

Prepared for
Omya Inc.
Florence, Vermont

MAY 2009 MONITORING REPORT

**OMYA VERPOL FACILITY
FLORENCE, VERMONT**

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1. INTRODUCTION

1.1 Site Description

The Omya Verpol Plant (the Site) is located in an industrial zone of Florence, Town of Pittsford, Rutland County, Vermont, on approximately 385 acres. The Omya Facility produces fine ground calcium carbonate (GCC) from marble ore. The ground ore is processed to remove natural mineral impurities by a flotation process using water, air, and organic flotation agents. Tailings generated from flotation consist of mineral impurities, calcium carbonate, flotation agent chemicals, and potentially trace amounts of other chemicals introduced through recycled process water. The tailings, initially about 90% water, were historically pumped to on-site settling cells for primary dewatering. Tailings were then transferred by truck to the Kane & Drake Quarry for additional dewatering and then transferred by truck to the Dolomite Quarry for final dewatering. The Loveland (aka Dog Leg) Quarry was used for tailings management from 1979 to 2005 but does not currently receive tailings. On-site roads were also historically used to transport the progressively dewatered tailings to the Kane & Drake and Dolomite Tailings Management Areas (TMAs). The settling cells and TMAs are depicted in Figure 1.

Since January 2009, Omya began commissioning a new mechanical tailings dewatering facility (TDF) that reduces the tailings moisture content to approximately 10% with subsequent reductions in the total volume of tailings slurry produced. These drier tailings are currently trucked directly to the Kane and Drake or Dolomite TMAs. Future plans include the construction of lined cells on top of the current TMAs for storage and containment of the drier tailings. Details are found in the application for full certification of these lined landfills, submitted to the Vermont Department of Environmental Conservation (VTDEC) in May 2009.

1.2 Monitoring Plan Strategy and Regulatory Requirements

Groundwater quality in and around the Verpol Plant is monitored using a series of groundwater monitoring wells, residential wells, a municipal well and surface water monitoring locations. The VTDEC requires semi-annual sampling (May and October) of on-site and off-site groundwater and surface water. The monitoring plan, under which these results are reported, incorporates VTDEC requirements.

The initial monitoring plan for the Site was submitted on June 29, 2005. A revised plan was submitted June 15, 2006, in response to VTDEC comments throughout the intervening year. The plan was then supplemented with a re-sampling plan dated September 19, 2006. VTDEC comments of January 16, 2007 were incorporated into a revised monitoring plan dated February 20, 2007. Additional VTDEC comments dated March 27, 2007 were incorporated into a revision of the monitoring plan dated April 18, 2007. Heindel and Noyes, Inc. of Burlington, VT authored all monitoring plans through 2007. The current Monitoring Plan (Geosyntec, 2008) was authored by Geosyntec. The current plan incorporates the original monitoring plan,

modified as discussed above, and results and recommendations presented in the Final Integrated Report for the Section 5 Study¹ (Cambridge Environmental and Geosyntec, 2008). Comment requests contained in VTDEC letters to Omya dated January 28, February 15, and March 13, 2008, and recent discussions among the Section 5 Consultants, Omya, and the VTDEC are also incorporated.

Under the current plan, there are two primary (biannual) monitoring events per year (May and October) and two additional quarterly events in August and January focused on surface water sampling. The May 2009 monitoring event represents the third biannual monitoring event since completion of the Section 5 study. Biannual monitoring locations include 24 on-site monitoring wells, three off-site monitoring wells, four off-site residential wells, and one off-site municipal well. Surface water samples include nine on-site locations, three off-site locations, and three locations from the Hogback Quarry north of the site. The plan calls for samples to be analyzed for compounds known to be associated with Omya operations. Additionally, the plan includes collection of a composite sample of tailings solids once per year from one of the settling cells (prior to dredging) and testing of this sample for similar compounds. As of May 2009 an approved method of analyzing tailings solids for flotation agent chemicals has not been developed. Alpha Woods Hole Labs (AWHL) of Mansfield, Massachusetts, and TestAmerica Laboratories, Inc. (TA) (formerly Severn Trent Laboratories) in North Canton, Ohio, and West Sacramento, California performed the laboratory analyses for the May 2009 samples. Analytical results have been reported to the Town of Pittsford, participating off-site well owners, and the VTDEC.

1.3 Contingency Plan

The monitoring program for the Site incorporates a contingency plan based on specified thresholds for drinking water and non-drinking water. These thresholds include specified locations and concentrations of certain chemicals that if detected would trigger additional reporting and monitoring requirements. Details of the contingency plan are found in the Omya Site Monitoring Plan dated March 2008 (Geosyntec, 2008). Although no new contingency plan thresholds were triggered by the May 2009 data, the following results are noted as requiring further monitoring:

- Arsenic was detected at Well V at 10.0 ppb in both May 2009 and in the previous sampling round in October 2008. Prior to October 2008, Well V was sampled once for arsenic, with a result of less than 5.0 ppb. Although this result does not trigger any contingencies under the plan, further monitoring will continue at this location.
- TOHI was analyzed for the fourth time at the Tailings Settling Cell supernatant in May 2009 and it was detected at 2940 ppb. TOHI was previously detected in a sample from

¹ The Section 5 Study was an independent evaluation of the human health and ecological risk posed by Omya's Operations in Florence, Vermont (www.omyainvermont.org). The final report of the Section 5 Study included recommendations for continuation of the existing site monitoring plan with modifications.

that location at 4930 ppb in December 2008, at 3400 ppb in October 2008, and at 2100 ppb in May of 2008. The Vermont Health Advisory for TOHI in drinking water is 126 ppb² and the Preventive Action Level (PAL) is 63 ppb. Continued monitoring of Settling Cell supernatant is planned until such time as the Settling Cells are closed and removed from the tailings dewatering process as proposed in the application for Full Certification.³

1.4 Monitoring Report Organization

The Monitoring Report is organized as follows:

- Section 1 presents a Site description and project background;
- Section 2 describes the sampling program and field procedures used for:
 - groundwater elevation monitoring;
 - groundwater and surface water sampling (monitoring wells, residential drinking water wells, quarries, and springs);
- Section 3 describes hydrogeology results;
- Section 4 presents the Pittsford Italian Quarry (PIQ) water balance;
- Section 5 presents analytical results for groundwater and surface water;
- Section 6 presents a summary of AEEA and arsenic fate and transport;
- Section 7 presents a data usability assessment; and
- Section 8 lists references.

2. FIELD ACTIVITIES AND PROCEDURES

This section describes field activities and procedures for the May 2009 monitoring event, including groundwater elevation monitoring and groundwater and surface water sampling. A monitoring well inventory is shown in Table 1.

2.1 Groundwater Elevation Monitoring

Prior to initiation of groundwater sampling, synoptic (within a four-hour time span) water level measurements were made at all site monitoring wells and the PIQ and Johnson Quarries. Depth

² A November 20, 2007 Draft Memorandum from Sarah Armstrong and Laura Green (Cambridge Environmental) to William Bress (VT Dep't of Health) recommended that the Vermont Health Advisory of 126 ppb for TOHI in drinking water be raised to 30,000 ppb (Cambridge Environmental and Geosyntec, 2008, Appendix C6).

³ Since the last monitoring report, Omya has started to operate the TDF and has not used the tailings settling cells for wet tailings since approximately the beginning of 2009.

to water measurements and calculated groundwater elevations are presented in Table 2 and discussed in Section 3.2.

2.2 Groundwater and Surface Water Sampling and Analysis

Samples collected for the May 2009 sampling round are listed in Table 3. An exploration location plan is presented as Figure 1.

2.2.1 Groundwater Sampling

Groundwater samples were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), total and dissolved arsenic, iron and manganese, ferrous iron, cations, and anions, petroleum hydrocarbons and flotation agent compounds.

