WEST VIRGINIA

DEPARTMENT OF ENVIRONMENTAL PROTECTION

RCRA CORRECTIVE ACTION PERMIT

UNION CARBIDE CORPORATION

TECHNOLOGY PARK

South Charleston, West Virginia

Permit ID # WVD060682291

April 2019

CORRECTIVE ACTION PERMIT
UNION CARBIDE CORPORATION - TECHNOLOGY PARK
PERMIT ID # WVD060682291

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ATTACHMENT II- 4	**2018 ANNUAL GROUNDWATER MONITORING REPORT –** This attachment contains the main results portion of the 2018 Annual Groundwater Monitoring Report (GWMR) as a sample of an approved GWMR content (36 pages)

MODULE I
STANDARD CONDITIONS

Module I sets forth the standard conditions that are applicable to all hazardous waste management and corrective action facilities. The regulations applicable to permitting, Parts 260 through 264, 268, and 270 of Title 40, Code of Federal Regulations (CFR), have been incorporated by reference into Sections 2 through 7, and 9 through 11, respectively, of the West Virginia State Legislative Rule, Title 33, Series 20, Hazardous Waste Management System (HWMS).

I-A EFFECT OF PERMIT

The Permittee is allowed to manage hazardous waste in accordance with the conditions of this Resource Conservation and Recovery Act (RCRA) Corrective Action Permit (CA Permit). Compliance with the CA Permit during its term constitutes compliance, for purposes of enforcement, with the Hazardous Waste Management Act (HWMA, the Act), Article 18, Chapter 22 of the West Virginia Code. Issuance of this CA Permit does not convey property rights of any sort or any exclusive privilege; nor does it authorize any injury to persons or property, any invasion of other private rights, or any infringement of State or local law or regulations.

Compliance with the terms of this CA Permit does not constitute a defense to any order issued or any action brought by the U. S. Environmental Protection Agency (US EPA) under Sections 3008(a), 3008(h), 3013, or 7003 of RCRA; Sections 104, 106(a), or 107, of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (42 U.S.C. §9601 et. seq., commonly known as CERCLA); or any other law providing for protection of public health or the environment.

I-B PERMIT ACTIONS

This CA Permit may be modified, revoked, reissued, or terminated as specified in 40 §§CFR 270.41, 270.42 and/or 270.43. This CA Permit may also be reviewed and modified by the West Virginia Department of Environmental Protection, Division of Water and Waste Management (DWWM), consistent with 40 CFR §270.41, to include terms and conditions determined necessary to protect human health and the environment, and to achieve compliance with §270.32 (b) (2). The filing of a request by the Permittee for a Permit modification, revocation and reissuance, termination, or a notification of planned changes or anticipated noncompliance, does not stay the applicability and enforceability of any Permit condition.

I-C PERMIT DURATION

This permit and all conditions herein shall be effective for a fixed term not to exceed ten (10) years. Except as provided by 40 CFR §270.51, the term of a permit shall not be extended by modification beyond the duration. The Director may issue a permit for a duration that is less than the full allowable term.

I-D SEVERABILITY

The provisions of this Permit are severable, and if any provision of this Permit, or if the application of any provision of this Permit, to any circumstance, is held invalid, the application of such provision to other circumstances and the remainder of this Permit shall not be affected thereby.

I-E DEFINITIONS

For the purpose of this CA Permit, terms used herein shall have the same meaning as those set forth in the Act. Where terms are not otherwise defined, the meaning associated with such terms shall be as defined by a standard dictionary reference or the generally accepted scientific or industrial meaning of the term. The following definitions also apply to this Permit.

E-1 "Director" shall mean Director of the Division of Water and Waste Management, Department of Environmental Protection;

E-2 "Days" shall mean calendar days;

E-3 "Facility" shall mean all contiguous property under the control of the owner or operator seeking a permit under Subtitle C of RCRA.

E-4 "Hazardous Constituent" shall mean any constituent identified in Appendix VIII of 40 CFR, Part 261, or any constituent identified in Appendix IX of 40 CFR, Part 264;

I-F FAILURE TO SUBMIT RELEVANT AND/OR ACCURATE INFORMATION

Whenever the Permittee becomes aware that it failed to submit any relevant facts in the permit application or incorrect information in a permit application or in any report to the Director, DWWM, the Permittee shall notify the Director of such failure within seven (7) days of becoming aware of such deficiency or inaccuracy. The Permittee shall submit the correct or additional information to the Director within thirty (30) days of becoming aware of the deficiency or inaccuracy (40CFR §270.30(I) (11) and 270.32(b)). Failure to submit the information required in this Permit or misinterpretation of any submitted information is grounds for termination of this Permit (40 CFR §270.43).

I-G DUTIES AND REQUIREMENTS (40 CFR 270.30)

G-1 The Permittee must comply with all terms and conditions of this CA Permit. An exception may be granted via an emergency permit issuance; see 40 CFR §270.61. Any Permit noncompliance, except under the terms of an emergency permit, constitutes a violation of the Act and is subject to enforcement action. An enforcement action may include permit termination, revocation, reissuance, and/or modification.

G-2 The Permittee shall submit a complete application for a new permit at least one hundred-eighty (180) days before this CA Permit expires unless: a) the Permittee is no longer required to have a RCRA CA Permit; or b) permission for a later date has been granted by the Director.

G-3 It shall not be a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this CA Permit.

G-4 In the event of noncompliance with the Permit, the Permittee shall take all reasonable steps to minimize releases to the environment and shall carry out such measures as are reasonable to prevent significant adverse impact on human health or the environment.

G-5 The Permittee shall, at all times, properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the Permittee to achieve compliance with the terms and the conditions of this Permit. Proper operation and maintenance include effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality control/quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of the Permit.

G-6 The Permittee shall furnish to the Director, within a reasonable time designated by the Director, any relevant information which the Director, may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Permit, or to determine compliance with this Permit. Upon request, the Permittee shall also furnish to the Director copies of records that are required by this Permit.

G-7 The Permittee shall allow the Director, or an authorized representative upon the presentation of credentials and other documents as may be required by law to: a) Enter, at necessary times during working hours, the permitted premises where the regulated facility or activity is located or conducted, or where records must be kept under the conditions of this CA Permit; and, b) Have access to and copy any records that must be kept under the conditions of this CA Permit.

G-8 The Permittee shall retain records of all monitoring information for a period of at least three years from the date of sampling. This period may be extended, by request of the Director, at any time.

G-9 The Permittee shall give advance notice to the Director, of any planned changes in the permitted Facility, or activity, which may result in noncompliance with Permit requirements. Such notice does not constitute a waiver of the Permittee's duty to comply with Permit requirements.

G-10 This Permit is not transferable to any person except after notice to the Director. The Director may require modification or revocation and reissuance of the Permit to change the name of the Permittee and incorporate such other requirements as may be necessary under RCRA.

G-11 A) The Permittee shall report to the Director any noncompliance, which may endanger human health or the environment orally within twenty-four (24) hours from the time the Permittee becomes aware of the circumstances. This report shall include the following:

a. Information concerning the release of any hazardous constituent which may endanger public drinking water supplies; and

b. Information concerning the release or discharge of any hazardous constituent, or of a fire or explosion at the facility, which could threaten the environment or human health outside the facility.

c. The description of the occurrence and its cause shall include:

1. Name, address, and telephone number of the owner or operator;
2. Name, address, and telephone number of the facility;
3. Date, time, and type of incident;
4. Name and quantity of material(s) involved;
5. The extent of injuries, if any;
6. An assessment of actual or potential hazard(s) to the environment and human health outside the facility, where this is applicable, and;
7. Estimated quantity and disposition of recovered material that resulted from the incident.

B) A written submission shall also be provided to the Director, within fifteen (15) days from the time when the Permittee becomes aware of the circumstances. The written submission shall contain:

1. A description of the non-compliance and its cause;
2. The period(s) of non-compliance (including exact dates and times);
3. Steps taken to minimize impact on the human health and the environments;
4. Whether the non-compliance has been corrected, and if not, the anticipated time it is expected to continue;
5. Steps taken or planned to be taken to reduce, eliminate or prevent recurrence of such non-compliance.

G-12 The Permittee shall report all other instances of noncompliance not otherwise required to be reported above within thirty (30) days of when the Permittee becomes aware of the noncompliance. The reports shall contain the information listed in Condition I-G-11.

G-13 All RCRA CA work plans, reports, notifications or other submissions required by Module II shall be sent by electronic means (preferred), certified mail, certified carrier, or hand-delivered as follows:

One Copy To:
RCRA CA Project Manager
West Virginia Department of Environmental Protection
Division of Water and Waste Management
601 57th Street
Charleston, WV 25301

One Copy To:
RCRA CA Program Manager
West Virginia Department of Environmental Protection
Division of Water and Waste Management
601 57th Street
Charleston, WV 25301

One Copy To:
EPA Project Manager
United States Environmental Protection Agency, Region III
Office of Remediation
1650 Arch Street
Philadelphia, PA 19103-2029
(3LC10)

G-14 All reports required by this Permit and other information requested by the Director shall be signed and certified. If an authorization is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, or because a new individual or position has responsibility for the facility's compliance with environmental laws and permits, a new authorization satisfying the requirements shall be submitted to the Director prior to or together with any reports, information, or applications to be signed by an authorized representative.

I-H CONFIDENTIAL INFORMATION

Any information submitted to the Director, pursuant to this Permit, may be claimed as confidential by the submitter. Any such claim must be asserted at the time of submission in the manner prescribed in Section 11.18.b. and c. of the HWMS Rule. If no claim is made at the time of submission, the Director shall make the information available to the public. If a claim is asserted, the information shall be treated in accordance with the procedures in Section 11.18 of HWMS Rule. Claims of confidentiality for the name and address of Permittee will be denied.

I- I DISCLOSURE IN DEED

Pursuant to Section 21 of the HWMA and Section 12 of the HWMS Rule, the Permittee shall make a notation on the deed that will notify any potential purchaser that the land has been used to manage hazardous waste. Such disclosure shall describe the location upon said property, identifying the type and quantity of hazardous waste and the method of storage, treatment, or disposal with respect to such waste.

MODULE II
FACILITY WIDE RCRA CORRECTIVE ACTION

On September 30, 2010, the United States Environmental Protection Agency (EPA) issued a Statement of Basis (SB) in which a Final Remedy for the Facility was proposed that consisted of the following:

- Institutional Controls including residential use restriction, groundwater use restriction, vapor intrusion and/or subsurface work restrictions;
- Engineering controls such as installation of vapor control system in occupied new structures;
- Compliance with and maintenance of institutional controls;
- Operations and Maintenance (O&M) activities including leachate collection; and
- Groundwater monitoring;

Public comments were requested on the proposed Final Remedy from September 30, 2010 through October 30, 2010 during a 30-day (30) day public comment period.

All of the comments received by EPA during the public comment period were carefully reviewed and have been addressed in Attachment A, Public Comments and EPA Responses, of the Final Decision and Response to Comments (FDRTC), Final Decision, document.

Based on the comments received during the public comments period, EPA determined that it was not necessary to modify its proposed Final Remedy as set forth in the SB. EPA did, however, made minor modifications to the factual background and clarified certain aspects of the proposed Final Remedy. Thus, the proposed Final Remedy became final as provided by the FDRTC, incorporating the factual clarifying information provided by the comments referred to above, and was issued on December 15, 2010. The FDRTC was incorporated into the Facility's RCRA Permit as Module II and was made a part thereof on April 12, 2012.

As requested in the November 2018 RCRA Corrective Action permit renewal application, the Ward B Central Drain Pumping System (hereafter referred to as the Ward B sump) is no longer a corrective measure for the facility. The FDRTC, that sets forth the Final Remedy, is hereby incorporated into this Facility Wide RCRA Corrective Action Module (Module) as Attachment II-2 except for the requirements pertaining to operation of the Ward B sump. The requirements of the FDRTC that remain in effect are below.

II-A DEFINITIONS

For the purposes of RCRA Corrective Action and this RCRA Corrective Action Module, the following definitions shall apply:

1. "Project Manager" shall mean the Division of Water and Waste Management RCRA Corrective Action Program Project Manager

2. "Area of Concern" shall mean an area at the Facility or an off-site area, not originally identified as a solid waste management unit, where hazardous waste and/or hazardous constituents are present or suspected to be present.

3. "Solid Waste Management Unit" shall mean any unit at the facility from which hazardous constituents might migrate, irrespective of whether the units were used for the management of solid and/or hazardous wastes. Such units include any areas at a facility which solid wastes have been routinely and systematically released. The term "unit" refers to containers, container storage areas, tanks, surface impoundments, waste piles, land treatment units, landfills, incinerators, underground injection wells, and other physical, chemical and biological units or treatment units.

II-B CORRECTIVE ACTION (CA) FOR CONTINUING RELEASES; PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

1. Section 3004(u) of RCRA, 42 U.S.C. § 6924(u), and regulations codified at 40 CFR §264.101, provide that all permits issued after November 8, 1984 must require CA as necessary to protect human health and the environment for all releases of hazardous waste or hazardous constituents from any solid waste management unit (SWMU) regardless of when waste was placed in the unit.

2. Under Section 3004(v) of RCRA, 42 U.S.C. § 6924(v), and 40 CFR §264.101(c), CA at a permitted facility may be required beyond the facility boundary, where necessary, to protect human health and the environment, unless the Facility demonstrates that, despite its best efforts, the Facility was unable to obtain the necessary permission to undertake such action.

3. This Permit requires that if additional releases of hazardous constituents and Hazardous waste from current or former UCC operations pose an unacceptable threat, the Permittee shall determine the nature and extent of those releases.

II-C REMEDY IMPLEMENTATION

The Final Remedy that has been selected for the Facility is described in detail in the FDRTC and set forth in Attachment II-1 and made a part hereof with the exception of any requirements pertaining to the operation of Ward B sump. The requirements of this Permit provide for the implementation of the Final Remedy. The Final Remedy for the UCC Technology Park facility is readily implementable. Commencing on the effective date of this Permit and thereafter, the Permittee shall implement the selected Final Remedy described in the FDRTC as summarized below:

1. For Facility groundwater, the corrective measures being implemented are:
    - Long-term groundwater monitoring;
    - Ground water shall not be used for any purpose other than O&M and monitoring activities.
2. For Tract A, the corrective measures implemented are:

    - Industrial/commercial areas shall not be used for residential purposes unless it is demonstrated that such use will not pose a threat to human

health or the environment and/or adversely affect or interfere with the selected remedy;
- For areas requiring vapor intrusion restrictions, installation of a vapor control system in all new structures that are to be occupied;
- For areas requiring subsurface work restrictions, no earth moving activities, including construction and drilling, may be performed unless such activities are conducted in accordance with a Health and Safety Plan approved by WVDEP, in consultation with EPA.

3. For Tracts B and C, the corrective measures implemented are:

    - Tracts B and C shall not be used for residential purposes unless it is demonstrated that such use will not pose a threat to human health or the environment and/or adversely affect or interfere with the selected remedy;
    - For areas requiring vapor intrusion restrictions, installation of a vapor control system in all new structures that are to be occupied.

4. For Tract D, the corrective measures implemented are:

    - Operation and maintenance of the Lower Ward Leachate Collection System;
    - Landfill inspections;
    - Long-term groundwater monitoring;
    - For areas requiring vapor intrusion restrictions, installation of a vapor control system in all new structures that are to be occupied; and
    - Compliance with and maintenance of other institutional controls and institutional control elements as detailed in the FDRTC.

5. Implementation of any corrective measures for newly discovered releases of hazardous constituents and hazardous waste that pose an unacceptable threat from current or former UCC operations shall be implemented in accordance with current State and Federal Regulations.

II-D EVALUATION OF THE SELECTED REMEDY

In lieu of facility progress reports the Permittee will be submitting an Operation, Maintenance and Inspection (OMI) Report and a Groundwater Monitoring (GWM) Report annually in accordance with the WVDEP approved plans. (see Attachment II-3 and II-4 for samples of an OMI Report and a GWM report, respectively)

If the Agencies determine that the selected remedy will not comply with the media clean-up requirements, the Agencies may require the Permittee to perform additional studies and/or perform modifications to the existing Corrective Action remedy.

II-E EMERGENCY RESPONSE; RELEASE REPORTING

1. If at any time, the Permittee discovers that a release of hazardous waste or hazardous constituents from a SWMU at the Facility is presenting or may

present an imminent and substantial endangerment to human health or the environment, the Permittee shall notify the WVDEP as soon as practicable of the source, nature, extent, location and amount of such release, the endangerment posed by such release and the actions taken and/or to be taken, to the extent known, to address such release.

2. Within five days of discovery, the Permittee shall notify WVDEP, in writing, of the nature, source, extent, and location of such release of hazardous waste or hazardous constituents from the SWMU.

3. If, based on the information submitted a release has not been adequately remediated to be protective of human health and the environment, WVDEP may require the SWMU and/or AOC to be included in an RFI or an IM.

II-F GUIDANCE DOCUMENTS

All work to be performed at the Facility pursuant to this Permit shall be in general accordance with applicable EPA RCRA corrective action guidance available at http://www.epa.gov/reg3wcmd/ca/ca_resources.htm.

II-G NEWLY DISCOVERED SOLID WASTE MANAGEMENT UNIT (SWMU) ASSESSMENT

1. The Permittee shall notify the Project Manager, in writing, of any newly identified SWMU at the Facility, no later than thirty days after the date of discovery. The notification shall include, but is not limited to, the following known information:

   a. A description of the newly identified SWMU(s), function, dates of operation, location (including a map), design criteria, dimensions, materials of construction, capacity, ancillary systems (e.g., piping), release controls, alterations made to the unit, engineering drawings, and all closure and post-closure information available, particularly whether wastes were left in place.

   b. A description of the composition and quantities of solid wastes processed by the newly identified SWMU(s) with emphasis on hazardous wastes and hazardous constituents.

   c. A description of any release (or suspected release) of hazardous waste or hazardous constituents originating from the newly identified SWMU. Include information on the date of release, type of hazardous waste or hazardous constituents, quantity and nature of the release, extent of release migration, and cause of release (e.g., overflow, broken pipe, tank leak, etc.). Also, provide any available data that quantifies the nature and extent of environmental contamination, including the results of soil and/or groundwater sampling and analysis efforts. Likewise, submit any existing monitoring information that indicates releases of hazardous waste or hazardous constituents have not occurred or is not occurring.

2. Upon receipt of the notification of any newly identified SWMU, the Project Manager will determine the need for corrective action at such SWMU. If corrective action is necessary to protect human health or the environment, the Project Manager will determine whether an RFI will be performed and the need for any IMs.

3. In lieu of a separate RFI, the Permittee may propose either to incorporate any newly identified SWMU into an ongoing RFI or to submit a proposal for the performance of corrective measures at such newly identified SWMU. Any such proposal shall be submitted to the Agencies along with notification of the discovery of the SWMU(s). Incorporation of any newly identified SWMU(s) into an ongoing RFI shall be through the submission of an RFI Work Plan Addendum by the Permittee. Any such RFI Work Plan Addendum shall receive approval by the Agencies prior to initiation of the related RFI work.

II-H FINANCIAL ASSURANCE

1. Revised Cost Estimate: Within ninety calendar days of the effective date of this Permit, the Permittee shall submit a revised cost estimate (Cost Estimate), in current dollars, to perform the work required under Section II-C "Remedy Implementation". The Cost Estimate must account for the costs of all foreseeable work, including all investigation and reports, construction work, monitoring, and other long-term care work, etc.

2. Annual Cost Estimate Updates: Within sixty days prior to the anniversary date of the establishment of the financial instrument for the work required Section II-C "Remedy Implementation", the Permittee shall submit to the CA Program Manager updated cost estimates, adjusted for inflation, for completing the approved work. If the financial test or corporate guarantee is used as the financial instrument, the owner or operator must send updated cost estimates to the CA Program Manager within 90 days after the close of each succeeding fiscal year in accordance with 40 CFR 264.145(f)(5).

3. Financial Assurance Demonstration: Within thirty calendar days of approval of the initial cost estimate for the work required under this Module, and annually thereafter, the Permittee shall demonstrate compliance with financial assurance to CA Program Manager in accordance with 40 CFR § 264.143 for completing the work required under Section II-C "Remedy Implementation" in accordance with 40 CFR § 264.101(b). Within thirty calendar days of approval of any revised cost estimate, the Permittee shall demonstrate to the CA Program Manager financial assurance for the updated cost estimates.

II-J RECORDKEEPING

Upon completion of closure of any current or future SWMU, the Permittee shall maintain in the Facility's operating record, documentation of the closure measures.

II-J ACCESS FOR CORRECTIVE ACTION OVERSIGHT

The WVDEP and its authorized representatives shall have access to the Facility at all reasonable times for monitoring compliance with the provisions of this Permit. The Permittee shall use its best efforts to obtain access to property for all parties beyond the boundaries of the Facility at which corrective action is required by this Permit.

II-K COMPLETION OF REMEDY

Within ten days of receipt of notification by the Project Manager that the remedy is complete, the Permittee shall submit a written certification to the Project Manager stating that the remedy has been completed in accordance with the requirements of this Permit Module. The certification must be signed by the Permittee. In cases where no other Permit Conditions remain, the Permit may be modified not only to reflect the completion determination, but also to change the expiration date of the permit to allow earlier permit expiration in accordance with 40 CFR Parts 124, 270.41, and 270.42, as applicable.

ATTACHMENT II - 1

PUBLIC NOTICE

This attachment will contain the Public Notice announcing the re-issuance of a draft RCRA CA Permit which is to be published in the Charleston Gazette-Mail in May 2019. The draft Permit will be open to Public Comment for 45 days (2 pages)

ATTACHMENT II – 2

FINAL DECISION and RESPONSE TO COMMENTS

UNITED STATES

ENVIRONMENTAL PROTECTION AGENCY

REGION III

FINAL DECISION AND RESPONSE TO COMMENTS
UNION CARBIDE CORPORATION
TECHNOLOGY PARK

SOUTH CHARLESTON, WEST VIRGINIA

EPA ID NO. WVD 060 682 291

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I. INTRODUCTION

The United States Environmental Protection Agency (EPA) is issuing this Final Decision and Response to Comments (FDRTC or Final Decision) in connection with the Union Carbide Corporation (UCC), Technology Park, South Charleston, West Virginia (hereinafter referred to as the Facility).

The Facility is subject to the 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. Sections 6901 et seq. The Corrective Action program is designed to ensure that certain facilities subject to RCRA have investigated and addressed releases of hazardous waste and hazardous constituents that have occurred at their property.

On September 30, 2010, EPA issued a Statement of Basis (SB) in which EPA proposed the Final Remedy for the Facility. EPA's proposed Final Remedy consisted of remedial components which collectively address Facility-wide groundwater contamination and Facility-wide soil contamination.

Consistent with public participation provisions under RCRA, EPA requested comments from the public on the proposed Final Remedy. The thirty (30) day public comment period began on September 30, 2010 and ended October 30, 2010. All of the comments received by EPA during the public comment period were carefully reviewed by EPA and have been addressed in Attachment A, PUBLIC COMMENTS AND EPA RESPONSES, and are incorporated into this Final Decision.

Based on comments received during the public comment period, EPA has determined that it is not necessary to modify its proposed Final Remedy as set forth in the SB. EPA is, however, making minor modifications to the factual background and clarifying certain aspects of the proposed Final Remedy as described in more detail in Attachment A, PUBLIC COMMENTS AND EPA RESPONSES. The Final Decision as set forth in Section II, "Final Decision," below, incorporates those minor modifications and clarifications.

II. FINAL DECISION

The Facility has been subdivided into four parcels, Tracts A, B, C and D, respectively. EPA's Final Remedy consists of the following remedial components for each Tract:

A. Tract A

EPA's remedy for Tract A consists of the following institutional controls:

a) Industrial/Commercial Areas, as depicted in Figure 5, shall not be used for residential purposes unless it is demonstrated to WVDEP, in consultation with EPA, that such use will not pose a threat to human health or the environment and/or adversely affect or interfere with the selected remedy and WVDEP, in consultation with EPA, provides prior written approval for such use;

b) In the areas within Tract A that are identified on Figure 5 as requiring Vapor Intrusion and/or Subsurface Work restrictions, no earth moving activities, including construction and drilling, may be done unless such activities are conducted in accordance with a Health & Safety Plan that was approved by WVDEP, in consultation with EPA, and that was prepared by an appropriately qualified person familiar with the environmental conditions at the Facility, and

c) Groundwater from Tract A shall not be used for any purpose other than to conduct the operation and maintenance and monitoring activities required by WVDEP and/or EPA, unless it is demonstrated to WVDEP, in consultation with EPA, that such use will not pose a threat to human health or the environment or adversely affect or interfere with the selected remedy and WVDEP, in consultation with EPA, provides written approval for such use.

