UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION III

STATEMENT OF BASIS

HERCULES, INC.
111 HERCULES ROAD
HOPEWELL, VIRGINIA

EPA ID NO. VA D003121928

May 2015

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Section 1: Introduction

The United States Environmental Protection Agency (EPA) has prepared this Statement of Basis (SB) to solicit public comment on its proposed remedy for the Hercules facility owned and operated by Ashland, Inc. and located at 1111 Hercules Road in Hopewell, VA (Facility or Site). EPA's proposed remedy for the Facility consists of the following components: 1) Continued groundwater monitoring; 2) compliance with and maintenance of groundwater and land use restrictions to be implemented through institutional controls; and 3) maintenance of the existing security fence around Facility property. This SB highlights key information relied upon by EPA in proposing its remedy for the Facility.

The Facility is subject to EPA's Corrective Action Program under the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA) of 1976, and the Hazardous and Solid Waste Amendments (HSWA) of 1984, 42 U.S.C. §§ 6901 et seq. (Corrective Action Program). The Corrective Action Program is designed to ensure that certain facilities subject to RCRA have investigated and cleaned up any releases of hazardous waste and hazardous constituents that have occurred at their property.

EPA is providing a thirty (30) day public comment period on this SB. EPA may modify its proposed remedy based on comments received during this period. EPA will announce its selection of a final remedy for the Facility in a Final Decision and Response to Comments (Final Decision) after the public comment period has ended.

EPA will select a final remedy after considering all comments received during the comment period, consistent with applicable RCRA requirements and regulations. If the final remedy is substantially unchanged from the one proposed, EPA will issue a final decision and inform all persons who submitted written comments or requested notice of EPA's final determination. If the final remedy is significantly different from the one proposed, EPA will issue a public notice explaining the new proposed remedy and will reopen the comment period. In the Response to Comments section attached to the Final Decision, EPA will respond in writing to each comment received.

Information on the Corrective Action program as well as a fact sheet for the Facility can be found by navigating http://www.epa.gov/reg3wcmd/correctiveaction.htm.

The Administrative Record (AR) for the Facility contains all documents, including data and quality assurance information, on which EPA's proposed remedy is based. See Section VIII, Public Participation, for information on how you may review the AR.

Section 2: Facility Background

2.1 Introduction

Ashland Inc. owns and operates the Facility in the City of Hopewell, Virginia. **Figure 1** shows the location of the site on the USGS topographic quadrangle map for Hopewell, Virginia. Located on a 390-acre Site in the eastern portion of the City, the Facility reacts several different chemicals with purified cellulose and sodium hydroxide precursor to manufacture lines of chemicals known as cellulose derivatives. The Facility property was initially part of a DuPont guncotton manufacturing facility which operated from 1912 through the World War I era. Hercules Incorporated (Hercules) first acquired part of the current Site in 1926 to manufacture purified cotton cellulose for use in the chemical and paper industry. In 2008, Ashland acquired Hercules. Hercules, Inc. is a wholly owned subsidiary of Ashland, Inc.

2.2 Site Physiography

The Site is situated in the eastern portion of the City of Hopewell, Virginia, which lies within the Coastal Plain Physiographic Province. The surface topography is characterized by rolling uplands and valleys that slope towards the James River to the northeast of the Facility. A series of terraces, formed by the transgression and regression of a marine environment, are situated parallel to the James River in the Hopewell area. These terraces have been modified extensively by fluvial processes.

The main portion of the Facility is located on one of these terraces. Surface drainage generally flows to the south or east to one of a series of small channels which dissect the edge of the flat terrace. The channels drain steeply towards Cattail Creek and Baily Creek, which form the Facility's southern and eastern property boundaries. The confluence of the two creeks is located just south of the Facility. Baily Creek continues to the northeast for approximately two miles until eventually emptying into the James River.

2.3 Local Hydrogeology

Review of the various boring logs and available literature indicate that the surface stratigraphy below the topographic highs at the Facility is composed of a fairly thick sequence (10 to 30 feet) of silty clay/clay, which is underlain by a layer of gray silty sand. The silty sand layer ranges in thickness from 10 to 20 feet and forms the uppermost aquifer at the Site. The aquifer is underlain by a second silty-clay to clay layer, which ranges in thickness from approximately 15 to 20 feet, and appears to be laterally continuous across the majority of the Site. With the exception of monitoring well LF-2 along Cattail Creek, where the clay was not observed, isolated lenses of silt and sand have been observed within the clay.

Deeper borings that have penetrated this clay layer encountered a second sand/gravel aquifer beneath the clay. Based on the calculated hydraulic conductivity of the lower clay, the data suggests that the clay serves as an aquatard between the upper and lower sand units. In general, groundwater from the upper sand discharges to surface water where it overlies the upper clay formation.

Section 3: Summary of Environmental Investigations

3.1 Areas of Investigations

In 2000, Hercules and EPA entered into a Facility Lead Agreement (FLA) for the implementation of Corrective Action under RCRA. In October 2001, Hercules submitted a Facility Lead Corrective Action Agreement Workplan identifying 34 Solid Waste Management Units (SWMUs). Of the 34 SWMUs identified, 10 were designated as needing further investigation, and 24 SWMUs were designated as needing No Further Action (NFA).

Several phases of a RCRA Facility Investigation (RFI) were conducted at the Facility under the FLA. In addition to the 10 SWMUs, various surface water bodies within and adjacent to the Facility property were investigated. Two SWMUs, Solid Waste Incinerator (SWMU 16) and Teepee Incinerator (SWMU 34) were determined by EPA to require no further action after the results from the Phase III investigation, and were not retained for evaluation in the human health or ecological risk assessments. In addition, the Main Holding Basin (SWMU 1) was not investigated under the RFI, since sludge and soils were removed and replaced with clean soils under Virginia Department of Environmental Quality (VDEQ) action in 1993. Hercules filed a deed restriction on groundwater use in 1999 for the MHB as a final requirement to receive a Certificate of No Further Action from VDEQ. However, under the RFI, groundwater was investigated around the MHB by installing monitoring wells and sampling groundwater from the wells.

All of the SWMUs investigated under the RFI are no longer used by Hercules. The Eastern White Lagoon (SWMU 3), the Western White Lagoon (SWMU 4), and the Vacuum Filter Sludge Pile (SWMU 15) were investigated as possible sources to groundwater contamination during the Phase III investigation. The predominant organics in groundwater at the Site consist of t-Butanol, diethyl ether, ethanol and methanol.

For SWMU 15, none of the organics identified in groundwater were found in the soil (sludge) samples. Analytical results from SWMU 15 groundwater well (VFSP-MW-1) have shown low levels of T-Butanol and diethyl ether, but at levels well below the applicable screening levels. This SWMU is not considered an ongoing source for groundwater contamination.

For SWMU 3 and SWMU 4, t-Butanol was detected in soil (sludge) samples in both lagoons. Residual sludge ranged from between 2 and 11 feet thick in the Western White Lagoon (SWMU 4) and 3 and 7 feet thick in the Eastern White Lagoon (SWMU 3). The lagoons were not used after 1989. Historical groundwater analytical results from monitoring wells around the lagoons show concentrations of t-Butanol (ranging from 30 ug/l to 590 ug/l) and diethyl ether (ranging from 810 ug/l to 8200 ug/l) in concentrations over their applicable screening levels. For t-Butanol the screening level of 150 ug/l was used and for diethyl ether the Regional Screening Level of 310 ug/l was used. Since the

2002 groundwater well sampling event, t-Butanol concentrations have decreased in wells WWL-2 (73 ug/l) and WWL-3L (Non-Detect), while remaining steady in well WWL-1 (330 ug/l). Diethyl ether concentrations in well WWL-3 (8100 ug/l) have remained stable, while concentrations in well WWL-3U (810 ug/l) have decreased by an order of magnitude. Groundwater trends are discussed in Section 8 of the *Final RFI Summary Report* dated November 28, 2011.

