FORMER WHITEMARSH TOWNSHIP LANDFILL
WHITEMARSH TOWNSHIP, MONTGOMERY COUNTY, PENNSYLVANIA

FINAL REPORT

Narrative

1.0 INTRODUCTION

Blazosky Associates, Inc. (BAI) has performed a site characterization of the former Whitemarsh Township Landfill Property ("Site") in Montgomery County, Pennsylvania under the requirements of Pennsylvania's Land Recycling and Environmental Remediation Standards Act, 35 P.S. §6026.101, et seq. ("Act 2") to obtain a release from legal liability. This work has included groundwater sampling, soil gas surveys, geophysical logging and incorporating results of several previous Site investigations. As part of this effort and on behalf of the Site owner Joshua Hill Inc. (JHI), BAI is submitting this Final Report to provide the Pennsylvania Department of Environmental Protection (PaDEP) with written documentation regarding the site conditions and request a release of liability for the Site through the Act 2 Land Recycling Program through demonstration of attainment of the Statewide Health Standard (SHS). The Notice of Intent to Remediate and the proof of publication submittal are included in Attachment 1. The required SHS report fee has been included with this report as well.

The purpose of this Final Act 2 Report is to document the findings of the site characterization and attainment demonstration activities that were performed. Additionally, this report presents the required documentation of attainment under the SHS for several volatile organic compounds, chlorinated solvents and metals identified to be present in the groundwater beneath the Site. These compounds include: tetrachloroethylene (PCE), trichlorothylene (TCE), 1,2-dichloroethane, methylene chloride, toluene, benzene, ethyl benzene, chromium, lead, nickel, thallium and zinc. Supporting documentation includes, in part, project and sample location maps, analytical data summary tables and laboratory reports, pertinent correspondence, groundwater well information, and other relevant information. Since attainment of the SHS is being sought, the format of this report follows the guidelines set forth in Section II.B.6 of the Act 2 Training Guidance Manual.

2.0 SITE DESCRIPTION

The former Whitemarsh Township Landfill property is made up of approximately 11.63 acres, and is situated along the northern side of Joshua Road, approximately one mile southeast of the intersection of Joshua Road and Ridge Pike in Whitemarsh Township, Montgomery County, Pennsylvania (Figure 1). The Site has an approximate latitude of 40.081915 and longitude of -75.276958. As shown on Figure 1, the Site is located at a topographic high point and extends Northwest down a gently sloping hill. Maximum relief across the Site is approximately 45 to 50 feet. The Site consists of a wooded lot, covered almost entirely with dense underbrush.

2.1 OWNERSHIP AND PROPERTY USE HISTORY

Previously owned by Whitemarsh Township Authority, the Site was a municipal waste landfill from the early 1960's to early 1970's. The method of disposal was that of a trench fill operation (typical at that time) where shallow trenches were cut into the earth and subsequently backfilled with waste material. Regulations at the time did not require a liner or cap after filling activities had been completed.

As depicted on Figure 2, a total of nine disposal trenches were cut laterally from east to west across topographic slope. Based on measurements taken from this drawing, the total area occupied by the disposal trenches encompasses approximately 7.5 acres. Information from shallow test pits completed during previous investigations indicated that the maximum depth of trash is on the order of twenty feet below ground surface (bgs).

At some time during the early to mid 1970's the landfill was ordered closed by the Pennsylvania Department of Environmental Resources. In 1987, the Site was placed under agreement of sale and in October 1988 JHI became the owner of record of the Site.

2.2 CURRENT SITE AND SURROUNDING LAND USE

The Site is now wooded and is bordered by residential and light industrial areas. Located to the east and south of the Site are established residential communities made up of townhouses and single family homes. To the north of the Site is a densely wooded tract of land, a large portion of which makes up the Spring Mill Impounding Basin. Immediately to the west and topographically downgradient of the Site is an active light industrial facility, which is owned and operated by National Label Company (NLC). To the northwest of the Site is an active light industrial facility, which is owned and operated by Whitemarsh Township to produce compost.

2.3 SOILS

According to the Pennsylvania State University's SoilMap web database (www.soilmap.psu.edu, accessed October 2008), soils present on the Site are associated with the Manor Series, which consist of very deep, well drained to somewhat excessively drained soils on uplands. These soils are mainly weathered from schist. However, due to the landfilling activities at the Site, much of the ground surface consists of Made Land soils. These soils consist of cut, fill, rubble land or other areas with little or no natural soils.

2.4 BEDROCK

According to the Bureau of Topographic and Geologic Survey, Open File Report OFBM-06-04.0, (Bedrock Geologic Map of the Chester Valley and Piedmont Portion of the Germantown, Malvern, Norristown and Valley Forge Quadrangles, Chester, Delaware, Montgomery and Philadelphia Counties, Pennsylvania) prepared by Howell Bosbyshell in 2006, Paleozoic-age metamorphic rocks associated with the Octoraro Formation underlie the Site. The Octoraro Formation is predominantly comprised of albite-chlorite schist, phyllite, hornblende gneiss and granitized members.