B. Tracts B and C

EPA's remedy for Tracts B and C consists of the installation of a vapor control system, the design of which shall be approved in advance by WVDEP, in consultation with EPA, in all new structures which are to be occupied in the areas identified on Figure 5 as requiring Vapor Intrusion and/or Subsurface Work restrictions and compliance with and maintenance of institutional controls.

The institutional controls for Tracts B and C contain the following elements:

a) Tracts B and C shall not be used for residential purposes unless it is demonstrated to WVDEP, in consultation with EPA, that such use will not pose a threat to human health or the environment or adversely affect or interfere with the selected remedy and WVDEP, in consultation with EPA, provides prior written approval for such use, and

b) Groundwater from Tracts B and C shall not be used for any purpose other than to conduct the operation and maintenance and monitoring activities required by WVDEP and/or EPA, unless it is demonstrated to WVDEP, in consultation with EPA, that such use will not pose a threat to human health or the environment or adversely affect or interfere with the selected remedy and WVDEP, in consultation with EPA, provides written approval for such use.

C. Tract D

EPA's remedy for Tract D consists of the following five components:

1) operation and maintenance of the Ward B central drain sump pumping system;
2) operation and maintenance of the Lower Ward leachate collection system in compliance with the EPA-approved Operation, Maintenance and Inspection Manual (OMII) dated, April 2010;
3) landfill inspections in compliance with the OMII;
4) long-term groundwater monitoring in compliance with the EPA-approved Groundwater Monitoring Plan dated December 2009; and
5) compliance with and maintenance of institutional controls.

The institutional controls for Tract D contain the following elements:

a) A restriction that the Lower Ward Landfill and Ward Hollow shall not be used for residential purposes unless it is demonstrated to WVDEP, in consultation with EPA, that such use will not pose a threat to human health or the environment or adversely affect or interfere with the selected remedy and WVDEP, in consultation with EPA, provides prior written approval for such use;

b) Tract D shall not be used in any way that will adversely affect or interfere with the integrity and protectiveness of the covers and the area within 100 feet of the landfill covers placed over the Lower Ward Landfill and Ward B Landfill and all associated pipes and wells unless it is demonstrated to WVDEP, in consultation with EPA, that such use will not pose a threat to human health or the environment or adversely affect or interfere with the selected remedy and WVDEP, in consultation with EPA, provides prior written approval for such disturbance;

c) Ward A and B Landfills and the area surrounding those landfills, as depicted in Figure 5, shall be limited to recreational uses that would result in only periodic limited use of the area such as hiking, jogging, wildlife viewing, and ecological studies (Figure 5). Based on a review of historical operations information, the area surrounding Ward A and B Landfills are not impacted by Facility related contamination. Nonetheless, the area will be limited to recreational use to ensure that the integrity and protectiveness of Ward A and B Landfills are maintained;

d) No earth moving activities, including construction and drilling, may be done on the area of Tract D depicted on Figure 5 unless such activities are conducted in accordance with a Health & Safety Plan that was approved by WVDEP, in consultation with EPA, and that was prepared by an appropriately qualified person familiar with the environmental conditions at the Facility, and

e) The contaminated groundwater from Tract D, including any groundwater that has migrated beyond the Facility boundary, shall not be used for any purpose other than to conduct the operation and maintenance and monitoring activities required by WVDEP and/or EPA, unless it is demonstrated to WVDEP, in consultation with EPA, that such use will not pose a threat to human health or the environment or adversely affect or interfere with the selected remedy and WVDEP, in consultation with EPA, provides written approval for such use.

D. Implementation of ICs

The ICs shall be implemented through an enforceable mechanism such as a permit, order, or an Environmental Covenant pursuant to the West Virginia Uniform Environmental Covenants Act, Chapter 22, Article 22.B, §§ 22-22B-1 through 22-22B-14 of the West Virginia Code (Environmental Covenant). UCC will be required to provide a coordinate survey as well as a metes and bounds survey of the Tracts and the Facility boundary. For properties located outside of the Facility boundary that are impacted by Facility-related contamination, WVDEP, in consultation with EPA, will require that UCC use its best efforts to obtain an Environmental Covenant from any such property owners.

If the Facility owner or subsequent owners fail to meet their obligations under the enforceable mechanisms selected or if EPA and/or WVDEP, in its sole discretion, deems that additional ICs are necessary to protect human health or the environment, EPA and/or WVDEP has the authority to require and enforce additional ICs, such as the issuance of an administrative order.

This Final Decision is supported by the information set forth in the Administrative Record (AR).

III. FACILITY BACKGROUND

The Facility consists of approximately 574 acres in South Charleston, West Virginia (Figure 1). The land use for the area surrounding the Facility is primarily industrial and commercial to the north and residential to the east, south, and west of the Facility. Located downgradient from the Facility to the northwest are two parcels, owned by the West Virginia Department of Transportation (WVDOT) and CSX Transportation, respectively.

Between 1947 and 1974, UCC, a wholly owned subsidiary of The Dow Chemical Company (Dow), purchased individual parcels of land from the Kanawha Land Company, Westvaco Chemical Company, a dairy farm, and other parties. These parcels collectively comprise the Facility property. Prior to UCC's ownership, the Facility property was undeveloped with the exception of several brine wells which were located on the former Westvaco Chemical Company parcel and were used to extract brine for the manufacture of chlorine bleach.

Currently, approximately 110 acres of the Facility property are developed with laboratory buildings, pilot plant areas (areas where materials developed are manufactured on a small scale), waste packaging, storage facilities, and office buildings. Some buildings and portions of the Facility property are currently leased to other entities.

The remaining land at the Facility includes three inactive landfills, the Lower Ward Landfill, Ward A Landfill, and Ward B Landfill. The three landfills were constructed primarily to receive fly ash slurry from the Facility. The landfills also received oxide tails from the UCC South Charleston facility's propylene oxide production unit, and municipal sludge from the South Charleston publicly owned treatment works (POTW). The landfills were created by constructing upper and lower dikes across a hollow, designated as Ward Hollow. The Lower Ward Landfill is located between the upper and lower dikes, and the Ward A and B Landfills are located south of the upper dike (Figure 1). Use of the landfills was discontinued in 1973, after which the Lower Ward and Ward B Landfills were covered and the Ward A Landfill was turned into a scenic pond.

Between 2002 and 2003, UCC modified the central drainage channel at Ward B Landfill by installing perforated high-density polyethylene piping buried under aggregate cover. The perforated piping is referred to as the central drainage line, and it discharged into Ward A Landfill until 2007, when the discharge was rerouted to Holz Impoundment and the previously uncovered aggregate was covered with soil (Figure 6). Holz Impoundment is a 76-acre active solid waste impoundment that is used by UCC and the City of South Charleston but is not part of

the Facility.

For development purposes, the Facility has been subdivided into four tracts, Tracts A through D, which are depicted on Figure 2. Currently, there is a tentative agreement in place between UCC and the State of West Virginia to donate Tracts A and B to the State of West Virginia. UCC anticipates that this land transfer will be finalized in December 2010. In addition, in July 2010 a portion of Tract D (shown as "Area D-1" on Figure 2) was sold by UCC to United Disciples of Christ Church which plans to construct a church and other buildings on that property.

IV. SUMMARY OF ENVIRONMENTAL INVESTIGATIONS AND INTERIM MEASURES

A total of 70 solid waste management units (SWMUs) have been identified at the Facility. EPA identified sixty-two SWMUs during a 1988 RCRA Facility Assessment (RFA) conducted by EPA. The remaining eight SWMUs were later identified by UCC as part of a response to an EPA RCRA request for information. In addition to the 70 SWMUs, there are four areas with environmental impacts at the Facility (hereafter referred to as Investigation Areas) that were identified by UCC between 2005 and 2009.

Since the 1988 RFA, UCC has conducted multiple investigations including human and ecological risk assessments, to evaluate the releases from the Facility. The following EPA-approved reports summarize UCC's investigations:

Solid Waste Management Unit Description and Investigation/Corrective Action Undertaken (1998) – UCC evaluated the 70 SMWUs and placed them into four priority categories, A-High Priority; B- Low Priority; C- No Further Action and D-Not a SWMU. This report also includes a description of the voluntary corrective actions taken up to 1998.

RCRA Facility Investigation Report (2001) – This report documents UCC's investigations (soil, groundwater, surface water, sediment and waste material) for A-High Priority SWMUs.

RCRA Facility Investigation Report (2005) – This report documents the investigation (soil, groundwater, surface water and sediment) at 11 SWMUs which were placed in the B, C or D categories, as described above.

Ecological Risk Assessment Ward A and B Landfills (Solid Waste Management Units 3 and 4)(2006)- This report documents the ecological evaluation of the fate and transport of constituents detected at the SWMUs through the ecological setting of the Facility.

Summary of Ecological Risk for RCRA Solid Waste Management Units 5 and 70 (2007) - These reports document the ecological evaluation of the fate and transport of constituents detected at the SWMUs through the ecological setting of the Facility.

Current Conditions Report (2008) – This report documents all the Facility investigations and corrective action work completed up to 2008.

Technology Park Groundwater Screening-Level Assessment (2009) - This report documents the human health risk assessment for current and future exposure to constituents in groundwater downgradient of the Facility.

Buildings 706 and 707 Area Soil Investigation, Removal Action and Vapor Intrusion Human Health Risk Assessment (2009) – This report documents the soil investigation and removal action. In addition, it documents the human health risk assessment for current and future exposure to constituents in indoor air in Buildings 706 and 707.

Human Health Risk Assessment for Ward A Pond, Ward Branch, and Vapor Intrusion (2009) – This report documents the human health risk assessment (HHRA) to assess the potential current and future human health risks from exposure to contaminants in surface water and sediment at Ward A Pond and Ward Branch and indoor air in Buildings 771, 2000, and 6000.

Screening Level Risk assessment for Ward Branch and Baseline Risk Assessment for Ward A Pond (2010) - This report documents the ecological evaluation of the fate and transport of constituents detected in Ward Branch and Ward A Pond thru the ecological setting of the Facility.

A description of the SWMUs and Investigation Areas along with a summary of investigation results and Interim Measures performed at these SWMUs and Investigation Areas are provided in Table 1.

As stated above, the Facility property has been subdivided into four tracts, Tracts A, B, C, and D, respectively. Tract A is located within the western portion of the Facility. The northern portion of Tract A is mostly developed; however, a large portion in the south and west of this tract is undeveloped. The majority of the SWMUs identified at the Facility are located within Tract A (Table 1).

Tracts B and C, located on the northeastern edge of the Facility, are the smallest tracts at the Facility. Currently, the primary use for these tracts is office space and parking. There are four SWMUs within these two tracts.

Tract D is the largest tract at the Facility. The southern and northern portions of Tract D are mostly undeveloped, while the central portion is comprised of the three landfills.

A. Facility Soils

1. Tract A

Fifty-six of the 70 SWMUs and the 4 Investigation Areas are located on this Tract. Based on the 1988 RCRA Facility Assessment and the 2001 and 2005 RCRA Facility Investigations, EPA determined there have been no known releases from 45 of the 56 SWMUs located on Tract A. In addition, after reviewing analytical results from soil samples collected in 2004, 2006 and 2008, respectively, EPA determined that soils at many of the remaining 11 SWMUs did not show the presence of contaminants or contained contaminants at concentrations that did not exceed

residential or industrial screening levels.

The following describes the SWMUs and Investigation Areas located on Tract A where contaminants remain in the soil:

a. SWMU 70

This SWMU is referred to as the Timberland Dump Site #2. In 2004 and 2005, UCC conducted soil sampling which revealed that samples exceeded the industrial screening level for arsenic and that the residential screening level was exceeded for mercury. Because arsenic concentrations were below the maximum West Virginia background concentration (13 milligrams per kilogram (mg/kg)), the concentrations of arsenic are considered representative of regional background conditions.

A Screening Level Ecological Risk Assessment (SLERA) was completed in 2005 which initially identified barium and mercury as contaminants of potential concern (COPCs) posing risk to soil invertebrates and plants located at SWMU 70. No soil COPCs were associated with potential food web exposure. Potential ecological risks fell within the acceptable range for the constituents, with the exception of mercury. For mercury, a supplemental evaluation was conducted with surface soil samples collected in 2005 and 2006, that compares the detected results to a range of toxicological values. Based on the results of the supplemental evaluation, EPA and WVDEP concluded that no further action at SWMU 70 was needed.

b. Investigation Area – Building 722

In 2005, soil samples were collected in this area to facilitate leasing a portion of the Facility where Building 722 is located to a third party. Based on the analytical results from the 2005 soil sampling event, tetrachloroethene (PCE) was the only constituent detected that exceeded the industrial screening level and it was only exceeded at one location. Other samples collected within 50 feet of that same location had PCE concentrations that were either non-detect or two orders of magnitude below the industrial screening level.

c. Rocket Hollow Area

In 2008, UCC conducted soil sampling in this area of the Facility to support the prospective sale of portions of Tract A. Soil sampling revealed the presence of polycyclic aromatic hydrocarbons (PAHs) in the subsurface (4-6 feet below the ground) which exceeded their respective industrial screening levels at one location. Based on these exceedances, corrective measures to address potential human health risks related to direct contact with soil are warranted for this area.

d. SWMU 5

Three COPCs (barium, mercury, and silver) were initially identified in soil at SWMU 5 as potentially posing a risk to soil invertebrates and plants. No soil COPCs were associated with potential food web exposure. Based on the results of the evaluation for SWMU 5, EPA and WVDEP concluded that no further action was required to address risk to the ecological resources

in SWMU 5.

2. Tracts B and C

There are four SWMUs within Tracts B and C. Two of the SWMUs, Nos. 46 an 47, are cooling towers. Historical Facility information revealed that the third SWMU, No. 65, was not used to manage waste (Table 1). The fourth SWMU, No. 60, is shelving on a loading dock located on the north side of Building 2000 which is used as a waste transfer area to manage printing chemicals for short durations. EPA determined that there have been no known releases from these four SWMUs based on its review and evaluation of the Solid Waste Management Unit Description and Investigation/Corrective Action Undertaken Report (1998). In addition, 1996 soil sample results from SWMU 65 were non-detect for 40 CFR Part 261 Subpart E Appendix IX volatile, semi-volatiles and metals under the Toxicity Characteristic Leaching Procedure.

3. Tract D

a. Lower Ward Landfill

In 1965, the Lower Ward Landfill was covered with an 18-inch clay cover and was seeded. In 1978, half of the Lower Ward Landfill was paved and converted into a parking lot. The 18-inch clay cover and the parking surface currently in place prevent direct contact with waste materials in Lower Ward Landfill, thus eliminating the pathway for human health exposure.

b. Ward B Landfill

In the 1970s, a clay-soil mix cover was installed at the Ward B Landfill to reduce potential human or ecological exposure to waste material. The average cover thickness across the landfill is 5.75 feet. In 2002, UCC installed additional cover material where the cover was thin near the bottom of the drainage ditches. The clay-soil mix cover currently in place prevents direct contact with waste materials in the Ward B Landfill, thus eliminating the pathway for human health exposure to waste material.

In April 2006, UCC conducted a SLERA to evaluate previously identified pathways and receptors for surface water and sediment in the Ward B Landfill drainage ditches. Based on the results of the SLERA, EPA determined that there are no unacceptable risks and no further action is required to address the ecological resources associated with the Ward B Landfill.

c. Ward A Landfill

The analytical results from investigations conducted at the Ward A Landfill between 2005 and 2008 were compared to EPA human health risk-based screening values. The results of the human health risk screening showed that constituent concentrations were above risk-based screening values; therefore, this area was evaluated as part of a 2009 Human Health Risk Assessment (HHRA) performed by UCC. The HHRA report for Ward A Landfill concluded that no unacceptable human health risks were associated with the current and proposed future land

use of the landfill as a scenic pond. For all these exposure scenarios, the non-carcinogenic hazards index (HI) and the carcinogenic risk are below EPA's target HI of 1, and within EPA's hazard target risk range of 1x10-6 to 1x10-4.

In January 2010, UCC conducted a baseline ecological risk assessment (BERA) to evaluate the identified pathways and receptors for surface water, sediment, and surface soil. Based on the results of the BERA, EPA and WVDEP concluded that no further action is required to address risk to the ecological resources of Ward A Landfill.

B. Facility Groundwater

There are two discrete areas of groundwater contamination at the Facility namely, Ward Hollow and the Greenhouse Area.

1. Ward Hollow Groundwater

Based on geologic and hydrogeologic investigations of the area, groundwater contamination in Ward Hollow is related to the three landfills and the former brine wells at the Facility. Contaminated groundwater is migrating from the landfills and former brine wells to the underlying weathered bedrock and then downgradient to the WVDOT property and potentially to the CSX Transportation property. The most prominent constituents within the Ward Hollow groundwater plume that are above their respective EPA Maximum Contaminant Levels (MCLs) codified at 40 C.F.R. Part 141 and promulgated pursuant to the Safe Drinking Water Act, 42 United States Code (USC) 300f *et seq.* or the EPA tap water Regional Screening Levels (RSLs) include 1,4-dioxane, benzene, bis(2 chloroisopropyl)ether, arsenic, and barium.

Based on groundwater sampling results conducted since the 1980s, the Ward Hollow groundwater plume extends downgradient approximately 300 feet to the northwest of the Facility onto WVDOT property and potentially onto CSX Transportation property. Consequently, UCC performed an HHRA to evaluate human health risks related to exposure to contaminated groundwater downgradient of the Facility. Results of the HHRA indicated that if the contaminated groundwater was used for drinking water it would result in unacceptable human health risks. However, groundwater under those properties is not used for potable purposes, and there are no known plans to do so in the future. In addition, the impacted aquifer is low yielding, so it is not a practical source of potable water. The hypothetical future construction worker exposure scenario was also quantitatively evaluated for incidental contact with groundwater given that it is possible that a future construction worker could have incidental exposure to groundwater during short-term construction activities (i.e., less than 1-year duration). For the construction worker exposure scenario, the non-carcinogenic hazards index (HI) and the carcinogenic risk are below EPA's target HI of 1, and within EPA's hazard target risk range of 1x10-6 to 1x10-4. Based on the results of the HHRA, EPA and WVDEP concluded that the groundwater does not pose unacceptable human health risks for the hypothetical future construction worker.

2. Greenhouse Area Groundwater

The Greenhouse Area is located on Tract A above in the area of a former greenhouse.

Groundwater data from two monitoring wells located in the Greenhouse Area (Table 1, Figure 1) show concentrations of volatile organic compounds (VOCs) above MCLs or adjusted EPA tap water RSLs. Sample results collected in 2009 showed that VOCs did not exceed screening levels in one of the monitoring wells, and only two detected VOCs, chloroform and tetrachloroethene, exceeded screening levels in the second monitoring well. Soil results from samples collected near these wells did not show the presence of VOC soil contamination.

C. Surface Water

1. Ward Branch

In 1964, the Facility started using a 78-inch-diameter culvert pipe to capture leachate from the landfills and prevent it from discharging to Ward Branch. Leachate in the culvert (estimated to be 15 to 20 gallons per minute) is intercepted by the catch basin in Building 730 at the base of the Lower Ward northern dike and is transferred to the South Charleston POTW via the Holz Impoundment decant line (Figure 3). The culvert and the catch basin collectively are referred to as the Lower Ward leachate collection system and are part of SWMU 2.

The analytical results from investigations conducted for Ward Branch (Figure 1) were compared to EPA human health risk-based screening values. Since the results of the human health risk screening showed that constituent concentrations were above risk-based screening levels, this area was evaluated as part of a HHRA. The 2009 HHRA report for Ward Branch concluded that no unacceptable human health risks were associated with the current and proposed future land use of Ward Branch. For all these exposure scenarios, the non-carcinogenic hazards index (HI) and the carcinogenic risk are below EPA's target HI of 1, and within EPA's hazard target risk range of 1x10-6 to 1x10-4.

In 2010, UCC conducted a SLERA at Ward Branch to evaluate pathways and receptors for surface water and sediment. Based on the results of the SLERA, EPA and WVDEP concluded that no further action is required to address risk to the ecological resources of Ward Branch.

2. Tributary to Davis Creek

The 2007 SLERA also evaluated constituents detected in the surface water and sediment of a small stream downgradient of SWMUs Nos. 5 and 70. There were no exceedances of conservative ecological screening values observed in either the surface water or sediment therefore indicating that there is no potential for unacceptable ecological risk.

D. Subsurface Vapor Intrusion

Generally, buildings located above a contaminated groundwater plume are vulnerable to subsurface vapor intrusion coming from the plume by entering through cracks, joints and utilities openings. The following sections discuss potential subsurface vapor intrusion associated with the two areas of groundwater contamination at the Facility which has been found in Ward Hollow and the Greenhouse Area, and with soil contamination in the vicinity of Buildings 706 and 707 located on Tract A:

1. Ward Hollow

Historical data regarding waste materials placed in Lower Ward Landfill, Ward A Landfill, and Ward B Landfill indicated that the landfills are the source of VOCs (1,4-dioxane and benzene) which have been detected in groundwater underlying and downgradient of the landfills. Consistent with the recommendations set forth in the EPA Draft Guidance for Evaluating the Vapor Intrusion from Groundwater and Soils (November 29, 2002), locations within 100 feet of potential sources for vapor intrusion (i.e., vapors from volatile chemicals contained in the landfill or groundwater affected by the landfills) were evaluated to determine if there are unacceptable risks. Locations that are within 100 feet of the landfills include buildings that were in use at the time of the investigation (Buildings 771, 2000, and 6000) and an undeveloped area west of the Lower Ward Landfill. Buildings 771, 2000, and 6000 are currently used for office space; portions of Building 771 are also used as a laboratory and a pilot plant.

For these locations, soil gas and/or indoor air samples were collected and evaluated as part of an HHRA using the indoor worker exposure pathway/scenario. For the indoor worker exposure scenario, the non-carcinogenic hazards index (HI) and the carcinogenic risk are below EPA's target HI of 1, and within EPA's hazard target risk range of 1x10-6 to 1x10-4. Based on the sampling results and exposure assumptions in the HHRA, EPA and WVDEP concluded that current and future human health exposure would not result in unacceptable human health risks for the people occupying the buildings under the exposure pathways evaluated. Based on non-carcinogenic hazards and carcinogenic risk results for future subsurface vapor intrusion for the area west of the Lower Ward Landfill, EPA and WVDEP concluded that no further evaluation of the area is required.

Occupied buildings near the landfills have been evaluated for subsurface vapor intrusion; however, it is possible that additional occupied buildings may be constructed near the landfills in the future. Because of the presence of VOCs in the landfills and groundwater plume, corrective measures for potential unacceptable human health risks related to vapor intrusion are warranted for portions of the Facility that are located within 100 feet of the landfills.

2. Greenhouse Area / Building 740

In 2007, UCC collected soil gas samples around Building 740 in order to evaluate potential vapor intrusion related to the groundwater contamination in the Greenhouse Area. Building 740, located in the Greenhouse Area, is used as office space. Sampling revealed the presence of 2-butanone and PCE in the vicinity of Building 740. The maximum detected 2-butanone concentration (109 µg/m3) did not exceed its industrial air risk-based screening level (22,000 µg/m3) provided in the EPA RSL for chemical contaminants, assuming an Attenuation Factor (AF) of 0.1. The detected PCE soil gas concentration did not exceed the EPA industrial air RSL (210 µg/m3), assuming an AF of 0.01. Based on the sample results and exposure assumptions, EPA and WVDEP concluded that current and future human health exposure associated with vapor intrusion into Building 740 would not result in unacceptable human health risks.

3. Buildings 706 and 707

In 2008 and 2009, UCC removed soil contaminated with VOCs such as 1,2,4-trichlorobenzene; 1,2-dichlorobenzene; 1,3-dichlorobenzene; 1,4-dichlorobenzene; and chlorobenzene in the vicinity of Buildings 706 and 707 which are located on Tract A. Building 706 is an active chemical processing facility and Building 707 is a former manufacturing building that is currently used for office space. The analytical results for the post-removal soil samples indicated that exposure to soil would not result in unacceptable human health risks. However, there was a potential for vapor intrusion into Buildings 706 and 707 based on residual VOCs concentrations.

