negative value ≈ Possible Pit Water Contribution
A positive value ≈ Runoff/No-Pit Water Contribution

During this reporting period, there was a ~2.2 MG or ~6.8 ac-ft net positive Quarry Sump Water balance, which strongly indicates that the Quarry Sump Water originates solely from storm water and

[4] As defined by 785:30-15-2

there is no Pit Water contribution. In other words, there was no indication of Pit Water usage (i.e., ground water) during this quarter. The negative value observed during March was due to limited rainfall during that month and additional pumping required to account for the 3.1 MG of storm water inflow in February. Roughly 57% of the rainfall occurred in the last week or so of February. This water had to be pumped out in March; consequently, there was more pumping in March than surface water inflow. It is anticipated that over the next several reporting periods the water balance will further confirm that the Quarry Sump Water is comprised of storm water and not ground water.

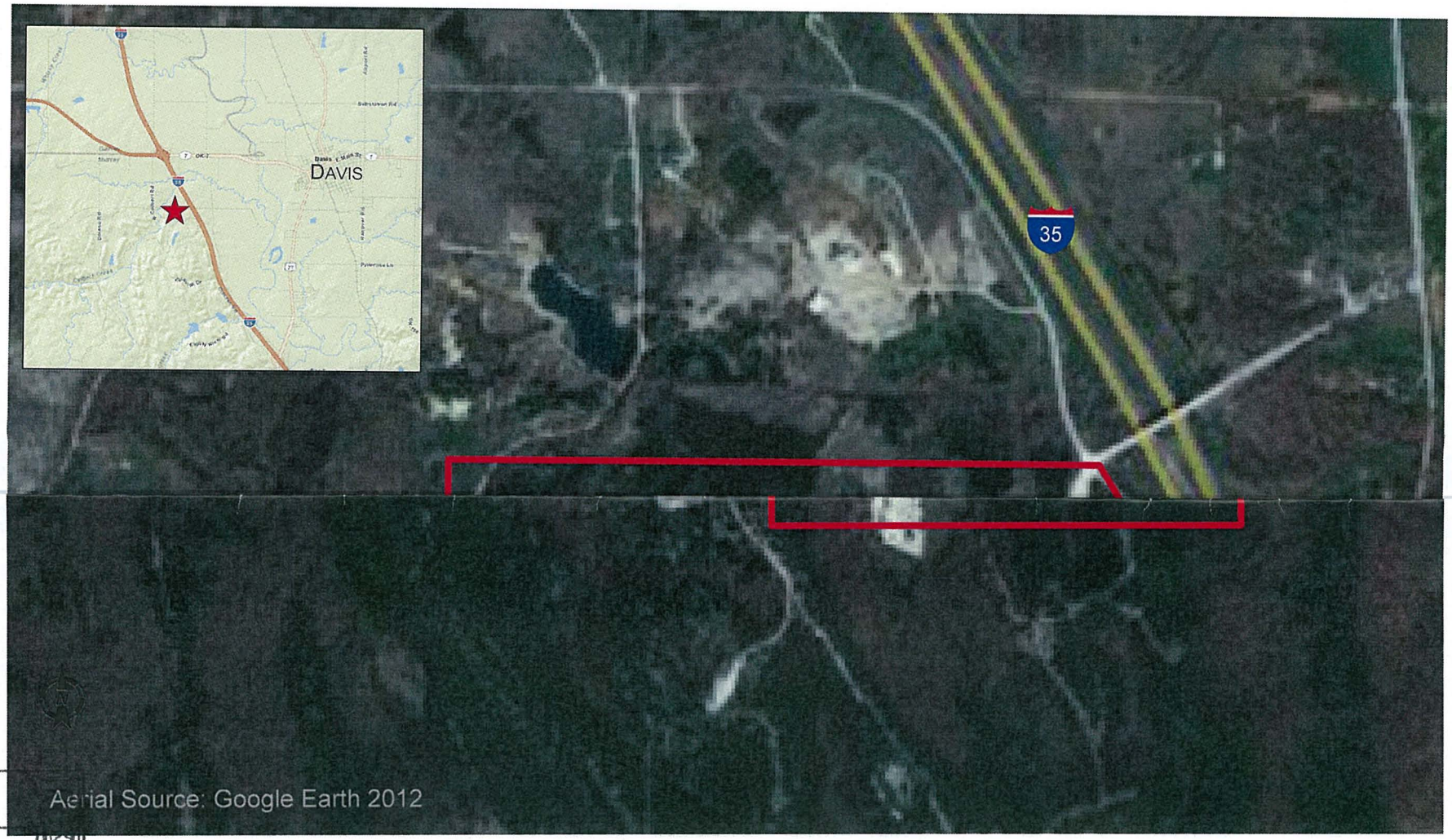
Table 3-4: Pit Water Calculation Summary