Due to lack of geologic logs for the existing wells, downhole borehole geophysical surveys were performed to better understand subsurface geologic conditions. This is discussed further in Section 3.2.

2.5 HYDROGEOLOGY

Five monitoring wells were installed by Roy F. Weston, Inc. (Weston) in 1994. Ranging in depth from 146 to 184 feet, they were constructed as open bedrock wells. Monitoring of these monitoring wells indicates that groundwater is approximately 110 to

140 feet below the ground surface under unconfined water table conditions. A water table contour map is included for reference as Figure 3.

According to groundwater elevation data collected by BAI, groundwater flow within the vicinity of the site is toward the northwest with a gradient of approximately 2%. Local discharge from the aquifer is likely into Spring Mill Creek located just north of the site. In this area, Spring Mill Creek is described as a losing stream whose headwaters begin in Green Valley Country Club to the northeast and meanders in a southwesterly direction eventually joining the Schuylkill River in Spring Mill.

2.6 SITE CONCEPTUAL MODEL

The Site is largely wooded and is underlain by Made Land soils consisting of rubble, fill and other disturbed materials. Beneath this is weathered metamorphic rock (primarily schist and phyllite) of the Octoraro Formation. As a result, the monitoring wells are constructed within the weathered saprolite zone.

Groundwater flow moves through pores and intergranular openings of the regolith as well as bedding, cleavage and schistosity planes; groundwater flow direction beneath the Site is northwest with an approximate gradient of 2%. Groundwater elevations in November of 2008 ranged from approximately 113 to 138 feet below ground surface.

Reportedly, landfill waste was placed in a series of trenches no deeper than 20 feet across the Site and covered with soil (the site is now wooded). Based on earlier test pit investigations, a buffer of approximately 70 feet exists between the bottom of the waste and groundwater. Test pit excavations, soil sampling and toxicity testing performed by others at the Site concluded that hazardous waste was not present in the soils at the Site. Impacts to groundwater were identified by sampling of monitoring wells.

Based on the site characterization activities discussed below and for the purposes of this Act 2 Final Report, the "Site" boundaries are considered the same as the boundaries of the property as shown on Figure 2. Monitoring wells MW-2 and MW-3 serve as the downgradient point of compliance monitoring locations.

3.0 SITE CHARACTERIZATION

Given that seven previous investigations have been performed on this Site, BAI's characterization and attainment work scope combined new activities with the results of these earlier investigations. Specifically, BAI's investigation included the following:

- Review of existing data;
- Location and gauging of existing monitoring wells;
- Site survey of property boundaries and well locations;
- Soil gas survey;
- Geophysical logging of three monitoring wells (MW-3, MW-4 and MW-5);
- 48 hour aquifer test;
- Four consecutive rounds of groundwater sampling; and,
- Final Report

3.1 PREVIOUS INVESTIGATIONS

During the period from 1984 through 1998, seven environmental investigations were conducted on the Site, two by an adjacent property owner known as National Label Company (NLC), one by Whitemarsh Township and four by JHI (not including the 2008 Site characterization). Reports from these investigations can be found under Attachment 2.

The initial investigation was performed by NLC in January 1984 for the purpose of assessing storm water runoff quality from the Site onto NLC's property. NLC was also considering purchasing the Site, so as a result, NLC conducted an investigation of the Site by collecting and analyzing a soil sample obtained from the shallow subsurface.

Following the NLC investigation, Whitemarsh Township hired VFL Technologies (VFL) of Malvern, Pennsylvania to conduct an investigation of the Site in May 1984. This included shallow soil borings and test pits from which VFL obtained two samples for analysis via EPA toxicity methods for metals, pesticides, herbicides and priority pollutants. Based on the results of these samples, VFL concluded that no hazardous levels of the tested parameters were present and that no migration of hazardous waste materials from the Whitemarsh Township Landfill had occurred.

In September 1987, prior to purchasing the Site, JHI obtained the services of VFL to perform a more comprehensive evaluation of the Site. This included the excavation of eleven shallow test pits within the waste material, the collection of soil samples and monitoring of explosive gases within the shallow subsurface. Results from this work noted the presence of municipal type solid waste and also concluded again that no hazardous waste was present on the Site within the areas investigated.

Following the first investigation, JHI hired Kaselaan and D'Angelo Associates, Inc. (KDA) to evaluate in more detail the nature of the gases present on the Site. Following the sampling of soil gases, KDA concluded that methane gas (CH_4), which is primarily generated during the decomposition of waste, was detected.

In 1994, a more detailed Phase II environmental evaluation of the Site was performed by Weston on behalf of NLC (as part of a potential purchase). This investigation included the installation and sampling of three monitoring wells, including one upgradient well (MW-1) and two downgradient wells (MW-2 and MW-3). These results indicated that the upgradient monitoring well was impacted by several VOC's and the downgradient monitoring well (MW-3) exceeded the regulatory limit for lead.