As a result, in July 2009, sub-slab soil gas, indoor air, and ambient air samples were collected in and around the buildings and evaluated as part of an HHRA. Human health risks for Buildings 706 and 707 were evaluated for exposure to VOCs in indoor air through subsurface vapor migration from exterior soil for current/future indoor workers. For the indoor worker exposure scenario the non-carcinogenic hazards index (HI) and the carcinogenic risk are below EPA's target HI of 1, and within EPA's hazard target risk range of 1x10-6 to 1x10-4. Based on the sample results and exposure assumptions in the HHRA, EPA and WVDEP concluded that current and future human health exposure associated with vapor intrusion into Buildings 706 and 707 from VOCs did not pose unacceptable human health risks.

V. EVALUATION OF EPA'S REMEDY

EPA evaluated the Final Remedy against ten criteria. The criteria were applied in two phases. In the first phase, EPA evaluates three criteria, known as threshold criteria. In the second phase, EPA evaluated seven balancing criteria.

The following is a summary of EPA's evaluation of the threshold criteria:

A. Threshold Criteria

(1) Protect Human Health and the Environment

EPA's remedy protects human health and the environment by adequately eliminating, reducing, or controlling unacceptable risk through the combination of the operation and maintenance of the interim measures already in place at the Facility and through the implementation of institutional controls to prevent potential future exposure. These institutional controls protect and prevent the use of groundwater at the Facility and the affected offsite properties, prevent or control the exposure to impacted soil through direct contact or vapor intrusion, and control land use to prevent changes inconsistent with the remedy.

(2) Achieve Media Cleanup Objectives

EPA's remedy meets the appropriate cleanup objectives which is the protection of human health and the environment. The majority of Facility soils contain contaminant concentrations that are below the EPA residential or industrial soil RSLs and the mean natural background concentration for the State of West Virginia. For those areas where contaminant concentrations

are above the EPA residential and/or industrial soil RSL, institutional controls will be implemented to manage potential direct contact risks.

Groundwater exceeds the MCLs and/or the EPA tap water RSLs in Ward Hollow and the Greenhouse Area; however, groundwater use restrictions will be applied to the entire Facility and the affected offsite properties (WVDOT and potentially CSX Transportation) to manage human exposure to contaminated groundwater.

(3) Control the Source(s)

The landfills (Lower Ward, Ward A and Ward B) are the remaining sources of hazardous constituents at the Facility for which the remedy is being considered. These sources are being controlled through the interim measures described above in Section III.A.3. Groundwater monitoring data show that the groundwater plume is stable and is not expanding and that the constituent concentrations do not show an increasing trend. In addition, groundwater monitoring and inspections will continue to detect any release that may occur in the future.

B. Balancing Criteria

Balancing criteria are presented below to illustrate the suitability of the components of the remedy.

(1) Long-Term Reliability and Effectiveness

The long-term reliability and effectiveness standard is intended to address protection of human health and the environment over the long term. EPA's remedy meets this standard. The landfill covers are reliable and effective long-term solutions to manage direct contact with waste material in Lower Ward and Ward B Landfill. Long-term groundwater monitoring is because the data have demonstrated that the groundwater plumes are stable. In addition, such long-term monitoring will provide the opportunity and the data for the agencies to evaluate any changes in the conditions of the Facility.

EPA also considers ICs long-term components of a remedy. EPA's remedy includes the implementation and maintenance of ICs to restrict activities that may result in human exposure to contaminants. EPA will require the ICs to be maintained as long as those contaminants remain in place at the Facility.

(2) Reduction of Toxicity, Mobility or Volume of Wastes

EPA's remedy requires UCC to manage the waste in the landfills in place. The landfill covers have shown to be an effective remedy controlling the mobility of the contaminants, as demonstrated by the data of the groundwater monitoring showing that the plumes are stable.

(3) Short-Term Effectiveness

The short-term effectiveness standard is intended to address hazards posed during the implementation of corrective measures. Short-term effectiveness is designed to take into

consideration the impact to facility workers and nearby residents during construction. Since the components of the remedy as described in Section IV of this SB have been in place, there are no associated short term impacts. A component of the remedy is ICs. ICs are administrative and/or legal instruments and as such will not pose any hazards to facility workers. Furthermore, ICs will be implemented to reduce hazards posed by direct contact with contaminants that remain in place.

(4) Implementability

The implementability decision factor addresses the regulatory constraints in employing the cleanup approach. Since the remedy includes the operation and maintenance of measures which have been implemented, and there do not appear to be any regulatory hurdles that would impede the implementation of ICs, EPA anticipates that the remedy will be fully implementable.

(5) Cost

The cost for continued operation and maintenance of the interim measures and the implementation of the institutional controls is approximately $145,000 per year.

(6) Community Acceptance

UCC currently meets with a Community Advisory Panel to foster an open dialogue, an exchange of ideas, better understanding and cooperation between UCC and the surrounding community regarding plant health, safety, and environmental protection programs. There have been no known conflicts within the community regarding the investigation, remediation efforts and community acceptance. Community acceptance of EPA's remedy will be evaluated based on comments received during the public comment period.

(7) State Acceptance

WVDEP has reviewed and concurred with the remedy for the Facility. Furthermore, EPA has solicited WVDEP's input and involvement throughout the investigation process at the Facility, and the remedy will be implemented pursuant to a modification by WVDEP of UCC's current permit.

VI. FINANCIAL ASSURANCE

EPA anticipates that the Facility's RCRA Permit will be modified to include implementation of the corrective measures selected in this Final Decision and to require updated financial assurance to include any costs associated with these corrective measures.

VII. DECLARATION

Based on the Administrative Record, I have determined that the Final Remedy as set forth in this Final Decision is appropriate and will be protective of human health and the environment.

Date: 12/15/10

Abraham Ferdas, Director
Land and Chemicals Division
U.S. Environmental Protection Agency, Region III

ATTACHMENT A

ATTACHMENT A
PUBLIC COMMENTS AND EPA RESPONSES
UNION CARBIDE CORPORATION, TECHNOLOGY PARK
SOUTH CHARLESTON, WEST VIRGINIA

I. PUBLIC COMMENTS AND EPA RESPONSES

EPA received comments from the Union Carbide Corporation (UCC) on the proposed Final Remedy for the UCC, Technology Park, South Charleston, West Virginia (hereinafter referred to as the Facility). Those comments and EPA's responses to those comments are set forth below:

Comment 1: Section II. – Facility Background

Paragraph 1 states that the CSX Transportation parcel abuts the Facility; however, the CSX Transportation parcel is separated from the Facility by the West Virginia Department of Transportation parcel. UCC proposes that paragraph 1 be revised to state, "Located downgradient from the Facility to the northwest are two parcels, owned by the West Virginia Department of Transportation (WVDOT) and CSX Transportation, respectively." In addition, UCC proposes including an updated version of Figure 4 (attached) in the Statement of Basis and Final Decision Document. The updated figure shows the property owners for the area where offsite groundwater use restrictions are proposed.

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 2: Section II. – Facility Background

The parties listed in paragraph 2 are not inclusive of all the parties UCC purchased land from for the Facility. In addition, not all of the parcels were purchased in 1947. UCC proposes that paragraph 2 be revised to state, "Between 1947 and 1974, UCC purchased individual parcels of land from the Kanawha Land Company, Westvaco Chemical Company, a dairy farm, and other parties."

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 3: Section II. – Facility Background

Paragraph 4 incorrectly states, "The landfills also received oxide tails from the Facility's propylene oxide production unit…" The oxide tails came from the propylene oxide production

unit at the UCC South Charleston Facility not the UCC Technology Park. UCC proposes that paragraph 4 be revised to state, "The landfills also received oxide tails from the UCC South Charleston Facility propylene oxide production unit…"

EPA Response:
EPA agrees with the comment and has incorporate this change into the Final Decision.

Comment 4: Section II. – Facility Background

Paragraph 6 incorrectly lists the name for the church that purchased the parcel from UCC; the correct entity is the United Disciples of Christ Church.

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision

Comment 5: Section II. – Facility Background

Figure 2 does not show the area that was sold to the United Disciples of Christ Church. UCC proposes including an updated version of Figure 2 (attached) in the Statement of Basis and the Final Decision Document. The updated figure shows the area of Tract D that was sold in July 2010. In addition, UCC proposes that paragraph 6 be revised to state, "In addition, in July 2010, a portion of Tract D (shown as "Area D-1" on Figure 2) was sold by UCC…"

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision by including a revised Figure 2.

Comment 6: Section III. – Summary of Environmental Investigations and Interim Measures

The report titled Summary of Ecological Risk for SWMU 5 and 20 in paragraph 2 is incorrect. The correct title is Summary of Ecological Risk Evaluations for RCRA Solid Waste Management Units 5 and 70. In addition, the sentence following the title of this document should be changed to say, "This report documents…" instead of "These reports document…"

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 7: Section III. – Summary of Environmental Investigations and Interim Measures

The description in paragraph 2 for the report titled, Screening Level Ecological Risk Assessment for Ward Branch and Baseline Ecological Risk Assessment for Ward A Pond states, "This reports documents the ecological evaluation of the fate and transport of constituents detected at the SWMUs…" Ward Branch is not a solid waste management unit (SWMU); therefore, UCC proposes that paragraph 2 be revised to state, "This report documents the ecological evaluation of the fate and transport of constituents detected in Ward Branch and Ward A Pond…"

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 8: Section III. – Summary of Environmental Investigations and Interim Measures

Information from the following reports is included in the Statement of Basis; therefore, UCC proposes that the following text be added to Section III of the Statement of Basis and Final Decision Document:

Ecological Risk Assessment Ward A and B Landfills (Solid Waste Management Units 3 and 4) (2006) – This report documents the ecological evaluation of the fate and transport of constituents detected at the SWMUs through the ecological setting of the Facility.

Technology Park Groundwater Screening-Level Assessment (2009) – This report documents the human health risk assessment for current and future exposure to constituents in groundwater downgradient of the Facility.

Buildings 706 and 707 Area Soil Investigation, Removal Action, and Vapor Intrusion Human Health Risk Assessment (2009) – This report documents the soil investigation and removal action. In addition, it documents the human health risk assessment for current and future exposure to constituents in indoor air in Buildings 706 and 707.

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 9: Section III. – Summary of Environmental Investigations and Interim Measures

Paragraph 3 references Table 1; however, Table 1 is not included in the Statement of Basis. The attached table appears to be the table that is missing from the Statement of Basis.

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision by including Table 1.

Comment 10: Section III.A.2 – Tracts B and C

SWMU 60 is still used as a waste transfer area for printing chemicals. UCC proposes that this section be revised to state, "The fourth SWMU, No. 60, is shelving on a loading dock on the north side of Building 2000 which is used as a waste transfer area to manage printing chemicals for short durations."

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 11: Section III.A.3.b – Tract D, Ward B Landfill

Paragraph 1 incorrectly states that the Ward B Landfill cover prevents human heath exposure to soil. The cover prevents human health exposure to waste material not soil. UCC proposes that paragraph 1 be revised to state, "The clay-soil mix cover currently in place prevents direct contact with waste material in the Ward B Landfill, thus eliminating the pathway for human health exposure to waste material."

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 12: Section III.A.3.b – Tract D, Ward B Landfill

Paragraph 2 states the incorrect date for the screening level ecological risk assessment (SLERA). The SLERA for Ward B Landfill was conducted in April 2006.

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 13: Section III.B.1 – Ward Hollow Groundwater

The constituents listed in paragraph 1 are not inclusive of all constituents within the Ward Hollow groundwater plume that are above their respective U.S. Environmental Protection Agency maximum contaminant level or EPA tap water regional screening level. This list only includes the most prominent constituents. UCC proposes that paragraph 1 be revised to state, "The most prominent constituents within the Ward Hollow groundwater plume that are above their respective EPA maximum contaminant levels (MCLs) codified at 40 Code of Federal Regulations (CFR) Part 141 and promulgated pursuant to the Safe Drinking Water Act, 42 United States Code (USC) 300f et seq. or the EPA tap water regional screening levels (RSLs) include 1,4 dioxane; benzene; bis(2-chloroisopropyl)ether; arsenic; and barium."

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 14: Section III.B.2 – Greenhouse Area Groundwater

This section states that the Greenhouse Area is above the location of the former greenhouse; however, the Greenhouse Area encompasses the location of the former greenhouse. UCC proposes this section be revised to state, "The Greenhouse Area is located on Tract A in the area of the former greenhouse."

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 15: Section III.C.1 – Ward Branch

Paragraph 2 states, "The 2009 HHRA report for Ward A Landfill concluded that no unacceptable human health risks were associated with the current and proposed future land use of the landfill as a scenic pond." This section is for Ward Branch not Ward A Landfill; therefore, UCC proposes that paragraph 2 be revised to state, "The 2009 HHRA report for Ward Branch concluded that no unacceptable human health risks were associated with the current and proposed future use of Ward Branch."

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 16: Section III.C.2 – Tributary to Davis Creek

This section states the incorrect date for the SLERA. The SLERA for the tributary to Davis Creek was conducted in 2007.

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 17: Section III.D.1 – Ward Hollow

Paragraph 3 only references Tract D; however, there are portions of Tracts A, B, and C within 100 feet of the landfills. In addition, paragraph 3 states, "...corrective measures for potential unacceptable human health risks related to vapor intrusion will be evaluated..." Corrective measures already have been evaluated for potential unacceptable human health risks related to vapor intrusion, and a remedy has been proposed (i.e., installation of a vapor control system for all new structures which are to be occupied). UCC proposes that paragraph 3 be revised to state, "Occupied buildings near the landfills have been evaluated for subsurface vapor intrusion; however, it is possible that additional occupied buildings may be constructed near the landfills in the future. Because of the presence of VOCs in the landfills and groundwater plume, corrective measures for potential unacceptable human health risks related to vapor intrusion are warranted for portions of the Facility that are located within 100 feet of the landfills."

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 18: Section III.D.2 – Greenhouse Area/Building 740

Table 1-1 is referenced in this section; however, Table 1-1 is not in the Statement of Basis. It appears this reference is not necessary.

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 19: Section IV.A – Introduction

Figure 5 of the Statement of Basis does not show all of the areas where UCC proposed subsurface work restrictions. UCC proposes including an updated version of Figure 5 (attached) in the Statement of Basis and Final Decision Document. The updated figure shows all of the areas where UCC proposed subsurface work restrictions.

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision by including an updated Figure 5.

Comment 20: Section IV.A – Introduction

In paragraph 3, the inactive landfills are referred to as closed surface impoundments. This is the first and only time the landfills are referred to as closed surface impoundments. To avoid confusion, it is recommended that the landfills not be referred to as closed surface impoundments in the Statement of Basis and Final Decision Document.

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 21: Section IV.B – Tract A

Paragraph 2, bullet b incorrectly states, "No earth moving activities, including construction and drilling, may be done on Tract A unless such activities are required by WVDEP, in consultation with EPA, or it is demonstrated to WVDEP, in consultation with EPA, that such activities will not pose a threat to human health or the environment or adversely affect or interfere with the selected remedy and WVDEP, in consultation with EPA, provides prior written approval for such activities." The subsurface work restriction only applies to the areas of Tract A shown on Figure 5 as having subsurface work restrictions. In addition, UCC requests that written approval from WVDEP not be required for earth moving activities. UCC proposes that bullet b be revised to state: "Earth moving activities, including construction and drilling, may only be conducted in the areas of Tract A depicted on Figure 5 as having subsurface work restrictions if it is determined that such activities will not pose a threat to human health or the environment or adversely affect or interfere with the selected remedy."

EPA Response:

When EPA proposed to require that UCC obtain written approval from WVDEP prior to any earth moving activities, it intended that UCC obtain and comply with a WVDEP-approved Health & Safety Plan prior to such activities. The requirement to develop and implement a Health & Safety Plan was described in the Subsection A (Introduction) of Section IV. (Summary of Proposed Corrective Measures) of the SB. For purposes of clarification, the Final Decision includes this requirement under in Sections IV, B and D, respectively. In addition, EPA agrees that the restriction on earth moving activities applies to the areas of Tract A which are shown on Figure 5.

Comment 22: Section IV.B – Tract A

UCC has proposed that the institutional controls for Tract A include a restriction on groundwater use. It is requested that a bullet be added to this section that states, "Groundwater from Tracts A shall not be used for any purpose other than to conduct the operation, maintenance and monitoring activities required by WVDEP and/or EPA, unless it is demonstrated to WVDEP, in consultation with EPA, that such use will not pose a threat to human health or the environment or adversely affect or interfere with the selected remedy and WVDEP, in consultation with EPA, provides written approval for such use."

EPA Response:
EPA agrees with the comment. The Facility-wide groundwater restriction was provided for in the SB in Section IV. D (Tract D) which listed the proposed institutional controls for Tract D. For purposes of clarification, the Final Decision includes the groundwater restriction under each Tract in Sections IV, A, B and C, respectively.

Comment 23: Section IV.C – Tracts B and C
UCC has proposed that the institutional controls for Tracts B and C include a restriction on subsurface work within 100 feet of any of the landfills. It is requested that text be added to this section to state, "Earth moving activities, including construction and drilling, may only be conducted in the areas of Tracts B and C depicted on Figure 5 as having subsurface work restrictions if it is determined that such activities will not pose a threat to human health or the environment or adversely affect or interfere with the selected remedy."

EPA Response: EPA disagrees with this comment. Based on historical information and soil sampling results, EPA determined that the areas on Tracts B and C that are within 100 feet of any of the landfills do not require a subsurface work restriction. Those areas do, however, pose a potential for unacceptable human health risks related to vapor intrusion. Figure 5 has been revised to clearly depict those areas where the potential for such vapor intrusion exists.

Comment 24: Section IV.C – Tracts B and C

UCC has proposed that the institutional controls for Tracts B and C include a restriction on groundwater use. It is requested that text be added to this section that states, "Groundwater from Tracts B and C shall not be used for any purpose other than to conduct the operation, maintenance and monitoring activities required by WVDEP and/or EPA, unless it is demonstrated to WVDEP, in consultation with EPA, that such use will not pose a threat to human health or the environment or adversely affect or interfere with the selected remedy and WVDEP, in consultation with EPA, provides written approval for such use."

EPA Response:
EPA agrees with the comment. The Facility-wide groundwater restriction was provided for in the SB in Section IV. D (Tract D) which listed the proposed institutional controls for Tract D.

For purposes of clarification, the Final Decision includes the groundwater restriction under each Tract in Sections IV, A, B and C, respectively.

Comment 25: Section IV.D – Tract D

Paragraph 2, bullet b states, "Tract D shall not be used in any way that will adversely affect or interfere with the integrity and protectiveness of the caps and the area within 100 feet of the caps placed over the Lower Ward Landfill, Ward A Landfill and Ward B Landfill..." Ward A Landfill does not have a cover; therefore, UCC proposes the reference to Ward A Landfill be removed from this sentence.

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 26: Section IV.D – Tract D

The landfill covers are referred to as "caps" in this section. This could be misconstrued to mean they meet the requirements for a Resource Conservation and Recovery Act (RCRA) cap. To avoid confusion, UCC proposes the landfill covers not be referred as caps in the Statement of Basis and Final Decision Document.

EPA Response:
EPA agrees with the comment and has incorporated this change into the Final Decision.

Comment 27: Section IV.D – Tract D

Paragraph 2, bullet d incorrectly states, "No earth moving activities, including construction and drilling, may be done on Tract D unless such activities are required by WVDEP, in consultation with EPA, or it is demonstrated to WVDEP, in consultation with EPA, that such activities will not pose a threat to human health or the environment or adversely affect or interfere with the selected remedy and WVDEP, in consultation with EPA, provides prior written approval for such activities." The subsurface work restriction only applies to the areas of Tract D shown on Figure 5 as having subsurface work restrictions. In addition, UCC requests that written approval from WVDEP not be required for earth moving activities. UCC proposes that bullet d be revised to state: "Earth moving activities, including construction and drilling, may only be conducted in the area of Tract D depicted on Figure 5 as having subsurface work restrictions if it is determined that such activities will not pose a threat to human health or the environment or adversely affect or interfere with the selected remedy."

EPA Response: When EPA proposed to require that UCC obtain written approval from WVDEP prior to any earth moving activities, it intended that UCC obtain and comply with a WVDEP-approved Health & Safety Plan prior to such activities. The requirement to develop and implement a Health & Safety Plan was described in the Subsection A (Introduction) of Section IV. (Summary of Proposed Corrective Measures) of the SB. For purposes of clarification, the Final Decision includes this requirement under in Sections IV, B and D, respectively. In

addition, EPA agrees that the restriction on earth moving activities applies to the areas of Tract D which are shown on Figure 5.