The following SWMUs, various surface water bodies, and groundwater related to MHB were retained for evaluation in the human health and ecological risk assessments for the Site:

- SWMU 3: Eastern Whitewater Lagoon (WWL);
- SWMU 4: Western Whitewater Lagoon (WWL);
- SWMU 5: Old Landfill and Landfill #156 (LF);
- SWMU 7: Natrosol Lagoon (NAT);
- SWMU 8 and 29: Retention/Aqualon Basin (RAB) (SWMUs 8 & 29 were addressed as one physical unit during RFI);
- SWMU 14: Sludge Drying Beds (SDB);
- SWMU 15: Vacuum Filter Sludge Pile (VFSP);
- Groundwater Main Holding Basin (MHB);
- East and West Bear Creek;
- Unnamed Tributary;
- Cattail Creek; and
- Bailey Creek.

The RFI was conducted in three (3) Phases. Each Phase building upon the previous information gathered to define the nature and extent of any contamination that may have been identified. For all environmental investigations, groundwater concentrations were screened against federal Maximum Contaminant Levels (MCLs) promulgated pursuant to Section 42 U.S.C. §§ 300f et seq. of the Safe Drinking Water Act and codified at 40 CFR Part 141, or EPA Regional Screening Levels (RSL) for tap water for chemicals for which there are no applicable MCL. Soil concentrations were screened against EPA RSLs for residential soil and industrial soil. EPA also has RSLs to protect groundwater, and soil concentrations were also screened against these RSLs.

3.2 Phase I and II Investigations

The Phase I Investigation was conducted in December 2001 and included groundwater well sampling at Retention/Aqualon Basin (SWMUs 8 and 29) and soil sampling at Sludge Drying Beds (SWMU 14), Vacuum Filter Sludge Pile (SWMU 15), Solid Waste Incinerator (SWMU 16) and Teepee Incinerator (SWMU 34).

The Phase II Investigation was conducted in November 2002, and included the installation and sampling of nine new groundwater monitoring wells associated with Eastern Whitewater Lagoon (SWMU 3), Western Whitewater Lagoon (SWMU 4) and

Old Landfill and Landfill #156 (SWMU 5).

3.3 Phase III Investigation

The Phase III Investigation was conducted in May and June 2007. The comprehensive investigation included the collection of soil, sludge, and sediment samples from the Eastern Whitewater Lagoon (SWMU 3), Western Whitewater Lagoon (SWMU 4), Natrosol Lagoon (SWMU 7), Old Landfill and Landfill #156 (SWMU 5), Sludge Drying Beds (SWMU 14) and Vacuum Filter Sludge Pile (SWMU 15). The Phase III investigation also included the installation of 4 new groundwater monitoring wells and site wide sampling of the entire groundwater monitoring network. In addition, an Ecological Evaluation was performed along with the collection of samples from ecological habitat in support of a Screening Level Ecological Risk assessment.

3.4 Constituents of Potential Concern

All available soil, groundwater, sludge, sediment and surface water data collected during the phased investigations were included, as appropriate, in the 2011 EPA-approved Human Health Risk Assessment (HHRA) and Baseline Ecological Risk Assessment (BERA) for the Facility. The following sections and referenced tables summarize the Constituents of Potential Concern (COPCs) identified, by environmental media, in the risk assessments.

3.4.1 Soil COPCs

Human Health

During the RFI investigations, surface soil samples (defined as 0- to 2-feet below ground surface [bgs]) were collected from the Old Landfill and Landfill #156 (SWMU 5), Sludge Drying Beds (SWMU 14) and Vacuum Filter Sludge Pile (SWMU 15). Solid samples collected from SWMU 14 and SWMU 15 were considered sludge/soil. For the purposes of the HHRA, samples collected from these locations were conservatively evaluated as soil. Samples were collected as follows:

- 13 samples collected from SWMU 5;
- 18 samples collected from SWMU 14; and
- 18 samples collected from SWMU 15.

Soil samples were analyzed for Volatile Organic Compounds (VOCs) plus Tentatively Identified Compounds (TICs), Semivolatile Organic Compounds (SVOCs) plus TICs, acrylamide, alcohols and glycols, metals and other inorganic parameters (e.g., chlorides, nitrates, nitrites, sulfate and total organic carbon).

COPCs (referred to as Constituents of Interest (COI) in the HHRA) for the direct contact pathway were identified as those constituents whose maximum detected concentrations exceeded their respective EPA Regional screening Level (RSL) for Industrial Soil. Other COI were identified in cases where a constituent lacked an

Industrial Soil RSL, did not have an appropriate surrogate and could not be eliminated based on low inherent toxicity. **Table 1** summarizes the COI identified in soil.

Ecological
As indicated above, a total of 13 soil samples were collected from the LF for the analysis of VOCs plus TICs, SVOCs plus TICs, acrylamide, alcohols and glycols, metals and other inorganic parameters. The solid matrix samples collected from SWMU 14 and SWMU 15 may represent sediment because there are periods when standing water is present in these SWMUs. For purposes of the BERA, samples collected from SWMU 14 and SWMU 15 were considered to represent sediment and are discussed in **Section 5.**

The final screening benchmarks used to identify constituents of potential ecological concern (CPEC) for SWMU 5 soil in the BERA are listed below.

- EPA 2010 Ecological Soil Screening Levels;
- EPA 2001 Region 4 Ecological Screening Values; and
- EPA 2003 Region 5 Ecological Screening Levels.

Table 2 summarizes constituents that were detected at concentrations greater than the screening benchmarks and were retained as CPEC for the SWMU 5 soil.

3.4.2 Groundwater COPCs

Human Health
The 2011 risk assessments evaluated groundwater analytical data collected during the 2007 site-wide groundwater monitoring event. Other groundwater monitoring data were collected at the Site prior to 2007; however, the 2007 sampling event was the first comprehensive, site-wide monitoring event conducted at the Site. Samples were collected as follows:

- Four (4) samples collected from the vicinity of SWMU 3 and SWMU 4;
- Five (5) samples collected from the vicinity of SWMU 5;
- Four (4) samples (plus one duplicate sample) collected from the vicinity of SWMU 7;
- Three (3) samples collected from the vicinity of SWMU 8 and 29;
- Three (3) samples collected from the vicinity of SWMU 14;
- One (1) sample collected from the vicinity of SWMU 15; and
- 15 samples collected from the vicinity of the Main Holding Basin.

Groundwater samples were analyzed for VOCs plus TICs, SVOCs plus TICs, acrylamide, alcohols and glycols, total and dissolved metals, and other inorganic parameters (e.g., chlorides, nitrates, nitrites, sulfate).

Direct Contact COPCs

Constituents of Interest for the direct contact pathway were identified as those constituents whose maximum detected concentrations exceeded their respective MCL, or in the absence of a MCL, the respective Tapwater RSL. Although groundwater at the Site is not used as a source of drinking water, the Tapwater RSLs for non-carcinogenic constituents were adjusted to reflect a conservative screening HQ of 0.1. **Table 3** summarizes the COI identified for groundwater (direct contact pathway).

Vapor Intrusion COPCs

The vapor intrusion pathway was also evaluated for a current or future hypothetical industrial scenario. To identify COI for the vapor intrusion pathway, groundwater concentrations were compared to EPA screening values appropriate for the vapor intrusion pathway obtained from the *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (Office of Solid Waste and Emergency Response, December 2001). These values are generic screening values that are protective of indoor air for residential land uses. Because the site is a non-residential property, comparison of the groundwater data to these values is a conservative method to identify COI. **Table 3** summarizes the constituents that were identified as COI for vapor intrusion from groundwater to indoor air.

