



July 21, 2008

Mr. Nick Warner
Mr. Dave Weinstein
CEDO
149 Church Street
Room 32, City Hall
Burlington, Vermont 05401

RE: Report: Semi-Annual Groundwater Monitoring & Pre-Dewatering Characterization
Former Moran Generating Plant, Burlington, Vermont (SMS Site #2005-3357)

Dear Nick and Dave:

Waite Environmental Management, LLC (WEM) is pleased to present the *Report: Semi-Annual Groundwater Monitoring & Pre-Dewatering Characterization* for sampling conducted in May 2008 at the Former Moran Generating Plant in Burlington, Vermont.

Do not hesitate to call or email if you have questions or concerns.

Sincerely,

Miles E. Waite, Ph.D.
Principal Hydrogeologist

Enclosure

Cc: Hugo Martinez Cazon, VT DEC
Alan Peterson, EPA Region I (electronic only)

**REPORT:
SEMI-ANNUAL GROUNDWATER
MONITORING &
PRE-DEWATERING
CHARACTERIZATION**

**MORAN GENERATING PLANT
Lake Street
Burlington, Vermont**

Prepared for:

**Community and Economic Development Office
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Burlington, Vermont 05401**

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1.0 INTRODUCTION

The following report was prepared by Waite Environmental Management, LLC (WEM) for the former Moran Generating Plant in Burlington, Vermont ("Site"; refer to Site Location Map in Appendix A). This report was prepared for the Community and Economic Development Office (CEDO) of the City of Burlington as part of an ongoing effort toward the future reuse of this Brownfield property. As this is a Brownfield project and a state-listed hazardous waste site (Site #2005-3357), both the Region I Environmental Protection Agency (EPA) and the Vermont Department of Environmental Conservation (VT DEC) are involved.

Work described in this report includes semi-annual groundwater monitoring conducted on May 19-20, 2008 and characterization of interior water and sediment quality conducted on May 13 and May 20, 2008. This work was conducted in accordance with WEM's Quality Assurance Project Plan (QAPP) Addendum II dated June 8, 2006, approved by the Environmental Protection Agency on July 3, 2006 and the QAPP Addendum III dated April 15, 2008 and approved by the EPA on May 5, 2008. The objective of the groundwater monitoring program is to monitor the presence of contaminants in the shallow groundwater under the Site that were revealed after a Phase II Environmental Site Assessment was conducted in March/April and November 2005. The scope of work includes groundwater monitoring from twelve (12) monitoring wells. The objective of the interior sampling was to characterize water and sediment that will need to be removed during future de-watering of the building and included sampling of interior building water and sediment at two (2) locations and sampling of Lake water at one (1) location. Sampling locations are shown on Site Plan in Appendix A.

2.0 GROUNDWATER MONITORING

2.1 Groundwater Level Monitoring

On May 19-20, 2008, WEM collected groundwater level measurements from twelve (12) monitoring wells at the Site. Depth to groundwater ranged from 1.04 to 4.00 feet below top of casing (TOC). The average water table elevation was slightly below to the May 2007 average, but higher than the November 2007 average by 0.67 feet, which can be attributed to normal seasonal variation. Like all previous monitoring events, no free product was encountered in any of the monitoring wells. Refer to Table 1 in Appendix B for a groundwater elevation summary.

Water table elevations were plotted and contoured to illustrate the estimated gradient and direction of groundwater flow beneath the site (see Figure 2 in Appendix A). According to the May 2008 data, groundwater under the central portion of the Site (MW-11 to MW-8) is flowing to the west/southwest at an average lateral hydraulic gradient of 0.016 ft/ft, or 1.6% slope. This slope is typical to prior the measurements from 2005-2007.

Well MW-12 is screened at a different depth interval than the other monitoring wells in this area, enabling the evaluation of vertical hydraulic gradient. Based on the comparison of the groundwater



elevation in MW-12 and the nearby wells MW-11 and MW-3, there does not appear to be a noticeable upward or downward vertical gradient.

2.2 Groundwater Sample Collection

Following water level measurement, WEM collected groundwater samples from ten (10) monitoring wells (MW-1, MW-2, MW-3, MW-4, MW-5, MW-7, MW-8, MW-11, MW-12, MW-14). Wells were first purged of at least three (3) well volumes using a peristaltic pump via polyethylene tubing dedicated to each well. In each case the tubing was inserted to a depth of 0.5 feet above the bottom of the well, the pump was activated, and each well was allowed to purge at a rate of 200-550 milliliters/minute. The purgewater was noted to be very clear except for light silt in MW-1 and MW-5 and a red oxidation in MW-7 and MW-8. No visual/olfactory evidence of contamination was noted in any of the wells. All purgewater was discharged to the ground surface. Refer to the field data sheets in Appendix C for sampling details.