TABLE 1

TABLE 1
SWMUs and Investigation Areas Summary Table
Statement of Basis
UCC Technology Park
South Charleston, West Virginia

SWMU No.	Tract	Unit Name	Unit Location	SWMU Classification[1]	Operational Status (as of March 2008)[2]	Wastes Managed	History of Release[3]	Interim Measures	Previous Investigation Results
1	D	Lower Ward Landfill	Located west of Building 2000	B	Inactive	The landfill was used for disposal of fly ash from the South Charleston Facility (SCF), municipal sludge, oxide tails from the SCF propylene oxide production unit, wastes from general chemical operations, and small amounts of organic chemicals.	This landfill and Ward A/B landfill are the sources for the groundwater contamination in Ward Hollow.	Covered with 18 inches of clay cover and seeded in 1965. Half the surface was paved in 1978. Since 1970s, some of the leachate has been collected in SWMU 2.	Groundwater in Ward Hollow is being impacted by Solid Waste Management Unit (SWMU) 1 and SWMU 3. Contaminated groundwater is migrating from these sources to the underlying weathered bedrock and then downgradient into Ward Hollow. The most prominent constituents that are present within the groundwater plume are: 1,4-dioxane; benzene; bis(2-chloroisopropyl)ether; arsenic; and barium. To evaluate the potential for vapor intrusion into nearby buildings, soil gas and indoor air sampling was conducted. Human health risks were evaluated in a human health risk assessment (HHRA) which concluded that current and future human health exposure would not result in unacceptable human health risks (CH2M HILL 2009a).
2	D	Lower Ward Leachate Collection System	Located north of Lower Ward Landfill (SWMU 1) inside Building 730	B	Active	Leachate could contain constituents that were deposited in the Lower Ward Landfill.	Strong chemical odor was observed during the Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) emanating from the leachate collected.	In 1970, two pumps were installed at Building 730 to pump the leachate from the leachate collection system to the South Charleston Publicly Owned Treatment Work (POTW).	Water samples collected from the Lower Ward leachate collection system show similar constituent found in Ward Hollow wells (CH2M HILL 2008).
3	D	Ward A/B Landfill	Located south of Lower Ward and the Main Technology Park complex	A	Ward A: Inactive Ward B: Inactive	The landfill was used for disposal of fly ash from the SCF, municipal sludge, and oxide tails from the SCF propylene oxide production unit.	This landfill and Lower Ward Landfill are the source of groundwater contamination in Ward Hollow.	(1) In 1969 and 1977 a flow of water was observed west of the upper dike; this was corrected after each observation. (2) Ward B was covered with a clay-soil mix in the 1970s. (3) Breached and thin areas in the cover at Ward B were repaired following the 2001 RFI investigation. (4) Central drain line sump pumping system was installed.	Soil, sediment, surface water, soil gas, and indoor air sampling have been conducted to evaluate impacts related to this SWMU. Ecological risks were evaluated in Ward A/B Screening Level Ecological Risk Assessment (SLERA) (CH2M HILL 2006) and the Ward A Pond Baseline Ecological Risk Assessment (CH2M HILL 2010a); these reports concluded that no unacceptable risks to ecological receptors are expected. Human health risks were evaluated in a HHRA which concluded that current and future human health exposure to evaluated media would not result in unacceptable human health risks (CH2M HILL 2009a).
4	D	Upper Ward A/B Landfills Overflow System Including Outfall 008	Located at north end of the pond that covers Ward A	A	Active	May contain constituents that were deposited in the Ward A/B Landfill.	None	None	Surface water and sediment sampling have been conducted to evaluate impacts related to SWMU 3. Ecological risks were evaluated in the Ward Branch SLERA (CH2M HILL 2010a); this evaluation concluded that no unacceptable risks to ecological receptors are expected. Human health risks were evaluated in a HHRA which concluded that current and future human health exposure to evaluated media would not result in unacceptable human health risks (CH2M HILL 2009a).
5	A	Timberland Landfill	Located approximately at the western edge of the Technology Park property in an area cleared for the power lines, southwest of Building 776	B	Inactive	Waste reportedly includes small quantities of laboratory sample bottles and latex polymer.	None	Wastes materials were reportedly removed from SWMU 5 and shipped off site (UCC 1998).	In 2004, a geophysical survey, two test pits to confirm the geophysical results, and soil sampling was completed. No waste was observed in the test pits or the soil borings. The analytical results from the soil sampling were evaluated in the Current Conditions Report (CCR) (CH2M HILL 2008), no industrial or residential screening level exceedances were observed. In addition, no unacceptable ecological risk was observed. In 2008/2009, additional excavations were completed to further evaluate if there is any remaining waste material in the former landfill. During these excavations some trash (concrete, metal, and plastic) was uncovered; however, the limited amount of trash observed did not indicate that a landfill is present in the excavation area.
6	A	701 Waste Accumulation Shed (8723)	Located northwest of the incinerator (SWMU 55)	C	Inactive as a SWMU	Was used formerly to store wastes generated at Building 701 and in laboratories and pilot plants throughout the facility. Currently only raw materials are stored here.	None	None	In 2008, soil sampling was completed to support potential future divestitures. The analytical results did not exceed the residential or industrial screening levels (CH2M HILL 2010b).
7	A	740 Waste Accumulation Shed (8736)	Located off the northwest corner of Building 740	C	Inactive	Stored wastes generated at Building 740, and in laboratories and pilot plants throughout the facility.	None	In 1989, this area was cleaned up, partially demolished and reconstructed. The containment sump was removed and the drain pipe valved off. After this, the area was no longer used as a waste transition area (UCC 1998).	In 2006, one soil sample (TCF-0063) was collected from this SWMU as part of the Donation Area Investigation. The results for this soil sample were nondetect (CH2M HILL 2008).
8	A	770 Waste Accumulation Shed (8722)	Located off the northeast corner of Building 770	C	Inactive	Stored wastes generated at Building 770, and in laboratories and pilot plants throughout the facility.	None	In 1989 this area was cleaned up, partially demolished and reconstructed. The containment sump was removed and the drain pipe valved off. After this, the area was no longer used as a waste transition area (UCC 1998).	Not Applicable

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9	A	9a. 722 Non-Hazardous Waste Accumulation Shed 9b. Dismantled Incinerator	These represent two units that occupied the same area at different times, the location is immediately southwest of the closed Incinerator (SWMU 55)	C	Inactive	9a. Stored non-hazardous waste from the pilot plant and laboratories. 9b. The incinerator burned mainly cardboard and other packing materials, but also took small lots of organic chemical sample bottles and 5-gallon cans.	None	Incinerator dismantled and closed in 1972. The foundation was cleaned and put in use as a pad under an accumulation shed. Waste accumulation shed was cleaned at the same time as the incinerator (UCC 1998).	Not Applicable
10	A	722 Waste Accumulation Pad	Located 50 feet west of the Incinerator (SWMU 55) and adjacent to the New Day Tank (SWMU 54)	C	Inactive	Stored wastes from all areas of the facility which were to be disposed of in the Incinerator (SWMU 55).	None	Cleaned and closed the same time as the Incinerator (SWMU 9b) (UCC 1998).	Not Applicable
11	A	706/707 Waste Accumulation Area	Located northeast of Building 707, on the east side of the Residue Tanks (SWMUs 48 and 49) and the Wastewater Tanks (SWMUs 51 and 52)	C	Inactive	Stored wastes from all areas of the facility which were designated to be emptied into either the Residue Tanks (SWMUs 48 & 49) or the Wastewater Tanks (SWMU 51 & 52).	Leaking drums were noted on an inspection (No date). The concrete base was cracked and stained at the time of the VSI.	None	In 2004, soil samples and a groundwater grab sample from a perched zone were collected. The analytical results were evaluated in the CCR (CH2M HILL 2008), no industrial or residential screening level exceedances were observed for soil. The groundwater grab sample did however exceed screening levels. In 2006, additional borings were completed to further assess the possibility of a perched groundwater zone. None of the direct pushing boring showed any indication of a perched groundwater zone (CH2M HILL 2008).
12	A	726/727 Waste Accumulation Area	Located on the north side of Building 726	C	Active	Stores waste generated in Building 726 & 727	In 1982, one drum of waste isocyanate exploded at the east end of Building 726. No estimate on the amount released.	None	In 1992, a soil sample was collected. The analytical results were nondetect (UCC 1998). In 2008, additional soil samples were collected from this area to support potential future divestitures. The results for these samples were also nondetect (CH2M HILL 2010b).
13	A	728 Waste Accumulation Area	Located at the west end of Building 728	C	Active	Stores waste generated in Building 728.	None	None	In 2008, soil samples were collected from this area to support potential future divestitures. The results for these samples were nondetect (CH2M HILL 2010b).
14	A	733 Waste Accumulation Area	Located west of Building 720 and north of Building 706	B	Inactive as a SWMU	Stored wastes generated from all areas of the facility. At the time of the VSI, lithium bromide and waste acetone were stored here. Currently only raw materials are stored in this area.	None	A closure plan was approved in 1997 (UCC 1998), but there is no record that the plan was implemented.	In 2004, soil sampling was completed. The analytical results from the soil sampling were evaluated in the CCR (CH2M HILL 2008), no industrial or residential screening level exceedances were observed.
15	A	740 Waste Oil Storage Area	Located east of Building 743	C	Inactive as a SWMU	Historically stored used vacuum pump oil, but currently stores acetone and drummed raw materials.	None	None	In 2006, one soil sample (TCF-0062) was collected from this SWMU as part of the Donation Area Investigation. The results for this soil sample were nondetect (CH2M HILL 2008).
16	A	770 Aldehydes Waste Accumulation Area	Located on the north side of the east wing of Building 770, approximately 1,000 feet west of Ward Hollow	C	Active	Stores waste aldehydes.	None	None	Not Applicable
17	A	771 Waste Accumulation Area	Located at the north end of Building 771	C	Active	Stores wastes generated in Building 771.	None	None	In 2008, soil sampling was completed to support potential future divestitures. The analytical results did not exceed residential or industrial screening levels (CH2M HILL 2010b).
18	A	773 Waste Accumulation Area	Located on the southwest side of Building 773	C	Active	Stores wastes generated in Building 773.	None	None	Not Applicable
19	A	776 Waste Accumulation Pad	Located on the north side of Building 776	C	Active	Stores wastes generated in Building 776 and other nearby buildings.	In 1987, 30 gallons of kerosene was spilled on the concrete pad. It was immediately absorbed and cleaned up.	The spilled kerosene was immediately absorbed and cleaned up. No long term impact occurred due to this release (A.T. Kearney, 1988).	Not Applicable
20	A	735 Waste Storage Pad	Located southwest of Building 720 and the 733 Waste Accumulation Pad (SWMU 14)	C	Active	Stores wastes generated from all areas of the facility. Wastes in accumulation areas (SWMUs 6-19) that are approaching 90-day storage limit are either incinerated or transferred to this unit.	None	None	Not Applicable
21	A	787 Waste Storage Bunker	Located approximately 50 feet north of Building 771	C	Active	Stores wastes and raw chemicals characterized as "highly ignitable, reactive, or toxic."	None	None	In 2008, soil sampling was completed to support potential future divestitures. The analytical results did not exceed the residential or industrial screening levels (CH2M HILL 2010b).
22	A	740 Area Sump	Located outside of the 740 Former Contaminated Oil Storage Area (SWMU 15)	C	Inactive	Received runoff from SWMU 15.	None	None	In 2006, one soil sample (TCF-0062) was collected from this SWMU as part of the Donation Area Investigation. The results for this soil sample were nondetect (CH2M HILL 2008).
23	A	776 Pad Sump	Located on the north Side of Building 776	C	Active	Receives runoff from SWMU 19.	Sump was inspected and found not to contain any spill material	None	Not Applicable
24	A	787 Bunker Sump	Located immediately west of the 787 Waste Storage Bunker (SWMU 21)	C	Active	Receives runoff from SWMU 21.	None	None	In 2008, soil sampling was completed to support potential future divestitures. The analytical results did not exceed the residential or industrial screening levels (CH2M HILL 2010b).

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25	A	701 Shed Sump	Located behind the 701 Waste Accumulation Shed (SWMU 6)	C	Inactive as a SWMU	Received runoff from SWMU 6.	None	None	In 2008, soil sampling was completed to support potential future divestitures. The analytical results did not exceed the residential or industrial screening levels (CH2M HILL 2010b).
26	A	722 Shed Sump	Located immediately west of the 722 non-hazardous waste accumulation shed (SWMU 9)	C	Inactive	Received runoff from SWMU 7.	None	Cleaned and closed the same time as the incinerator (SWMU 9b) (UCC 1998).	Not Applicable
27	A	740 Shed Sump	Located behind 740 Waste Accumulation Shed (SWMU 7)	C	Inactive	Received runoff from SWMU 8.	None	In 1989, this area was cleaned up, partially demolished and reconstructed. The containment sump was removed and the drain pipe valved off. After this, the area was no longer used as a waste transition area (UCC 1998).	In 2006, one soil sample (TCF-0063) was collected from this SWMU as part of the Donation Area investigation. The results for this soil sample were nondetect (CH2M HILL 2008).
28	A	770 Shed Sump	Located behind 770 Waste Accumulation Shed (SWMU 8)	C	Inactive	Received runoff from SWMU 9.	None	In 1989 this area was cleaned up, partial demolished and reconstructed. The containment sump was removed and the drain pipe valved off. After this the area was no longer used as a waste transition area (UCC 1998).	Not Applicable
29	A	704 Empty Drum Area	Located on the east side of Building 704	D	Active	Stores empty drums from Building 704 and other nearby facilities.	None	None	Not Applicable
30	A	707 Empty Drum Rack	Located east of Building 706	D	Active	Stores only empty stainless steel drums that are steam cleaned at SWMU 59 prior to storage.	None	None	Not Applicable
31	A	706/707 Empty Drum Area	Located west of Building 707	D	Active	Stores empty drums from Building 706/707 and other nearby facilities.	None	None	Not Applicable
32	A	726 Empty Drum Area	Located on the north side of Building 726, just east of the 726/727 Waste Accumulation Area (SWMU 12)	D	Active	Stores empty drums from Building 726/727 and other nearby facilities.	Small amount of liquid from one drum appeared to have seeped onto the pad. Leak did not get transported off the pad.	None	In 2008, soil samples were collected from this area to support potential future divestitures. The results for these samples were nondetect (CH2M HILL 2010b).
33	A	742/743 Empty Drum Area	Located immediately east of Building 742	D	Active	Stores empty drums from Building 742/743 and other nearby facilities.	None	None	In 2006, one soil sample (TCF-0061) was collected from this SWMU as part of the Donation Area Investigation. The results for this soil sample were nondetect (CH2M HILL 2008).
34	A	770 Empty Drum Area	Located approximately 30 feet east of 771 Waste Accumulation Area (SWMU 17)	D	Active	Stores empty drums from Building 770 and other nearby facilities.	None	None	In 2008, soil sampling was completed to support potential future divestitures. The analytical results did not exceed the residential or industrial screening levels (CH2M HILL 2010b).
35	A	771 Empty Drum Area	Located approximately 20 feet north of 787 Waste Storage Bunker (SWMU 21)	D	Active	Stores empty drums from Building 771 and other nearby facilities.	None	None	In 2008, soil sampling was completed to support potential future divestitures. The analytical results did not exceed the residential or industrial screening levels (CH2M HILL 2010b).
36	A	776 Empty Drum Area	Located north of Building 773	D	Active	Stores empty drums from Building 776 and other nearby facilities.	None	None	Not Applicable
37	A	704 Cooling Tower Basin	Located approximately 100 feet west of the incinerator (SWMU 55), and 30 feet west of 701 Waste Accumulation Shed (SWMU 6)	D	Active	Chromium compound was added to the cooling water from 1940s to 1980s. The basin is emptied once a year and any biological solids washed down the clean sewer (SWMU 61).	None	None	In 1989, TCLP analysis for metals was performed on cooling tower wood that was replaced. The results were nondetect except for barium and chromium, which were below RCRA characteristic and treatment standard levels (UCC 1998).
38	A	742 Cooling Tower Basin	Located approximately 100 feet west of Building 742	B	Inactive as a SWMU	Chromium compound was added to the cooling water from 1940s to 1980s. The basin is emptied once a year and any biological solids washed down the clean sewer (SWMU 61).	Cooling water was observed during the VSI dripping onto the soil near the southeast corner of the tower.	In 1990, minor cracks that penetrated the full thickness of the wall were repaired. Sometime in the 1980s, chromium compound was eliminated as an additive to the cooling water (UCC 1998).	In 2004, soil sampling was completed. The analytical results from the soil sampling were evaluated in the CCR (CH2M HILL 2008), no industrial or residential screening level exceedances were observed.
39	A	770 Cooling Tower Basin	Located approximately 100 feet north of Building 770	D	Active	Chromium compound was added to the cooling water from 1940s to 1980s. The basin is emptied once a year and any biological solids washed down the clean sewer (SWMU 61).	None	Chromium compounds are no longer used in the cooling water (UCC 1998).	Not Applicable
40	A	773 Cooling Tower Basin	Located approximately 100 feet west of Building 773	D	Active	Chromium compound was added to the cooling water from 1940s to 1980s. The basin is emptied once a year and any biological solids washed down the clean sewer (SWMU 61).	Cooling water was observed during the VSI dripping onto the soil on the west side of the tower basin.	Sometime in the 1980s, chromium compound was eliminated as an additive to the cooling water (UCC 1998).	In 2004, soil sampling was completed. The analytical results from the soil sampling were evaluated in the CCR (CH2M HILL 2008), no industrial or residential screening level exceedances were observed.
41	A	777 Cooling Tower Basin	Located on the northeast side of the 776 Waste Accumulation Pad (SWMU 19)	D	Active	Chromium compound was added to the cooling water from 1940s to 1980s. The basin is emptied once a year and any biological solids washed down the clean sewer (SWMU 61).	Cooling water was observed during the VSI dripping onto the soil on the east side of the tower basin.	Sometime in the 1980s, chromium compound was eliminated as an additive to the cooling water (UCC 1998).	In 2004, soil sampling was completed. The analytical results from the soil sampling were evaluated in the CCR (CH2M HILL 2008), no industrial or residential screening level exceedances were observed.

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42/43	A	791 Cooling Tower East Basin	Located behind Building 791 on the south side	D	Active	Chromium compound was added to the cooling water from 1940s to 1980s. The basin is emptied once a year and any biological solids washed down the clean sewer (SWMU 61).	Cooling water was observed during the VSI dripping onto the soil near the basin of the tower.	Sometime in the 1980s, chromium compound was eliminated as an additive to the cooling water (UCC 1998).	In 2004, soil sampling was completed. The analytical results from the soil sampling were evaluated in the CCR (CH2M HILL 2008), no industrial or residential screening level exceedances were observed.
44	A	705 Roof Cooling Tower Basin	Located on the roof of Building 705	D	Active	Chromium compound was added to the cooling water from 1940s to 1980s. The basin is emptied once a year and any biological solids washed down the clean sewer (SWMU 61).	None	Chromium compounds are no longer used in the cooling water (UCC 1998).	Not Applicable
45	A	770 Roof Cooling Tower Basin	Located on the roof of Building 770	D	Active	Chromium compound was added to the cooling water from 1940s to 1980s. The basin is emptied once a year and any biological solids washed down the clean sewer (SWMU 61).	None	Chromium compounds are no longer used in the cooling water (UCC 1998).	Not Applicable
46	B	2000 Roof Cooling Tower Basin	Located on the roof of Building 2000	D	Active	Chromium compound was added to the cooling water from 1940s to 1980s. The basin is emptied once a year and any biological solids washed down the clean sewer (SWMU 61).	None	Chromium compounds are no longer used in the cooling water (UCC 1998).	Not Applicable
47	C	6000 Roof Cooling Tower Basin	Located on the roof of Building 6000	D	Active	Chromium compound was added to the cooling water from 1940s to 1980s. The basin is emptied once a year and any biological solids washed down the clean sewer (SWMU 61).	None	Chromium compounds are no longer used in the cooling water (UCC 1998).	Not Applicable
48	A	Eastern Residue Tank	Located in a diked area 15 feet east of Building 707	C	Inactive	Tank stored ignitable or solvent wastes, including those with EPA hazardous waste code D001, F002, and F003.	None	In 1989, the tank and ancillary equipment were cleaned and closed. Closure was documented and submitted to WVDEP OMW, which acknowledged the closure on August 16, 1989 (UCC 1998).	Not Applicable
49	A	Western Residue Tank	Located in a diked area 15 feet east of Building 707	C	Inactive	Tank stored ignitable or solvent wastes, including those with EPA hazardous waste code D001, F002, and F003.	None	In 1989, the tank and ancillary equipment were cleaned and closed. Closure was documented and submitted to WVDEP OMW, which acknowledged the closure on August 16, 1989 (UCC 1998).	Not Applicable
50	A	Residue Tank Sump	Located directly beneath the Western Residue Tank (SWMU 48) in the southwest corner of the diked concrete pad beneath the tanks	C	Inactive	Managed spills from the residue tanks (SWMU 48 and 49).	None	In 1989, the tank and ancillary equipment were cleaned and closed. Closure was documented and submitted to WVDEP OMW, which acknowledged the closure on August 16, 1989 (UCC 1998).	Not Applicable
51	A	Wastewater Tank	Located North of the Residue Tanks (SWMU 49 and 50) on the East side of Building 707	C	Inactive	Tank stored process wastewater from all areas of the UCC Technology Park. Wastewater could contain variable amounts of potentially any chemical utilized at the site	None	In 1993 this tank was cleaned and removed (UCC 1998).	Not Applicable
52	A	Wastewater Tank	Located north of the Residue Tanks (SWMU 49 and 50) on the east side of Building 707	C	Inactive	Tank stored process wastewater from all areas of the UCC Technology Park. Wastewater could have contained variable amounts of any chemical utilized at the site.	None	In 1993 this tank was cleaned and removed (UCC 1998).	Not Applicable
53	A	709 Septic Tank	Located east of Building 709 near the Incinerator (SWMU 55)	No classified	Inactive	Tank received mainly sanitary wastes from toilets, showers, and sinks. It was also hooked to the floor drain and sink in building 709. Tank was not used after 1968.	None	None	Not Applicable
54	A	New Day Tank	Located approximately 50 feet west of the Incinerator (SWMU 55)	C	Inactive	Tank held and blended compatible chemical wastes before on-site incineration. The waste was piped directly to SWMU 55. The tank could have received any chemical utilized at the site.	None	Tank was cleaned and the waste from the cleaning was disposed of in accordance with applicable requirements. UCC submitted the certificate of closure of this unit to WVDEP OMW in 1993. The secondary containment area and its sump were cleaned and closed with the incinerator (SWMU 55) (UCC 1998).	Not Applicable
55	A	Incinerator	Located northeast of Building 722	C	Inactive	The incinerator handled a variety of chemical wastes generated in laboratories and pilot plants on-site, and occasional off-site waste from UCC facilities. Ash generated was deposited in a regulated hazardous waste landfill operated by UCC.	In 1992, a release of incinerator scrubber water occurred to the hillside soil on the east side of the incinerator. No contamination associated with this release as documented in the Clean Closure Certification.	The incinerator was clean closed in early 1996 in accordance with a modified closure plan approved by the WVDEP OWM in June 1995 (UCC 1998).	Not Applicable

TABLE 1
SWMUs and Investigation Areas Summary Table
Statement of Basis
UCC Technology Park
South Charleston, West Virginia

SWMU No.	Tract	Unit Name	Unit Location	SWMU Classification[1]	Operational Status (as of March 2008)[2]	Wastes Managed	History of Release[3]	Interim Measures	Previous Investigation Results
56	A	Building 704 Boiler	Located inside Building 704	B	Inactive	The Boiler handled mostly coal and paper trash, but also burned wastes from the Residue Tanks (SWMU 48 and 49). Prior to 1985.	None	In 1993, this boiler was cleaned and mothballed. Later on the boiler was removed (UCC 1998).	Not Applicable
57	A	Building 704 Boiler	Located Inside Building 704	B	Inactive	The Boiler handled mostly coal and paper trash, but also burned wastes from the Residue Tanks (SWMU 48 and 49). Prior to 1985.	None	In 1993, this boiler was cleaned and mothballed. Later on the boiler was removed (UCC 1998).	Not Applicable
58	A	Boiler Ash Handling System	Unit is part of Building 704	B	Inactive	Managed ash from the boilers (SWMU 56 and 57).	None	In 1993, this boiler was cleaned and mothballed. Later on the boiler was removed (UCC 1998).	In 2004, soil sampling was conducted. The analytical results for TCF-SB004 exceeded the industrial screening level for arsenic and the residential screening level for mercury (CH2M HILL 2008). In 2005, additional soil samples were collected to confirm the results for arsenic at TCF-SB004 and evaluate the extent. All of the 2005 soil analytical results were below the industrial and residential screening level (CH2M HILL 2008).
59	A	Drum Rinsing Station	Located Inside the diked area by the Wastewater Tanks (SWMUs 51 and 52)	C	Inactive	Managed rinsate from drum steam cleaning process. The rinsate was discharged to the sanitary sewer (SWMU 62).	None	None	Not Applicable
60	B	2000 Waste Transfer Area	Located within Building 2000 on the loading dock	C	Active	Manages printing chemicals for a short duration before they are transferred to waste operations for disposal.	None	None	Not Applicable
61	N/A	Clean Sewer	Located under the entire Technology Park	B	Active	Manages waste discharged from SWMU 10, 11, 14, 17, 29, 37-45, and 54. It also received plant stormwater run-off. This sewer system operates under the NPDES permit number WV0000124.	None	None	Not Applicable
62	N/A	Sanitary Sewer	Located under the entire Technology Park	B	Active	Manages mainly sanitary waste and small amount of industrial waste from SWMU 20, 22, 23, 48, and 49. This sewer operates under South Charleston Sanitary Board Permit number SBPT-01.	None	None	Not Applicable
63	A	Greenhouse Soil Filled Area	North of former Building 741	A	Inactive	Managed soil and waste material from Building 766, which may have contained pestlcides and herbicides.	None	In 1983, the structure was removed. Only the concrete pad remains (UCC 1998).	In 2000, soil samples and a groundwater grab sample was collected. The analytical results were evaluated in the 2001 RFI Report (Key Environmental 2001), no industrial soil screening soil exceedances were observed and the analytical results for groundwater were nondetect.
64	D	Lower Ward Bottle Disposal Area	Located on the Northern dike of Lower Ward Landfill (SWMU 1)	B	Inactive	Unit was used to dispose of small chemical bottles by breaking them on the rocks. The unit could contain any chemical utilized at the site.	None	Area is presently covered and has been reworked several times with rip-rap (UCC 1998).	Not Applicable
65	C	6000 Dump Area	Located south of Building 6000	A	Inactive	Historical review, personnel interviews and aerial photo review determined that the SWMU area was utilized as a parking lot from 1958 until Building 6000 was constructed. No wastes were managed in this area.	None	None	In 1997, soil samples were collected. All samples came back non-detect (UCC 1998). This SWMU was determined to be used exclusively as a paved parking lot from 1958 until Building 6000 was constructed (Key Environmental 2001).