As documented in Table 3, samples collected in May 2009 were analyzed by the following United States Environmental Protection Agency (EPA) and other analytical methods:

- Volatile Organic Compounds (VOCs) by EPA Method 8260B/524.2;
- Semi Volatile Organic Compounds (SVOCs) by EPA Method 8270C;
- Total Petroleum Products by EPA Method 8015;
- Arsenic, iron, and manganese by EPA Methods 6010/6020;
- Perchlorate by EPA Method 332.0;
- Anions (sulfate, nitrate/nitrite, bicarbonate) by EPA Method 300.0; Flotation Agent (FA) (tall oil hydroxyethyl imidazoline (TOHI), DT (Duomeen T or amine acetate), aminoethylethanolamine (AEEA), and Tall Oil Amino Amine (TAA)) by HPLC/MS/MS (High Pressure Liquid Chromatography/tandem Mass Spectroscopy) (TestAmerica, Sacramento, CA); and
- Ferrous iron (Hach Method 8146).

Analyses for metals were conducted at Test America Labs in West Canton, Ohio because this laboratory has an Inductively-Coupled Plasma Mass Spectrometer (ICP-MS) with a collision cell attachment. The collision cell breaks up argon-chloride complexes, which can lead to a high bias in arsenic quantification. Further discussion of this issue was presented in the May and October 2008 Monitoring Reports⁴. Arsenic analysis by the hydride generation method was not conducted during the May 2009 sampling round.

⁴ The ICP-MS used in previous rounds did not have a collision cell. When analyzing samples by ICP-MS, argon gas is used. Argon has an atomic mass of 39.9. Argon can combine with chloride (atomic mass = 35.4) in the samples to form argon-chloride molecules. With a mass of 75.3, the argon-chloride molecule has nearly the same mass as arsenic (74.9) and can result in false positives and a high bias for arsenic on some ICP-MS instruments. EPA Method 7062 (hydride generation) does not use argon in the Method and is not subject to interference and false positives due to argon chloride formation. In previous rounds, samples which had elevated arsenic results by ICP-MS were also analyzed by hydride generation.

Groundwater samples were collected from monitoring wells following the standard operating procedure (SOP) for low flow sampling (based on EPA/540/S-95/504) contained in Appendix B of the 2008 Site Monitoring Plan (Geosyntec, 2008). Groundwater samples were collected from open bedrock wells:

- at the depth believed to represent the shallowest producing fracture zone; or
- near the TMAs, at the shallowest producing fracture zone that is at an elevation at or beneath the assumed base elevation of the TMAs; or
- if contaminants have been detected historically, from the zone that previously contained the highest concentration of contaminants.

Target sample depths for Wells A, C, C-2, G, H, and I were taken from the 2006 Omya Monitoring Plan (Heindel and Noyes, 2006a) and were based on drilling observations and borehole video data. Target sample depths for wells D, E, and F were determined based on fracture yield as identified in the Site Characterization Report (Heindel and Noyes, 2006b). Target sample depths for Wells J, K, L, M, and N were taken from the Section 5 Study and were based on borehole geophysical data. Target sample depths for Well B and Well #2 were based on borehole geophysical data and past sampling results. Sample depths for new wells J1, Q, R, S, T, U, and V were based on observations made during drilling. Sample depths are listed in Table 3.

Equipment for low-flow purging and sampling included a variable speed, stainless-steel submersible QED ST1102PM™ Bladder pump or Grundfos™ Redi-Flow 2; LaMotte 2020 turbidity meter; polyethylene tubing; and a YSI 6820™ multi-parameter meter with flow-through cell for measuring water quality parameters. Sample tubing from the Section 5 Study in 2007 and the May 2008 sampling event was carefully labeled, bagged, and sealed for future use. This tubing, when found to be in good condition, was reused in May 2009 at the same locations where used in previous sampling rounds. For new wells and wells without existing sample tubing, new sample tubing was used. Following the sampling of each well, the tubing was rolled up, labeled with the well identification, placed in individual clean bags, and labeled for possible use in subsequent sampling rounds.

The purge rate during low flow sampling was limited to avoid excessive drawdown in the well (< 0.3 ft) and to draw formation water horizontally from the target depth into the pump. Typical flow rates were between 0.1 and 0.5 L/min, and were adjusted based on continuous monitoring of drawdown.

Low flow sampling was conducted at all wells except Well 5, Well I, and Well R. Well 5 is a former supply well and is sampled by turning on the down-hole submersible pump and collecting water from a sample port in the discharge line at ground surface. At most monitoring wells, a Grundfos submersible pump was used for low flow sampling. For monitoring Wells L-1, 96-1, T, and V, which had target-sampling depths of 248 ft, 269 ft, 315ft, and 310ft, respectively, a QED bladder pump was used. The target sampling depth of Well G was 361 ft, but due to

blockage in the well, a Grundfos pump was positioned at approximately 250 ft (similar to previous sampling rounds).

Due to poor yields, low flow sampling is not possible at Well I and Well R. Instead, these wells have historically been purged and allowed to recover for the weeklong sampling period prior to sampling. At Well R, the water level recovers over this period to allow a grab sample to be collected from the target depth of 95 ft. At Well I, the water does not recover to pre-evacuation levels after purging. For the May 2009 sampling event, Well I was sampled using a HydraSleeve™. This device is a collapsed 4-mil polyethylene bag that is lowered to the target depth of 361 ft. When withdrawn, the bag opens, pulling a "core" of water from the discrete interval in the well.

Wells sampled by the low flow method were purged until measured water quality parameters (temperature, pH, specific conductance, ORP, dissolved oxygen, and turbidity) were stable. Water quality parameters were recorded every five minutes and considered stable when three consecutive readings were within percentage requirements presented in the SOP for low flow sampling (Appendix B of Monitoring Plan). Low flow geochemical parameter data are presented in Table 4. Low flow field forms are presented in Appendix A.

Groundwater samples were collected into certified pre-cleaned, pre-preserved bottles from the tubing upstream of the flow-through cell. Samples were collected in the following order: VOCs, SVOCs, other organic compounds, inorganics, and, lastly, wet chemistry parameters. Filtered samples, where specified, were collected through a 0.45 µm filter for dissolved metals by ICP-MS and a 0.2 µm filter for perchlorate analysis.

All field meters were calibrated at the start of each day. The calibration was checked (and corrected, if necessary) if any anomalous measurements were observed, and, at a minimum, at the end of each day. All pumps were decontaminated after each use.

2.2.2 Surface Water Sampling

Fifteen surface water samples were collected from on-site and off-site locations including the Hogback Quarry. Three surface water samples were collected for total and dissolved iron, manganese, arsenic. Nine samples were collected for SVOCs, two for VOCs, three for perchlorate and nitrate, and eleven for flotation agent compounds. Sample locations are presented in Table 3. Samples were collected by filling a new glass amber 500 mL bottle and pouring the collected water into certified pre-cleaned, pre-preserved containers. To sample for dissolved metals, water was collected into a 1 mL plastic squeeze bottle. A 45 µm filter was screwed into a pre-drilled hole in the cap of the bottle. Water was then squeezed from the 1 mL bottle through the filter into certified pre-cleaned containers. The sampler stood downstream (where applicable) from the location at all times.

The sample taken from the Settling Cell in May 2009 was collected from the West Settling Cell from the weir/conveyance system that returns supernatant water directly back to the West Plant. The sample from the Dolomite TMA was collected from the northeastern portion of the TMA

where accessible supernatant was available. The sample from the Kane & Drake (K&D) TMA was taken from the northeastern portion of the TMA where accessible supernatant collects.