After purging, all groundwater samples were collected in VOAs that were pre-preserved with hydrochloric acid (HCL), placed on ice in a cooler, and transported to TestAmerica (TA) laboratory in South Burlington, Vermont (formerly Severn-Trent laboratory) under chain-of-custody procedures. Each sample was analyzed for VOCs via EPA Method 8260B. Results are discussed in Section 2.3.

For purposes of quality assurance/quality control (QA/QC), WEM also collected a blind duplicate groundwater sample; sample "MW-Y" was collected in conjunction with the sample from MW-14 and submitted to TA for analysis by EPA Method 8260B. A trip blank provided by TA (TB-1), and a field blank (FB-1) prepared by WEM using de-ionized water during the sampling process were also submitted for analysis. Discussion of QA/QC is presented in Section 2.5.

2.3 Groundwater Sampling Results

Groundwater sampling results from May 2008 are provided in Appendix D and shown with historical data in Table 2 in Appendix B. These results indicate that low levels of VOCs were detected in wells MW-1, MW-2, MW-3, MW-7, MW-8, and MW-14. A trace level (i.e. estimated concentration below detection limit) of one compound was detected in MW-4 and MW-11. All reported compounds are *chlorinated VOCs*, including : tetrachloroethene (PCE), trichloroethene (TCE), 1,1-dichloroethane (1,1-DCA), 1,1,1-trichloroethane (1,1,1-TCA), and 1,4-dichlorobenzene (1,4-DCB). The range in compounds reported and relative concentrations are similar to all previous sampling results from 1999 and 2005-2007.

No compounds were detected in MW-5 or MW-12 during May 2008, and historical data indicate that compounds have never been detected in MW-6 and are only occasionally detected at trace levels in MW-4. VOCs are present in the immediate vicinity of the former Moran Plant building and do not extend to the northern or eastern portions of the Site. In addition, well MW-12, which monitors groundwater quality from the deeper (35-40 feet deep) aquifer, continues to show a lack of detectable aqueous contamination.



All concentrations are of a relatively low magnitude. The only compound reported in excess of the Vermont Groundwater Enforcement Standards is TCE in well MW-3. The compounds PCE and TCE, and occasionally the degradation by-product cis-1,2-DCE, are confined to a small area of the Site, previously termed the “hot spot”. Trace concentrations of these compounds are present to the west (MW-8) and east (MW-11) of the hot spot.

The compounds 1,1,1-TCA and 1,1-DCA are more widespread throughout the Site (MW-1, MW-2, MW-3, MW-7, MW-8, and MW-14), but are all at concentrations well below their respective VGES. The highest reported concentrations of these two compounds are regularly at well MW-2.

Compared to previous (November 2007) sampling results, there have been overall slight decreases in contaminant concentrations. Regarding PCE/TCE concentrations, trends in MW-3 and MW-14 can be seen in the graphs in Appendix B. From these graphs, it is evident that:

- MW-14 shows an overall decreasing trend in PCE and TCE since sampling began in 1999.
- TCE in MW-14 hovers around the VGES concentration (5 parts per billion, or ppb), and PCE is generally below the VGES.
- Well MW-3 has shown a decreasing trend in TCE since July 2006, and PCE generally hovers around the VGES concentration (5 ppb).
- There is not an obvious relationship between contaminant concentrations and groundwater elevations in MW-3 or MW-14.

2.4 Contaminant Limits and Source Discussion

WEM has divided the target contaminants into two groups: 1) PCE/TCE, and 2) 1,1-DCA/1,1,1-TCA. The concentrations and extent of these compounds are shown visually in Figures 3 and 4 in Appendix A. The PCE/TCE plume is shown as a thin plume centered at the hot spot with a general east-west orientation, as anticipated from the groundwater flow direction. The 1,1-DCA/1,1,1-TCE plume is much wider with no discernable orientation. Given the concentrations at western-most wells MW-7 and MW-8, the western limit of this plume may extend to the Lake.

The source of these two plumes is not well understood, but it is assumed that they stem from the former use of solvent-type chemicals for maintenance of the machinery used as part of the coal-burning plant. It may well have been small drips over time and not distinct spills or intentional releases to the ground that resulted in the contamination.