In October 1994, two additional monitoring wells (MW-4 and MW-5) were installed both slightly downgradient from MW-1. Samples were then collected by Weston from the onsite monitoring wells and analyzed for a suite of parameters. Analytical results revealed detections of VOCs in samples from the newly installed MW-5. Monitoring well construction logs can be found under Attachment 3.

In November 1998, JHI retained BAI to assess the current quality of the groundwater beneath the Site and to determine if previously identified constituents are

still present and, if so, in what concentrations. Therefore, BAI collected groundwater samples from MW-1 and MW-4. The two samples were then analyzed for the PaDEP Bureau of Land Recycling and Waste Management Form 19, for municipal solid waste landfills. This list was similar to parameters run during the previous investigations, but also tested for additional constituents commonly tested at municipal solid waste landfills. The results of the analysis revealed VOCs and lead in water samples collected from MW-1 and MW-4. Sampling of MW-2, MW-3 and MW-5 was not conducted during this investigation.

In 2008, BAI began a Site characterization performed as outlined in PADEP's Land Recycling Program Technical Guidance Manual. A Notice of Intent to Remediate was submitted on May 23, 2008. These activities are discussed further below.

3.2 GEOPHYSICAL SURVEY

In May 2008, EarthData, Inc. performed borehole geophysical surveys of three existing monitoring wells at the Site. Specifically, the logging suite included: borehole video, fluid temperature, fluid conductivity, 3-arm caliper, natural gamma and acoustic televiewer. These data were used to establish basic construction details as well as assist in geologic evaluation. These details are shown on the well construction logs in Attachment 3. Overall, these data showed consistent fractured lithology which supports the published mapping for the Site of a schist and phyllite. A copy of the report can be found under Attachment 4.

3.3 AQUIFER TESTING

On June 11, 12 and 13, 2008, BAI performed a 48 hour aquifer test to assess hydrogeologic characteristics. The test was performed using a submersible pump. Drawdown was recorded with Aquistar® PT2X data-logging pressure transducers in the pumping well (MW-4) and in observation wells MW-1 and MW-5. Water levels were also recorded in all wells manually. Pumping rate for the test was 5 gallons per minute. At the end of the test, total observed drawdown in the pumping well was approximately nine feet while drawdown in the closest observation well (MW-5) was approximately one foot. Calculated transmissivities for the aquifer ranged from 1,200 to 2,112 gallons per day per foot. Aquifer test plots are included in Attachment 5.

3.4 GROUNDWATER SAMPLING

The Site currently has a network of five monitoring wells, which includes three upgradient monitoring wells (MW-1, MW-4 and MW-5) and two downgradient monitoring wells (MW-2 and MW-3). As shown in the attached figures, the monitoring wells are spaced upgradient and downgradient of the waste disposal trenches. MW-2 and MW-3 are not only located downgradient of the waste disposal trenches but are along the downgradient Site boundary as well.

The initial sampling event was performed by BAI personnel on March 11, 2008, using standard low-flow well purging and sampling techniques. Prior to the collection of groundwater samples, static water levels and total well depths were recorded for each well. Both readings were referenced from the top of the protective steel casing of each well head. Following this, each well was adequately purged at a rate of approximately one quarter gallon per minute using a Grundfos Redi-Flow 2® submersible pump which

was set at approximately the middle of the water column for each well. During the purge event, field parameters such as dissolved oxygen, oxygen-reduction potential, specific conductivity, temperature, turbidity, and pH were measured periodically throughout the event. Once the field monitored parameters stabilized (<10% change over three consecutive readings), samples were collected in laboratory prepared sample collection bottles. The sample for dissolved metals was collected last and field filtered via a disposable inline 0.45 micron filter, which was installed directly into the discharge tube. After the samples were collected, they were stored on ice then transported to Analytical Laboratory Services, Inc. (ALSI) in Middletown, PA to be analyzed for EPA priority pollutants. Samples were collected for a total of four quarters (March 11, 2008, May 12, 2008, July 18, 2008, and October 16, 2008) of results. Depth-to-water measurements were used to construct a groundwater contour map (depicted on Figure 3). Groundwater sampling purge sheets are included in Attachment 6.

3.5 SOIL-GAS INVESTIGATION

On March 21, 2008, BAI field personnel conducted a soil gas survey at the Site, monitoring for methane gases (typically generated during the decomposition of municipal waste). Given the historical use of the Site and previous detections of methane concentrations in soil gas, BAI concluded this would be a useful approach to assess the level of waste degradation that has occurred at the Site. This investigation was completed utilizing a Landtec GEM-2000 and an Ion Science PhoCheck+ 1000Ex (10.6eV lamp) Photo Ionization Detector (PID). The Landtec GEM-2000 is commonly used at landfills to measure the levels of methane (CH_4), carbon dioxide, oxygen and the remaining balance of air in the atmosphere. The PID was utilized to screen for VOC's that may be found in the soil pore spaces as a gas.