2.2.3 Off-Site Residential and Municipal Well Sampling

Samples were collected from three residential wells and the Florence Municipal well. The list of off-Site drinking water wells sampled is presented in Table 3 and locations are shown on Figure 1. The LaFlamme well was listed as an off-site residential well to be sampled in May 2009, however, the residents at this location could not be contacted either by phone or in person, and the well was not sampled.

Samples were collected from taps located upstream from any water treatment systems, such as filters or water softener or disinfecting chemical additions at the Florence Municipal Well. Prior to sampling, aerator screens were removed from faucets. The faucet was disinfected with isopropanol, heated with a flame, and purged of any stagnant water by flushing for 15 minutes. Samples were collected in certified pre-cleaned, pre-preserved containers by placing each container directly under the faucet. No field parameters were measured during sampling of the wells in this group.

2.2.4 Analytical methods for flotation agent constituents

As discussed in the Section 5 Study, high performance liquid chromatography/tandem mass spectrometer (HPLC/MS/MS) methods (developed by Test America of Sacramento, CA) have been used to detect and quantify individual components of FA since the Fall of 2006.

The HPLC/MS/MS method provides results for three chemicals that are components of the flotation reagent manufactured as IC-912M: tall oil hydroxyethyl imidazoline (IM, also known as TOHI), aminoethylethanolamine (AEEA) and amine acetate (AA) also referred to as the trade name Duomeen-T (DT). IC-912M, like Custamine 51G, was developed by Akzo Nobel as a low-AEEA alternative to Custamine 51D. These low-AEEA alternative reagents have been in use at Verpol since November 2007. IC-912M contains about 91.9% TOHI, 7.5% AA, and < 0.6% AEEA. The imidazoline ring portion of TOHI can open up to the straight chain compound tall oil amido amine (TAA); TAA is also a target analyte for the HPLC/MS/MS method.

TOHI and AEEA are the only flotation agent constituents that have been detected by the HPLC/MS/MS method at the Verpol Site. The Method Detection Limit (MDL) and Method Reporting Limit (MRL)⁵ used by Test America for AEEA are currently 2 and 50 parts per billion (ppb or µg/L), respectively. As during the Section 5 Study, we have identified a low bias in the reported results due to incomplete recovery of AEEA from the sample matrix. Therefore, the

⁵ The MDL is the lowest concentration that can be detected within a stated confidence limit for the method employed. The MRL is the lowest concentration reported on the sample-analysis data report. Instrument reported values between the MDL and MRL are "J" qualified (J=Judgment), which means that professional judgment was used to estimate a concentration from a result that was too small to be quantified reliably, but that clearly indicated a detection.

results discussed below and summarized in Sections 5.1.1 and 5.3.1.1 reflect our estimates of the actual concentration of AEEA in the samples.

Our estimates were developed as follows:

- Chromatograms from both mass spectrometers were reviewed to determine if peaks identified as AEEA had a sufficient signal-to-noise ratio to be indicative of a true detection of AEEA.
- This initial estimate of AEEA concentration was adjusted upward to account for the incomplete recovery of AEEA from a spiked sample matrix.
- The adjustment factor was derived from the average recovery of the Matrix Spike and Matrix Spike Duplicate, if a duplicate was analyzed, or the recovery of the matrix spike alone if no duplicate was analyzed.
- For example, if the reported concentration of a non-detect was 10 ppb, and the average matrix spike recovery was 50%, the corrected concentration was calculated as:

$$10 \text{ ppb} / 0.5 = 20 \text{ ppb}$$

- Results were not adjusted for reported AEEA concentrations greater than 1,000 µg/L.

It should be noted that this adjustment is not considered standard practice by analytical laboratories and the adjusted value represents an estimate of the actual AEEA concentration. The upward adjustments to AEEA concentrations below 1000 ppb were made to present conservative values for AEEA in groundwater and surface water, and provide consistency with previously reported AEEA results.

2.3 Tailings Solids Sampling

The LCMS method for the analysis of flotation agent chemicals in solids was not yet available at the time of the May 2009 monitoring event.

2.4 Equipment Decontamination

Water level measuring devices, and groundwater and surface water sampling equipment were decontaminated between locations using a mixture of phosphate free soap and water followed by a rinse with distilled water. Decontamination procedures were carried out at the East Plant truck load-out containment area.

2.5 Water Balance

As described in the May 2008 Monitoring Report, three new monitoring wells were installed near the PIQ to improve our understanding of hydraulic gradients in this area as part of enhancements to the PIQ water balance.

Since May 2008, the following additional tasks have been conducted:

- Installation of pressure transducers in Wells A, Q, R and S to provide continuous water level monitoring;
- Installation of a permanent circular recording weir on the stormwater discharge to the PIQ to provide a continuous accurate record of inflows to the PIQ from the northern TMA areas;
- Continued monitoring of inflows and outflows from the PIQ including water pumped to the PIQ from the Johnson Quarries and the West Stormwater Settling Basin, and water pumped from the PIQ to the West Plant; and
- Water level measurements in the Johnson Quarry and PIQ to evaluate changes in water storage.

Results of this monitoring are discussed in Section 4.

3. HYDROGEOLOGY

3.1 Bedrock geology

No new bedrock wells were drilled during the May 2009 Monitoring Event and thus no updates to bedrock geology are presented.

3.2 Groundwater Gradients

Groundwater elevation data measured in site monitoring wells and in surface water were used to construct an updated groundwater elevation contour plan (Figure 2). This plan indicates generally similar hydraulic gradients as depicted in the May and October 2008 groundwater elevation contour plans. Depth to groundwater and groundwater elevation data are presented in Table 2.

As presented in previous reports, hydraulic gradients converge from the west and east toward the center of the Site both in the upgradient areas around the TMAs (toward Well 2 and Well J and karst zones) and to a lesser extent in downgradient areas of the Site (toward Well 96-2). As with previous measurements in the TMA areas, the water level at Well P (west of the K&D) was approximately 25 ft higher than at Well B and 65 feet higher than Well 2, which are both to the east and cross-gradient of the K&D TMA. The water level at Wells G and H on the eastern side of the Dolomite Quarry are also approximately 25 ft higher than Wells J and 2 in the center of the Site.

The May 2009 water elevation data represent the third round of data since the new wells (Wells Q, R, and S) were installed near the PIQ in April 2008. Water levels in the PIQ and Johnson Quarries are lower than the water levels in all the surrounding wells, indicating that the PIQ is a likely sink for groundwater. As discussed in Section 4, the water level in the PIQ is typically

lower than the groundwater levels in surrounding wells due to pumping from the PIQ for plant process water. Downgradient of the PIQ, hydraulic gradients are generally oriented northwest toward Whipple Hollow Road.

Groundwater elevation data from the monitoring network, including new wells T, U and V, indicate that hydraulic gradients at and beyond the northwest corner of the site are oriented northwestward across Whipple Hollow Road. Hydraulic gradients in the northeast corner of the Site (near Well D) suggest some potential for flow to the northeast. These data indicate that bedrock groundwater migrates generally toward the unnamed tributary to Smith Pond and Smith Pond area.

4. PIQ WATER BALANCE

The PIQ water balance was initially conducted in 2007 during the Section 5 study to estimate if water within the PIQ may be a source of groundwater recharge (water from the PIQ migrates to groundwater). The impetus for this assessment was based on the observance of 200 ppb of AEEA in the PIQ in 2007 and the desire to understand the fate of this AEEA-impacted water. The need for this assessment has become less critical as concentrations of AEEA in the PIQ have dropped significantly, with only one low level detections (5 ppb) since August 2008.

The PIQ water balance was conducted by measuring water inputs and outputs and evaluating if on balance the PIQ is a discharge point for groundwater (groundwater discharges to the PIQ) due to pumping from the PIQ for process use, or if stormwater diversion to the PIQ causes it to be a local mounding feature that results in groundwater recharge.