2.5 Data Verification and Validation

The groundwater analytical results were validated by Phoenix Chemistry Services (PCS) of North Ferrisburg, Vermont. PCS’s validation was performed in conformance with Tier I and Tier II (as appropriate) guidelines as defined by USEPA Region I, modified by the QAPP and Brownfields guidance from the Region I office. The modified Tier I validation process evaluates the data package submitted by the laboratory (TA) for completeness, issues pertaining to sample-related quality control parameters, and issues pertaining to methodological compliance. Issues pertaining to contractual compliance and compliance with the National Environmental Laboratory Accreditation Conference (NELAC) standard (effective date July, 2004) are also noted where applicable.



The data validation reporting is presented in Appendix E. As the report indicates, TA submitted a complete data package with appropriate forms and documentation, reported under sample delivery group (SDG) No. 125579. There were several minor methodological compliance issues noted in regard to the initial calibration and continuing calibrations, but since these were for analytes that are not pertinent to this study (acrolein, acetone, 2-butanone, propionitrile, isobutyl alcohol, 1,4-dioxane), they are not of concern.

The field duplicate, trip blank, and field blank results are presented in Table 3 in Appendix B. There were no detections in any of the blanks, indicating that there were not any spurious influences on sample quality. The duplicate results were evaluated using a relative percent difference (RPD) analysis (The RPD is defined as 100 times the difference in reported concentration between sample and duplicate, divided by the mean of the two samples. A small RPD indicates good correlation between sample and duplicate.) Acceptable precision (<30% RPD) was obtained in compound results greater than two times the detection limit in the field duplicated pair MW-14 and MW-Y, with the single exception of 1,1,1-trichloroethane, which had a 61.9% RPD.

2.6 Data Usability and Qualifications

Based on the results of the data validation, there are no qualifications or issues that affect the validity or usability of the data collected in May 2008.

3.0 PRE-DEWATERING CHARACTERIZATION

The City of Burlington is planning to dewater the basement of the Moran Plant building as part of the process of redeveloping / re-using of the building. The City has preliminary approval for this work from the US Army Corps of Engineers and the Vermont Department of Environmental Conservation Water Quality Division. While this process is not anticipated to mobilize or be affected by the trace contaminants that are present in the surrounding groundwater and shallow soil, characterization of the water and sediment was necessary to investigate interior contaminant levels for the purposes of water and sediment disposal.

The water in the basement stems from Lake Champlain. There is a gated sluiceway that allows Lake water to occupy the sub-basement chambers that were part of the cooling process for the former power generating operations. There is also a gated outflow channel connected to these chambers. With the annual mean Lake water elevation at approximately 96 ft and the basement floor elevation at 96.0, the basement floor is occasionally dry. However, the spring elevation is often above 100 ft, allowing for flooding of the basement through the sluiceway gates. The City would like to dewater the basement and replace the sluiceway gates to prevent future flooding. With an approximate square footage of 8,000 ft², there is a volume of 60,000 gallons for every foot of water above the 96-ft floor elevation.

Contaminants of concern, based on the Phase II Environmental Site Assessment and previous use considerations, are volatile organic compounds (VOCs), polycyclic aromatic compounds (PAHs), polychlorinated biphenyls (PCBs), and the metals arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.



3.1 Interior & Lake Water Sampling

Water samples were collected from two locations inside the building and one location outside the building in the sluiceway (control sample). Water sampling locations are shown as DBS-1, DBS-2, and DBS-3 in the Site Plan in Appendix B.

The water samples for analysis of VOCs were collected using passive diffusion bag samplers (Eon Products, Equilibrator Passive Diffusion Sampler, 18 in. x 1.75 in, 350 ml). These samplers were submerged into the water attached to 8 oz. stainless steel weights using hanging devices on May 13, 2008. The samplers had been filled with deionized water by TA laboratory on the day prior to installation. On the day of installation, there was 39 inches of water measured above the 96-ft floor level inside the building. Also present on this day was Russ Miller-Johnson of Engineering Ventures. On May 20, after a week of installation, WEM retrieved the samplers and decanted them using the discharge tubing into the appropriate containers for VOC analysis (EPA Method 8620B). Also on May 20, water samples were collected with disposable bailers at locations DBS-1, DBS-2, and DBS-3. The bailers were dropped into the water slowly as not to disturb the sediment on the floor. These samples were collected for analysis of PAHs (EPA Method 8270C), PCBs (EPA Method 8082), metals (EPA Method 6010B & 7470A), and pH. All samples were placed on ice and transported to TA laboratory under chain-of-custody procedures.