BAI field personnel had previously marked monitoring locations spaced on a 100 foot grid across the Site totaling 51 sampling locations. Some of these locations could not be sampled due to the dense underbrush preventing access to the area.

At each location a three foot long steel soil probe with a sliding hammer was advanced to two and a half feet, followed by a perforated plastic pipe connected to the meters. The top of the plastic pipe was sealed to prevent atmospheric air from entering the pipe/tubing. Both meters were calibrated in the field, connected to the tubing and allowed a few minutes to draw gas from the soil, and then readings were recorded. Results are summarized in Section 4.0 and locations are shown on Figure 4.

3.6 RESULTS AND FINDINGS

3.6.1 SOIL

Soil at the Site has been characterized by several previous investigations. Therefore this work and its conclusions are summarized here.

VFL Technologies was retained by Whitemarsh Township to perform a soil investigation in 1984 and then was retained again by JHI to perform a more comprehensive investigation in 1987. Together, these investigations included 13 test pits, two soil borings and eight soil samples. Four of the eight soil samples were analyzed for RCRA hazardous waste characteristics, two were analyzed for priority pollutants and two were analyzed for EPA toxicity, metals, pesticides,

herbicides and priority pollutants. Both investigations resulted in similar findings. In summary, VFL concluded in their 1987 report that:

- Visual observations from test pits excavated at random locations throughout the Site indicate that municipal refuse and occasional incinerator ash constitute the waste deposited at the landfill;
- There is no evidence of the presence of hazardous waste characteristics or priority pollutants in the waste or soil samples sampled; and,
- There is no visual evidence of the presence of buried steel drums on the ground surface or within the test pits.

Data from the 1984 VFL report is included in Table 2 as well as the results of another soil sample collected in 1984 by NLC. The PADEP MSCs are included for comparison as well. Laboratory data for the 1987 investigation was not available for inclusion with this report.

3.6.2 GROUNDWATER MONITORING

The results of the analyses performed on the groundwater samples collected from the downgradient wells during the past four quarters of sampling events from the downg indicated that there were no detections of the analyzed VOC's (including associated degradation products of chlorinated solvents) or metals were above natural background levels. The findings show VOC detections in samples from monitoring wells MW-1 and MW-5 in the downgradient monitoring wells, MW-2 and MW-3, as well as several metals. The samples from MW-1 indicate the presence of four separate VOC's, two of which (tetrachloroethene (PCE) and trichloroethene (TCE) were noted to have exceeded the PaDEP SHS Medium Specific Concentration (MSC) of 5 µg/L for each. MW-1 was also noted to have concentrations of metals. In particular, thallium was measured in one sample event over the MSC of 2 µg/L. Subsequent sampling efforts did not detect thallium. Results for MW-5 indicate the presence of four VOC's as well, two of which (methlyene chloride and benzene) exceed the MSC of 5 µg/L for each. These results are similar to the historical results found during the prior investigations conducted by NLC and JHI. The analytical data is summarized in Table 1. The complete laboratory analytical data packages from each monitoring event is included under Attachment 6.

3.6.3 SOIL-GAS MONITORING

Of the 51 locations field measured, only four locations had measurable levels of methane(<0.1 ppm). The highest concentration was SG-48 located near a buried sewer line manhole which passes directly through the Site. Due to the proximity of the measurable levels of methane to the sewer line manhole, the source of the methane is likely the manhole. At monitoring locations SG-27 and SG-30, methane levels of 0.3% were measured, however these were within in very organic rich soils, with significant dead and decaying organic matter and leaf litter surrounding the area.

The minimal extent of methane concentrations in the soil gas indicates that waste degradation has been largely completed and current detections are

related to organic soils and an on-site sewer line. Results from the soil gas survey are shown on Figure 4.

Throughout the monitoring event, no VOC concentrations were detected with the Ion Science PID.

4.0 STATEWIDE HEALTH STANDARD

The Medium Specific Concentrations (MSC's) chosen for the SHS for groundwater are based on a used aquifer with total dissolved solis less than 2,500 ppm for a residential property as well. Groundwater analytical results were compared to the MSC's for each representative constituent found in "Table 1-Medium Specific Concentrations For Organic Related Substances in Groundwater" found in Appendix A of the Pennsylvania Code Title 25 Environmental Protection, Chapter 250, Administration of Land Recycling Program regulations. Refer to Table 1 for a listing of MSC values for compounds analyzed during these investigations.

The MSC's chosen for the Statewide Health Standard for soil is based on a used aquifer with total dissolved solids less than 2,500 ppm for a residential property. Soil analytical results were compared to the MSC's for each representative constituent found in "Table 3B-Medium Specific Concentrations For Organic Related Substances in Soil" found in Appendix A of Pennsylvania Code Title 25 Environmental Protection, Chapter 250, Administration of Land Recycling Program regulations. Refer to Table 2 for a listing of MSC values for the analyzed compounds.