Possible *inputs* to the PIQ include: stormwater runoff, pumpage, from the Johnson Quarry, West Basin, and the water system at the Verpol Plant, direct rainfall, and groundwater inflow. Possible *outputs* from the PIQ include: withdrawals for process water, water pumped out for stormwater management, evaporation, and groundwater outflow. The difference between total inputs and outputs over any particular timeframe must be equal to the change in water stored in the PIQ over that same timeframe, as reflected by a change in water level in the PIQ. For any particular timeframe:

$$\Delta HA = I + S + GW_{IN} + PI_{JQ} + PI_{WB} + PI_V + PI_{EP} - E - GW_{OUT} - PO_V - PO_{EP} - PO_{EUSB}$$

Where:

ΔHA = change in storage

ΔH = the change in head (water level) in the Quarry,

A = the area of the Quarry

I = direct rainfall into the Quarry

S = stormwater inflow (S1 and S2 from TMA areas)

GW_{IN} = groundwater inflow

PI_{JQ} = pumped inflow from the Johnson Quarry

PI_{WB} = pumped inflow from the West Basin

PI_V	= pumped inflow from the Verpol Plant
PI_{EP}	= pumped inflow from the east plant
E	= evaporation
GW_{OUT}	= groundwater outflow
PO_V	= pumped outflow to the Verpol Plant
PO_{EP}	= Pumped outflow to the East Plant
PO_{EUSB}	= pumped outflow to the EUSB

Groundwater inflow and outflow are very difficult to measure; by measuring the other inputs and outputs, as well as the change in storage, we attempt to estimate the net groundwater exchange rate by difference. If, on average, more water is withdrawn from the PIQ than is collected there, it is a groundwater discharge point. If an excess of water is collected at the PIQ, it is a groundwater recharge point. Water levels in the PIQ should generally be lower than in surrounding groundwater if the former is true, and higher than surrounding groundwater if the latter is true. The converging hydraulic gradients discussed above and depicted in Figure 2 suggest that the PIQ could be a net groundwater discharge point.

Omya has been monitoring input and output flows to and from the PIQ via automated flow monitoring devices. These data are downloaded and analyzed by Geosyntec. Since the last monitoring event, Omya has upgraded the flow sensors through additional equipment installations and calibrations. Rainfall and evaporation are estimated based on local meteorological data.

Groundwater elevation data are collected from monitoring wells surrounding the PIQ and compared to water levels within the PIQ. A plot of groundwater elevations vs. the PIQ surface water elevation is presented as Figure 3. This figure shows that the majority of time, the PIQ level is well below the groundwater elevations both upgradient and downgradient of the PIQ. These data indicate that the PIQ is a net discharge point for groundwater. To confirm this, we have evaluated inputs and outputs as well as the change in storage within the PIQ for a period of 80 days (01 Nov. 2008 to 21 Jan. 2009) and 180 days (01 Nov. 2008 to 21 May 2009). Results show a net average inflow to the PIQ of approximately 4 gpm during the 80 day period and 6 gpm during the 180 day period. These results are consistent with the measured hydraulic gradients between local groundwater and the PIQ. The quantitative PIQ water balance summary is presented on Table 5.

When the water balance was first initiated in 2007 (when AEEA was detected in the PIQ at 200 ppb), there were insufficient water input/output data to quantitatively complete the water balance. Based on the results presented here, there is now good evidence that the vast majority of time the PIQ is a groundwater discharge point and that past AEEA impacted water within the PIQ was pumped back to the West Plant and used as process water rather than discharged to downgradient groundwater.

Analysis of Figure 3 shows that the elevation of the Johnson quarries is always below the PIQ level. The two Johnson Quarries are located between the West Plant and the PIQ. These quarries are each roughly 160 square ft in size, approximately 75 ft apart and are apparently

hydraulically connected. The Johnson Quarries are used to collect stormwater from the central portion of the West Plant (approximately 24 acres). A pump in the southern Johnson Quarry is controlled by level sensors, which turn the pump on at a pre-determined high water level, and off at a pre-determined low water level. The water levels in the Johnson Quarries are always below the local groundwater elevation because the high-level sensor, which activates the pump, is set below the local groundwater level. Although the Johnson Quarries are also a sink for groundwater, this collected groundwater is pumped back to the PIQ. Based on water elevation data from the past three sampling events, there appears to be a groundwater divide between the PIQ and Johnson Quarries as evidenced by a higher water level in Well Q located between the quarries.

5. MONITORING RESULTS

This section describes the current distribution of Verpol-related and other chemicals in groundwater and surface water. Results presented herein are based on the May 2009 sampling of:

- monitoring wells;
- off-site residential wells;
- the off-site Florence Municipal Well;
- on-site and off-site surface water; and
- surface water in the Hogback Quarry.

Analytical results for flotation agent compounds in groundwater and surface water are presented in Table 6. A summary of all May 2009 detects only are presented on Table 7. Historical analytical results for VOCs, SVOCs, metals, petroleum hydrocarbons, perchlorate, and anions for on-site groundwater are presented in Table 8, for off-site groundwater in Table 9, and for surface water in Table 10. Historical perchlorate results for surface water associated with the Hogback Quarry are presented in Table 11. Primary Vermont Groundwater Enforcement Standards (VTGES) and Vermont Preventive Action Levels (PALs) are also presented on the groundwater data tables. PALs are typically set at 50% of the VTGES except for carcinogenic, mutagenic, or teratogenic compounds where the PAL is set at 10% of the VTGES⁶.

The following sections present a discussion of analytical results for monitoring wells, residential wells, surface water on-site and off-site, and Hogback Quarry surface water testing.

⁶ Complete descriptions of the VTGES and PAL standards are contained in Chapter 12 of the Vermont ANR, DEC, Groundwater Protection Rule and Strategy (February 14, 2005).

5.1 Monitoring Wells

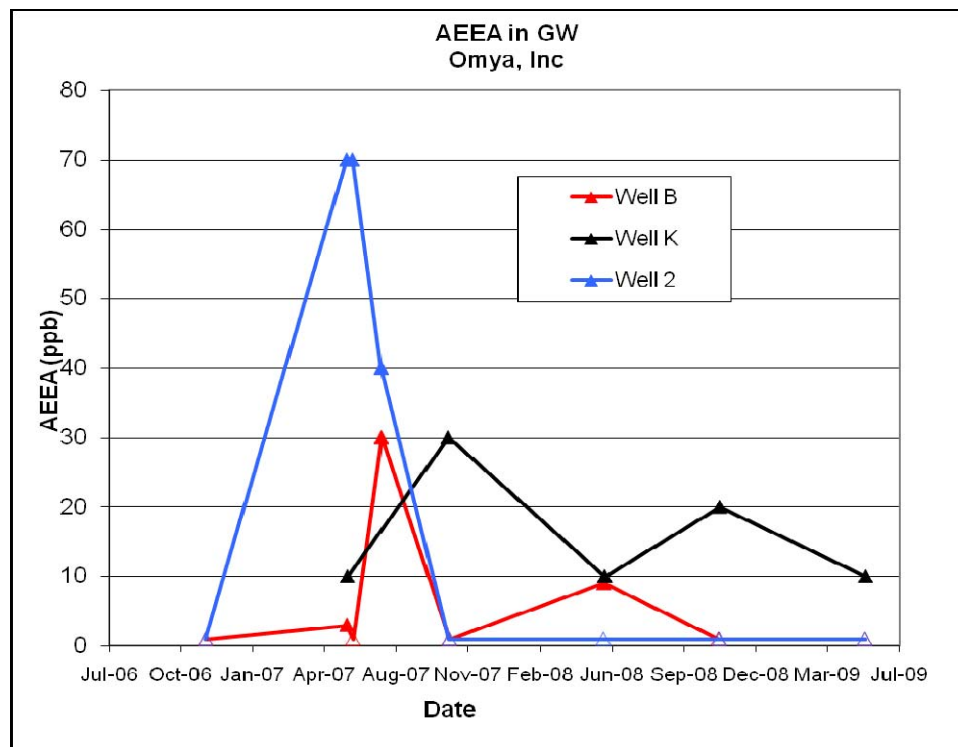
Groundwater samples were collected from 26 monitoring wells including 24 samples from open bedrock boreholes and 2 samples from screened wells. A detailed discussion of the scope and methods for sampling is provided in Section 2.2.1.