Ecological

No CPEC for groundwater were identified in the BERA. Groundwater is not considered a potential exposure medium for ecological receptors as there are no direct pathways for groundwater contact. The potential for groundwater to migrate to surface water was considered through the direct evaluation of surface water.

3.4.3 Sediment COPCs

Human Health

Sediment samples were collected from SWMU 3, SWMU 4, SWMU 7, East Bear Creek, West Bear Creek, the Unnamed Tributary, Cattail Creek and Bailey Creek. Solid samples from the lagoons are considered sludge/sediment. For the purposes of the human health risk assessment, samples collected from these locations were evaluated as sediment. Samples were collected as follows:

- 10 samples collected from SWMU 3;
- 11 samples collected from SWMU 4;
- Six (6) samples collected from the SWMU 7;
- Four (4) samples collected from East Bear Creek;
- Four (4) samples collected from West Bear Creek;
- Five (5) samples collected from the Unnamed Tributary;

- Three (3) samples collected from Cattail Creek; and
- One (1) sample collected from Bailey Creek.

Sediment samples were analyzed for VOCs plus TICs, SVOCs plus TICs, acrylamide, alcohols and glycols, Polychlorinated Biphenyls (PCBs), metals and other inorganic parameters.

The COI identification process for constituents in sediment was identical to that for soil. The screening values were based on the RSL for Industrial Soil. Other COI were identified in cases where a constituent lacked an Industrial Soil RSL, did not have an appropriate surrogate and could not be eliminated based on low inherent toxicity. **Table 4** summarizes the COI identified for sediment.

Ecological
The sediment samples collected from SWMU 3, SWMU 4, SWMU 7, East Bear Creek, West Bear Creek, the Unnamed Tributary, Cattail Creek and Bailey Creek outlined above were included in the ecological risk assessment. As indicated in **Section 3.4.1**, the solid matrix samples collected from the SDBs (18 samples) and SWMU 15 (18 samples) were considered to represent sediment and were evaluated as such in the BERA.

The final screening benchmarks used to identify CPEC for sediment of each aquatic habitat are listed below.

- EPA 2006 Region 3 Freshwater Sediment Screening Benchmarks;
- EPA 2003 Region 5 RCRA Ecological Screening Levels for Sediment; and
- EPA 1999 Freshwater Sediment Toxicity Reference Values.

Table 4 summarizes the constituents that were detected at concentrations greater than the screening benchmarks and were retained as CPEC for sediment.

3.4.4 Surface Water COPCs

Human Health
Surface water samples were collected from SWMU 3, SWMU 4, SWMU 7, SWMU 14, SWMU 15, East Bear Creek, West Bear Creek, the Unnamed Tributary, Cattail Creek and Bailey Creek. Samples were collected as follows:

- Three (3) samples collected from SWMU 3;
- Three (3) samples collected from SWMU 4;
- Two (2) samples collected from SWMU 7;
- Three (3) samples collected from SWMU 14;

- One (1) sample collected from SWMU 15;
- Three (3) samples collected from East Bear Creek;
- Three (3) samples collected from West Bear Creek;
- Three (3) samples collected from the Unnamed Tributary;
- Three (3) samples collected from Cattail Creek; and
- One (1) sample collected from Bailey Creek.

Surface water samples were analyzed for VOCs plus TICs, SVOCs plus TICs, acrylamide, alcohols and glycols, total metals and other inorganic parameters.

For constituents in surface water, screening values were based primarily on the 2010 Virginia Water Quality Standards (WQS) for Human Health. In the absence of a Virginia WQS, the EPA Tapwater RSLs were conservatively used to identify COI in surface water. **Table 4** summarizes the COI that were identified in surface water.

Ecological

The surface water samples collected from SWMU 3, SWMU 4, SWMU 7, SWMU 14, SWMU 15, East Bear Creek, West Bear Creek, the Unnamed Tributary, Cattail Creek and Bailey Creek outlined above were included in the ecological risk assessment.

The final screening benchmarks used to identify CPEC for surface water of each aquatic habitat are listed below.

- EPA 2006 Region 3 Freshwater Screening Benchmarks;
- EPA 2009 National Recommended Water Quality Criteria (WQC) – Chronic Freshwater Values;
- EPA 2001 Region 4 Freshwater Chronic Screening Values;
- EPA 2003 Region 5 RCRA Ecological Screening Levels for Water; and
- Oak Ridge National Laboratory Freshwater Tier II Secondary Chronic Values.

Table 2 summarizes the constituents that were detected at concentrations greater than the screening benchmarks and were retained as CPEC for surface water.

3.4.5 Identification of COPC for Unknown TICs

The screening process to identify COPC (referred to as COI in the HHRA or CPEC in the case of the BERA) for unknown TICs was identical to the screening process presented above for standard analytes in each medium. The basis for the constituent-specific screening values used in the comparisons for unknown TICs is the probable TIC identity or probable TIC chemical class assigned to the unknown TICs. If RSLs or ecological screening benchmarks were not available

for an assigned identity, surrogate screening values were selected based on constituents with structural similarity. In addition, for unknown TICs assigned to a chemical class, a representative chemical was selected to conservatively represent that chemical class. Those unknown TICs whose concentrations were below the RSLs or screening benchmarks were eliminated as COPC.

3.5 Groundwater Study in 2012

As indicated in the *Final RFI Summary Report* and associated attachments, the HHRA documented that there were no unacceptable risks or hazards to human health receptors associated with groundwater exposure at the Site. The objective of the 2012 sampling event was to add to the existing data set to demonstrate that the current groundwater conditions and observed concentrations are consistent with the groundwater data incorporated into the HHRA. The groundwater sampling results indicated that the COI concentrations were similar to previous results. Results of the 2012 groundwater sampling event are presented in the *Corrective Measures Study*, dated April 2014.

3.6 Geochemistry

In April and May 2011, Hercules conducted geochemical sampling of soil and groundwater at the Site, in the vicinity of the Main Holding Basin, in order to identify and quantify groundwater/sediment reactions, and understand the aquifer geochemistry. A detail discussion is presented in Section 9 of the *Final RFI Summary Report*. Sampling results were evaluated as they pertain to microbial biodegradation reactions in the aquifer that have the potential to reduce concentrations of organic constituents in the aquifer. The predominant organics in groundwater include diethyl ether, t-butanol, ethanol, and methanol.

Field measurements and laboratory analytical results for the geochemical parameters show the occurrence of active biodegradation of organic compounds. Aerobic and anaerobic biodegradation reactions are occurring that result in a reduction of oxidizing agents (oxygen and nitrate in groundwater) and high levels of reduced by products (ammonium, sulfide, iron and manganese). Additionally, the redox potential is low in the plume showing the consumption of natural aquifer oxidizing agents by reactions with organic reducing agents. Although the organic contaminants persist in the aquifer, there are high concentrations of reducible iron hydroxide minerals in the solid phase that will allow microorganisms to continue biodegradation of the organic contaminants.

Section 4: Potential Receptors and Exposure Pathways

4.1 Human Health

As an active facility, potential human receptors were identified based on the assumption that current and future land use is non-residential. Additional information regarding the Facility's industrial land use designation was included in Section 2.3 of the November 2007 *Phase III Site Investigation Summary Report.*

In addition, land use restrictions will be implemented for the Site that will prohibit future residential use. These land use restrictions will also prohibit the use of groundwater for any purpose. Further detail regarding the land use restrictions is included in **Section 7.5**. Recreational use of the offsite surface water bodies (Bailey Creek and Cattail Creek) is possible. As outlined in Section 4.2 of the HHRA, the following potential receptors were evaluated for the Site:

- Current/Future Onsite Outdoor Industrial Worker;
- Current/Future Onsite Indoor Industrial Worker;
- Current/Future Onsite Construction Worker;
- Current/Future Onsite Youth Trespasser;
- Current/Future Offsite Recreational Adult; and
- Current/Future Offsite Recreational Youth.