5.0 ECOLOGICAL SCREENING

Ecological Screen Flow Chart	
Step	**Result**
1. Presence of Light Petroleum Product the only Constituents?	No
2. Is the area < 2 acres of impacted soil or < 1000 sq. ft. of impacted sediment?	No
3. Does the site have features which would obviously eliminate specific exposure pathways?	No
4. Have CPEC's associated with the release under Act 2 been detected onsite?	Yes (Benzene, Trichloroethylene, Chromium, Nickel, Zinc)
6. Conduct detailed site evaluation to determine if species or habitats of concern likely exist onsite in its current or intended use, or, if endangered or threatened exist within a 1,000 ft radius of the site.	A Pennsylvania Natural Diversity Inventory Review was conducted, and results are included in Attachment 7. Results from the evaluation indicated that nspecies or habitats of concern were not identified onsite, no endangered or threatened species exist within a 1,000 ft radius of the site, and no exceptional value wetlands were found onsite. The screening process moves to Step 9, according to PaDEP Act 2 Technical Training Manual, Section II.B.6.e.
Step 9.	NO FURTHER ECOLOGICAL ACTION REQUIRED.

6.0 REMEDIATION

Remediation at the Site has consisted of natural attenuation/biodegradation of the constituents found onsite. Data collected from recent groundwater monitoring and soil gas monitoring has shown no exceedances of the analyzed parameters at the point of compliance. This is consistent with the significant length of time that the waste has remained undisturbed at the Site (over 35 years.)

7.0 ATTAINMENT

As required under Title 25 Pennsylvania Code §250.704 in order to fulfill the requirements for groundwater under Act 2, for any standard, attainment for groundwater must be based on at least eight consecutive quarters of groundwater data, or as an alternative, the PaDEP may accept four consecutive quarterly sampling events or less with written approval if the following conditions are met:

1. There is adequate spatial monitoring of the plume upgradient which indicates a decreasing concentration trend toward the downgradient property boundary.
2. Parameters affecting the fate and transport of regulated substances within the plume have been fully evaluated.

3. Concentrations of regulated substances in the plume at the point of compliance (POC) monitoring wells along the downgradient property boundary are all less than or equal to the groundwater standard or the limit relating to the practical quanitation limit, whichever is higher, in all samples collected during the quarters of monitoring.

4. One of the following requirements are met:
   a. The age of the plume is sufficiently well known to permit a judgment to be made regarding its stability.
   b. The remediation includes source removal or containment actions which would reduce the chemical flux into the plume.

A formal Request for Sampling reduction was filed with the PaDEP in December 2008 and acceptance was granted in January 2009, under Title 25 Pennsylvania Code §250.704.d.4.b.i. A copy of the approval letter is enclosed in Attachment 8.

Groundwater monitoring performed during this investigation has shown consistent patterns for on-site groundwater flow direction (northwest). As a result, the existing monitoring well network provides adequate spatial monitoring of the plume.

Fate and transport modeling has been performed and is discussed in Section 8.0. The results of this conservative model are consistent with empirical data from on-site groundwater monitoring wells. For example, the model indicates that the primary constituents of concern (PCE, TCE and benzene) in the eastern-central portion of the Site will not reach the downgradient wells (MW-2 and MW-3). This is supported by the empirical groundwater analytical data. Specifically, during the four consecutive quarters of sampling events performed by BAI during 2008, attainment of the SHS was achieved at the POC. The analyzed constituents from samples collected from the POC wells (MW-2 and MW-3) were either not detected or were below the respective MSCs during the sampling events that occurred during this investigation. Results from the sampling events can be found under Table 1.

As noted in Section 3.1, numerous Site evaluations were conducted prior to this investigation, and included numerous soil samples. Results from these sampling events can be found under Table 2.

8.0 FATE AND TRANSPORT MODEL FOR CHLORINATED SOLVENTS

8.1 BIOCHLOR

Per direction of the Act 2 requirements under the SHS, a fate and transport model has been developed for benzene, PCE and PCE's daughter products in groundwater. This model has been designed to accurately represent the fate and transport of PCE and its daughter products on the Site. This model uses the first sampling event of this Act 2 investigation, conducted on March 11, 2008. Concentrations of regulated constituents detected in samples from MW-1 and MW-5 were entered into the model to simulate and calibrate the model. The model also incorporates a conservative product degradation rate for benzene and PCE and associated daughter products, conservative values for aquifer hydraulic properties (i.e. bulk density and porosity) as well as calculated values for hydraulic conductivity and hydraulic gradient.

These combined conservative values together provide a model that overestimates the actual rate of movement and size of the contaminant plume.