5.1.1 Flotation Agent

Analytical results for AEEA and TOHI quantified by the HPLC/MS/MS method are summarized in Table 6. This table shows the initial reported result and the Test America qualifier, the relevant MS and MSD results, our estimate of the actual concentration (rounded to one significant figure), and observational notes for each chromatogram. This table also includes relevant results for samples collected prior to the May 2009 sampling round. Historically, AEEA has been detected at only three groundwater wells: Wells 2, K, and B. Results from May 2009 indicate that of the 24 on-site groundwater wells tested for AEEA in May 2009, only one contained a detectable level of AEEA (i.e. greater than 2 ppb).

Our analysis of the chromatograms determined that AEEA was present in the sample from Well K. After correction for incomplete recovery, AEEA was conservatively estimated to have been detected at 10 ppb at Well K. This result was confirmed with a duplicate sample and is consistent with past estimated results for this well, which vary from 9 to 30 ppb. Well K is located only 50 ft downgradient of the Settling Cells and approximately 2,500 feet from the downgradient end of the Site (Whipple Hollow Road). The Vermont Health Advisory level for AEEA in drinking water is 20 ppb⁷. The graph below presents AEEA results from the three wells where AEEA has been detected historically.

⁷ According to the April 16, 2008 VTDEC Waste Management Division Fact Sheet for Omya's application for Interim Certification of the disposal areas at the Site, the Vermont Department of Health established a Vermont Health Advisory for AEEA of 20 ppb on December 10, 2007.



For multiple depth samples at a location on the same date, the highest detection is plotted. Open symbols represent non-detects at half the 2 ppb detection limit.

Results of groundwater analysis for TOHI indicated no TOHI detects in groundwater in May 2009. Historically, TOHI has been detected only at Well B (max of 64 ppb) and in Well 2 (max of 50 ppb).

Analytical results for AEEA in groundwater are depicted in Figure 4. This figure illustrates that the extent of AEEA in groundwater is limited to the vicinity immediately downgradient of the TMAs. These results are consistent with results from the Section 5 Study, the Fall 2007 monitoring round, and the May and October 2008 monitoring rounds. AEEA was also detected in surface water; these results are presented in Section 5.3.1.1.

5.1.2 VOCs and SVOCs

Analytical results for VOCs and SVOCs in on-site groundwater are summarized in Table 8. The only VOC detected in the May 2009 samples was acetone. Of the 26 on-site groundwater samples analyzed, only one (Well R) contained acetone. Acetone was detected at Well R at 18.1 ppb, well below the PAL (350 ppb) and VTGES (700 ppb). The detection of acetone in groundwater at the Site is consistent with previous findings. Acetone is an intermediate degradation product of isopropanol (IPA) that is found in dispersants used at the Plant. Acetone has been previously detected in both the old and new tailings as well as tailings pore water and Site groundwater. Detection of acetone in some samples may also be related to analytical laboratory contamination.

No SVOCs were detected in groundwater samples collected from the Site in May 2009.

5.1.3 Metals

A complete summary of metals results for on-site groundwater is provided in Table 8. Results are consistent with the findings of the Section 5 Study and previous sampling rounds. Analytical results for these metals in groundwater and surface water are presented on Figures 5 through 7 and discussed further below.

Iron in groundwater at the Verpol Site is elevated relative to background. In the Section 5 Study, background concentrations for dissolved iron were based on samples collected in 2007 from locations upgradient of the Site (Well C-2 and Well I) and from residential wells. At that time, background for dissolved iron was estimated at 400–530 ppb. In May 2009, dissolved iron was measured at upgradient locations Well C-2 and Well I at non-detect (<50 ppb) and 60.6 ppb respectively. Current dissolved iron concentrations within the Verpol Site vary from non-detect (<50 ppb) to 24,100 ppb (Figure 5). As in 2008, the highest dissolved iron concentration was detected in the groundwater sample collected from Well B at 25,000 ppb (Well B duplicate).

Manganese is elevated relative to background in some locations within the Verpol Site. While background manganese in bedrock groundwater varies from 1.6 ppb (“J” qualified) to 12.3 ppb (Well C-2 and Well I respectively), manganese concentrations within the Verpol Site vary from non-detect (<1 ppb) to 3,230 ppb in Well B (Figure 6). Although manganese is not as uniformly distributed as iron, all of the elevated results occur within areas exhibiting elevated dissolved iron.

All historical and current arsenic results are summarized in Table 12. All groundwater samples collected in May 2009 for arsenic were analyzed using EPA method 6020 with the use of a collision cell to eliminate false positives from chloride interference.

Arsenic results presented on Figure 7 represent the highest (total or dissolved) value at each location. These results indicate that several samples from within the Verpol Site exceed local background. While arsenic measured in groundwater samples from upgradient locations Well C-2 and Well I were 1.5 ppb (“B” qualified) and 0.7 ppb (“B” qualified) respectively, arsenic concentrations within the Verpol Site vary from non-detect (<0.5 ppb) to 16.6 ppb at Well B. Arsenic is present above or equal to the VTGES standard of 10 ppb at Well B (16.6 ppb), Well E (11 ppb), and Well V (10.0 ppb). Results for these wells are consistent with previous results. Well B is located beneath the Kane and Drake TMA, Wells E is located at the northeast corner of the property and Well V is located just north of Whipple Hollow Road. Historically, other locations (Well K, Well 2, and Well S) have had arsenic detects above 10.0 ppb.

Further discussion of arsenic fate and transport is presented in Section 6.2

5.1.4 Perchlorate

Previous analysis of Site groundwater for perchlorate indicated sporadic low level detections with no evidence of increases over time. In accordance with State Approval, analysis of Site groundwater for perchlorate was not included in the Monitoring Plan for the May 2009 sampling

round. A detailed discussion of perchlorate distribution and transport is found in the Section 5 Phase II report.

5.1.5 Other Compounds

Several inorganic parameters (total organic carbon (TOC), alkalinity, chloride, sulfate, and phosphate) were analyzed in five selected locations (Wells A, E, K, S, U, and V) to augment the existing site geochemical data with respect to understanding the occurrence of elevated arsenic in groundwater. Total organic carbon results were low ranging from <0.5 to 7.4 ppm. Alkalinity ranged from 230 to 370 ppm; consistent with past results. Chloride ranged from 3.8-860 ppm and was elevated at Wells S, U, and E adjacent to Whipple Hollow Road and presumably from road salting. Well V had lower levels of chloride, however, producing fractures at this well are located at deeper elevations than at other wells adjacent to Whipple Hollow Road. Sulfate concentration in Site groundwater ranged from 10 to 66 ppm.

5.2 Off-Site Wells

Groundwater samples were collected from three residential wells: two for VOCs and metals north of the Verpol property (2192 and 2247 West Creek Rd), one for flotation agents east of the Verpol property (1377 West Creek Rd). The Florence Municipal Well was sampled for VOCs, SVOCs, flotation agent compounds, and perchlorate. These locations are shown on Figure 1; results are presented in Table 7.