In the HHRA, receptors were evaluated based on the media (i.e., surface water vs. soil) they would likely come in contact with and the frequency of Site visits (i.e., employee vs. trespasser). For example, an outdoor worker is evaluated for direct exposure to surface soil and onsite standing surface water whereas a temporary construction worker may be evaluated for direct exposure to surface soil as well as shallow groundwater. Offsite streams were also taken into account as potentially complete exposure pathways for the recreational receptors' swimming. Specifically, the receptors identified above were evaluated for the following exposure routes:

- Outdoor Industrial Worker
  - Surface soil from onsite SWMUs (5, 14 and 15) via incidental ingestion, dermal contact, inhalation of particulates and inhalation of volatiles;
  - Sediment from onsite SWMUs (3, 4 and 7) via incidental ingestion and dermal contact; and
  - Surface water from onsite SWMUs (3, 4, 7, 14 and 15) via incidental ingestion and dermal contact.
- Indoor Industrial Worker
  - Indoor air (vapor intrusion from groundwater) from onsite groundwater (associated with SWMUs 3 and 4, SWMU 5, SWMU 7, SWMU 8 and 29, SWMU 14, SWMU 15 and Main Holding Basin) via inhalation
- Construction Worker
  - Surface soil from onsite SWMUs via incidental ingestions, dermal contact, inhalation of particulates and inhalation of volatiles;
  - Onsite groundwater via incidental ingestion, dermal contact and inhalation of volatiles; and
  - Sediment and surface water from onsite SWMUs via incidental ingestion and dermal contact.

- Youth Trespasser
  - Sediment and surface water from onsite surface water bodies (East Bear Creek, West Bear Creek and the Unnamed Tributary) via incidental ingestion and dermal contact.
- Recreational Adult and Youth
  - Sediment and surface water from offsite surface water bodies (Cattail Creek and Bailey Creek) via incidental ingestion and dermal contact.

Additional information regarding the potential human receptors and exposure routes can be found in Section 4.0 of the HHRA.

Based on the conclusions of the HHRA for surface water, sediment, vapor inhalation, soil and groundwater, potential hazards and risks associated with anticipated routine exposures do not pose a risk to humans who may live nearby or work at the Facility. It is noted there are no current or future direct exposures anticipated with groundwater at the Facility.

4.2 Ecological

In order to identify potential species or ecosystems that could be at risk, representative ecological receptors were selected based on the potential to be exposed to CPEC. Potential habitats were identified during initial Site reconnaissance (conducted as part of the 2007 Screening Level Ecological Risk Assessment) as well as more recent Site visits and EPA recommendations. The following habitats have been identified at the Site:

- Terrestrial habitat of the Landfill area;
- Aquatic habitat of SWMU 3, SWMU 4, SWMU 7, SWMU 14 and SWMU 15 (lentic systems); and
- Aquatic habitat of East and West Bear Creek, the Unnamed Tributary, Bailey Creek and Cattail Creek (lotic systems).

The selection of representative species and receptor groups was based on species residence in the receptor habitats, dynamics, toxicological sensitivity to constituents and ecological relevance. Other factors that can affect the perceived value of different species, such as status as a game or commercial species or as a threatened or endangered species, were also considered.

The following representative species and receptor groups were evaluated as potential ecological receptors at the Site:

- Terrestrial birds (American robin and red-tailed hawk);
- Terrestrial mammals (short-tailed shrew and red fox);
- Aquatic invertebrates and fish;

- Semi-aquatic birds (mallard and great blue heron); and
- Semi-aquatic mammals (mink).

The following potentially complete and significant exposure pathways were identified for the Site:

- Incidental ingestion of surface soil by terrestrial birds and mammals;
- Ingestion of plants, invertebrates and small animal prey by terrestrial birds and mammals;
- Direct contact with sediment and surface water by macroinvertebrates and fish;
- Incidental ingestion of sediment by semi-aquatic birds and mammals;
- Ingestion of surface water by semi-aquatic birds and mammals; and
- Ingestion of prey (invertebrates and fish) by semi-aquatic birds and mammals.

Additional information regarding the potential ecological receptors can be found in Section 3.3 of the BERA.

Based on the conclusions of the BERA, adverse ecological hazard to terrestrial and aquatic receptors in the habitats associated with the Facility is low, not visually observable, and associated with the physical characteristics of the habitat rather than the presence of chemical constituents in environmental media.

4.3 Environmental Indicators

Under the Government Performance and Results Act (GPRA), EPA has set national goals to address RCRA corrective action facilities. Under GPRA, EPA evaluates two key environmental clean-up indicators for each facility: (1) Current Human Exposures Under Control, and (2) Migration of Contaminated Groundwater Under Control. The Facility met both the Current Human Exposures Under Control and the Migration of Contaminated Groundwater Under Control in September 2004.

Section 5: Corrective Action Objectives

EPA's Corrective Action Objectives (CAO) for the specific environmental media at the Facility are the following:

Soils

EPA's Corrective Action Objective for soils is to attain the applicable RSLs for industrial soils.

Groundwater
EPA's Corrective Action Objectives for Facility groundwater are 1) to restore the groundwater to drinking water standards, otherwise known as MCLs, or to the relevant tap water RSL for contaminants that do not have an MCL and, 2) until such time as drinking water standards are restored, to control exposure to the hazardous constituents remaining in the groundwater by requiring the continued implementation of the groundwater monitoring program, the installation of vapor intrusion control systems where necessary, and compliance with and maintenance of groundwater use restrictions.

Section 6: Proposed Remedy

1. Soils

Facility soils have attained applicable RSLs for industrial use. Therefore, EPA has determined that there are currently no unacceptable risks to human health and the environment via the soil direct contact or inhalation exposure pathway for the present and anticipated industrial use of the Facility property. EPA's proposed remedy for Facility soils, therefore, is to prohibit residential use of the Facility through land use restrictions. See Paragraph 3 of this Section, for a list of the use restrictions EPA proposes for the Facility.

2. Groundwater

Monitoring at the Facility has shown that the contaminants are effectively being addressed by natural attenuation. Specifically, the extent of contamination in groundwater is not increasing and concentrations of contaminants are declining over time. A synopsis of the Site geochemistry is presented in Section 3.6 as well as a more detail discussion of natural attenuation in Section 9.0 of the *Final RFI Summary Report.* Groundwater trends are presented in Section 8 of the *Final RFI Summary Report.* Therefore, the proposed remedy for groundwater consists of monitored natural attenuation until MCLs or the RSL for tap water are met, and compliance with and maintenance of groundwater use restrictions at the Facility to prevent exposure to contaminants while levels remain above drinking water standards. See Paragraph 3 of this Section, for a list of the use restrictions EPA proposes for the Facility. The proposed remedy also includes the installation of a vapor intrusion control system in all new structures, as necessary, the design of which shall be submitted to EPA for review and approval.

3. Institutional Controls

Because some contaminants remain in the soil and groundwater at the Facility at levels which exceed residential use, EPA's proposed remedy requires the compliance with and maintenance of land and groundwater use restrictions. EPA is proposing the following land and groundwater use restrictions be implemented and maintained at the Facility:

1. Groundwater at the Facility shall not be used for any purpose other than to conduct the operation, maintenance, and monitoring activities required by VADEQ and/or EPA, unless it is demonstrated to EPA, that such use will not pose a threat to human health or the environment or adversely affect or interfere with the final remedy and EPA provides prior written approval for such use;

2. No new wells will be installed on Facility property unless it is demonstrated to EPA that such wells are necessary to implement the final remedy and EPA provides prior written approval to install such wells.