TABLE 1
SWMUs and Investigation Areas Summary Table
Statement of Basis
UCC Technology Park
South Charleston, West Virginia

SWMU No.	Tract	Unit Name	Unit Location	SWMU Classification[1]	Operational Status (as of March 2008)[2]	Wastes Managed	History of Release[3]	Interim Measures	Previous Investigation Results
66	D	Ward A Dump Pond Burn Area #1	Southeast of Building 6000	A	Inactive	Unit was used to burn and dispose of used or spent chemicals. The unit may contain any chemical utilized at the site.	None	None	In 2000, a groundwater samples was collected from a piezometer installed at this SWMU. The analytical results showed that bis(2-chloroisopropyl)ether was the only constituent that exceeded screening criteria (Key Environmental 2001).
67	D	Ward A Dump Pond Burn Area #2	Located approximately 800 feet north of Ball Field #3, east of the Ward A pond	A	Inactive	Historical review, personnel interviews, and aerial photo review determined that the SWMU was either inaccessible (flooded from Ward A) or not used as a solid waste disposal area.	None	None	Not Applicable
68	D	Concrete Batch Mix Disposal Area	Located on the northwestern side of Lower Ward Landfill (SWMU 1), approximately 200 feet east of the southeastern corner of Building 771	B	Inactive	Unit used to dispose of concrete and chemicals mixed with concrete.	None	None	In 2004, soil sampling was completed. The analytical results from the soil sampling were evaluated in the CCR (CH2M HILL 2008), no industrial or residential screening level exceedances were observed.
69	A	Timberland Dump Site #1	Located on the west side of the facility in the Timberland area	C	Inactive	Unit was used to dispose of general facility refuse, construction debris, wooden pallets, and cut vegetation.	None	In 1992, a major cleanup of this area was undertaken; all trash was removed and properly disposed (UCC 1998).	Not Applicable
70	A	Timberland Dump Site #2	Located on the west side of the facility in the Timberland area	B	Inactive	Unit was used to dispose of general facility refuse, construction debris, wooden pallets, and cut vegetation.	None	None	In 2004, soil sampling and test pits were completed. In addition, nearby surface water and sediment was sampled. Additional soil samples were collected in 2005 to evaluate ecological risk related to mercury in surface soil. The analytical results from the soil sampling were evaluated in the CCR (CH2M HILL 2008). The industrial screening level was exceeded for arsenic and the residential screening level was exceeded for mercury. There were no surface water exceedances, but there were sediment exceedances for arsenic, barium, cadmium, chromium, and lead. Based on the ecological risk evaluation in the CCR, there is no unacceptable risk to ecological receptors. In 2009, additional soil sampling was conducted and waste sampling was conducted to support potential future divestitures. The analytical results exceeded the industrial screening levels and background only for arsenic (CH2M HILL 2010b).
Not Applicable	A	Greenhouse Area	Located north of former Building 741	Not Applicable	Not Applicable	Not Applicable	None	None	Groundwater data from two monitoring wells (MW-104A and WVU-04) in this area have detected concentrations of volatile organic compounds (VOCs) above screening criteria. The 2009 sample results showed that no VOCs exceed screening criteria in MW-104A and only two detected VOCs (chloroform and tetrachloroethene) exceed screening criteria in WVU-MW04.
Not Applicable	A	Building 722 Area	Located north of Building 722	Not Applicable	Not Applicable	Not Applicable	None	None	In 2005, soil samples were collected to support leasing this area to an interested party. The analytical results from the soil sampling were evaluated in the CCR (CH2M HILL 2008), PCE was the only constituent that exceeded the industrial screening level and it was only exceeded at one location.
Not Applicable	A	Rocket Hollow Area	Located near SWMU 19 and 23	Not Applicable	Inactive	Historically, Rocket Hollow stored rocket fuel waste and fuel testing involving Resin B & Pyrolisis oil. Daily rocket fuel shots went off in the 1960s during these tests. Polypropoline glycol was identified as an inert binder used in this area. Rocket Hollow is currently used to store machines, parts, and materials associated with landscape work.	None	None	In 2008, soil sampling was completed to support potential future divestitures (CH2M HILL 2010b). Several polycyclic aromatic hydrocarbons exceeded the industrial screening levels.

TABLE 1
SWMUs and Investigation Areas Summary Table
Statement of Basis
UCC Technology Park
South Charleston, West Virginia

SWMU No.	Tract	Unit Name	Unit Location	SWMU Classification[1]	Operational Status (as of March 2008)[2]	Wastes Managed	History of Release[3]	Interim Measures	Previous Investigation Results
Not Applicable	A	Building 707 Area	The drainage ditch located South of Building 707	Not Applicable	Inactive	According to a UCC employee, water from a former drum steam cleaning pad was washed into this drainage ditch.	None	Soil removal actions were performed in 2008 and 2009. A total of approximately 30 cubic yards of soil was removed from the drainage ditch (CH2M HILL 2009c).	Soil contamination was identified during a 2007 investigation to support potential future divestitures. Follow-up soil sampling was conducted in 2008 and 2009. The analytical results were evaluated in the Buildings 706 and 707 Area Soil Investigation, Removal Action, and Vapor Intrusion Human Health Risk Assessment Report (CH2M HILL 2009b). No industrial exceedances were observed for samples collected outside the soil removal areas. To evaluate the potential for vapor intrusion into nearby buildings (Buildings 706 and 707), subslab soil gas, indoor air, and ambient air samples were collected. The results indicate that current and future human health exposure associated with vapor intrusion into existing buildings from VOCs does not pose unacceptable human health risks (CH2M HILL 2009b).

1 - **Category A** = High Priority, **Category B** = Low Priority, **Category C** = No Further Action Needed, **Category D** = Does not meet the definition of a SWMU (UCC 1998)
2 - **Active** = still operates as SWMU, **inactive** = no longer in operation, **Inactive as a SWMU** = these areas are still in operation, but not used for purposes that meet the definition of a SWMU.
3 - Draft RCRA Facility Assessment Report (A.T. Kearney 1988)

FIGURES

Figure 1
Site Location Map
Statement of Basis
UCC Technology Park
South Charleston, West Virginia

CH2MHILL

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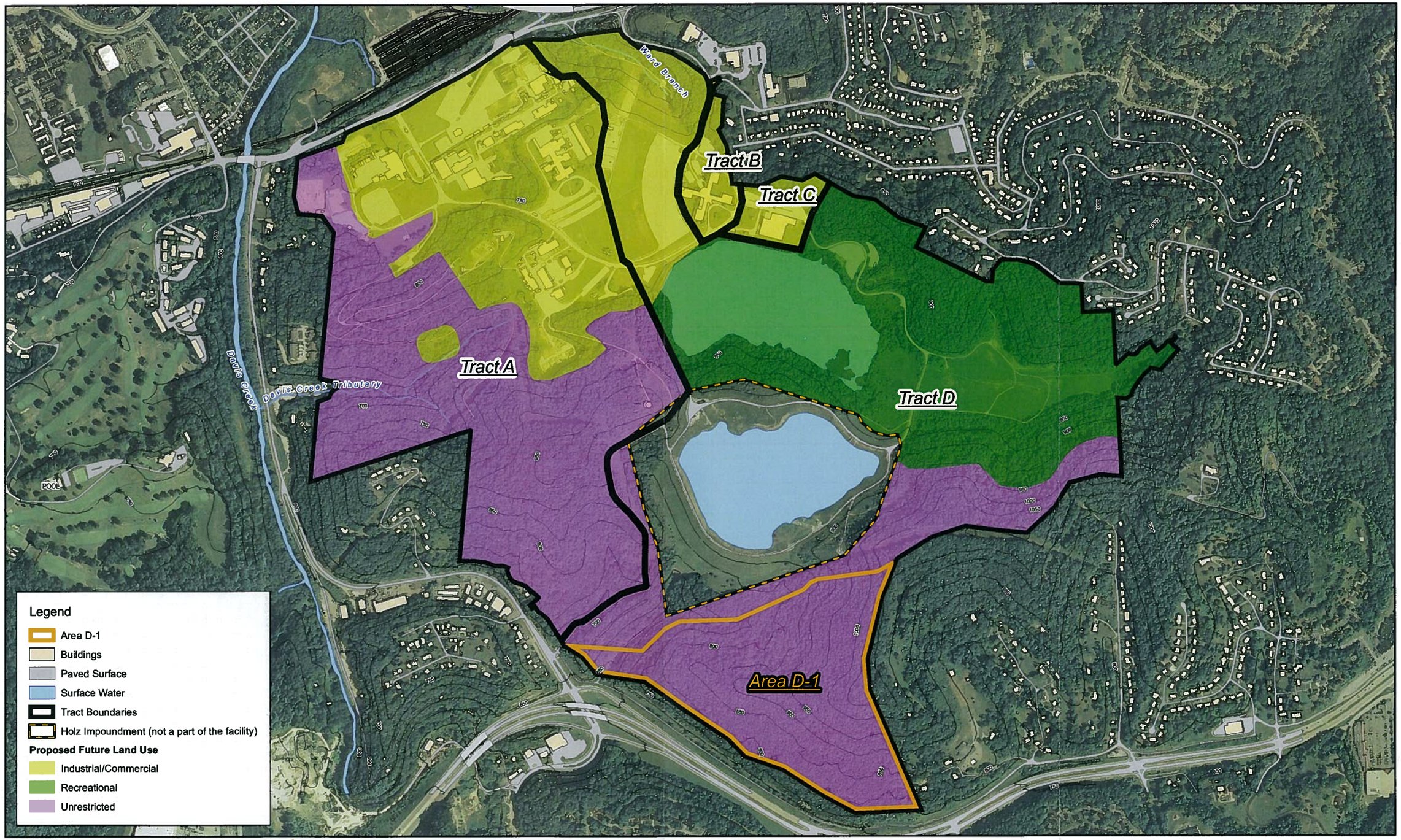

Figure 2
Proposed Future Land Use
Statement of Basis
UCC Technology Park
South Charleston, West Virginia

CH2MHILL

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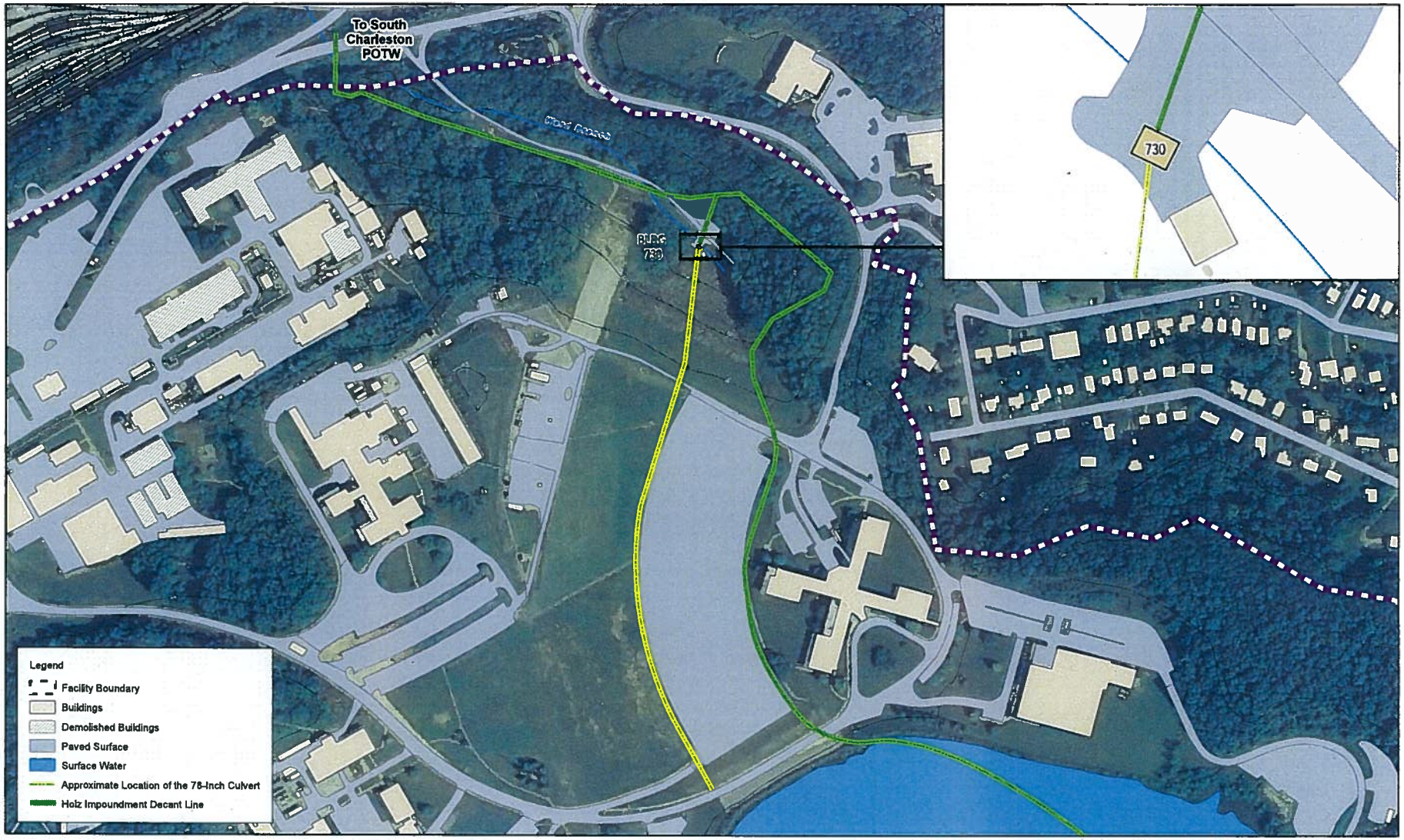

Figure 3
Lower Ward Leachate Collection System
Statement of Basis
UCC Technology Park
South Charleston, West Virginia

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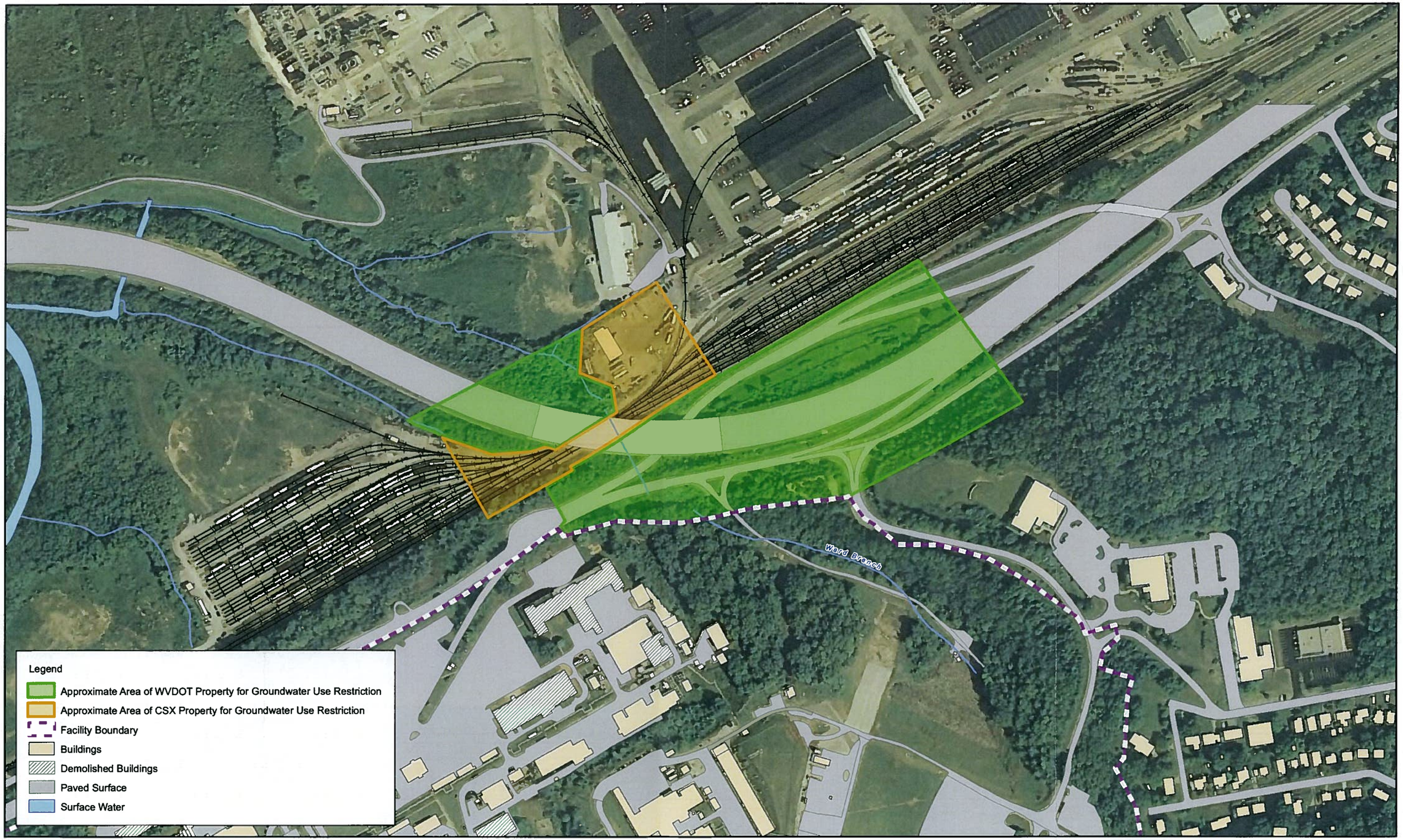

Figure 4
Off-Site Groundwater Use Restrictions
Statement of Basis
UCC Technology Park
South Charleston, West Virginia

CH2MHILL

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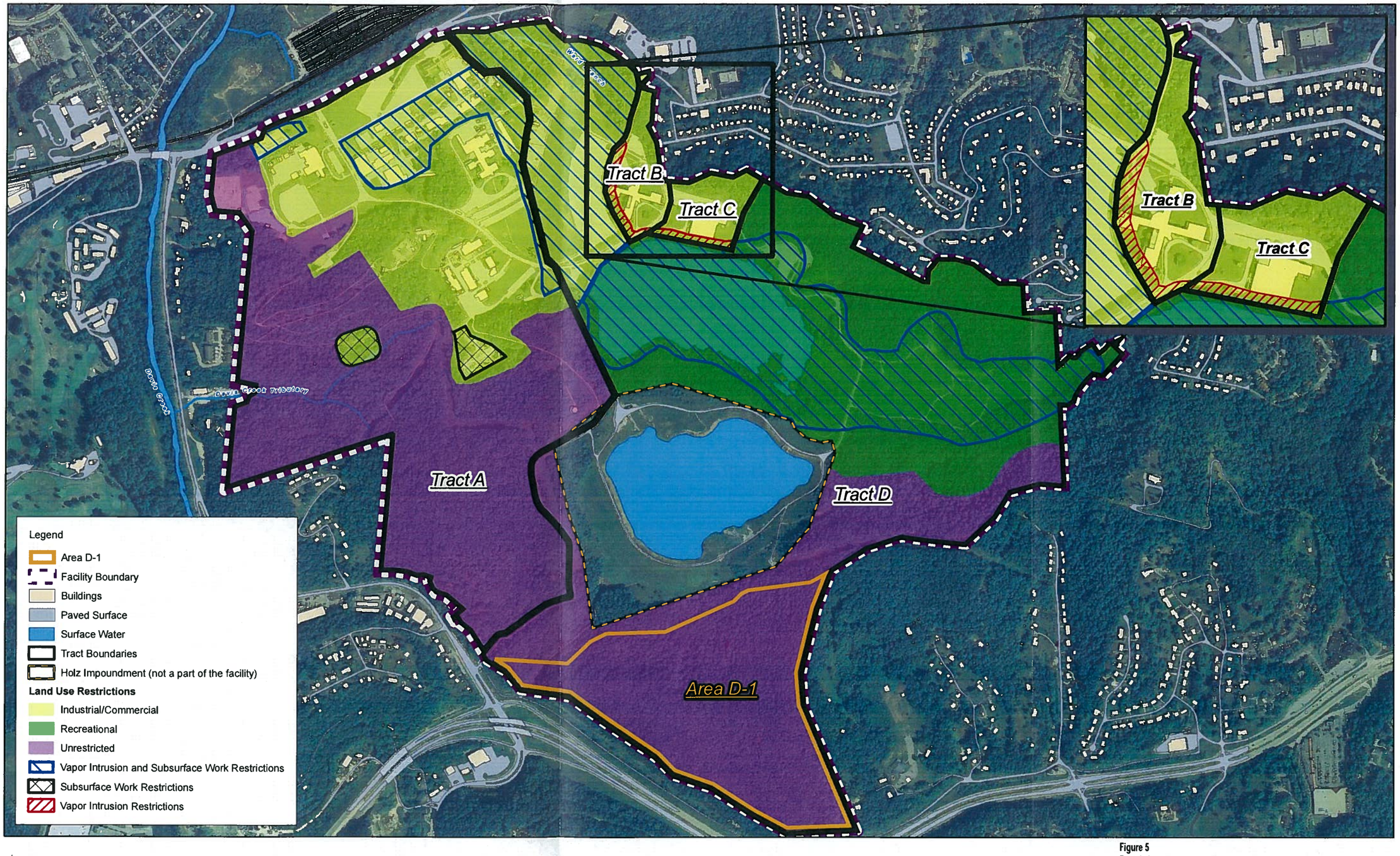

Figure 5
Restrictions
Statement of Basis
UCC Technology Park
South Charleston, West Virginia

CH2MHILL

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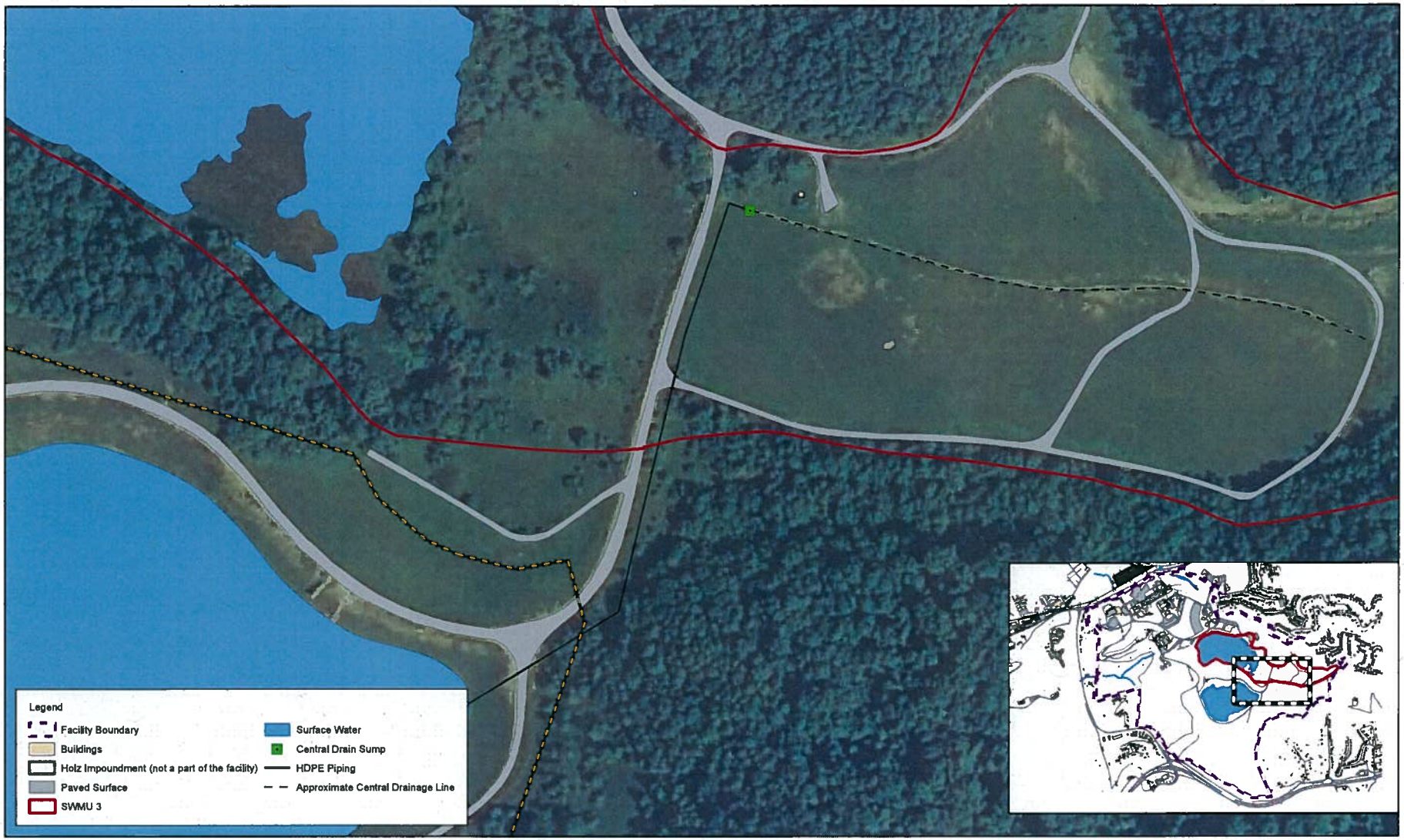

Figure 6
Central Drain Sump and Associated Piping
Statement of Basis
UCC Technology Park
South Charleston, West Virginia

CH2MHILL

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ATTACHMENT II- 3

2018 OPERATIONS, MAINTENACE, AND INSPECTION (OMI) REPORT

Amy L. Lee
Remediation Leader
Authorized Representative of The Dow Chemical Company
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Fax 770 435 2666
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Environmental

Subject:
UCC Technology Park 2018 Operations and Maintenance Activities Memo
South Charleston, West Virginia

Date:
March 28, 2019

Contact:
Chris Schell

Phone:
864.987.3924

Email:
Chris.Schell@arcadis.com

Our ref:
DOWOMD19.WV04

Dear Ms. Lee:

The following memorandum has been prepared to summarize operations and maintenance (O&M) activities that have taken place at UCC Dow Technology Park (Site) for 2018; a Site Location Map is provided on **Figure 1**. O&M activities conducted in 2018 were done so in accordance with the specified corrective measures rendered in the final decision by the U.S. Environmental Protection Agency (US EPA) on December 17, 2010. Those decisions were incorporated in The West Virginia Department of Environmental Protection's (WV DEP) revised Resource Conservation and Recovery Act (RCRA) facilities permit on February 2, 2012. A new RCRA permit application was submitted to WV DEP on November 30, 2018. The Site will remain under the February 2, 2012, permit until the new permit is issued.