1st Quarter		PIT WATER CALCULATION - NET BALANCE SUMMARY				
2013		Interception & Runoff	Sump Evaporation	Sump Diversion	Balance	
					Monthly Total	Monthly Total
January		1.353	0.019	0.989	1.058	0.345
February		4.677	0.025	1.547	9.528	3.105
March		0.165	0.044	1.356	-3.789	-1.235
April					0.000	0.000
May					0.000	0.000
June					0.000	0.000
July					0.000	0.000
August					0.000	0.000
September					0.000	0.000
October					0.000	0.000
November					0.000	0.000
December					0.000	0.000
TOTALS		6.194	0.088	3.892	6.796	2.214
		MG	MG	MG	ac-ft	MG

3.3 Reporting Consumptive Use of Pit Water

Evaluation of the Quarry Sump Water disposition indicated that there was no Pit Water present; therefore, no ground water was consumptively used during this quarter.

4.0 FIGURES



Process Water

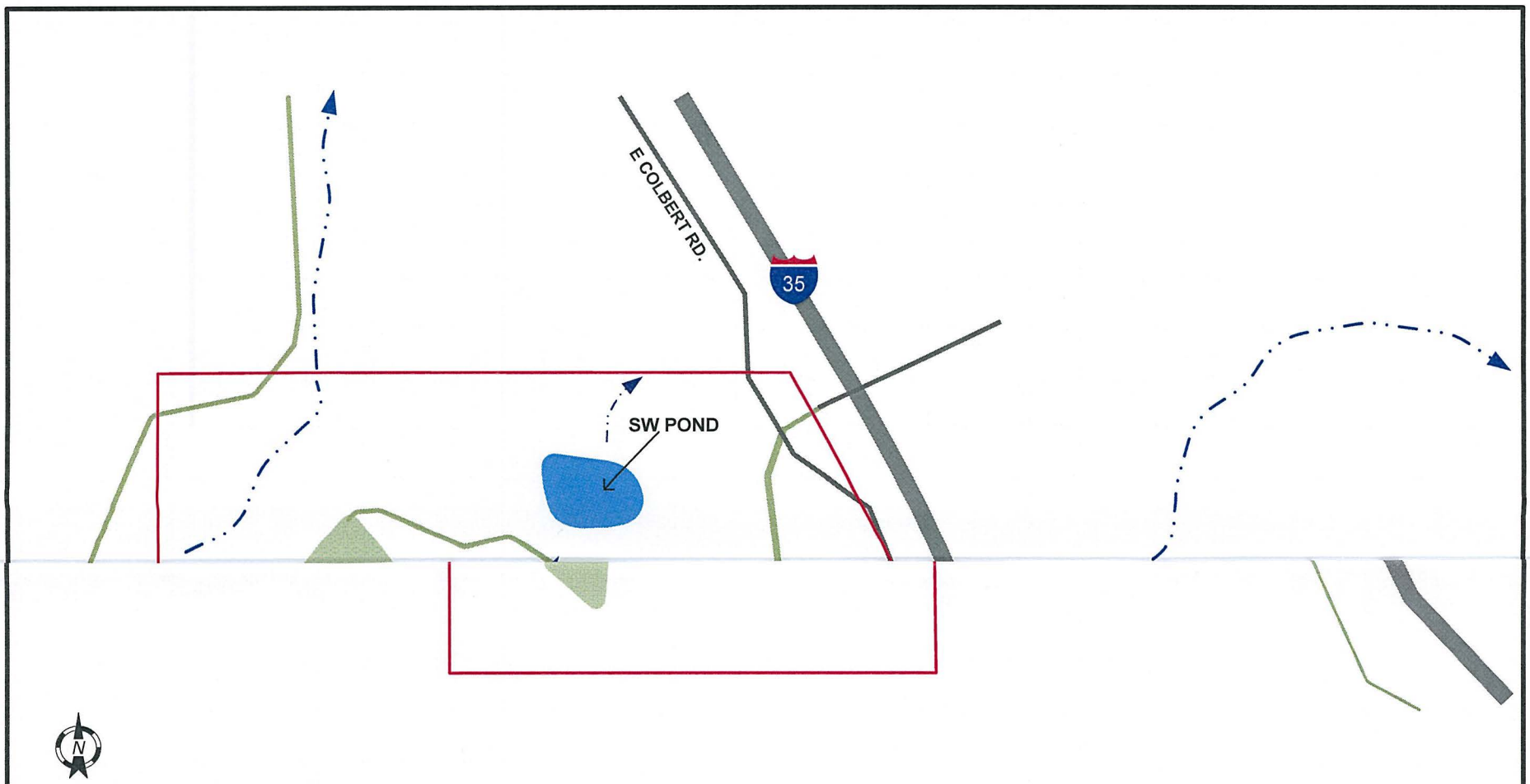
QWMP Aerial Site Diagram
Davis Quarry