For purposes of quality assurance/quality control (QA/QC), WEM also collected a blind duplicate water sample; sample “DBS-X” was collected in conjunction with the sample from DBS-1 and submitted to TA for analysis by the same methods. A trip blank provided by TA (TB-2), and a field blank (FB-2) prepared by WEM using de-ionized water during the sampling process were also submitted for analysis

Water quality results are tabulated in Table 4 in Appendix B and lab reports are provided in Appendix D. These results are summarized below:

- The Lake water sample collected in the sluiceway (DBS-1) has detectable concentrations (estimated below reporting limits) of the metals barium, chromium and lead. This sample has no detectable VOCs, PAHs, or PCBs and a normal pH of 7.7.
- Interior water sample collected in the western end of the Moran Plant (DBS-2) has no detectable VOCs, a trace of one PCB compound, significant concentrations of PAHs and metals, and a pH of 7.5. Compared to applicable groundwater standards (Vermont Groundwater Enforcement Standards, or VGES), only one (1) PAH compound, one (1) PCB compound, and four (4) metals are above the standards. Compared to applicable surface water standards (Vermont Water Quality Standards for Consumption of Water and Organisms), seven (7) PAHs, one (1) PCB, and two (2) metals are above the standards. The results that stand out above others are the high concentrations of arsenic and lead.
- Interior water sample collected from the eastern end of the Plant (DBS-3) has a trace of one (1) VOC, several metals, and a pH of 7.6. This sample has no detectable PAHs or PCBs. Compared to applicable groundwater standards only the metal lead is above the standard. Compared to applicable surface water standards, only the compounds arsenic and mercury are above the standards. The result that stands out above others is the relatively high concentration of lead.



3.2 Interior Sediment Sampling

Sediment samples were collected from two locations inside the building, shown as SED-2 and SED-3 on the Site Plan in Appendix B. These sampling locations were directly under the water where DBS-2 and DBS-3 were collected.

Prior to sampling, WEM met with Steve Roy and an assistant from the City of Burlington Department of Public Works to measure the sediment thickness inside the building using a “sludge judge”. This clear PVC sampling device was placed through the water column to the 96-ft floor at four locations. At each location, the sediment was too minimal to be recovered; less than 0.5-inch of sediment was observed.

To collect the sediment, WEM then used a steel hoe to scrape sediment from the concrete floor into a small pile that could be slowly lifted out of the water and placed into the sampling containers. Inspection of the sediment revealed fine particles as well as evidence of paint chips, rust flakes, concrete pieces, wood, feathers, and egg shells. The color was reddish brown. These samples were collected for analysis of PAHs (EPA Method 8270C), PCBs (EPA Method 8082), metals (EPA Method 6010B & 7470A), and pH. All samples were placed on ice and transported to TA laboratory under chain-of-custody procedures.

Sediment quality results are tabulated in Table 5 and lab reports are provided in Appendix D. The results from SED-2 and SED-3 are summarized below:

- Interior sediment has detectable levels of the VOCs PCE, 1,1-DCA, 1,1,1-TCA, and 1,4-DCB. The concentrations are estimated only (below reporting limits), and well below applicable standards (EPA Region IX Preliminary Remediation Goals for industrial properties, or PRGs). These VOCs are also present in aqueous form in groundwater collected outside the building.
- Interior sediment has detectable levels of the VOCs acetone and 2-butanone, but at concentrations well below the PRGs. These compounds are not typically detected in groundwater outside the building.
- Interior sediment has detectable levels of all PAHs. Several of the PAH compounds, including benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, dibenzo(a)anthracene, and dibenzo(1,2,3-cd)pyrene are at concentrations above the PRGs. These compounds are also detected in shallow soil outside the building.
- Interior sediment has detectable levels of two PCB compounds. Concentrations are below the PRGs with the exception of Arochlor-1254 in SED-3. These compounds are also detected at trace levels in the shallow soil outside the building.
- Interior sediment has detectable levels of the metals arsenic, barium, cadmium, chromium, lead, mercury, and selenium. Only the concentrations of arsenic and lead are above the PRGs. While the presence of these metals is not surprising given the former presence of coal and metallic objects/paint inside the building that have been degrading for years, the concentrations of lead at 10,300 - 11,900 mg/Kg are higher than anticipated.