5.2.1 Flotation Agent

No flotation agent compounds were detected in any of the off-site wells sampled.

5.2.2 VOCs and SVOCs

No VOCs or SVOCs were detected in any residential or municipal groundwater samples collected.

5.2.3 Metals

Samples from residential wells located at 2192 and 2247 West Creek Rd were analyzed for metals. Results are presented on Figures 5 through 7.

Iron was not detected at either location greater than the 50 ppb detection limit and manganese was not detected above the detection limit of 1 ppb.

The laboratory reported a low level detect of arsenic in groundwater (0.76 ppb) from the 2192 West Creek Road well. Arsenic, however was detected in the laboratory blank and thus the detect at this location may be a false positive. This result is within the range of background levels for arsenic in bedrock groundwater around the Verpol Site. The VTGES for arsenic is 10.0 ppb.

5.2.4 Perchlorate

A pre-treatment sample from the Florence Municipal Well was analyzed for perchlorate via EPA method 332.0; results indicate 0.18 ppb of perchlorate was detected. The Vermont drinking water standard for perchlorate is 4 ppb; this detection is well below the drinking water standard and consistent with past results for this location.

5.3 Surface Water

Surface water samples were collected at and near the Verpol Site to assess the fate of Verpol-related chemicals in surface water, and at the Hogback Quarry to assess the presence of perchlorate related to Quarry operations. Results of these two sampling efforts are described below.

5.3.1 Verpol and Near Verpol Locations

Surface water samples were collected from eight on-site locations (Tailings Settling Cell, supernatant from the K&D and Dolomite TMAs, Duck Pond (an intermediate onsite stormwater collection location) and TMA stormwater discharge to the PIQ, PIQ, Pumped water from the PIQ to the West Plant, PIQ2, and the Johnson Quarry), and three off-site locations (Chrusciel Spring, PO-5, and PO-3). Locations are shown on Figure 1; results are discussed below. Samples were not taken at EUSB, S/N001, or S/N002 because the PIQ was not actively discharging to these locations during the sampling round.

5.3.1.1 Flotation Agent

Consistent with past results, AEEA was detected only in on-site surface water with no detects of AEEA in off-site surface water (Chrusciel Spring, PO-5, and PO-3). Table 6 presents all AEEA and TOHI analytical results since Fall of 2006 when the new HPLC/MS/MS method became available. As summarized in Table 6, surface water was sampled in May 2008 and then approximately monthly between July and December 2008 and again in May 2009. Results of AEEA analysis in surface water are presented on Figure 4 and on Table 13.

Water from the settling cells was first sampled in December 2007; 4,800 ppb of AEEA was detected. A sample collected from the settling cells in May 2008 contained 19,000 ppb of AEEA. In the following four monthly samples from July to October 2008, samples consistently ranged between 6000 to 8000 ppb. Since October 2008, concentrations have dropped to approximately 5,000 ppb. TOHI was reported for the settling cells at 3,400 ppb in October 2008, 4930 in December 2008, and 2940 in May 2009.

AEEA was detected in supernatant from the K&D at 600 ppb in October 2007 and 400 ppb in May 2008. Since then, concentrations have varied significantly with two elevated detects (8,640 ppb in Sept. 2008 and 14,100 ppb in December 2008). AEEA in the K&D supernatant in May 2009 was the lowest concentration measured to date at this location at 30 ppb.

AEEA was detected in supernatant from the Dolomite TMA at 30 ppb in October 2007 and 7 ppb in December 2007. An anomalously high concentration of 15,000 ppb of AEEA was detected in May 2008 and may have been related to watering of the haul roads with water from the Settling Cells. Since then, concentrations have been equal or less than 100 ppb with 9 ppb of AEEA detected from the Dolomite TMA in May 2009. TOHI was detected in the Dolomite TMA supernatant at 250 ppb in October 2008, but was not detected in December 2008 or May 2009.

Duck Pond area discharge to the PIQ has been sampled twice (December 2008 and May 2009). No AEEA was detected in either sample.

Lastly, stormwater from the Dolomite TMA area is normally sampled at the stormdrain outfall on the southern side of the PIQ (TMA Discharge to PIQ). The outfall was not sampled in May 2009 as it was completely submerged due to a high water level in the PIQ. This outfall to the PIQ has been sampled eight times since October 2007 with detects of AEEA from 4 to 300 ppb on five occasions. AEEA was not detected at this location in September and October 2008. In May 2009, as a surrogate for the outfall sample, Dolomite discharge was sampled at a 4-inch discharge pipe located at the northwest corner of the Dolomite TMA prior to its migration to the culvert that discharges to the PIQ. No AEEA was detected in the water from this sample.

Typically two surface water samples are collected and analyzed from the PIQ for AEEA: a sample of surface water collected directly from the PIQ (PIQ SW), and a sample from a tap on the pumped discharge line from the PIQ to the West Plant (PIQ to Plant). The highest concentration of AEEA detected in the PIQ surface water sample was 200 ppb in 2007. Since that time, concentrations have dropped steadily with no detections in October 2008 or May 2009. Samples taken from the discharge from the PIQ to the West Plant contained 20 ppb of AEEA in May 2008, 30 ppb in August 2008, and no detectable AEEA in September and October 2008, and May 2009.

AEEA was not detected in the Johnson Quarry, Chrusciel Spring, or the PO-5 and PO-3 locations in May 2009 samples. The Chrusciel Spring has been sampled 13 times for AEEA with no detections in any of the last 10 samples collected between October 2007 and May 2009.

5.3.1.2 VOCs and SVOCs

Samples for VOC analysis (by EPA Method 8260) were collected at Chrusciel Spring and PO-5; both contained no detectable VOCs.

No SVOCs were detected in any surface water samples in May 2009.

5.3.1.3 Metals

The following presents a summary of metals detections in surface water samples collected in May 2009.

- Iron was not detected above 50 ppb at PO-5. Historically, iron has been present at PO-5 at between 456 and 4900 ppb. At Chrusciel Spring, total iron was 4,640 ppb, but dissolved iron was not detected above 50 ppb. It is likely that the total iron result was due to suspended solids in the sample. Historically, iron concentrations at the Chrusciel spring have been 450 to 1420 ppb. At PIQ2 117 ppb of total iron was detected, and dissolved iron was not detected.
- Manganese was detected at the Chrusciel Spring (149 ppb), PIQ2 (22.8 ppb), and PO-5 (16.6 ppb). The VTGES for manganese is 300 ppb.
- Very low levels of total Arsenic consistent with background concentrations in groundwater were detected at PO-5 (0.79 ppb), PIQ2 (1.2 ppb), and Chrusciel Spring (1.2 ppb). These detections are below the VTGES (10 ppb).

5.3.2 Hogback Property Perchlorate and Nitrate Results

The Hogback Quarry was sampled for perchlorate and nitrate at the Northern Outfall (HB-1), the Southern Outfall (HB-2), and the Quarry Sump. Perchlorate was detected in the Quarry Sump sample at 0.2 ppb, and in the Southern Outfall (HB-2) at 0.36 ppb. Perchlorate was not detected above 0.05 ppb in the northern Outfall (HB-1). These results are similar to those from the 2008 sampling rounds. The drinking water advisory for perchlorate in Vermont is 4 ppb.

Nitrate was also detected in all three sampling locations of the Hogback Quarry (0.11 ppb at the Northern Outfall, 1.8 ppb at the Southern Outfall, and 1.9 ppb from the Quarry Sump). The VTGES for nitrate is 10 ppm.