3. The Facility property shall not be used for residential purposes unless it is demonstrated to EPA that such use will not pose a threat to human health or the environment or adversely affect or interfere with the final remedy, and EPA provides prior written approval for such use;

4. All earth moving activities, including excavation, drilling and construction activities, in the areas at the Facility where any contaminants remain in soils above EPA Region III's Screening Levels for Industrial Soils or in groundwater above their MCLs or EPA Region III's Tap Water RSLs, shall be prohibited unless it is demonstrated to EPA that such activity will not pose a threat to human health or the environment or adversely affect or interfere with the final remedy, and EPA provides prior written approval for such use. In the event of such approval, a Materials Management Plan specifying protocols for soil, groundwater, and surface water within the plume areas will be created for all earth moving activities and submitted in writing to EPA for review and approval;

5. A vapor intrusion control system, the design of which shall be approved in advance by EPA, shall be installed in each new structure constructed above the contaminated groundwater plume or within 100-foot around the perimeter of the contaminated groundwater plume, unless it is demonstrated to EPA that vapor intrusion does not pose a threat to human health and EPA provides prior written approval that no vapor intrusion control system is needed;

6. The existing soil cover over SWMU 5 (Old Landfill and Landfill #156) shall be maintained to prevent exposure and provide a substrate for vegetation to grow.

The Facility property will not be used in a way that will adversely affect or interfere with the integrity and protectiveness of the final remedy selected by EPA in the Final Decision and Response to Comments (FDRTC);

Access to the Facility property will be restricted through the use and maintenance of fencing and controlled access (security gate).

EPA, VADEQ, and/or their authorized agents and representatives, shall have access to the Facility property to inspect and evaluate the continued effectiveness of the final remedy and if necessary, to conduct additional remediation to ensure the protection of the public health and safety and the environment based upon the final remedy selected in the FDRTC.

EPA proposes to implement the land and groundwater use restrictions through an enforceable mechanism such as an order, permit and/or an Environmental Covenant pursuant to the Virginia Uniform Environmental Covenants Act (UECA), Title 10.1, Chapter 12.2, §§10.1-1238 - 10.1-1250 of the Code of Virginia. If an Environmental Covenant is selected, it will be recorded in the chain of title for the Facility property.

In addition, the Commonwealth of Virginia State Board of Health Private Well Regulations, 12 VAC 5-630-10 et seq. (Regulations) and its implementing statute set forth at the Code of Virginia, Title 32.1 (Health), Chapter 6 (Environmental Health Services), Va. Code §32.1, is an institutional control mechanism that will reduce potential human exposure to contaminated groundwater attributable to the Facility. Pursuant to Section 12 VAC 5-630-30, the purpose of these Regulations is to "ensure that all private wells are located, constructed and maintained in a manner which does not adversely affect ground water resources, or the public welfare, safety and health."

Accordingly, Section 12 VAC 5-630-230 through 12 VAC 5-630-270 of the Regulations prescribes the process by which construction permits for the installation of private wells are received and issued. Pursuant to the Regulations, if a private well is installed or modified without a permit, Section 12 VAC 5-630-150 sets forth an enforcement mechanism which provides for the notification of violations of the Regulations, the issuance of orders requiring cessation and correction of violations, appropriate remedial action to ensure that the violation does not recur, and any appropriate corrective action to ensure compliance with the Regulations.

4. Additional Requirements

1. On an annual basis and whenever requested by VADEQ or EPA, the then current owner shall submit to VADEQ and EPA a written certification stating whether the groundwater and land use restrictions are in place and being complied with.

2. Within one month after any of the following events, the then current owner of the Facility shall submit, to VADEQ and EPA written documentation describing the following: observed noncompliance with the land and/or groundwater use restrictions; transfer of the Facility; changes in use of the Facility; or filing of applications for building permits for the Facility and any proposals for any Site work, if such building or proposed Site work will affect the contamination on the Facility.

3. In addition, the Facility owner shall provide VADEQ and EPA with a coordinate survey as well as a metes and bounds survey, of the Facility boundary. Mapping the extent of the land use restrictions will allow for presentation in a publicly accessible mapping program such as Google Earth or Google Maps.

4. A Materials Management Plan shall be submitted for review and written approval by EPA before any earth moving activities, including construction and drilling, can be conducted on areas known to contain COCs. The Materials Management Plan will detail how soil and groundwater will be managed during any future subsurface activities conducted at the Facility. The Materials Management Plan will detail how all excavated soils will be handled and disposed. All soils that are to be disposed of shall be sampled and disposed of in accordance with applicable State and Federal regulations. The Materials Management Plan will include analysis of constituents detected at the Facility not previously identified.

Soil remediation cleanup standards will be EPA's RSL for industrial soil. In addition, the Materials Management Plan will include soil stabilization requirements to minimize contact between storm water runoff and the parcel soils. Soil stabilization measures may include the construction of berms to prevent storm water from flowing onto certain areas as well as the construction of sumps with pumps to remove ponded water from low lying areas.

Section 7: Evaluation of Proposed Remedy

This section provides a description of the criteria EPA used to evaluate the proposed remedy consistent with EPA guidance. The criteria are applied in two phases. In the first phase, EPA evaluates three decision threshold criteria as general goals. In the second phase, for those remedies which meet the threshold criteria, EPA then evaluates seven balancing criteria.

Threshold Criteria	Evaluation
1) Protect human health and the environment	EPA's proposed remedy for the Facility protects human health and the environment by eliminating, reducing, or controlling potential unacceptable risk through the implementation and maintenance of land and groundwater use restrictions. EPA is proposing to restrict land use to commercial or industrial purposes at the Facility. With respect to groundwater, while low levels of contaminants remain in the groundwater beneath the Facility, the contaminants are contained in the aquifer and decreasing through attenuation or are stable at the facility as shown by

	groundwater monitoring. Groundwater trends are presented in Section 8 of the *Final RFI Summary Report*. In addition, groundwater monitoring will continue until groundwater clean-up standards are met. The existing State of Virginia well construction regulations will aid in minimizing exposure to contaminated groundwater by restricting the installation of wells in contaminated water sources. With respect to future uses, the proposed remedy requires groundwater use restrictions to minimize the potential for human exposure to contamination and protect the integrity of the remedy.
2) Achieve media cleanup objectives	EPA's proposed remedies meet the media cleanup objectives based on assumptions regarding current and reasonably anticipated land and water resource use(s). The remedy proposed in this SB is based on the current and future anticipated land use at the Facility as commercial or industrial. As such, industrial media cleanup objectives were selected and the majority of Facility soils contain contaminant concentrations that are below EPA's industrial soil RSLs. The Risk Assessment for the Facility concluded that there would be no risk associated with the soil as long as the Facility remains industrial. The groundwater plume appears to be stable (not migrating); although contaminants are above MCLs, they are either stable or declining over time. In addition, groundwater monitoring will continue until groundwater clean-up standards are met. The Facility meets EPA risk guidelines for human health and the environment. EPA's proposed remedy requires the implementation and maintenance of institutional controls to ensure that groundwater beneath Facility property is not used for any purpose except to conduct the operation, maintenance, and monitoring activities required by VADEQ and EPA
3) Remediating the Source of Releases	With all proposed remedies, EPA seeks to eliminate or reduce further releases of hazardous wastes and hazardous constituents that may pose a threat to human health and the environment. The Facility has met this objective. As documented in Section 2.5 of the Corrective Measures Study dated April 2014, the remaining SWMUs at the Facility are out of service and remaining source material (i.e., sludge in the Eastern/Western Whitewater Lagoons (SWMU 3 and 4) have been in place for many years. Given these reasons, it is expected that the source strength has diminished and the groundwater concentrations are expected to continue to