3.3 Data Verification and Validation

The surface water and sediment analytical results were validated by Phoenix Chemistry Services (PCS) of North Ferrisburg, Vermont. PCS's validation was performed in conformance with Tier I and Tier II (as appropriate) guidelines as defined by USEPA Region I, modified by the QAPP and Brownfields guidance from the Region I office. The data validation reporting is presented in Appendix E.

As the report indicates, TA submitted a complete data package for these analyses, reported under sample delivery group (SDG) No. 125580. However, because the laboratory inadvertently neglected to log in the mercury analyses when the samples were delivered to the laboratory on May 20, 2008, an addendum reported as SDG No. 125580A was submitted.

There were some documentation and methodological compliance issues noted, including detection of VOCs (acetone and dichlorobenzene) in method preparation blanks, detection of metals outside the instrument detection levels in calibration blanks, surrogate recoveries above acceptance limits, and low response factors for select VOCs. The analyses were complicated by the need for dilution of sediment samples to be within acceptable calibration ranges and anomalies attributed to matrix related interferences.

The most notable compliance issues were the following:

- The laboratory neglected to log in the mercury analyses when the samples were received, and the error was not noted until after the holding time had expired. The water samples were analyzed seven days out of holding time, and the soil samples were analyzed 8 days out of the laboratory-recommended holding time, and the results were reported in an addendum to the original data package by the request of WEM and the data validator. Because of this oversight, results for mercury in all samples (aqueous and solid) should be considered estimated (J or UJ qualifier) on the basis of the digestion and analysis 7 and 8 days, respectively, outside the established holding time for aqueous samples.
- The VOC acetone was detected at the reporting limit (5.0 ug/Kg) in the solid volatiles method preparation blank, and was also detected above the linear calibration range in both the original analysis of SED-2, and in the re-analysis SED-2RE. Based on professional judgment, WEM has qualified the acetone in SED-2 as estimated (J).

Lastly, one field duplicate pair was submitted with this sample set: the aqueous sample DBS-X was collected in conjunction with DBS-1. No results greater than two times the quantitation limit were reported for any analytes in this field duplicate pair, so precision could not be determined. There were no contamination issues noted for the trip blank or field blank.



4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Groundwater Monitoring

Groundwater results from May 2008 continue to show low levels of chlorinated hydrocarbons in the immediate vicinity of the Moran Plant building. The PCE/TCE plume appears to stem from a confined hot spot near wells MW-3 and MW-14 and is present in a thin east-west orientation. The 1,1-DCA/1,1,1-TCA plume is more widespread with no discernable orientation. The only compounds reported in excess of VGES was TCE in the hot spot. Per VT DEC protocol, WEM recommends a continued groundwater monitoring program until there are two consecutive events in which all concentrations are below the VGES. Sampling should continue on a semi-annual basis in the spring and fall, with the next round to be conducted in November 2008. Samples should continue to be analyzed by EPA Method 8260B.

4.2 Pre-Dewatering Characterization

Surface water and sediment results from inside the Moran Plant from May 2008 indicate the presence of select VOCs, PAHs, PCBs, and metals. The VOCs are present at trace levels only in sediment and have not resulted in any significant contamination of surface water by VOCs either inside or outside (Lake water) the building. The magnitude of VOC results suggests that the interior material is not the source of VOCs detected in the groundwater outside the building. The PAH results in the sediment are above federal standards for soil, and have resulted in interior surface water contamination by select PAHs inside the building. The same is true for select PCB results. Lastly, metals are present in both interior surface water and sediment above state/federal standards, with very high concentrations of lead noted in both. WEM suspects that the presence of PAHs, PCBs and metals in the interior water and sediment are directly attributed to the former presence of coal and machinery inside the building compounded by rusting/degrading metal and painted concrete which has been submerged or flaking into the base level for many years.

Based on these results, WEM recommends that any dewatering of the building must involve pumping the water into the City's municipal treatment system after approval by the Department of Public Works. Based on the late June 2008 water level (9 inches) inside the building, the volume of water is estimated at 40,000 – 50,000 gallons. The pumping should be done in a manner that minimizes the volume of sediment that is pumped. If the sediment is to be removed after pumping, removal must be by an approved hazardous waste contractor and disposal must be at a certified hazardous waste facility, as the lead concentration is likely above the toxic threshold for landfill disposal.