6. FATE AND TRANSPORT OF CHEMICALS

6.1 AEEA

As discussed in Section 2.2.4, AEEA comprises a small fraction (0.6% in IC-912M) of the flotation agent product. However, it is the most water-soluble and environmentally mobile constituent, and is therefore expected to be found in settling cell and TMA supernatant. The settling cells have historically served as the primary dewatering step for tailings with supernatant from the settling cells returned to the plant for re-use. Residual partially-dewatered tailings were historically trucked to the K&D TMA. Beginning in fall of 2007, supernatant from the K&D quarry were collected and returned to the plant for re-use. This change serves to limit AEEA transport to the Dolomite TMA and subsequently to the stormwater discharge to the PIQ. Residual tailings from the K&D were historically trucked to the Dolomite TMA. Beginning in January 2009, the majority of tailings have been sent to the TDF for dewatering to 10% moisture prior to being trucked to the TMAs. Minimal wet tailings slurry has been piped to the Settling Cells and no partially dewatered tailings from the Settling Cells have been moved to the K&D TMA. After October 1, 2009, all tailings will be dewatered through the TDF.

The PIQ is used as a collection point for most stormwater on the Site and is the primary source of process water for the Verpol Plant. Stormwater from the southern portion of the Site (where the TMAs are located) as well as supernatant from the Dolomite TMA has been and is currently drained to the PIQ via a culvert that discharges to the south end of the PIQ. Based on the historical tailings dewatering and handling process, AEEA concentrations should attenuate from the settling cells to the K&D to the Dolomite TMA as water is progressively removed and degradation of AEEA occurs. With the operation of the TDF, discharge of AEEA to the TMAs has been further limited as the tailings are 90% dewatered prior to deposition in the TMAs.

Historical concentrations of AEEA in the Settling Cells have ranged from 4,800 to 19,000 ppb. Although the May 2009 concentration of AEEA in the Settling Cells remained at the low end of this range (4,906 ppb), the concentration of AEEA in the settling cells supernatant should continue to attenuate in the future, as they no longer receive any new tailings.

Concentrations of AEEA in the K&D and Dolomite supernatant as well as the PIQ have shown significant attenuation over the last several years corresponding with: 1) the switch to lower concentration AEEA in the flotation agent, 2) the recovery and recycling of K&D supernatant into the West Plant process water system (instead of the stormwater system), 3) the startup of the TDF, and 4) the limited use of Tailings Settling Cells. Corresponding attenuation of AEEA in site groundwater has also been observed, with AEEA currently detected in only one well (Well K) at 10 ppb compared to the Vermont Health Advisory for AEEA of 20 ppb.

Other than wells B, K, and 2 immediately adjacent to TMAs or settling cells, AEEA is not currently and has not historically been detected in any of the 19 bedrock monitoring wells located downgradient of TMA or Settling Cell locations. These findings indicate that groundwater migration is a minor and incomplete pathway for transport of AEEA and that AEEA degrades or otherwise rapidly attenuates in groundwater.

Impacts to downgradient surface water at the Chrusciel Spring have been observed in the past. While the source of water to the Chrusciel Spring has not been determined, there has been no AEEA detected there since July 2007 and AEEA has not been detected over the last 10 sample rounds between October 2007 and May 2009. Due to historical detects of AEEA at the Chrusciel Spring, this location will continue to be monitored for AEEA in future sampling rounds. However, with significant attenuation of AEEA observed at the Site, with no detects in groundwater or surface water at locations downgradient of TMAs, any potential risk of exposure related to the Chrusciel Spring has been significantly diminished.

6.2 Arsenic

A detailed discussion of arsenic geochemistry is found in the Section 5 Study Report. Consistent with Section 5.1.3, the arsenic results referred to in the following discussion are the higher of the total or dissolved results. Current data support earlier conclusions relative to the conceptual model of arsenic fate and transport:

- 2008 and 2009 data continue to show that iron, manganese, and arsenic are elevated above background in portions of the Verpol Site.

- Arsenic mobility appears to be correlated with iron reduction. Historically, samples containing arsenic concentrations at or above approximately 10 ppb (Wells 2, B, E, K, S, and V) also contain from 2,600 to 23,700 ppb dissolved iron, and have a field-measured ORP of less than -100 mV (with the exception of Well S, which has had positive ORP values). May 2009 data shows a similar pattern as all wells with arsenic concentrations at or above 9.8 ppb (Wells K, 2, V, E, and B) contain 1,200 to 25,000 ppb of dissolved iron and field-measured ORP values less than -77 mV.
- Sulfate depletion can be an indicator of sulfate reduction and potentially favorable geochemical conditions for the mobilization of arsenic from sulfide phases. Sulfate concentration in Site groundwater ranged from 10 to 66 ppm. Sulfate data from May 2009 did not provide conclusive results; sulfate was detected at 14 ppm in Well E and 12 ppm in Well V where arsenic was also detected at 11.0 and 10.0 ppb respectively. Sulfate was depleted at Well B (<10 ppm) where arsenic was detected at 16.6 ppb.
- The source of arsenic has not been precisely identified, but appears to be related to naturally occurring arsenic in local bedrock and possibly the tailings. Over the past two years, samples from certain wells have consistently contained arsenic at or greater than approximately 10 ppb (Wells, B, K, 2, E, and V) suggesting that a potentially labile source of arsenic occurs in bedrock in these areas.
- Iron reduction is apparent in some areas without corresponding arsenic mobilization (i.e., some locations (Wells D, F, J, L1, N, and U) with higher than 2000 ppb of dissolved iron had no detectable arsenic). These areas may lack a nearby labile source of geologic arsenic, or other processes may be limiting arsenic transport.
- As shown in the table below, there are consistent reducing conditions in the northeast corner of the property (Wells D and E) and immediately downgradient of the property boundary (Well V). At these three locations, elevated dissolved iron concentrations exist but elevated arsenic is only seen at Wells E and V indicating there is likely a limited source of labile arsenic near Well D.

	May '08 Oct. '08 May '09 Results											
	Total Arsenic (ppb)			Dissolved Arsenic (ppb)			Dissolved Iron (ppb)			ORP (mv)		
Well D	<1	<0.5	0.46	<1	<0.5	<0.5	3140	2350	3000	-182	-168	-166
Well E	10.3	15.9	10.8	8.97	11.2	11	3140	2350	3000	-112	-124	-77
Well T	1.44	1.14	1.0	ND	ND	0.76	205	582	68	33	-61	26
Well U	3.34	ND	2.2	3.25	ND	2	595	2040	35	61	97	148
Well V	2.03	10.0	10.0	0.76	8.38	7.7	469	2660	1200	-111	-157	-84

ND= not detected above detection limit

Continued monitoring is appropriate for arsenic, iron, manganese, and various geochemical data to better describe temporal and spatial variability.

7. DATA USABILITY ASSESSMENT

This section provides an analysis of the usability of the May 2009 data. A combination of statistical procedures and qualitative evaluations was used to evaluate the quality of the data. These procedures were employed by the analytical laboratory and by a data validator independent of the laboratory.

This data usability assessment includes both an analytical and a field component, each of which is discussed in the following subsections. The analytical data assessment evaluates whether the data support the conclusion(s) of the monitoring report, whereas the field data assessment evaluates the representativeness of the samples by assessing collection and preservation methods, hold times, and field quality control (QC) samples.

The case narratives from the laboratory data packages address all quality control deviations as required by the analytical methods; this data usability assessment is focused on deviations from quality standards for analytical and field data judged relevant to supporting the conclusion(s) of the monitoring report.

The sampling rationale for this monitoring program was based on historical groundwater and surface water data. The nature and extent of chemicals in groundwater and surface water were presented in the final report of the Section 5 Study, from which the 2008 Monitoring Plan was developed. The extent and distribution of groundwater and surface water sampling locations presented in the 2008 Monitoring Plan were selected and approved in conjunction with the VTDEC.