The following corrective measures required ongoing O&M in 2018: the Lower Ward Landfill, Ward A Landfill, Ward B Landfill, Lower Ward leachate collection system, Ward B central drain sump pumping system, and the facility-wide institutional controls. A Site Map indicating the location for each O&M site is provided on **Figure 2**.

CH2M completed O&M of the above referenced corrective measures during January, February, March, and April of 2018. On May 7, 2018, O&M of the above referenced corrective measures were transitioned to Arcadis U.S., Inc. (Arcadis).

Inspection of the landfills and institutional controls were completed by Arcadis in 2018.

Lower Ward Landfill

Lower Ward Landfill was inspected quarterly by Arcadis on March 28, 2018, June 19, 2018, September 24, 2018, and December 11, 2018. The inspections consisted of a technician walking over and around the perimeter of the landfill to visually verify landfill cover showed no signs of damage. Landfill cover was inspected for areas bare of vegetation, erosion, furrows and ruts or animal burrows. No signs of damage or deterioration was observed during the 2018 inspections.

Ward A Landfill

Ward A Landfill was inspected quarterly by Arcadis on March 28, 2018, June 19, 2018, September 24, 2018, and December 11, 2018. The Ward A Landfill is maintained as a scenic pond (Ward A Pond). Ward A Landfill was inspected for the presence of damage or deterioration. No damage or deterioration was observed during the 2018 inspections.

Ward B Landfill

The Ward B Landfill was inspected quarterly by Arcadis on March 28, 2018, June 19, 2018, September 24, 2018, and December 11, 2018. The inspections consisted of a technician walking over and around the perimeter of the landfill to visually verify landfill cover showed no signs of damage. Landfill cover was inspected for areas bare of vegetation, erosion, furrows and ruts or animal burrows. No signs of damage or deterioration was observed during the 2018 inspections.

Lower Ward Leachate Collection System

The Lower Ward Leachate Collection System operates as a collection basin for the Lower Ward Landfill. Utilizing the Holz Impoundment decant line, water collected by the leachate system is discharged into the South Charleston Waste Water Treatment Plant (WWTP) for processing.

- The system was inspected weekly in 2018. The inspections were documented on an inspection log and included the following:
    - Inspection of overflow conditions
    - Inspection of sump for leaks, visual wear of parts, and noises associated with the deterioration of moving parts
    - Testing the telemetry system
    - Inspection of the tank to ensure man-ways and pipe caps for vacuum truck hook-ups are secure
    - Inspection of the system discharge pipe, and Holz Impoundment decant line operational pressure

The Holz Impoundment decant line was shut down February 6-8, 2018 for maintenance. During this time, the pumps in the leachate collection system were turned off, and vacuum trucks were used to remove the leachate from the system to prevent it from discharging to Ward Branch. Leachate pumped into the vacuum trucks was transported to and discharged into Holz Impoundment.

No overflow events occurred in 2018.

Ward B Central Drain Sump Pumping System

Ward B Central Drain Sump Pumping System operated as a leachate collection system from the Ward B Landfill and discharged that leachate into the Holz Impoundment. During rain events the system allowed for stormwater overflow into the Ward A pond.

On December 9, 2017, a balloon plug was installed in the influent line to the sump to prevent water from flowing into the sump. This was done to temporarily shut down the system in winter/early spring, as approved by the WV DEP via email on November 14, 2017, to support an evaluation of alternatives to operating the system in the future. During second quarter 2018, the WV DEP and US EPA agreed the Ward B sump could remain shutdown for the recharge study, and potentially be decommissioned in the future.

The Ward B Sump remained shut down through the end of 2018. The new RCRA Permit Application submitted on November 30, 2018, includes a request to permanently shut down and decommission the Ward B Sump.

Institutional Controls

Inspection of institutional controls were performed quarterly by Arcadis on March 28, 2018, June 19, 2018, September 24, 2018, and December 11, 2018. Institutional controls for the facility generally fall into the following three categories:

- Groundwater use restrictions;
- Land use restrictions (e.g., industrial/commercial use or recreational use); and
- Vapor intrusion (VI) building restrictions.

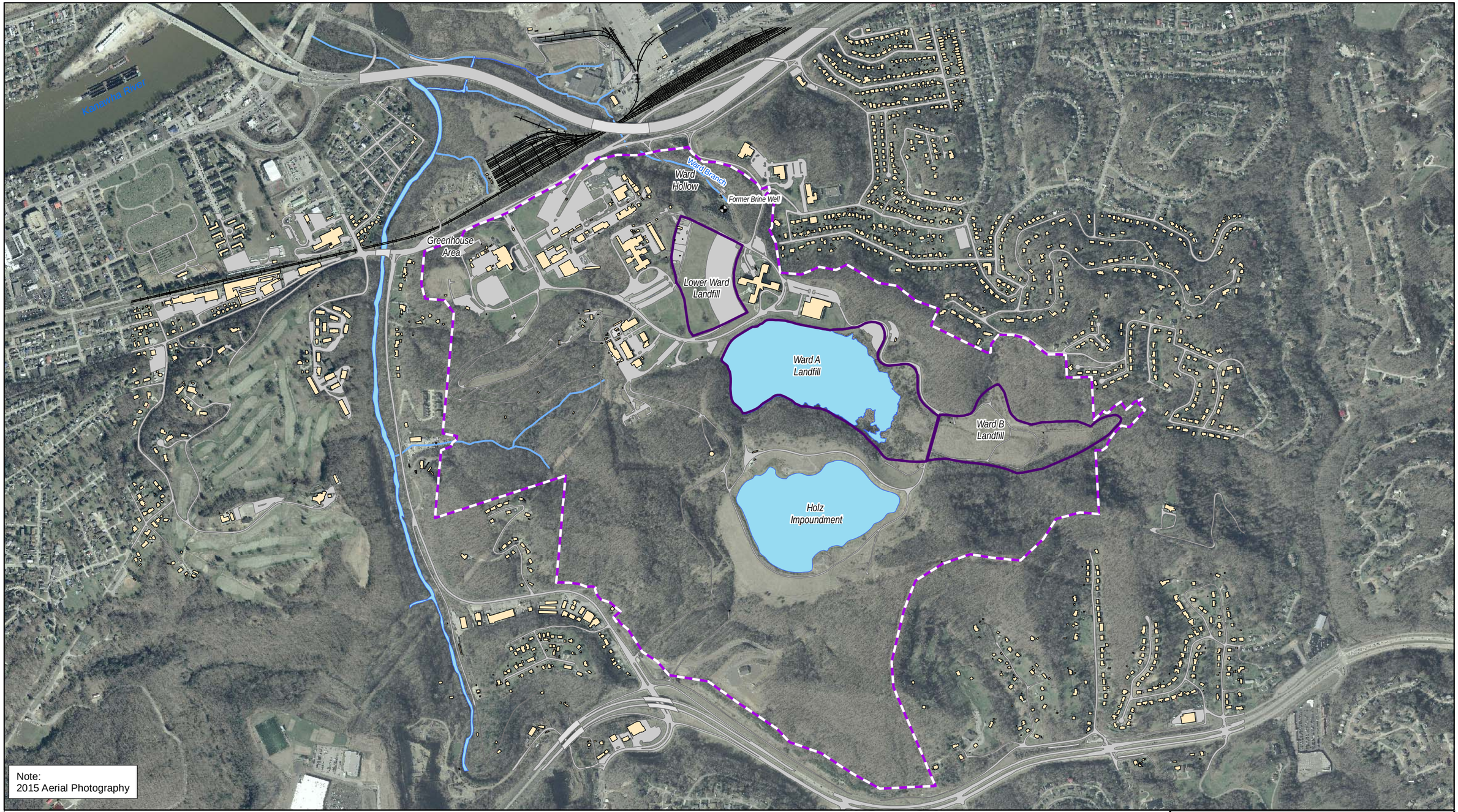
The inspections consisted of walking and driving around the institutional control areas and contacting the Kanawha-Charleston Health Department (KCHD) to determine if any potable wells had been constructed at the facility or at offsite affected properties.

Inspections conducted on the respective dates revealed no violation of Institutional Controls. There were no potable wells located on facility grounds or offsite affected properties. There were no new occupied structures within the vapor intrusion restriction zone and no recorded non-conforming activities taking place on industrial/commercial or recreational land.

Inspection Checklists from the 2018 inspections and a letter from KCHD are provided as **Attachment A**.

FIGURES

MKE Z:\GISPROJECTS_ENV\DOW_DEER_PARK\TECH PARK\MXD\FIGURE 1 - SITE LOCATION MAP.MXD SKI01076 1/18/2019 5:45:37 PM



Legend

- Former Brine Well
- Facility Boundary
- Landfill Boundary
- Building
- Paved Surface
- Surface Water

N

0 1,000 2,000
Feet

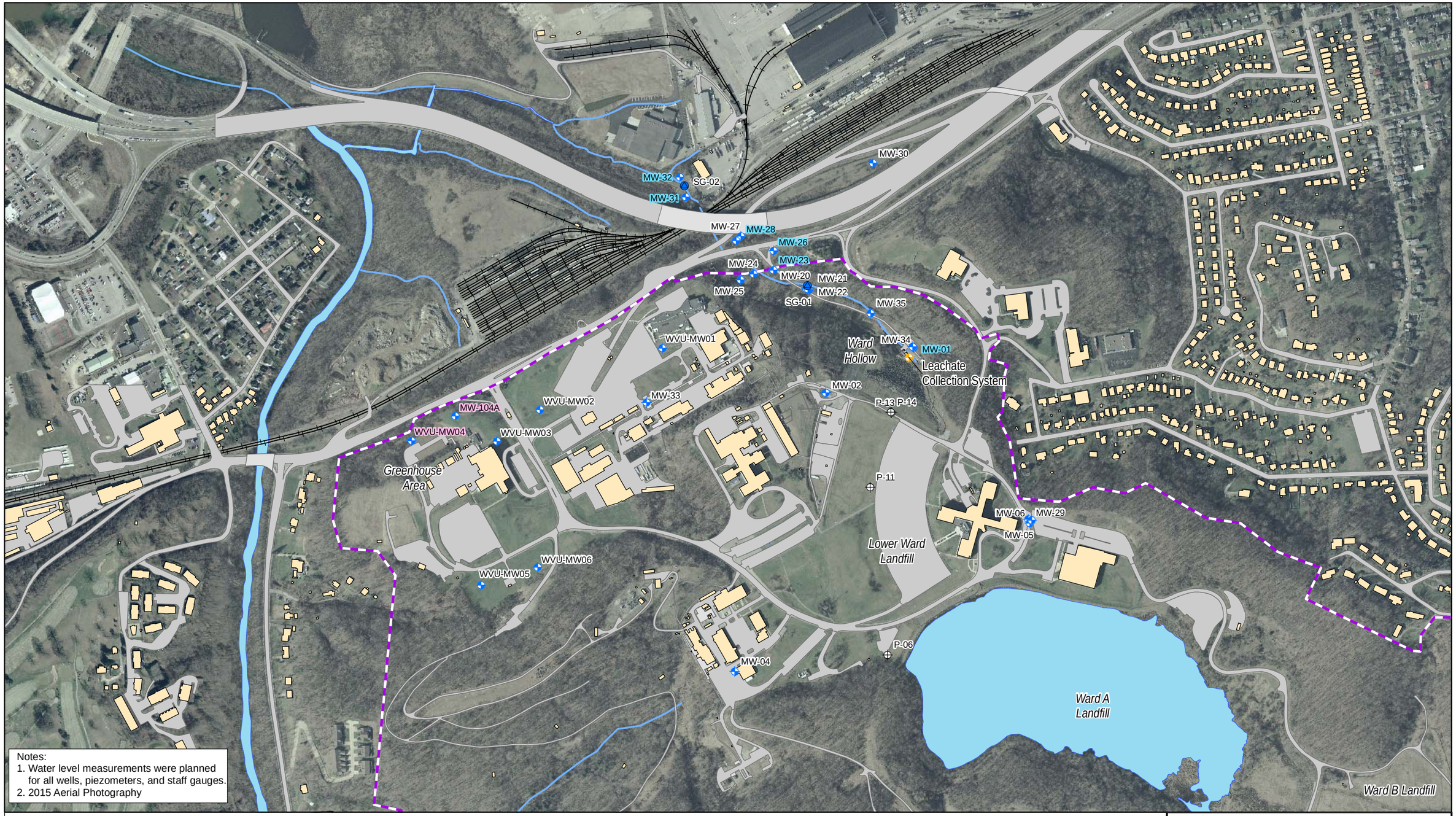
UCC Technology Park
South Charleston, West Virginia

SITE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE 1

MKE Z:\GISPROJECTS_ENV\DOW_DEER_PARK\TECH PARK\MXD\FIGURE 2 - SITE MAP.MXD MAI00749 1/18/2019 8:34:33 PM



Notes:
1. Water level measurements were planned for all wells, piezometers, and staff gauges.
2. 2015 Aerial Photography

Legend

- Staff Gauge
- Monitoring Well
- Piezometer
- Leachate Collection System
- Greenhouse Area Sampling Location
- Ward Hollow Sampling Location
- Paved Surface
- Surface Water
- Facility Boundary
- Building

N

0 500 1,000
Feet

UCC Technology Park
South Charleston, West Virginia

SITE MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2

ATTACHMENT A

2018 Inspection Sheets & KCHD Letter

Tech Park
Institutional Controls Inspection Checklist

Inspection Date: 03.28.18 **Inspector:** W. Keith Carr

Cap, Grounds & Fencing	Yes	No	Comments	Inspection Completed (date/initials)
Is there any evidence of potable wells at the facility or the offsite affected properties	☐	☑	None	WKC 03.28.18
Are there any new occupied structures within the vapor intrusion restriction area? If so, indicate in the comments if a vapor barrier or other engineering controls were utilized as part of the new structure.	☐	☑	None	WKC 03.28.18
Is any portion of the industrial/commercial land use area being used for non-conforming purposes such as schools, day care centers, nursing homes, or other residential-style facilities	☐	☑	None	WKC 03.28.18
General Comments and/or Observations:				

Ward B Landfill Cover
Inspection Checklist

Inspection Date: 03.28.18 **Inspector:** W. Keith Carr

Inspection Items	Yes	No	Comments, Deficiencies & Repairs Recommended or Implemented	Inspection Completed (date/initials)
A) Are there bare areas or signs of erosion, furrows, ruts or animal burrows? If so, note this area on a copy of Figure 2	☐	☑	None	WKC 03.28.18
Photographed?	☐	☑		
Repair Implemented?	☐	☑		

General Comments and/or Observations: None

Lower Ward Landfill Cover
Inspection Checklist

Inspection Date: 03.28.18 **Inspector:** W. Keith Carr

Inspection Items	Yes	No	Comments, Deficiencies & Repairs Recommended or Implemented	Inspection Completed (date/initials)
A) Are there bare areas or signs of erosion, furrows, ruts or animal burrows? If so, note this area on a copy of Figure 2	☐	☑	None	WKC 03.28.18
Photographed?	☐	☑		
Repair Implemented?	☐	☑		

General Comments and/or Observations: None

Lower Ward Landfill Cover
Inspection Checklist

Inspection Date: 6-19-18 **Inspector:** J. PHILBROOK

Inspection Items	Yes	No	Comments, Deficiencies & Repairs Recommended or Implemented	Inspection Completed (date/initials)
A) Are there bare areas or signs of erosion, furrows, ruts or animal burrows? If so, note this area on a copy of Figure 2	☐	☒		JJP 6-19-18
Photographed?	☐	☒		
Repair Implemented?	☐	☒		

General Comments and/or Observations:

Tech Park
Institutional Controls Inspection Checklist

Inspection Date: 6-19-18 **Inspector:** J PHILBROOK

Cap, Grounds & Fencing	Yes	No	Comments	Inspection Completed (date/initials)
Is there any evidence of potable wells at the facility or the offsite affected properties	☐	☒		JJP 6-19-18
Are there any new occupied structures within the vapor intrusion restriction area? If so, indicate in the comments if a vapor barrier or other engineering controls were utilized as part of the new structure.	☐	☒		JJP 6-19-18
Is any portion of the industrial/commercial land use area being used for non-conforming purposes such as schools, day care centers, nursing homes, or other residential-style facilities	☐	☒		JJP 6-19-18

General Comments and/or Observations:

Ward B Landfill Cover
Inspection Checklist

Inspection Date: 6-19-18 **Inspector:** J PHILBROOK

Inspection Items	Yes	No	Comments, Deficiencies & Repairs Recommended or Implemented	Inspection Completed (date/initials)
A) Are there bare areas or signs of erosion, furrows, ruts or animal burrows? If so, note this area on a copy of Figure 2	☐	☒		JJP 6-19-18
Photographed?	☐	☒		
Repair Implemented?	☐	☒		

General Comments and/or Observations:

Lower Ward Landfill Cover
Inspection Checklist

Inspection Date: 9-24-18 **Inspector:** J PHILBROOK

Inspection Items	Yes	No	Comments, Deficiencies & Repairs Recommended or Implemented	Inspection Completed (date/initials)
A) Are there bare areas or signs of erosion, furrows, ruts or animal burrows? If so, note this area on a copy of Figure 2	☐	☒		JJP 9-24-18
Photographed?	☐	☒		
Repair Implemented?	☐	☒		

General Comments and/or Observations:

Tech Park
Institutional Controls Inspection Checklist

Inspection Date: 9-24-18 **Inspector:** J PHILBROOK

Cap, Grounds & Fencing	Yes	No	Comments	Inspection Completed (date/initials)
Is there any evidence of potable wells at the facility or the offsite affected properties	☐	☒		BJP 9-24-18
Are there any new occupied structures within the vapor intrusion restriction area? If so, indicate in the comments if a vapor barrier or other engineering controls were utilized as part of the new structure.	☐	☒		BJP 9-24-18
Is any portion of the industrial/commercial land use area being used for non-conforming purposes such as schools, day care centers, nursing homes, or other residential-style facilities	☐	☒		BJP 9-24-18
General Comments and/or Observations:				

Ward B Landfill Cover
Inspection Checklist

Inspection Date: 9-24-18 **Inspector:** J PHILBROOK

Inspection Items	Yes	No	Comments, Deficiencies & Repairs Recommended or Implemented	Inspection Completed (date/initials)
A) Are there bare areas or signs of erosion, furrows, ruts or animal burrows? If so, note this area on a copy of Figure 2	☐	☑		JBP 9-24-18
Photographed?	☐	☐		
Repair Implemented?	☐	☐		

General Comments and/or Observations:

Lower Ward Landfill Cover
Inspection Checklist

Inspection Date: 12-11-18 **Inspector:** J PHILBROOK

Inspection Items	Yes	No	Comments, Deficiencies & Repairs Recommended or Implemented	Inspection Completed (date/initials)
A) Are there bare areas or signs of erosion, furrows, ruts or animal burrows? If so, note this area on a copy of Figure 2	☐	☒		JJP 12-11-18
Photographed?	☐	☒		
Repair Implemented?	☐	☒		

General Comments and/or Observations:

Tech Park Institutional Controls Inspection Checklist				
Inspection Date: 12-11-18		**Inspector:** J PHILBROOK		
Cap, Grounds & Fencing	**Yes**	**No**	**Comments**	**Inspection Completed (date/initials)**
Is there any evidence of potable wells at the facility or the offsite affected properties	☐	☒		JJP 12-11-18
Are there any new occupied structures within the vapor intrusion restriction area? If so, indicate in the comments if a vapor barrier or other engineering controls were utilized as part of the new structure.	☐	☒		JJP 12-11-18
Is any portion of the industrial/commercial land use area being used for non-conforming purposes such as schools, day care centers, nursing homes, or other residential-style facilities	☐	☒		JJP 12-11-18
General Comments and/or Observations:				

Ward B Landfill Cover
Inspection Checklist

Inspection Date: 12-11-18 **Inspector:** J PHILBROOK

Inspection Items	Yes	No	Comments, Deficiencies & Repairs Recommended or Implemented	Inspection Completed (date/initials)
A) Are there bare areas or signs of erosion, furrows, ruts or animal burrows? If so, note this area on a copy of Figure 2	☐	☒		JJP 12-11-18
Photographed?	☐	☒		
Repair Implemented?	☐	☒		

General Comments and/or Observations:

KANAWHA-CHARLESTON HEALTH DEPARTMENT
108 Lee Street East, Charleston, WV 25312
PO Box 927, Charleston, WV 25323
PUTNAM COUNTY HEALTH DEPARTMENT
11878 Winfield Road, Winfield, WV 25213
PO Box 927, Charleston, WV 25323
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Michael R. Brumage, MD, MPH, FACP
Executive Director/Health Officer

December 28, 2018

Jane Perdue Adams
Arcadis
111-D Sanders Lane
Bluefield, VA 24605
P: 276-284-2781

Re: UCC Technology Park, South Charleston, WV

Dear Ms. Adams:

Your FOIA request that was received by the Kanawha-Charleston Health Department states you are requesting information of water well installations on the Union Carbide Corporation (UCC) Technology Park.

The Kanawha-Charleston Health Department does not have any of the information requested above.

You have a right to appeal this matter of your request to the Kanawha County Circuit Court.