The BIOCHLOR spreadsheet model has been used to develop the fate and transport characteristics of the chlorinated solvents found at the Site. BIOCHLOR is a screening model that simulates remediation by natural attenuation (RNA) of dissolved solvents in groundwater. It is also capable of modeling three different scenarios:

- Solute transport without decay;
- Solute transport with biotransformation modeled as a sequential first-order decay process; and,
- Solute transport with biotransformation modeled as a sequential first-order decay process with two different reaction zones.

For this model, solute transport with biotransformation as a sequential first-order decay process was used. This is primarily due to evidence of reductive dechlorination which is the most dominant biotransformation process at chlorinated solvent sites.

As stated above, conservative input values were used in the model and these include the following:

BIOCHLOR Model Input Data

Source Concentration	57.6 µg/L PCE 13.9 µg/L TCE 1.2 µg/L DCE	
Source Dimensions	100 ft wide x 4 ft thick	
Hydraulic Conductivity (K)	1.8 x 10⁻³ cm/sec	Based on results from 48 hour aquifer test
Hydraulic Gradient (i)	0.021 ft/ft	Calculated from groundwater contour map
Porosity (n)	25%	Conservative estimate for fractured metamorphic bedrock
Seepage Velocity (Vs)	10.7 ft/yr	Calculated in worksheet
Soil Bulk Density	1.6 Kg/L	Default value
Koc	300 PCE 94 TCE 38 DCE	Table 1 Act 2 Regulations
Fraction Organic Carbon	0.005	Conservative default value from BIOCHLOR instructions
Longitudinal Dispersivity (Alpha X)	11 ft	Per BIOCHLOR instructions
Transverse Dispersivity (Alpha Y)	3.63 ft	Per BIOCHLOR instructions
Vertical Dispersivity (Alpha Z)	0.36 ft	Per BIOCHLOR instructions

Model Assumptions

* The initial source concentration used was the first sampling event from the Act 2 investigation, conducted on March 11, 2008. The reasoning behind the use of this event, and not the most recent historic high concentration of PCE observed in monitoring well MW-1 (66.2 µg/L, 5/12/08), is due to the fact that more constituents were detected during this sampling event, and enable for more accurate calibration of the model. Additional predictive BIOCHLOR model runs for successive years consider the migration of the contaminant plume over time. These runs were done in five year increments after the first year to obtain the current plume location. Therefore, a time of 40 years was entered into the model, since the waste at the Site was disposed of in the late 1960's. It is assumed that potential groundwater impacts also occurred during this time.

** The source width used in the model has been conservatively estimated as the distance measured perpendicular to groundwater flow between wells MW-1 and MW-4, where elevated concentration levels of PCE have been observed in MW-1, but have not been detected in MW-4. This width serves as a conservative estimate of the contaminant plume at the source.

*** KOC = Organic Carbon Partition Coefficient obtained from Table 5 of the Act 2 regulations.

**** Per BIOCHLOR Instructions, Longitudinal Dispersivity (Alpha X) is 10% of the observed historic travel distance (Lp), equal to Lp*(.1). The travel distance of contaminants is the distance measured from the original source area to the furthest known point of contamination (MW-5). This distance is measured perpendicular to the groundwater contours (parallel with groundwater flow direction) from the approximate center of the original surface soil impacted source area (MW-1), to well MW-5, which equals 110 feet. Therefore Alpha X = 110 feet(.10) = 11 feet. In order to present a conservative theoretical worst-case scenario, this value for longitudinal dispersivity is held constant for each successive run of the model over time.

***** Per BIOCHLOR Instructions, Transverse Dispersivity (Alpha Y) is equal to be 33% of Alpha X. Therefore Alpha Y = 0.33(11 feet) = 3.63 feet.

****** Per BIOCHLOR Instructions, Vertical Dispersivity (Alpha Z-dispersion perpendicular to the groundwater flow and the water table), is equal to 5% of Alpha X. Therefore Alpha z = 0.05(11 feet) = 0.55 feet.

Based on the above input data, a total of seven model runs were generated. The purpose of each model run was to predict the location of the leading edge of the contaminant plume (5 µg/l) over time beginning with the present time (May 2009) and after five years, ten years, fifteen years, twenty years, twenty five years, and thirty years. Based on these individual model runs, which are included in Attachment 9, the lead edge of the contaminant plume centerline where the concentration of PCE is at 5 µg/l has been determined to be located at the following distances downgradient from well MW-1. PCE was chosen to show the furthest extent of the contaminant plume

since it has the highest source concentration, and traveled the furthest distance in all models, compared to other constituents.

May 2009	5 years	10 years	15 years	20 years	25 years	30 years
140 ft	144 ft	160 ft	160 ft	160 ft	160 ft	160 ft

As seen in the above summary, the maximum extent of the PCE plume is predicted to reach 160 feet downgradient of well MW-1 at 30 years from the present, well within the Site property boundary. Approximately 10 years from the present, the plume will reach its maximum extent, and daughter products will naturally attenuate due to the conditions currently found at the Site.