	decrease. This hypothesis was further substantiated by the results of the 2011 geochemical evaluation (Section 9.0 of the Final RFI Summary Report), in which sampling results indicated that intrinsic microorganisms are utilizing naturally-occurring terminal electron acceptors to actively oxidize organics in the aquifers. Although organics have not been eliminated in groundwater by biodegradation reactions to date; the presence of reducible iron and manganese minerals in the solid phase in the aquifer, which can be used as terminal electron acceptors, indicate that the aquifer has the ability to continue to promote microbial biodegradation reactions for organics in the future. Groundwater is not used for potable purposes at the Facility or at neighboring facilities. In addition, groundwater monitoring will continue until groundwater clean-up standards are met through natural attenuation.
Balancing Criteria	Evaluation
4) Long-term effectiveness	Groundwater is not used on the Facility for drinking water, and no down gradient users of off-site groundwater exist. Therefore, the proposed long term effectiveness of the remedy for the Facility will be maintained by the continuation of the groundwater monitoring program and implementation of land use controls (institutional controls).
5) Reduction of toxicity, mobility, or volume of the Hazardous Constituents	The reduction of toxicity, mobility and volume of hazardous constituents will continue by attenuation at the Facility. Reduction has already been achieved, as demonstrated by the data from the groundwater monitoring. In addition, the groundwater monitoring program already in place will continue.
6) Short-term effectiveness	EPA's proposed remedy does not involve any activities, such as construction or excavation that would pose short-term risks to workers, residents, and the environment. EPA anticipates that the land and groundwater use restrictions will be fully implemented shortly after the issuance of the Final Decision and Response to Comments. The groundwater monitoring program is already in place and will continue.
7) Implementability	EPA's proposed decision is readily implementable. The groundwater monitoring is already in place and operational. EPA does not anticipate any regulatory constraints in implementing its proposed remedy. EPA proposes to implement the institutional controls through an enforceable mechanism such as an environmental covenant

8) Cost	EPA's proposed remedy is cost effective. The costs associated with this proposed remedy and the continuation of groundwater monitoring have already been incurred. The long-term monitoring plan when approved by EPA, will require far less groundwater monitoring then under the RFI, which will significantly reduce the annual costs for monitoring. The costs to record an environmental covenant in the chain of title to the Facility property are minimal. The costs associated with issuing an order are also minimal.
9) Community Acceptance	EPA will evaluate community acceptance of the proposed remedy during the public comment period, and it will be described in the Final Decision and Response to Comments.
10) State/Support Agency Acceptance	VDEQ has reviewed and concurred with the proposed remedy for the Facility.

Section 8: Financial Assurance

EPA has evaluated whether financial assurance for corrective action is necessary to implement EPA's proposed remedy at the Facility. Given that EPA's proposed remedy does not require any further engineering actions to remediate soil, groundwater or indoor air contamination at this time and given that the costs of implementing institutional controls at the Facility will be de minimis, EPA is proposing that no financial assurance be required.

Section 9: Public Participation

Interested persons are invited to comment on EPA's proposed remedy. The public comment period will last 30 calendar days from the date that notice is published in a local newspaper. Comments may be submitted by mail, fax, e-mail, or phone to Mr. Michael Jacobi at the address listed below.

A public meeting will be held upon request. Requests for a public meeting should be made to Mr. Michael Jacobi at the address listed below. A meeting will not be scheduled unless one is requested.

The Administrative Record contains all the information considered by EPA for the proposed remedy at this Facility. The Administrative Record is available at the following location:

U.S. EPA Region III
1650 Arch Street
Philadelphia, PA 19103
Contact: Mr. Michael Jacobi (3LC20)
Phone: (215) 814-3435
Fax: (215) 814 - 3113
Email: jacobi.mike@epa.gov

ATTACHMENTS:

Figure 1: Location Map
Table 1: Summary of Constituent of Interest in Soil in the Human Health Risk Assessment
Table 2: Summary of Constituents of Potential Ecological Concern in All Areas
Table 3: Summary of Constituent of Interest in Groundwater in the Human Health Risk Assessment
Table 4: Summary of Constituent of Interest in Sediment and Surface Water in the Human Health Risk Assessment

Date: 5.26.15

John A. Armstead, Director
Land and Chemicals Division
US EPA, Region III

Section 10: Index to Administrative Record

EPA and Hercules Facility Lead Agreement - signed February 4, 2000

Hercules Letter to EPA dated November 8, 2001; attachments
Volume 1 = QAPP dated October 2001
Volume 2 = Facility Lead CA Agreement Workplan (FLCAA) – dated October 2001

EPA letter dated 11/29/2001 "approval of FLCAA Work Plan, dated October 2001.

Copies of Final Environmental Indicator Forms, EI 725 and EI 750

Hercules RCRA Facility Investigation Report, Phase I and II Investigations, Facility Lead Corrective Action, dated September 2005.

Hercules Phase III Sampling and Analysis Plan – Revision No. 1, dated April 2007

Hercules Phase III Site Investigation Summary Report (including EPA Response to Comments on Phase I/II RFI Report), dated November 2007.

Hercules, Interim Tentatively Identified Compounds (TIC) Submittal, dated July 6, 2010.

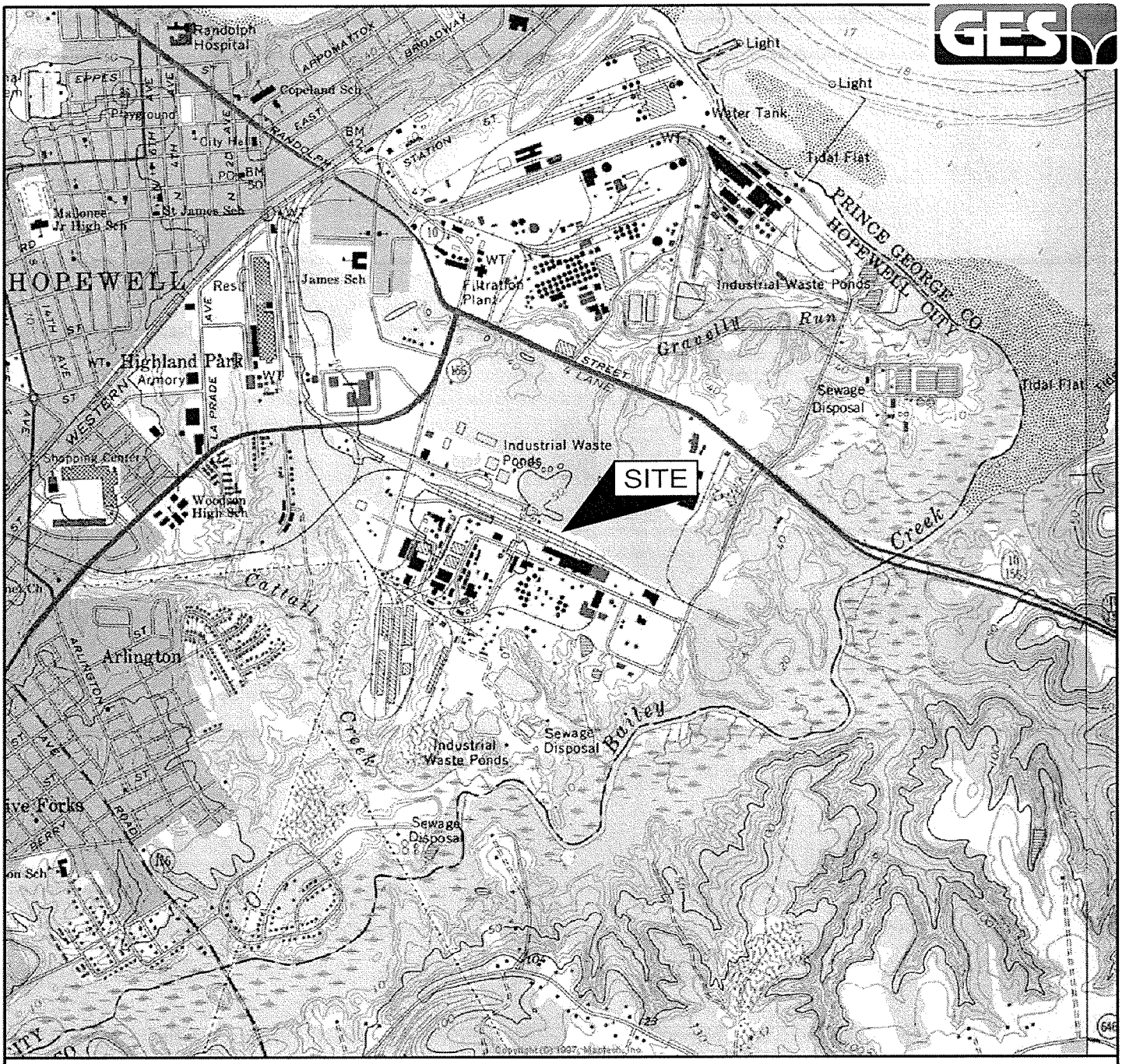
EPA Email dated 7/28/2010- concurrence on path forward for TIC evaluation based on July 6, 2010 TIC Report.