BORAL

Figure
1

Note: The diagram is partially diagrammatic; exact dimension will vary from those shown above. Not to scale.

AJC/DDS	06/13/2013	FINAL	Environmental



COMMENTS

Facility Boundary (approx)

Process Water Flow

Storm Water Flow

Potential Flow Path

Quarry Sump Water Flow

Tank Battery TB

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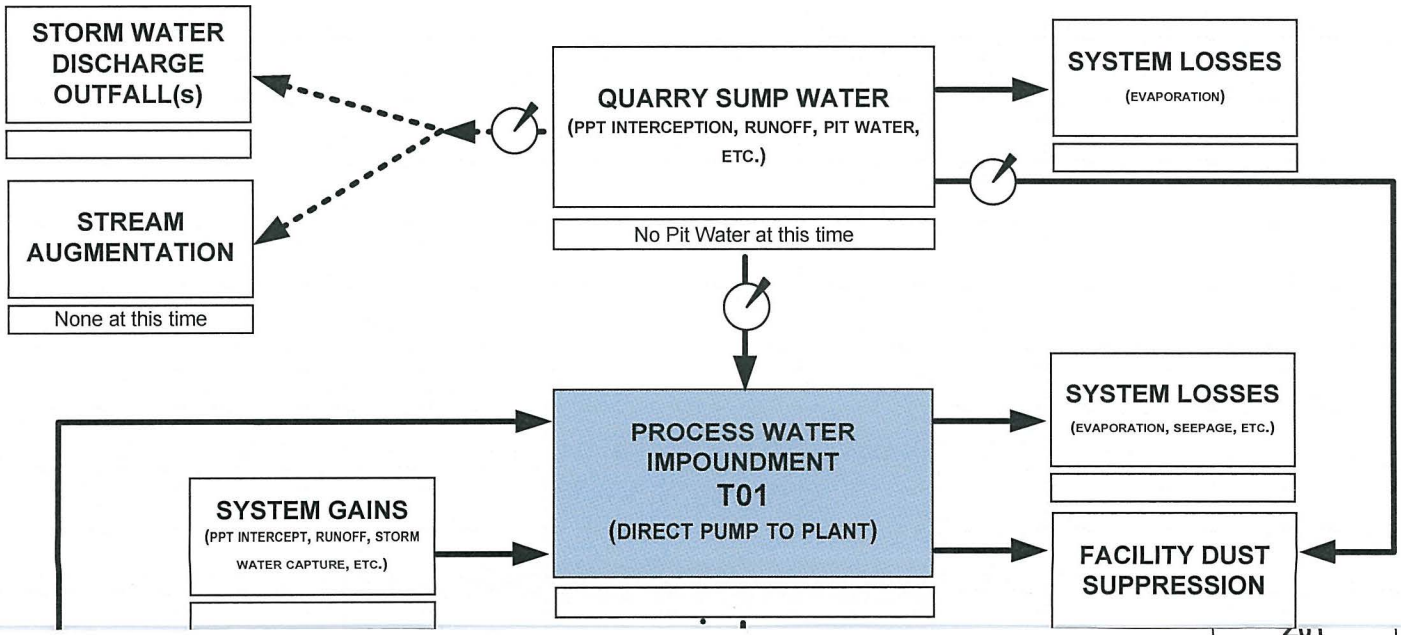
QWMP Site Diagram
1st Quarter 2013

Davis Quarry
Murray County, OK
Boral Construction Materials of Oklahoma, LLC

AJC/DDS	06/13/2013	FINAL	Environmental

Figure 2



COMMENTS

- POTENTIAL FLOW PATH
- TYPICAL FLOW PATH
- PUMP

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QWMP Water Paths/Flow Schematic

1st Quarter 2013

Davis Quarry
Murray County, OK
Boral Construction Materials of Oklahoma, LLC

AJC/DDS	06/13/2013	**FINAL**	C Environmental

Figure 3