This model reasonably depicts what is currently occurring onsite, as well as the future extent of the plume. These model outputs correspond with the model output curve closely matching actual field data measured in MW-5. This shows the model is calibrated, and uses appropriate input parameters to model the conditions at the Site. Given these actual observations and model outputs, it is reasonable to conclude that the contaminant plume is simulated and that the established SHS MSC value for PCE and its associated daughter products is not exceeded at locations much more than a few tens of feet from downgradient well MW-5. This is confirmed by the lack of detections of PCE and associated daughter products in samples collected from the downgradient wells (MW-2 and MW-3).

8.2 QUICK DOMENICO

BAI also developed a fate and transport analysis model for benzene in groundwater. benzene has been detected in MW-5, with a historical high concentration of 7 µg/L recorded on October 28, 1994.

The Quick-Domenico (QD) spreadsheet model has been used to develop the fate and transport characteristics of benzene at the Site. Although the QD model was designed for applications of groundwater and contaminant flow in unconsolidated media, it is considered appropriate for use at this site because groundwater flow in the subsurface is through highly fractured metamorphic bedrock.

As stated above, conservative input values were used in the QD model and these include the following:

Quick Domenico Input Data

Source concentration*	7.0 µg/L	Benzene
Source Dimensions*	50 ft wide x 14 ft thick	
Hydraulic conductivity (K)	1.3×10^{-1} cm/sec	Based on results from 48 hour aquifer test
Hydraulic Gradient (i)	0.021 ft/ft	Calculated from groundwater contour map
Porosity (n)	25%	Conservative estimate for fractured metamorphic bedrock
Groundwater Velocity	0.008 ft/day	V=Ki/n
Soil Bulk Density	1.6 kg/L	Default value

KOC ***	58	Table 5 Act 2 Regulations
Fraction Organic Carbon	0.005	Conservative default value from QD instructions
Longitudinal Dispersivity (Alpha X) ****	11	Estimated, Per QD instructions
Transverse Dispersivity (Alpha Y) *****	1.1	Per QD instructions
Vertical Dispersivity (Alpha Z) ******	0.05	Per QD instructions

Model Assumptions

* The initial source concentration is the most recent historic high concentration of benzene observed in monitoring well MW-5 (7.0 µg/L, 10/28/1994). Additional predictive Quick-Domenico model runs for successive years consider the migration of the benzene plume over time. These runs were done in five year increments after the first year to obtain the current plume location. Therefore, a time of 14,600 days (40 years) was entered into the model, since the waste at the site was disposed of in the late 1960's. It is assumed that potential groundwater contamination also occurred during this time.

** The source width used in the model has been conservatively estimated as the distance measured perpendicular to groundwater flow between wells MW-5 and MW-4, where elevated concentration levels of benzene have been observed in MW-5, but have not been detected in MW-4. This width serves as a conservative estimate of the contaminant plume at the source.

*** KOC = Organic Carbon Partition Coefficient obtained from Table 5 of the Act 2 regulations.

**** Per PaDEP Quick Dominico Instructions, Longitudinal Dispersivity (Ax) is set equal to the observed historic travel distance (X) divided by 10. The travel distance of benzene is the distance measured from the original source area to the furthest known point of contamination. This value has been estimated to equal the same travel distance as PCE (110 Feet) or the distance between MW-1 and MW-5, since the historic travel distance of benzene is unknown. Therefore Alpha X = 110 feet/10 = 11 feet. In order to present a conservative theoretical worst-case scenario, this value for longitudinal dispersivity is held constant for each successive run of the model over time.

***** Per QD Instructions, Transverse Dispersivity (Alpha Y) is equal to Alpha X/10. Therefore Alpha Y = (11 feet)/10 = 1.1 feet.

****** To keep this model conservative, Vertical Dispersivity (Az-dispersion perpendicular to the groundwater flow and the water table), was minimized to keep contaminant flow in the Ax and Ay axis's. This in return maximizes the models size of the contaminant plume, representing a conservative theoretical worst-case scenario.

Based on the above input data, a total of seven model runs were generated. The purpose of each model run was to predict the location of the leading edge of the contaminant plume (5 µg/l) over time beginning with the present time (May 2009) and after five years, ten years, fifteen years, twenty years, twenty five years, and thirty years. Based on these individual model runs, which are included in Attachment 9, the lead edge of the contaminant plume centerline where the concentration of benzene is at 5 µg/l has been determined to be located at the following distances downgradient from well MW-5.

May 2009	5 years	10 years	15 years	20 years	25 years	30 years
10 ft	6 ft	6 ft	6 ft	6 ft	6 ft	6 ft

As seen in the above summary, the maximum extent of the benzene plume is predicted to reach 10 feet downgradient of well MW-5 under current conditions. Approximately five years from the present, the plume will shrink to 6 feet and remain constant.