Hercules Final RFI Summary Report (appended by HHRA and BERA), November 28, 2011.

EPA Letter dated March 27, 2012, approving the Hercules Final RFI Report dated November 28, 2011.

Hercules Corrective Measures Study Report, dated April 2014.

Hercules 2013/2014 Groundwater Monitoring Report, dated January 2015



SOURCE: USGS 7.5 MINUTE SERIES
TOPOGRAPHIC QUADRANGLE 1987
HOPEWELL, VIRGINIA
CONTOUR INTERVAL = 10'

QUADRANGLE LOCATION
LAT. 037° 17' 19.86" N
LONG. 077° 16' 37.63" W
(APPROXIMATE SITE COORDINATES)

DRAFTED BY: W.A.W. (N.J.)	SITE LOCATION MAP
CHECKED BY:	HERCULES INCORPORATED AQUALON DIVISION HOPEWELL, VIRGINIA
REVIEWED BY:	Groundwater & Environmental Services, Inc. 23 SOUTH 13th STREET, SUITE 201, RICHMOND, VA 23219
NORTH	SCALE IN FEET: 0 — 2000 / DATE: 10-26-07 / FIGURE: 1

Table 1

Summary of Constituents of Interest (COI) in Soil in the Human Health Risk Assessment

Hercules - Aqualon

Hopewell, Virginia

Area	Pathway	Constituents of Interest	
Landfill Areas (SWMU 5)	Direct Contact	28-Norolean-17-en-3-one 2,2-dimethoxy-propane Arsenic	Chromium Thallium
Sludge Drying Beds (SWMU 14)	Direct Contact	Arsenic	Chromium
Vacuum Filter Sludge Pile (SWMU 15)	Direct Contact	Arsenic Chromium	Iron

Table 2
Summary of Constituents of Potential Ecological Concern (CPEC) in All Areas
Hercules - Aqualon
Hopewell, Virginia

Area	Medium	Constituents of Potential Ecological Concern		Known TICs	Unknown TICs
Landfill Areas (SWMU 5)	Soil	Chloroform Antimony Arsenic Chromium Cobalt Copper Iron	Lead Manganese Mercury Selenium Vanadium Zinc	28-Norolean-17-en-3-one* 4,5-Dimethylthiazole S-oxide* 1-methyl-4-(1-methylethyl)-benzene 2-(2-propenyl)-phenol 2,2-dimethozy-propane	Unknown; phenol Unknown; Chemical class: fluorinated VOC Unknown; Chemical class: dichlorobenzene Unknown; Chemical class: alkane
Eastern Whitewater Lagoon (SWMU 3)	Sediment	2-Butanone 2-Methyl-1-propanol Acetone t-Butanol Methanol Aluminum Antimony Barium Beryllium* Cadmium	Chromium Copper Iron Lead Nickel Silver Thallium* Vanadium Zinc	None	Unknown; carbon disulfide Unknown; Chemical class: alkene Uknown; Chemical class: PAH Unknown; acetaldehyde
	Surface Water	Benzo(a)pyrene Aluminum	Barium	None	Unknown; Chemical class: alkane
Western Whitewater Lagoon (SWMU 4)	Sediment	Acetone Carbon disulfide Diethyl ether t-Butanol Methanol Aluminum Antimony Barium Beryllium* Cadmium	Chromium Copper Iron Lead Nickel Silver Thallium* Vanadium Zinc	1-Decene Cyclododecane nonyl-Cyclopropane	Unknown; carbon disulfide Unknown; Chemical class: alkene Unknown; acetaldehyde Unknown; methoxy ethane Unknown; Chemical class: alkyl ether Unknown; Chemical class: alkyl ring
	Surface Water	Aluminum Barium	Iron Lead	None	None
Natrosol Lagoon (SWMU 7)	Sediment	Acetone t-Butanol Methanol Aluminum Barium	Beryllium* Iron Thallium* Vanadium		Unknown; carbon disulfide Unknown; Chemical class: alkene Unknown; acetaldehyde Unknown; Chemical class: amide
	Surface Water	Aluminum Barium	Iron	None	None

Table 2
Summary of Constituents of Potential Ecological Concern (CPEC) in All Areas
Hercules - Aqualon
Hopewell, Virginia

Area	Medium	Constituents of Potential Ecological Concern		Known TICs	Unknown TICs
Sludge Drying Beds (SWMU 14)	Sediment	2-Butanone 4-Methyl-2-pentanone Acetone Benzo[a]anthracene Benzo[b]fluoranthene Bis(2-ethylhexyl) phthalate Chrysene Aluminum	Barium Beryllium* Chromium Iron Lead Vanadium Zinc	C10H16 Hexanal Hexane Pentanal Nonadecane	None
	Surface Water	Benzon(a)pyrene Dibenz(a,h)anthracene Triphenylphosphine oxide Aluminum	Barium Iron Manganese	None	None
Vacuum Filter Sludge Pile (SWMU 15)	Sediment	2-Butanone Acetone Carbon disulfide Bis(2-ethylhexyl) phthalate Aluminum Antimony Baruium Beryllium* Cadmium Chromium	Copper Iron Lead Manganese Mercury Nickel Selenium Vanadium Zinc	1,3,5-Trimethylbenzene 1-Docosanethiol 1-Dotriacontanol 2,4,6,7,8,8a-hexahydro-5(iH)-azulenone Benzo[b]naphtho[2,3-d]furan Cyclooctacosane Pentacosane Pentatriacontane	Unknown; Chemical class: alkyl aromatic
	Surface Water	Benzon(a)pyrene Benzo(k)fluoranthene Dibenz(a,h)anthracene Aluminum	Barium Iron Lead	None	None
East Bear Creek	Sediment	Acetone Carbon disulfide t-Butanol Methanol PCB-1254 PCB-1260 Aluminum Arsenic Barium Beryllium*	Cadmium Chromium Copper Iron Lead Mercury Thallium* Vanadium Zinc	None	Unknown; acetaldehyde Unknown: Chemical class: alcohol

Table 2
Summary of Constituents of Potential Ecological Concern (CPEC) in All Areas
Hercules - Aqualon
Hopewell, Virginia