7.1 Analytical Data Assessment

7.1.1 Groundwater

All groundwater data collected as part of the semi-annual monitoring event were analyzed with accepted EPA or other documented analytical methods. There were no deviations from the analytical method protocols that would affect the ability of these data to support the conclusions of this monitoring report; however, there were deviations from the approved Plan in regards to sample collection. None of these deviations affect the usability of these data.

7.1.1.1 Deviations from Sampling Plan

Due to low recharge rates and the inability to perform low flow sampling, Wells I and R were sampled without measuring low-flow parameters. Well R was purged dry at the beginning of the sampling round. The water level in Well R was allowed to recover and a grab sample was collected three days later. Due to the historically lower recharge rate at Well I (its water level

does not recover within a weeklong sampling event) this well was sampled using a HydraSleeve™.

The following exceptions and additions to the sampling plan occurred:

- Samples were not analyzed for stearic acid. As discussed in the May 2008 Monitoring Report, stearic acid results by Method 8270 are considered unreliable. As no commercial laboratories capable of quantifying stearic acid at low levels are available, groundwater was not analyzed for stearic acid in October 2008 or May 2009. This compound does not have a VTGES or Federal MCL.
- Cations/Anions were collected at selected wells to further characterize geochemistry.

7.1.1.2 Analytical Interferences for Arsenic Analysis

Historically, some reported results for arsenic have been biased high due to false detects due to interferences for arsenic associated with the EPA method 6020 software in which argon chloride (ArCl) may be formed. Argon chloride is formed in the plasma and has a mass of 75 atomic mass units (amu); the same as total arsenic, and may display as a false positive. In October 2008, samples were analyzed by the hydride generation method to avoid these false positives. In May 2009, samples were analyzed by ICP-MS using a collision cell to break up argon chloride complexes and eliminate positive bias. The ICP-MS with collision cell was used instead of the hydride generation method because it provides lower detection limits.

7.1.2 Surface Water

Stormwater from the Dolomite TMA area is normally sampled at the stormdrain outfall on the southern side of the PIQ (TMA Discharge to PIQ). The outfall was not sampled in May 2009 as it was completely submerged due to a high water level in the PIQ. In May 2009, as a surrogate for the outfall sample, Dolomite discharge was sampled at a 4-inch discharge pipe located at the northwest corner of the Dolomite TMA prior to its migration to the culvert that discharges to the PIQ.

Surface water samples were collected using the “dip” method as described in the 2008 Monitoring Plan. Water was placed immediately into pre-cleaned, pre-preserved bottles. When appropriate (for dissolved metals sample collection), water was collected into a 1mL plastic squeeze bottle. A hole was pre-drilled in the cap of the bottle and a 45um filter was screwed into this hole. Water was then squeezed from the 1mL bottle through the filter into certified pre-cleaned containers. The monitoring plan also specifies the collection of field parameters (temperature, pH, and conductivity) during surface water sampling—this specification was not intended, and is not necessary to ensure usability of the surface water data. Field parameters were not measured during surface water sampling.

There were no deviations from the analytical methods that would affect the ability of these data to support the conclusions of this monitoring report.

7.2 Field Data Assessment

All groundwater, surface water, and residential samples collected as part of the May 2009 monitoring event were collected in accordance with EPA protocols where possible. Exceptions included locations where low flow sampling was not possible. As noted in Section 7.1.1.1, water quality (“field”) parameters were measured during groundwater purging and sampling from monitoring wells sampled by low flow methods to verify that representative samples of formation water were collected.

Groundwater samples were collected using dedicated tubing stored at the site. All equipment was decontaminated using Alconox and deionized water between each sample location. All samples were received at the laboratory within hold time although some temperature discrepancies were noted by the laboratory upon receipt. Some of the samples were received at a temperature of 12°C; however, since the samples were received by the laboratory within 24 hours of collection, the usability of the data were not affected.

The following table is a list of quality assurance/quality control samples collected during this sampling effort and a brief description as to their QA/QC goal. More detailed descriptions of QA/QC sample collection methods and goals are found in the 2008 Monitoring Plan.

QA/QC Sample	Matrix	Number Submitted	Frequency	QA/QC Goal
Field Duplicate	GW	2	1 per 10	Evaluate sample collection
Field Duplicate	SW	2	1 per 10	Evaluate sample collection
Matrix Spike/Spike Duplicate	GW	2	1 per 20	Laboratory accuracy & precision
Matrix Spike/Spike Duplicate	SW	2	1 per 20	Laboratory accuracy & precision
Field Blanks	N/A	2	Each lot of DI water	Decontamination procedures
Equipment Blank	N/A	1	1 for sample round	Decontamination procedures
Rinsate Blank	N/A	1	1 for sample round	Decontamination procedures
Trip Blanks	N/A	4	1 per cooler of VOCs	Shipping & storage

For the May 2009 sampling event, the following identifications were used for various QA/QC samples:

Z1 = blind duplicate and MS/MSD for Well B

Z2 = blind duplicate and MS/MSD for Well K

Z3 = MS/MSD AEEA for Well 96-1

Z4 = blind duplicate for SW sample "Duck Pond." This was the sample taken instead of TMA discharge which was submerged

Z5 = MS/MSD AEEA for SW sample Johnson Quarry

Z6 = blind duplicate and MS/MSD for SW sample Northern Outfall (in Hogback Quarry).

Results of QA/QC sampling are presented in Table 13.

7.2.1 Trip Blanks

All trip blanks were non-detect for all measured analytes. Based on these data, no contamination occurred during shipment to and from the Site.

7.2.2 Field, Equipment, and Rinsate Blanks

7.2.2.1 VOCs

Acetone was detected in EQ-BLANK-05202009 (5.95 ug/L). No other VOCs were detected in any of the equipment, blanks. These results do not materially affect data usability.

7.2.2.2 SVOCs

Equipment Blank EQ-BLANK-05202009 had detections of azobenzene (4.96 ug/L), di-n-butyl phthalate (0.632 ug/L), and bis(2-ethylhexyl) phthalate (4.98 ug/L). Butylbenzyl phthalate (0.625 ug/L) and diethyl phthalate (0.562 ug/L) were detected in the equipment blank, EQ-BLANK-05182009. No other SVOCs were detected in any of the, equipment blanks.

Di-n-butyl phthalate was also found in one groundwater sample, though azobenzene and bis(2-ethylhexyl) phthalate were not. Therefore, the low level concentration (slightly above the RL) of di-n-butyl phthalate in the associated sample may be attributable to the decontamination procedure used in the field during the sampling event. Butylbenzene phthalate was also detected in the associated method blank; therefore, the concentrations of butylbenzyl phthalate in the equipment blank and the associated samples may be attributable to laboratory contamination.

These results do not materially affect data usability.

7.2.2.3 AEEA

Lower than normal AEEA recoveries were reported for the matrix spike/matrix spike duplicate (MS/MSD) pairs that were analyzed with the surface and ground water samples. The percent recoveries have historically been reported in the range of 45-65% for MS/MSD samples; however, the recoveries for this sampling event ranged from 30-46%. The laboratory control spikes (LCS) exhibited acceptable recoveries (70-130%). While the raw AEEA data presented in laboratory reports may have a low bias due to matrix or sample processing effects, results presented in the tables and figure have been corrected (adjusted upward) for this low bias. As noted in Section 2.2.4, this adjustment is not considered standard practice by analytical laboratories and the adjusted value represents an estimate of the actual AEEA concentration. The upward adjustments to AEEA concentrations below 1000 ppb were made to present conservative values for AEEA in groundwater and surface water, and provide consistency with previously reported AEEA results. All sample results, both detections and non-detects, were qualified as estimated due to the low matrix spike recoveries.

8. REFERENCES

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