8.3 RISK ASSESSMENT SUMMARY

Since no use of groundwater was defined to exist within the limits of the modeled plume, it is concluded that no direct exposure pathway to impacted groundwater currently exists. In addition the proposed residential development for the Site would utilize public water and public sewer. Based on this, there is no risk from ingestion of groundwater. In addition, no soil impacts were identified in previous investigations above PADEP Direct Contact MSCs, therefore there is no risk from ingestion of soil. Although there are no structures currently on site, based upon previous soil investigations and existing groundwater monitoring data no constituents of potential indoor air concern (COPIACs) were identified or were below their respective screening values listed in Tables 1 and 4 of PADEP's Vapor Intrusion into Buildings from Groundwater and Soil technical guidance manual (January 24, 2004). Therefore, no inhalation pathway exists for this Site.

As discussed above, fate and transport modeling for the primary constituent of concern in groundwater (PCE and benzene) predicts that elevated levels above SHS MSCs will not reach the downgradient limits of the Site nor existing off-site water supply sources.

9.0 POST REMEDIATION CARE PLAN

The investigation revealed no adverse impact requiring post remediation care.

10.0 FUTURE LAND USE

Current plans for the property include redevelopment into residential townhouses. Construction would be slab-on-grade, with public water and public sewer. Preliminary sketch plans have been prepared and an agreement has been developed between JHI and Whitemarsh Township. This agreement stipulates that Whitemarsh Township is in support of the project and desires to see the Act 2 release of liability obtained and redevelopment of the property occur. A copy of the Whitemarsh Township Settlement Agreement is enclosed in Attachment 10.

11.0 SUMMARY

After eight separate investigations of soil, groundwater and soil gas carried out over the last 20 years performed by National Label Company (adjacent owner), Whitemarsh Township (former Site owner) and JHI (current owner), the conditions of the property have been assessed and documented. BAI's Act 2 Site Characterization and Attainment Demonstration activities over the last year mark the final step to requesting a release from legal liability.

This investigation on the Former Whitemarsh Township Landfill, located on Joshua Road, Whitemarsh Township, Montgomery County, Pennsylvania has met the requirements for the Act 2 Final Report under the SHS. This investigation included research of prior investigations, soil-gas monitoring, groundwater monitoring, and constituent fate and transport analysis, all of which indicate attainment of the SHS.

Parameters affecting the fate and transport of benzene, PCE and degradation daughter products have been evaluated and conservatively modeled within the contaminant plume for a time period of thirty years past the present time (May 2009). Results from this model show that the leading edge of the benzene and PCE plume during this time reaches no further than a distance of 160 feet downgradient of MW-1. Sampling results have been input into the model, to ensure the model is properly calibrated, and reasonably depicts the on-site conditions. The model shows that benzene, PCE and its associated daughter products degrade within the Site property boundary. These findings correspond to those found during the groundwater sampling events and indicate that the input parameters into the model are reasonable, yet conservative in estimating the fate and transport of the VOC plume within the site boundaries.

Results from the four quarters of groundwater results, found under Table 1, consistently show that the concentrations of regulated substances at the point of compliance (the Site boundary) are less than the groundwater SHS MSC for the particular regulated substance. The current and historical results show that samples from MW-1 (in the upgradient, central portion of the Site) have detections of four VOC's with some metals and appear to have largely stabilized. Samples from MW-5 have also had detections of four VOC's as well and show a decreasing trend in the regulated substance concentrations. Historically, samples collected from MW-2 and MW-3 had detections of lead; however, through natural attenuation and other processes samples from these wells no longer have lead detections. Again, four quarters of groundwater samples collected from the point of compliance wells, MW-2 and MW-3, have shown attainment with the residential Statewide Health Standard MSCs.

Given that the on-site waste is over 35 years old, significant degradation is likely to have already occurred as evidenced by the lack of or minimal detections of regulated constituents in the groundwater and further supported by the minimal methane soil gas detections. The groundwater and modeling data together indicate that the plume has stabilized and has consistently not reached the downgradient point of compliance monitoring wells. On-site soil investigations (including TCLP testing) performed by others found no evidence of hazardous waste disposal.

Therefore, on behalf of JHI, BAI is requesting a release of liability under the SHS for the soil and groundwater at the Former Whitemarsh Township Landfill for the parameters analyzed under Tables 1 and 2.

12.0 SIGNATURES

Prepared By: Jordan Rajan
Title: Geologic Specialist
Date: May 19, 2009

Reviewed By: Edward J. Layton, P.G.
Title: Project Manager
Date: May 19, 2009

Consulting Firm: Blazosky Associates, Inc.
Address: 649 N. Lewis Rd., Suite 215
Royersford, PA 19468
Phone No: (610) 495-5585

Remediator/Owner: Marc A. Zaid, Esq.
Joshua Hill, Inc.
Address: 920 Matsonford Road, Suite 100
West Conshohocken, PA 19428
Phone No: (610) 940-3610

Preparer's Relationship to User: Environmental Consultant

Signature of Preparer — Date: 5-19-09

Signature of Reviewer — Date: 5-19-09

Signature of Remediator/Owner — Date: 5/19/09