Area	Medium	Constituents of Potential Ecological Concern		Known TICs	Unknown TICs
East Bear Creek	Surface Water	Aluminum Barium Beryllium Cadmium Chromium Copper	Iron Lead Manganese Thalliuim Vanadium Zinc	None	None
West Bear Creel	Sediment	2-Butanon Acetone Carbon disulfide Diethyl ether t-Butanol PCB-1254 PCB-1260 hexachloro-1,1'-biphenyl Pentachlorobiphenyl Aluminum Barium	Beryllium* Cadmium Copper Iron Lead Manganese Mercury Nickel Thallium* Vanadium Zinc	2,2',4,4',5-pentachloro-1,1'-biphenyl 2,2',4,5,5'-pentachloro-1,1'-biphenyl 2,3,3',4,4',5-hexachloro-1,1'-biphenyl 2,3',4,4',6-Pentachloror-1,1'-biphenyl Eicosane Hexacosane	Unknown; Chemical class: alkene Unknown; Chemical class: PAH Unknown; acetaldehyde Unknown; Chemical class: alcohol Unknown; Chemical class: ketone
	Surface Water	Aluminum Barium Iron	Lead Manganese Vanadium	None	None
Unnamed Tributary	Sediment	Acetone Carbon disulfide t-Butanol Benzo(b)fluoranthene Indeno(1,2,3-cd)pyrene Methanol PCB-1254 PCB-1260 hexachloro-1,1'-biphenyl Pentachlorobiphenyl Aluminum Antimony Arsenic	Barium Beryllium* Cadmium Chromium Copper Iron Lead Manganese Mercury Nickel Thallium* Vanadium Zinc	2,3',4,4',6-Pentachloror-1,1'-biphenyl pentaxhloro-1,1'-biphenyl 17-Pentatriacontene	Unknown; carbon disulfide Unknown; Chemical class: alkene Unknown; Chemical class: PAH Unknown; acetaldehyde Unknown; Chemical class: alcohol Unknown; Chemical class: alkane
	Surface Water	Aluminum Barium Cadmium Copper Iron	Lead Manganese Vanadium Zinc	None	None

Table 2
Summary of Constituents of Potential Ecological Concern (CPEC) in All Areas
Hercules - Aqualon
Hopewell, Virginia

Area	Medium	Constituents of Potential Ecological Concern		Known TICs	Unknown TICs
Cattail Creek	Sediment	2-Butanone	Beryllium*	1-Naphthalenepropanol, .alpha.-ethenyle	Unknown; carbon disulfide
		Acetone	Copper	nonyl-Cyclopropane	Unknown; Chemical class: alkene
		Carbon disulfide	Iron	Eicosane	Unknown; Chemical class: PAH
		t-Butanol	Lead	Heptacosane	Unknown; acetaldehyde
		Aluminum	Mercury	2,6,10,15-tetramethyl-heptadecane	Unknown; Chemical class: alcohol
		Antimony	Thallium*	Hexadecane	Unknown; Chemical class: ketone
		Arsenic	Vanadium	Pentacosane	Unknown; Chemical class: alkane
		Barium	Zinc		Unknown; Chemical class: cycloalkane
	Surface Water	Aluminum	Iron	None	None
		Barium	Lead		
		Copper	Manganese		
Bailey Creek	Sediment	2-Butanone	Barium	1-Dotriacontanol	Unknown; Chemical class: alkene
		Acetone	Beryllium*	2,4,6,7,8,8a-hexahydro-5(iH)-azulenone	Unknown; acetaldehyde
		Carbon disulfide	Thallium*	Heptadecane	Unknown; Chemical class: alcohol
		Aluminum		9-octyl-heptadecane	Unknown; Chemical class: cycloalkane
	Surface Water	Aluminum	Iron	None	None
		Barium	Manganese		

Notes:
* - This constituent is identified as a CPEC because it lacks a screening value. It is retained for qualitative evaluation

Table 3
Summary of Constituents of Interest (COI) in Groundwater in the Human Health Risk Assessment
Hercules - Aqualon
Hopewell, Virginia

Area	Pathway	Constituents of Interest	
Site-wide	Direct Contact	1,1,2,2-Tetrachloroethane	Arsenic (Total & Dissolved)
		1,1-Dichloroethane	Barium (Total)
		Chloroform	Cadmium (Total)
		Diethyl ether	Chromium (Total & Dissolved)
		t-Butanol	Cobalt (Total & Dissolved)
		Tetrachloroethene	Iron (Total & Dissolved)
		Trichloroethene	Lead (Total)
		1,4-Dioxane	Manganese (Total & Dissolved)
		1,1,2-Trichloro-1-propene	Mercury (Total)
		1,2,3 -Trichloro -1-propene	Nickel (Total)
		1-1'-Oxybis[2-ethoxy-]ethane	Vanadium (Total)
		Ethanol	Unknown; Chemical Class: glycol ether derivative
		Methanol	Unknown; Chemical Class: chlorinated VOC
		Aluminum (Total)	Unknown; Chemical Class: alcohol
	Vapor Intrusion	Diethyl ether	Mercury
		Tetrachloroethene	Unknown; Chemical Class: chlorinated VOC
		Trichloroethene	Unknown; Chemical Class: alkene
		1,1,2-Trichloro-1-propene	Unknown; Chemical Class: 2-methyl-1-propene
		1,2,3 -Trichloro -1-propene	

Table 4
Summary of Constituents of Interest (COI) in Sediment and Surface Water in the Human Health Risk Assessment
Hercules - Aqualon
Hopewell, Virginia

Area	Medium	Constituents of Interest
Eastern and Western Whitewater Lagoons (SWMUs 3 and 4)	Sediment	Arsenic Chromium Thallium Unknown; Chemical Class: PAH
	Surface Water	Benzo(a)pyrene Benzo(b)fluoranthene Indeno(1,2,3-cd)pyrene Arsenic Chromium
Natrosol Lagoon (SWMU 7)	Sediment	Arsenic Chromium Thallium
	Surface Water	Arsenic Chromium
Sludge Drying Beds (SWMU 14)	Surface Water	Benzo(a)pyrene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene Arsenic Chromium Cobalt Iron Manganese

Table 4
Summary of Constituents of Interest (COI) in Sediment and Surface Water in the Human Health Risk Assessment
Hercules - Aqualon
Hopewell, Virginia

Area	Medium	Constituents of Interest
Vacuum Filter Sludge Pile (SWMU 15)	Surface Water	Benzo(a)pyrene Benzo(k)fluoranthene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene Arsenic Chromium Cobalt Iron
East Bear Creek	Sediment	Arsenic Chromium Thallium
	Surface Water	Aluminum Arsenic Chromium Cobalt Iron Lead Manganese Mercury Thallium Vanadium

Table 4
Summary of Constituents of Interest (COI) in Sediment and Surface Water in the Human Health Risk Assessment
Hercules - Aqualon
Hopewell, Virginia

Area	Medium	Constituents of Interest
West Bear Creek	Sediment	2,3,3',4,4',5-Hexachloro-1,1'-biphenyl PCB-1254 Pentachlorobiphenyl Arsenic Chromium Thallium Unknown; Chemical Class: PAH
	Surface Water	Aluminum Arsenic Chromium Cobalt Iron Manganese Vanadium
Unnamed Tributary	Sediment	PCB-1254 Pentachlorobiphenyl Arsenic Chromium Thallium Unknown; Chemical Class: PAH
	Surface Water	Aluminum Arsenic Chromium Cobalt Iron Lead Manganese Vanadium

Table 4
Summary of Constituents of Interest (COI) in Sediment and Surface Water in the Human Health Risk Assessment
Hercules - Aqualon
Hopewell, Virginia

Area	Medium	Constituents of Interest
Cattail Creek	Sediment	Hexadecane Arsenic Chromium Thallium Unknown; Chemical Class: PAH
	Surface Water	Arsenic Chromium Cobalt Iron Manganese
Bailey Creek	Sediment	Arsenic Chromium Thallium
	Surface Water	Arsenic Iron Manganese