Sincerely,

Stanley B. Mills
Director of Environmental Services

SM/er
Enclosures

ATTACHMENT II- 4

2018 ANNUAL GROUNDWATER MONITORING REPORT

ARCADIS Design & Consultancy for natural and built assets

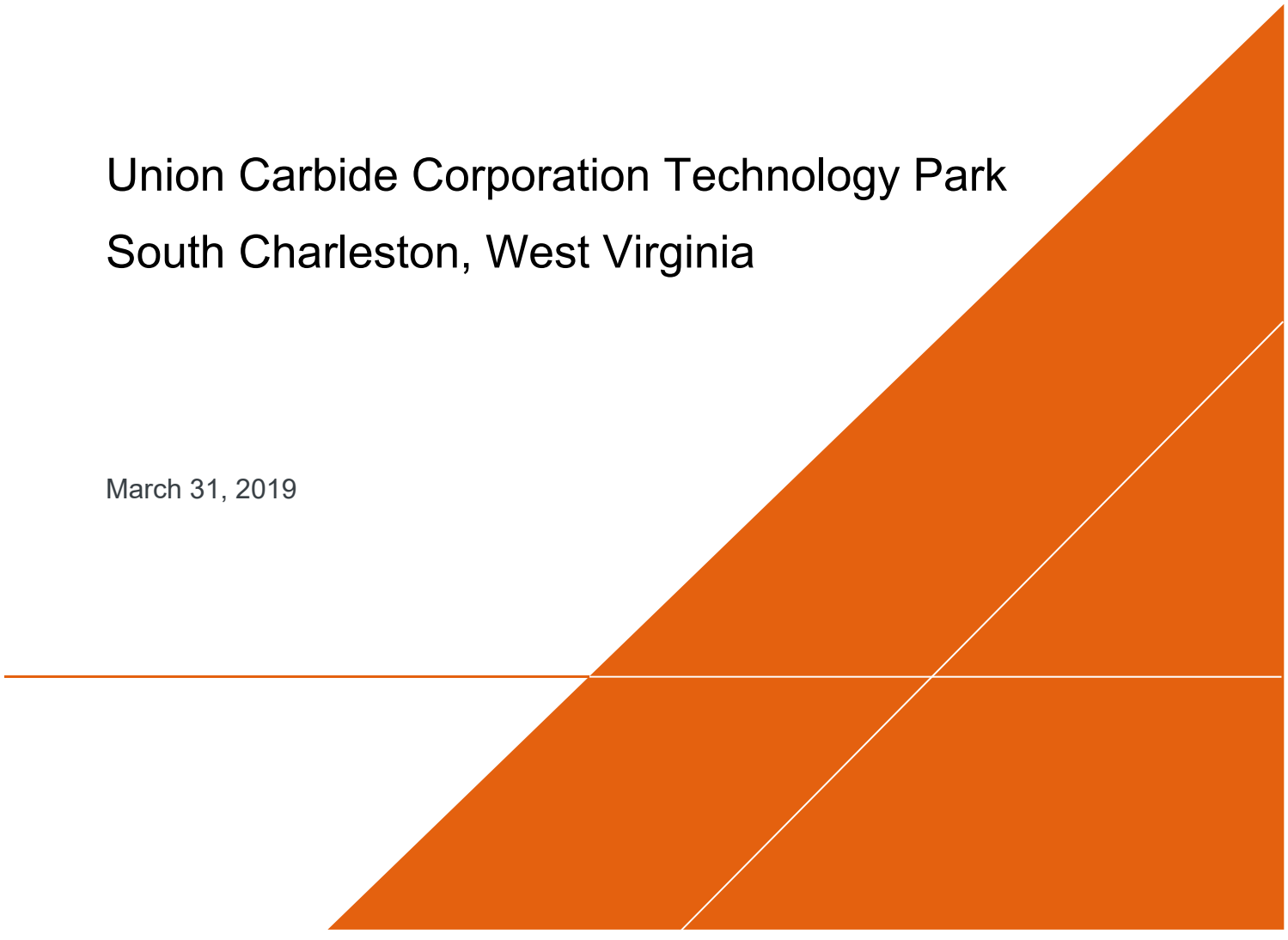
Union Carbide Corporation

2018 GROUNDWATER MONITORING REPORT

Union Carbide Corporation Technology Park

South Charleston, West Virginia

March 31, 2019



2018 GROUNDWATER MONITORING REPORT

Kelley Sharpe

Project Task Manager 1

Chris Schell

Project Manager

Prepared for:

Union Carbide Corporation

Technology Park, South Charleston, West Virginia

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Our Ref.:

DOWOMD19.WV04

Date:

March 31, 2019

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APPENDICES

ACRONYMS AND ABBREVIATIONS

CCR	Current Conditions Report
GWMP	groundwater monitoring plan
GWMR	groundwater monitoring report
PCE	tetrachloroethene
RSL	regional screening level
SIM	selective ion monitoring
site	Union Carbide Corporation Technology Park, South Charleston, West Virginia
UCC	Union Carbide Corporation
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

1. INTRODUCTION

This groundwater monitoring report (GWMR) has been prepared for the Union Carbide Corporation (UCC) Technology Park in South Charleston, West Virginia (site; **Figure 1-1**). This GWMR presents the data and findings for groundwater sampling conducted in 2018.

The U.S. Environmental Protection Agency (USEPA) issued its final decision for the site on December 17, 2010, and the West Virginia Department of Environmental Protection (WVDEP) incorporated the final decision into a revised Resource Conservation and Recovery Act permit for the site on February 2, 2012 (WVDEP 2012). A new RCRA permit application was submitted to WVDEP on November 30, 2018. Long-term groundwater monitoring in accordance with the agency-approved groundwater monitoring plan (GWMP) (CH2M HILL Inc. [CH2M] 2009) is a component of the final decision for the site.

Groundwater monitoring at the site was conducted in accordance with the GWMP to meet the following objectives:

- Monitor water levels to evaluate potential changes in groundwater flow directions
- Monitor constituent concentrations to evaluate trends
- Monitor constituent concentrations to evaluate groundwater conditions in Ward Hollow
- Monitor constituent concentrations to evaluate groundwater conditions in the Greenhouse Area
- Evaluate the integrity of the monitoring wells by conducting inspections
- Monitor the effectiveness of corrective measures

Additional groundwater monitoring, beyond that which is required in the GWMP, was conducted for Ward Hollow in 2018 to further evaluate observed increases in groundwater constituent concentrations in some of the Ward Hollow monitoring wells. The additional monitoring consisted of increased frequency of groundwater monitoring (conducted quarterly). This GWMR includes the results of the additional monitoring completed in 2018.

2. BACKGROUND

The site covers 574 acres in the city of South Charleston, West Virginia, including 267 acres that have been sold or donated to other parties. UCC has retained the remaining 307 acres, which consist largely of the landfills and areas surrounding the landfills. Topography at the site is generally steep, with flatter, developed areas at the top of hills. Other portions of the site terrain have been altered by the construction of the Lower Ward Landfill, Ward A Landfill, and Ward B Landfill (**Figure 1-1**). The elevation of the site ranges from 580 to 1,090 feet above mean sea level.

The areas of groundwater contamination addressed in this GWMR are Ward Hollow and the Greenhouse Area, both of which are discussed in detail in the Current Conditions Report (CCR; CH2M 2008) and summarized below.

2.1 Ward Hollow

The Lower Ward Landfill, Ward A Landfill, Ward B Landfill, and a former brine well north of Lower Ward Landfill have contaminated the groundwater in Ward Hollow. Contaminated groundwater has migrated from these sources to the underlying weathered bedrock and then downgradient into Ward Hollow. The most prominent constituents present within this plume are 1,4-dioxane, benzene, bis(2-chloroisopropyl)ether, and barium.

2.2 Greenhouse Area

The source of groundwater contamination in the Greenhouse Area is unknown. Two monitoring wells (WVU-MW04 and MW-104A) screened in the Mahoning Sandstone have exhibited detectable concentrations of volatile organic compounds (VOCs).

3. GROUNDWATER MONITORING

The GWMP requires groundwater samples and water levels to be collected every 9 months at the locations shown on **Figure 3-1** (CH2M 2009). Additional groundwater monitoring, beyond that which is required in the GWMP, was conducted for Ward Hollow in 2018 to further evaluate observed increases in groundwater constituent concentrations in some of the Ward Hollow monitoring wells. Per the GWMP, the 2018 sampling was scheduled to occur in June for the Greenhouse Area. For Ward Hollow, groundwater sampling was completed in March, June, September, and December 2018. This section summarizes how the sampling was conducted and observations made during sampling activities.

3.1 Water Level Measurements

Table 3-1 lists water levels and groundwater elevations measured in March, June, September, and December 2018. **Table 3-2** lists the well construction details. During each event, measurements were collected using a handheld water level meter. Water levels were collected from monitoring wells, piezometers, and staff gauges during each event. Groundwater elevation data from the monitoring wells and piezometers were used to analyze the potentiometric surface and groundwater flow patterns.

3.2 Groundwater Sampling

Groundwater samples were collected at the Greenhouse Area in June 2018 in accordance with the GWMP (CH2M 2009). Groundwater samples also were collected from Ward Hollow in March, June, September, and December 2018. **Table 3-3** lists the analytical suites and sample identifiers for the monitoring wells sampled. Sampling was conducted using low-flow sampling protocols (USEPA 2002) or volumetric purging if low-flow was not possible based on historical data for a given monitoring well.

Monitoring locations for the Ward Hollow groundwater plume consists of downgradient wells, sentinel wells, and impacted wells (**Table 3-3**). Downgradient wells are the wells that are furthest downgradient and typically have constituent concentrations that are below screening levels. The sentinel wells are the most downgradient wells that consistently have constituent concentrations above screening levels. Impacted wells are wells immediately downgradient of the landfills.

The groundwater samples collected from Ward Hollow were analyzed for VOCs, semi-volatile organic compounds, and dissolved metals. The two monitoring wells sampled in the Greenhouse Area (WVU-MW04 and MW-104A) historically have contained concentrations of VOCs above screening levels; therefore, the samples from these wells were only analyzed for VOCs.

3.3 Leachate Collection System Sampling

Grab samples of the leachate in the Lower Ward Landfill leachate collection system were collected in March, June, September, and December 2018 to better understand concentrations leaching from the landfill. The leachate samples were analyzed for VOCs, semi-volatile organic compounds, and dissolved metals.

4. GROUNDWATER MONITORING

4.1 Groundwater Flow Patterns

Groundwater level data, along with the top-of-casing elevations, were used to determine groundwater elevations at the site and prepare a potentiometric surface map. **Table 3-1** presents the water level measurements and calculated elevations for each monitoring well, piezometer, and staff gauge.

4.1.1 Ward Hollow

Consistent with the topography of Ward Hollow, groundwater flow is to the northwest, toward the Kanawha River. **Figure 4-1** shows the potentiometric surface of the Upper Freeport Formation within Ward Hollow for data collected on December 11, 2018. Water levels observed in March, June and September 2018 were consistent with the groundwater flow patterns observed in December 2018 and previous years; therefore, only the December 2018 results were mapped.

4.1.2 Greenhouse Area

Figure 4-2 shows the potentiometric surface of the Mahoning Formation within the Greenhouse Area for data collected on December 11, 2018. Water levels observed in June and September 2018 were consistent with the groundwater flow patterns observed in December 2018, therefore only the December 2018 results were mapped.

4.2 Constituent Concentration Evaluation

Tables 4-1 and **4-2** list the analytical results for detected constituents in groundwater and leachate for Ward Hollow and the Greenhouse Area, respectively. The analytical results were compared to USEPA maximum contaminant levels (USEPA 2009), or if a maximum contaminant level was not available for a detected constituent, the USEPA adjusted tap water regional screening level (RSL) (USEPA 2018) was used. USEPA RSLs are based on a target cancer risk equal to 1 x10-6 and an adjusted noncancer hazard quotient of 0.1. The noncancer RSLs are adjusted to account for potential additive effects. These comparisons are provided in **Tables 4-1** and **4-2**. **Appendix A** contains the laboratory data and **Appendix B** contains the data quality evaluation memorandum.

4.2.1 Ward Hollow

A comparison of the analytical results to screening levels (**Table 4-1**) shows that 1,4-dioxane, benzene, bis(2-chloroisopropyl) ether, and barium remain the most prominent constituents present within this groundwater plume. **Figure 4-3** through **Figure 4-6** show the lateral extents of 1,4-dioxane, bis(2-chloroisopropyl) ether, benzene, and barium in Ward Hollow. 1,4-Dioxane and bis (2-chloroisopropyl)ether have the largest lateral extent in groundwater, which is observed vertically within the aquifer as well. **Figures 4-7** and **4-8** show the vertical extents of 1,4-dioxane and bis (2-chloroisopropyl)ether, respectively, in Ward Hollow. 1,4-Dioxane is observed throughout the aquifer, whereas bis(2-chloroisopropyl)ether is observed primarily within the shallow aquifer in the monitoring wells closest to the landfill as well as deeper within the aquifer in downgradient monitoring wells.

Analytical data collected from the 2018 sampling events for Ward Hollow show that exceedances for benzene remains delineated downgradient by MW-28; however, 1,4- dioxane, bis(2-chloroisopropyl)ether, and barium were detected at a concentrations above the screening level in downgradient monitoring well MW-28. Minor exceedances of the 1,4-dioxane screening level in downgradient monitoring well MW-31 was observed in the 2018 sampling events. In December 2016, barium concentrations exceeded the screening level in MW-31 for the first time, and this was observed again in December 2017. Barium concentrations in MW-31 was detected below the screening level in 2018.The source of barium contaminations in Ward Hollow does not appear to be related to the landfills because concentrations downgradient of the landfills are an order of magnitude higher than what is observed in the leachate collection system. The source of barium contamination is assumed to be the former brine well next to MW-01 (**Figure 1-1**).

Other constituent concentrations that exceeded screening levels were arsenic, bis(2-chloroethyl)ether, and naphthalene. Arsenic concentrations exceeded the screening level in monitoring well MW-23 and were detected in MW-01, MW-21, MW-26, MW-28, MW-32, MW-34 and MW-35. Arsenic concentrations observed in groundwater throughout Ward Hollow appear to be representative of naturally occurring levels. The arsenic concentrations in Ward Hollow are similar to those observed previously in monitoring wells outside the boundary of the groundwater plume that are screened in the Upper Freeport Formation (e.g., MW-29 and MW-30). In addition, detections of arsenic in Ward Hollow are highly variable (e.g., arsenic was only detected in MW-34 during the May 2017 event as compared to detections in 2018 where detections observed in MW-01, MW-21, MW-26, MW-28, MW-32, MW-34 and MW-35), which is different than what is observed for other constituents in the groundwater plume. Cadmium concentrations exceeded the screening level in all wells except the two most downgradient wells (MW-31 and MW-32) in 2017 whereas in 2018 only MW-01 andMW-23 exceeded the screening levels for cadmium for samples collected in March 2018.

Bis(2-chloroethyl)ether concentrations exceeded the screening level in wells MW-01, MW-21, MW-23, MW-26, MW-28, MW-34 and MW-35 at least once. Naphthalene also exceeded their respective screening level in MW-01, MW-21, and MW-26.

The groundwater plume stability was evaluated based on monotonic trend analysis of groundwater data using the Mann-Kendall non-parametric statistical test (Gilbert 1987) to investigate whether constituent concentrations in groundwater are increasing, decreasing, or stable. Mann-Kendall statistical tests were performed for four key constituents (1,4-dioxane, bis(2-chloroisopropyl)ether, benzene, and barium) using groundwater analytical data collected at six monitoring wells and the leachate collection system. The Mann-Kendall statistical tests were performed for two different data sets; one for all data and the other for data from 2011 through 2018. The results of Mann-Kendall statistical tests along with graphs showing concentrations over time are provided in **Appendix C**. The trends were stable or decreasing except for the following:

- 1,4-Dioxane: Monitoring well MW-31 exhibits an increasing trend for all data and for data from 2011 to 2018.
- Bis(2-chloroisopropyl)ether: Monitoring wells MW-01, MW-23, and MW-31 and Leachate collection system exhibit increasing trends for all data; however, MW-31 and Leachate Collection System exhibit stable trends for data from 2011 to 2018.
- Benzene: Monitoring wells MW-01, MW-23, and MW-26 exhibit increasing trends for all data; however, MW-01, MW-23 and MW-26 exhibit a stable trend for data from 2011 to 2018. The maximum detected concentration of benzene for MW-01, MW-23 and MW-26 was observed in 2017.

- Barium: Monitoring wells MW-23, MW-26, MW-28, MW-31, and MW-32 exhibit increasing trends for all data; however, only MW-23 and MW-31 exhibit increasing trends for data from 2011 to 2018. Barium levels in 2018 show a decreasing trend.

4.2.2 Leachate Collection System

Analytical data collected from the leachate in 2018 show that the most prominent constituents (1,4-dioxane, benzene, bis(2-chloroisopropyl)ether, and barium) within the groundwater plume also are observed in the leachate at concentrations above screening levels. In addition, 2-methylnaphthalene, Bis(2-chlroroethyl) Ether, naphthalene,1,2-dichloroethane, 1,2-dichloropropane, and arsenic were detected above their respective screening levels (**Table 4-1**).

Mann-Kendall statistical tests were performed for 1,4-dioxane, bis(2-chloroisopropyl)ether, benzene, and barium using analytical data for the leachate. The Mann-Kendall statistical tests were performed for two different data sets; one for all data and the other for data from 2011 to 2018. **Appendix C** contains the Mann-Kendall statistical test results along with graphs showing concentrations over time. Trends based on all data are stable for 1,4-dioxane and bis(2-chloroisopropyl)ether and are decreasing for benzene and barium. Trends based on data from 2011 through 2018 are stable for 1,4-dioxane and barium, and are decreasing for benzene and bis(2-chloroisopropyl)ether.

4.2.3 Greenhouse Area

The June 2018 analytical data for the Greenhouse Area showed that tetrachloroethene (PCE) concentrations exceeded the screening level in WVU-MW04 (**Figure 4-9**). No other VOCs exceeded screening levels in the Greenhouse Area in 2018.

Mann-Kendall statistical tests were performed using groundwater analytical data collected at the two Greenhouse Area monitoring wells for two key constituents (PCE and trichloroethene); the Mann- Kendall statistical test results along with graphs showing concentrations over time are in **Appendix C**. The key constituents for the Greenhouse Area showed either no trend or decreasing trends.

5. SUMMARY

Groundwater monitoring for Ward Hollow and the Greenhouse Area in 2018 shows that groundwater flow patterns have remained stable and are consistent with the conceptual site model presented in the CCR (CH2M 2008).

Analytical data collected from 2003 through 2018 for Ward Hollow generally show that bis(2-chloroisopropyl)ether and benzene have a similar distribution, and concentrations are below their respective screening levels in the downgradient monitoring wells.

The groundwater concentration trends based on the Mann-Kendall statistical test for Ward Hollow were either stable or decreasing, except for the following:

- 1,4-Dioxane: Monitoring well MW-31 exhibits an increasing trend for all data and for data from 2011 to 2018.
- Bis(2-chloroisopropyl)ether: Monitoring wells MW-01, MW-23, and MW-31 and Leachate collection system exhibit increasing trends for all data; however, MW-31 and Leachate Collection System exhibit stable trends for data from 2011 to 2018.
- Benzene: Monitoring wells MW-01, MW-23, and MW-26 exhibit increasing trends for all data; however, MW-01, MW-23 and MW-26 exhibit a stable trend for data from 2011 to 2018. The maximum detected concentration of benzene for MW-01, MW-23 and MW-26 was observed in 2017.
- Barium: Monitoring wells MW-23, MW-26, MW-28, MW-31, and MW-32 exhibit increasing trends for all data; however, only MW-23 and MW-31 exhibit increasing trends for data from 2011 to 2018. Barium levels in 2018 show a decreasing trend.

The 2018 analytical data for the Greenhouse Area shows an exceedance of the screening level for PCE in WVU-MW04. No other VOCs exceeded screening levels in the Greenhouse Area in 2018. The key constituents for the Greenhouse Area showed stable or decreasing trends.

An additional downgradient monitoring well was installed in 2018 (MW-40) in order to further monitor the groundwater plume. The well installation activities and initial groundwater sampling results for MW-40 will be reported on under separate cover by Jacobs. Future routine groundwater sampling events at Ward Hollow will include monitoring well MW-40 beginning in 2019.

It is recommended that quarterly groundwater monitoring be continued for wells MW-1, MW-23, and downgradient wells MW-31, MW-32 and MW-40, It is recommended that the remaining wells be sampled annually. If WVDEP agrees with these changes, the GWMP will be updated.

6. REFERENCES

CH2M HILL Inc. (CH2M). 2008. Current Conditions Report. UCC Technology Park. Prepared for Union Carbide Corporation. March.

CH2M HILL Inc. (CH2M). 2009. Groundwater Monitoring Plan. UCC Technology Park. Prepared for Union Carbide Corporation. January.

Gilbert, R. O. 1987. Statistical Methods for Environmental Pollution Monitoring. Wiley, New York.

U.S. Environmental Protection Agency (USEPA). 2002. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers, Ground Water Forum Issue Paper. Office of Solid Waste and Emergency Response. EPA 542-S-02-001. May.

U.S. Environmental Protection Agency (USEPA). 2009. National Primary Drinking Water Regulations. EPA 816-F-09-004. May.

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U.S. Environmental Protection Agency (USEPA). 2017. Regional Screening Levels for Chemical Contaminants at Superfund Sites. November.

West Virginia Department of Environmental Protection. 2012. “Final Decision into a Revised Resource Conservation and Recovery Act Permit for the UCC Technology Park.” February 2.

CH2M HILL Inc. (CH2M). 2018. 2017 Groundwater Monitoring Report. UCC Technology Park. Prepared for Union Carbide Corporation. March 2018.

TABLES

Table 3-1. 2018 Groundwater and Surface Water Elevation Data
2018 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia

Location	Top of Casing Elevation (ft amsl)	March 2018		June 2018		September 2018		December 2018	
		Water Level (ft btoc) 3/26/2018	Groundwater Elevation (ft amsl) 3/26/2018	Water Level (ft btoc) 6/25/2018	Groundwater Elevation (ft amsl) 6/25/2018	Water Level (ft btoc) 9/25/2018	Groundwater Elevation (ft amsl) 9/25/2018	Water Level (ft btoc) 12/11/2018	Groundwater Elevation (ft amsl) 12/11/2018
Monitoring Wells									
Ward Hollow Wells									
MW-01	622.34	1.64	620.70	1.17	621.17	1.55	620.79	1.70	620.64
MW-02	775.88	80.84	695.04	80.98	694.90	81.90	693.98	82.15	693.73
MW-04	770.05	8.49	761.56	8.31	761.74	8.05	762.00	8.12	761.93
MW-05	800.71	30.57	770.14	32.88	767.83	33.22	767.49	33.57	767.14
MW-06	801.18	58.98	742.20	59.20	741.98	59.33	741.85	60.10	741.08
MW-20	608.85	6.30	602.55	0.30	608.55	0.30	608.55	0.35	608.50
MW-21	608.69	0.02	608.67	0.30	608.39	0.80	607.89	0.80	607.89
MW-22	608.73	5.98	602.75	5.30	603.43	8.61	600.12	8.70	600.03
MW-23	617.65	16.35	601.30	16.98	600.67	16.81	600.84	17.00	600.65
MW-24	604.07	6.87*	597.20	7.06	597.01	6.91	597.16	6.95	597.12
MW-25	606.70	10.34	596.36	10.81	595.89	10.38	596.32	10.29	596.41
MW-26	635.37	27.46	607.91	26.98	608.39	27.03	608.34	27.80	607.57
MW-27	621.09	30.69	590.40	30.89	590.20	30.72	590.37	30.80	590.29
MW-28	622.45	31.89	590.56	29.34	593.11	31.91	590.54	31.90	590.55
MW-29	801.50	118.44	683.06	118.44	683.06	Past 100' of tape	NM	NM	NM
MW-30	620.19	25.19	595.00	25.35	594.84	23.90	596.29	23.92	596.27
MW-31	592.06	14.95	577.11	15.02	577.04	14.80	577.26	15.50	576.56
MW-32	589.05	18.14	570.91	17.98	571.07	19.52	569.53	19.90	569.15
MW-34	623.65	10.59	613.06	10.38	613.27	9.50	614.15	9.30	614.35
MW-35	615.46	6.20	609.26	5.99	609.47	9.00	606.46	6.40	609.06
Green House wells									
MW-104A	693.21	NM	NM	53.59	639.62	54.04	639.17	54.12	639.09
WVU-MW01	695.10	NM	NM	22.04	673.06	21.00	674.10	21.10	674.00
WVU-MW02	693.57	NM	NM	24.18	669.39	19.70	673.87	19.75	673.82
WVU-MW03	690.88	NM	NM	33.83	657.05	33.35	657.53	33.30	657.58
WVU-MW04	678.55	NM	NM	15.00	663.55	15.40	663.15	15.45	663.10
WVU-MW05	712.22	NM	NM	5.10	707.12	NM	NM	10.20	702.02
WVU-MW06	721.38	NM	NM	1.15	720.23	1.20	720.18	1.20	720.18
Piezometers									
P-06	784.00	8.20	775.80	9.05	774.95	9.50	774.50	9.10	774.90
P-11	767.20	5.73	761.47	5.99	761.21	5.15	762.05	5.98	761.22
P-13	769.90	100.01	669.89	99.78	670.12	99.80	670.10	99.67	670.23
P-14	770.70	43.70	727.00	44.80	725.90	45.00	725.70	44.75	725.95
Staff Gauges									
SG-01 (Next to MW-21)	599.00	0.00	599.00	-0.30	599.30	0.03	598.97	0.35	598.65
SG-02 (Next to MW-31)	584.00	3.58	580.42	3.40	580.60	0.20	583.80	3.35	580.65

Notes:

ft btoc = feet below top of casing

ft amsl = feet above mean sea level

NM = not measured

* = Tubing stuck in well, may cause displacement of water and water level may vary

Table 3-2. Well Construction Table
2018 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia

ARCADIS Design & Consultancy for natural and built assets

Location	Lithology in Screened Interval	Ground Elevation (ft amsl)	Screen Elevation (ft amsl)		Screened Interval (ft bgs)	
			Top	Bottom	Top	Bottom
Monitoring Wells						
Ward Hollow Wells						
MW-01	Siltstone and Shale above Upper Freeport Sandstone	621.91	613	598	9	24
MW-02	Mahoning Sandstone	773.54	654	634	120	140
MW-04	Conemaugh Red Beds	770.84	745	735	26	36
MW-05	Red and Gray Claystone and Shale	799.45	761	741	38	58
MW-06	Mahoning Sandstone	799.59	680	660	120	140
MW-20	Upper Freeport Sandstone (deep)	606.61	548.1	529.1	58.5	77.5
MW-21	Upper Freeport Sandstone	606.80	578.7	558.7	28.1	48.1
MW-22	Siltstone and Shale above Upper Freeport Sandstone	606.96	596.46	576.46	10.50	30.50
MW-23	Upper Freeport Sandstone	614.51	NA	545.65	NA	68.86
MW-24	Upper Freeport Sandstone	600.95	NA	546.15	NA	54.80
MW-25	Upper Freeport Sandstone	603.52	NA	543.64	NA	59.88
MW-26	Upper Freeport Sandstone	632.28	568	548	64	84
MW-27	Upper Freeport Sandstone	618.21	558	538	60	80
MW-28	Upper Freeport Sandstone	619.55	562	542	58	78
MW-29	Upper Freeport Sandstone	799.63	610	590	190	210
MW-30	Upper Freeport Sandstone	620.51	556	536	65	85
MW-31	Upper Freeport Sandstone	590.26	540.07	520.07	50.19	70.19
MW-32	Upper Freeport Sandstone	587.34	529.02	508.72	58.32	78.62
MW-34	Upper Freeport Sandstone	620.95	565.5	545.5	55.5	75.5
MW-35	Upper Freeport Sandstone	612.73	569	549	44	64
Green House wells						
WVU-MW03	Mahoning Sandstone	691*	654	634	37	57
WVU-MW04	Mahoning Sandstone	678.8*	657.3	637.3	21.5	41.5
WVU-MW05	Shale above the Mahoning Sandstone	712.5*	704.5	684.5	8	28
WVU-MW06	Mahoning Sandstone	721.5*	711.5	691.5	10	30
Technology Park Piezometers						
P-06	Clay and Siltstone	781.59	764	762	18	20
P-11	Landfill Waste	765.14	747	745	18	20
P-13	Clay and Siltstone	768.07	670	668	98	100
P-14	Claystone	768.12	721.6	719.6	46.5	48.5

Notes:

NA = not available

ft bgs = feet below ground surface

ft amsl = feet above mean sea level

* = Estimated value. Survey data not available

Table 3-3. 2018 Groundwater Sampling Summary
2018 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia

ARCADIS Design & Consultancy for natural and built assets

Monitoring Well	Well Type	Sample ID	Date Sampled	Analysis		
				VOCs	SVOCs	Dissolved Metals
MW-01	Impacted	MW01-GW-MMDDYY	3/29/2018, 6/28/2018, 9/27/2018, 12/12/2018	X	X	X
MW-21	Impacted	MW21-GW-MMDDYY	3/28/2018, 6/26/2018, 9/26/2018, 12/12/2018	X	X	X
MW-23	Sentinel	MW23-GW-MMDDYY	3/29/2018, 6/28/2018, 9/27/2018, 12/12/2018	X	X	X
MW-26	Sentinel	MW26-GW-MMDDYY	3/30/2018, 6/28/2018, 9/28/2018, 12/12/2018	X	X	X
MW-28	Sentinel	MW28-GW-MMDDYY	3/27/2018, 6/26/2018, 9/28/2018, 12/13/2018	X	X	X
MW-31	Downgradient	MW31-GW-MMDDYY	3/28/2018, 6/26/2018, 9/28/2018, 12/13/2018	X	X	X
MW-32	Downgradient	MW32-GW-MMDDYY	3/28/2018, 6/26/2018, 12/13/2018	X	X	X
MW-34	Impacted	MW34-GW-MMDDYY	3/29/2018, 6/28/2018, 9/26/2018, 12/12/2018	X	X	X
MW-35	Impacted	MW35-GW-MMDDYY	3/29/2018, 6/28/2018, 9/27/2018, 12/12/2018	X	X	X
WVU-MW04	Impacted	WVU04-GW-MMDDYY	6/28/2018	X		
MW-104A	Impacted	MW104A-GW-MMDDYY	6/28/2018	X		

Notes:

VOC = volatile organic compound

SVOC = semi-volatile organic compound

Location	Screening Level	Screening Level Source	MW01					MW21			
Sample ID			MW01-GW-032918	MW01-GW-032918S	MW01_20180628	MW-1_20180927	MW01-GW-20181212	MW21-GW-032818	MW-21_20180626	MW-21_20180926	MW-21_20181212
Sample Date			3/29/2018	3/29/2018	6/28/2018	9/27/2018	12/12/2018	3/28/2018	6/26/2018	9/26/2018	12/12/2018
Analyte											
Metals (mg/L)											
Arsenic	0.01	MCL	**0.0036**	0.01 U	**0.0067**	**0.004**	**0.0035**	**0.0035**	**0.0049**	**0.0032**	0.002 UB
Barium	2	MCL	**55.5**	**53.8**	**52**	**54**	**50.4**	**54.4**	**52.4**	**53**	**57.6 J**
Cadmium	0.005	MCL	0.0005 U	**0.00741**	0.002 U	0.001 U	0.001 U	0.0005 U	0.002 U	0.001 U	0.001 U
Chromium, total	0.1	MCL	0.015 U	**0.00824**	0.03 U	0.015 U	0.015 U	0.015 U	0.03 U	0.015 U	0.015 U
Selenium	0.05	MCL	0.002 U	**0.0141**	0.004 U	0.002 U	0.002 U	0.002 U	0.004 U	0.002 U	0.002 U
Semi-Volatile Organic Compounds (µg/L)											
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tap water RSL	**57 D**	**147 J**	**100 D**	**99 D**	**200 J**	**92 D**	**110 D**	NA	**220 J**
2,4-Dimethylphenol	36	Adjusted Tap water RSL	1 UJ	5.56 U	**11 R**	10 U	**11 R**	**1 R**	**10 R**	**11 R**	**10 R**
2-Methylnaphthalene	3.6	Adjusted Tap water RSL	0.5 UJ	5.56 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	**2 J**
3 & 4 Methylphenol	--	--	5 UJ	5.56 U	**2 R**	2 U	**2 R**	**5 R**	**2 R**	**2 R**	**2 R**
Acenaphthene	53	Adjusted Tap water RSL	**2 J**	5.56 U	**2**	**2**	0.5 U	0.5 UJ	**0.5 R**	0.5 U	0.5 U
Acenaphthylene	--	--	0.5 UJ	5.56 U	0.5 U	0.5 U	0.5 U	0.5 UJ	**0.5 R**	0.5 U	0.5 U
Anthracene	180	Adjusted Tap water RSL	0.5 UJ	5.56 U	0.5 U	0.5 U	0.5 U	0.5 UJ	**0.5 R**	0.5 U	0.5 U
Benzo(a)anthracene	0.03	Adjusted Tap water RSL	0.05 U	5.56 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 UJ	0.05 U	0.05 U
Benzo(a)pyrene	0.2	MCL	0.05 U	5.56 U	0.05 U	0.05 U	0.05 U	0.05 UJ	0.05 UJ	0.05 UJ	0.05 UJ
Benzo(a)fluoranthene	--	--	0.05 U	5.56 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 UJ	0.05 U	0.05 U
Benzo(g,h,i)perylene	--	--	0.5 U	5.56 U	0.5 U	0.5 U	0.5 U	0.5 U	**0.5 R**	0.5 U	0.5 U
Benzyl Butyl Phthalate	16	Adjusted Tap water RSL	5 U	5.56 U	5 U	5 U	5 U	5 U	**5 R**	5 U	5 U
Bis(2-chloroethyl) Ether	0.014	Adjusted Tap water RSL	**2**	5.56 U	**2**	**2**	**3**	**3 J**	**3 J**	**2 J**	**3 J**
Bis(2-chloroisopropyl) Ether	71	Adjusted Tap water RSL	**490 D**	**571 I**	**560 D**	**670 D**	**1,100**	**550 D**	**590 DJ**	**480 D**	**1,000**
Diethyl Phthalate	1,500	Adjusted Tap water RSL	15 U	5.56 U	5 U	5 U	5 U	15 U	**5 R**	5 U	5 U
Fluoranthene	80	Adjusted Tap water RSL	0.5 UJ	5.56 U	0.5 U	0.5 U	0.5 U	0.5 UJ	**0.5 R**	0.5 U	0.5 U
Fluorene	29	Adjusted Tap water RSL	0.5 UJ	5.56 U	0.5 U	0.5 U	0.5 U	0.5 UJ	**0.5 R**	0.5 U	0.5 U
Indeno(1,2,3-cd)pyrene	0.25	Adjusted Tap water RSL	0.05 U	5.56 U	0.05 U	0.05 U	0.05 U	0.05 UJ	0.05 UJ	0.05 UJ	0.05 UJ
Isophorone	78	Adjusted Tap water RSL	5 UJ	5.56 U	2 U	2 U	2 U	5 UJ	**2 R**	2 U	2 U
Naphthalene	0.17	Adjusted Tap water RSL	**7**	**15.7**	**12 D**	**9**	**3**	**0.7**	**0.7 J**	**0.6**	**2 J**
Phenanthrene	--	--	0.5 UJ	5.56 U	0.5 U	0.5 U	0.5 U	0.5 UJ	**0.5 R**	0.5 U	0.5 U
Phenol	580	Adjusted Tap water RSL	5 U	5.56 U	**2 R**	2 U	**2 R**	**5 R**	**2 R**	**2 R**	**2 R**
Volatile Organic Compounds (µg/L)											
1,2-Dichlorobenzene	600	MCL	5 U	1 U	0.5 U	0.5 U	1 U	5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	5	MCL	5 U	1 U	0.5 U	0.5 U	1 U	5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	5	MCL	5 U	1 U	0.5 U	0.5 U	1 U	5 U	0.5 U	0.5 U	0.5 U
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tap water RSL	1,000 U	**195**	**320 J**	**230**	**240**	1,000 U	**260 J**	**240 J**	**230**
Acetone	1,400	Adjusted Tap water RSL	50 U	**7.44**	**11**	5 U	10 U	50 U	5 U	5 U	5 U
Benzene	5	MCL	**28**	**32.3**	**31 D**	**26 D**	**30**	**20**	**23**	**21**	**24**
Carbon Disulfide	81	MCL	10 U	1 U	1 U	1 U	2 U	10 U	1 U	1 U	1 U
Chlorobenzene	100	MCL	5 U	1 U	0.5 U	0.5 U	1 U	5 U	0.5 U	0.5 U	0.5 U
Ethylbenzene	700	MCL	**24**	**27.7**	**26 D**	**23 D**	**26**	**5.7**	**6.7**	**6.1**	**7.7**
2-Butanone	560	Adjusted Tap water RSL	50 U	5 U	5 U	5 U	10 U	50 U	5 U	5 U	5 U
4-Methyl-2-Pentanone	630	Adjusted Tap water RSL	50 U	5 U	5 U	5 U	10 U	50 U	5 U	5 U	5 U
Pyrene	12	Adjusted Tap water RSL	0.5 UJ	5.56 U	0.5 U	0.5 U	0.5 U	0.5 UJ	**0.5 R**	0.5 U	0.5 U
Styrene	100	MCL	5 U	1 U	0.5 U	0.5 U	1 U	5 U	0.5 U	0.5 U	0.5 U
Toluene	1,000	MCL	5 U	**3.19**	**3.6**	**3**	**2.8**	5 U	**1.9**	**1.6**	**2**
Xylenes, Total	10,000	MCL	**9.3**	**10.5**	**12**	**10**	**10**	5 U	**4.3**	**4**	**4.9**

Notes:

B = The analyte was detected in the associated method and/or calibration blank

D = Concentration is based on a diluted sample analysis

E = Concentration exceeds the calibration range

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

L = The analyte was positively identified, but the associated numerical value may be biased low.

R = Concentration difference between the primary and confirmation column > 40%. The higher result is reported.

U = The analyte was analyzed for, but was not detected above the reported samplequantitation limit.

UJ = The analyte was below the reported sample quantitation limit. However, thereported value is approximate.

UL = The analyte was analyzed for but was not detected. The quantitation limit maybe biased low.

MCL= maximum contaminant level

RSL= regional screening level

mg/L = Milligrams per Liter

µg/L = Micrograms per Liter

Bold indicates the analyte was detected.

Shading indicates the result exceeded screening criteria.

1,4-Dioxane results included under Semi Volatile Organic compounds includes both sample analysis by 8270 SIM method and isotope dilution methods.

Location	Screening Level	Screening Level Source	MW23					MW26			
Sample ID			MW23-GW-032918	MW23-GW-032918S	MW23_20180628	MW23_20180927	MW23_20181212	MW26-GW-033018	MW26_20180628	MW26_20180928	MW26_20181212
Sample Date			3/29/2018	3/29/2018	6/28/2018	9/27/2018	12/12/2018	3/30/2018	6/28/2018	9/28/2018	12/12/2018
Analyte											
Metals (mg/L)											
Arsenic	0.01	MCL	**0.0209**	**0.0269**	**0.0067**	0.002 U	**0.0096**	**0.0067**	0.004 U	0.002 U	0.002 U
Barium	2	MCL	**51.6**	**48**	**49.3**	**52.8**	**52.7 J**	**60.6**	**57.3**	**36.6**	**55.1**
Cadmium	0.005	MCL	0.0005 U	**0.0075**	0.002 U	0.001 U	0.001 U	0.0005 U	0.002 U	0.001 U	0.001 U
Chromium, total	0.1	MCL	0.015 U	**0.00558**	0.03 U	0.015 U	**0.0175**	0.015 U	0.03 U	0.015 U	0.015 U
Selenium	0.05	MCL	0.002 U	**0.0121**	0.004 U	0.002 U	0.002 U	0.002 U	0.004 U	0.002 U	0.002 U
Semi-Volatile Organic Compounds (µg/L)											
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tap water RSL	**90 D**	**148 J**	**130 D**	**110 D**	**220 J**	**74 D**	**130 D**	**88 D**	**200 J**
2,4-Dimethylphenol	36	Adjusted Tap water RSL	**1 R**	11 UJ	**10 R**	**11 R**	**11 R**	**1 R**	**10 R**	**10 R**	**10 R**
2-Methylnaphthalene	3.6	Adjusted Tap water RSL	0.5 UJ	11 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
3 & 4 Methylphenol	--	--	**5 R**	11 UJ	**2 R**	**2 R**	**2 R**	**1 R**	**2 R**	**2 R**	**2 R**
Acenaphthene	53	Adjusted Tap water RSL	0.5 UJ	11 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Acenaphthylene	--	--	0.5 UJ	11 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Anthracene	180	Adjusted Tap water RSL	0.5 UJ	11 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Benzo(a)anthracene	0.03	Adjusted Tap water RSL	11 UJ	0.05 U	0.05 U	**0.1**	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Benzo(a)pyrene	0.2	MCL	11 UJ	0.05 U	0.05 UJ	**0.1**	0.05 UJ	0.05 UJ	0.05 UJ	0.05 UJ	0.05 UJ
Benzo(a)fluoranthene	--	--	11 UJ	0.05 U	0.05 U	**0.2 J**	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Benzo(g,h,i)perylene	--	--	0.5 U	11 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzyl Butyl Phthalate	16	Adjusted Tap water RSL	5 U	11 UJ	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bis(2-chloroethyl) Ether	0.014	Adjusted Tap water RSL	**2**	11 UJ	**2 J**	**2**	**2 J**	**2 J**	**3 J**	**1 J**	**3 J**
Bis(2-chloroisopropyl) Ether	71	Adjusted Tap water RSL	**410 D**	**518 I**	**390 D**	**310 D**	**790 D**	**530 D**	**410 D**	**110**	**950 D**
Diethyl Phthalate	1,500	Adjusted Tap water RSL	15 U	11 UJ	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Fluoranthene	80	Adjusted Tap water RSL	0.5 UJ	11 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Fluorene	29	Adjusted Tap water RSL	0.5 UJ	11 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Indeno(1,2,3-cd)pyrene	0.25	Adjusted Tap water RSL	11 UJ	0.05 U	0.05 UJ	**0.07**	0.05 UJ	0.05 UJ	0.05 UJ	0.05 UJ	0.05 UJ
Isophorone	78	Adjusted Tap water RSL	5 UJ	11 UJ	2 U	2 U	2 U	1 UJ	2 U	2 U	2 U
Naphthalene	0.17	Adjusted Tap water RSL	**0.1**	11 UJ	0.07 U	0.07 U	0.07 U	**0.08**	0.07 U	0.07 U	**0.2**
Phenanthrene	--	--	0.5 UJ	11 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Phenol	580	Adjusted Tap water RSL	**5 R**	11 UJ	**2 R**	**2 R**	**2 R**	**1 R**	**2 R**	**2 R**	**2 R**
Volatile Organic Compounds (µg/L)											
1,2-Dichlorobenzene	600	MCL	5 U	1 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	1 U
1,2-Dichloroethane	5	MCL	5 U	1 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	1 U
1,2-Dichloropropane	5	MCL	5 U	1 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	1 U
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tap water RSL	1,000 U	**190**	**300 J**	**180 J**	**240**	1,000 U	**250 J**	**140**	**240**
Acetone	1,400	Adjusted Tap water RSL	50 U	**6.87**	**5.6**	5 U	5 U	50 U	5 U	5 U	10 U
Benzene	5	MCL	5 U	**10.5**	**4.2**	**3.2**	**11**	**17**	**20**	**1**	**18**
Carbon Disulfide	81	MCL	10 U	**1.16**	1 U	1 U	1 U	10 U	1 U	1 U	2 U
Chlorobenzene	100	MCL	5 U	1 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	1 U
Ethylbenzene	700	MCL	5 U	1 U	0.5 U	0.5 U	**1**	5 U	**3.2**	0.5 U	**2.7**
2-Butanone	560	Adjusted Tap water RSL	50 U	5 U	5 U	5 U	5 U	50 U	5 U	5 U	10 U
4-Methyl-2-Pentanone	630	Adjusted Tap water RSL	50 U	5 U	5 U	5 U	5 U	50 U	5 U	5 U	10 U
Pyrene	12	Adjusted Tap water RSL	0.5 UJ	11 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Styrene	100	MCL	5 U	1 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	1 U
Toluene	1,000	MCL	5 U	1 U	0.5 U	0.5 U	0.5 U	5 U	**1.4**	0.5 U	**1.3**
Xylenes, Total	10,000	MCL	5 U	1 U	0.5 U	0.5 U	**1.1**	5 U	**2.8**	0.5 U	**2.4**

Notes:

B = The analyte was detected in the associated method and/or calibration blank

D = Concentration is based on a diluted sample analysis

E = Concentration exceeds the calibration range

J = The analyte was positively identified; the associated numerical value is the appr

L = The analyte was positively identified, but the associated numerical value may be

R = Concentration difference between the primary and confirmation column > 40%.

U = The analyte was analyzed for, but was not detected above the reported sample

UJ = The analyte was below the reported sample quantitation limit. However, there

UL = The analyte was analyzed for but was not detected. The quantitation limit may

MCL= maximum contaminant level

RSL= regional screening level

mg/L = Milligrams per Liter

µg/L = Micrograms per Liter

Bold indicates the analyte was detected.

Shading indicates the result exceeded screening criteria.

1,4-Dioxane results included under Semi Volatile Organic compounds includes both

Table 4-1. 2018 Detected Results for Ward Hollow Groundwater
2018 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia

Location	Screening Level	Screening Level Source	MW28				MW31			
Sample ID			**MW28-GW-032718**	**MW-28_20180626**	**MW-28_20180928**	**MW-28_20181213**	**MW31-GW-032818**	**MW-31_20180626**	**MW-31_20180928**	**MW-31_20181213**
Sample Date			**3/27/2018**	**6/26/2018**	**9/28/2018**	**12/13/2018**	**3/28/2018**	**6/26/2018**	**9/28/2018**	**12/13/2018**
Analyte										
Metals (mg/L)										
Arsenic	0.01	MCL	**0.0042**	0.02 U	**0.0044**	**0.003**	0.002 U	0.004 U	0.002 U	0.002 U
Barium	2	MCL	**36.2**	**28.9**	**30.4**	**28.3**	**1.89**	**0.922**	**0.511**	**0.283**
Cadmium	0.005	MCL	0.0005 U	0.01 U	0.001 U	0.001 U	0.0005 U	0.002 U	0.001 U	0.001 U
Chromium, total	0.1	MCL	0.015 U	0.03 U	0.015 U	0.015 U	0.015 U	0.03 U	0.015 U	0.015 U
Selenium	0.05	MCL	0.002 U	0.004 U	0.002 U	0.002 U	0.002 U	0.004 U	0.002 U	0.002 U
Semi-Volatile Organic Compounds (µg/L)										
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tap water RSL	**65 D**	**86 D**	**64 D**	**150 J**	**19 D**	**8 J**	**4**	**6 J**
2,4-Dimethylphenol	36	Adjusted Tap water RSL	1 UJ	**10 R**	**11 R**	**10 R**	1 UJ	**11 R**	10 U	10 U
2-Methylnaphthalene	3.6	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
3 & 4 Methylphenol	--	--	5 UJ	**2 R**	**2 R**	**2 R**	5 UJ	**2 R**	2 U	2 U
Acenaphthene	53	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Acenaphthylene	--	--	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Anthracene	180	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Benzo(a)anthracene	0.03	Adjusted Tap water RSL	0.05 U	0.05 UJ	0.05 U	0.05 U	0.05 U	0.05 UJ	0.05 U	0.05 U
Benzo(a)pyrene	0.2	MCL	0.05 U	**0.05 R**	0.05 UJ	0.05 UJ	0.05 U	0.05 UJ	0.05 U	0.05 U
Benzo(a)fluoranthene	--	--	0.05 U	0.05 UJ	0.05 U	0.05 U	0.05 U	0.05 UJ	0.05 U	0.05 U
Benzo(g,h,i)perylene	--	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzyl Butyl Phthalate	16	Adjusted Tap water RSL	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bis(2-chloroethyl) Ether	0.014	Adjusted Tap water RSL	**0.5**	**0.5 J**	**0.3 J**	**0.4 J**	0.05 U	0.07 UJ	0.07 U	0.07 U
Bis(2-chloroisopropyl) Ether	71	Adjusted Tap water RSL	**120**	**160 D**	**62**	**93**	5 U	2 U	2 U	2 U
Diethyl Phthalate	1,500	Adjusted Tap water RSL	15 U	5 U	5 U	5 U	15 U	5 U	5 U	5 U
Fluoranthene	80	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Fluorene	29	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Indeno(1,2,3-cd)pyrene	0.25	Adjusted Tap water RSL	0.05 U	**0.05 R**	0.05 UJ	0.05 UJ	0.05 U	0.05 UJ	0.05 U	0.05 U
Isophorone	78	Adjusted Tap water RSL	5 UJ	2 U	2 U	2 U	5 UJ	2 U	2 U	2 U
Naphthalene	0.17	Adjusted Tap water RSL	0.06 U	0.07 UJ	**0.1**	0.07 U	0.06 U	0.07 UJ	0.07 U	0.07 U
Phenanthrene	--	--	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Phenol	580	Adjusted Tap water RSL	5 U	**2 R**	**2 R**	**2 R**	5 U	**2 R**	2 U	2 U
Volatile Organic Compounds (µg/L)										
1,2-Dichlorobenzene	600	MCL	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	5	MCL	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	5	MCL	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tap water RSL	1,000 U	**230 J**	**130**	**170**	100 U	100 U	100 U	100 U
Acetone	1,400	Adjusted Tap water RSL	50 U	5 U	5 U	**8.1**	5 U	5 U	5 U	5 U
Benzene	5	MCL	5 U	**2.3**	**0.7**	**1.2**	0.5 U	0.5 U	0.5 U	0.5 U
Carbon Disulfide	81	MCL	10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	100	MCL	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ethylbenzene	700	MCL	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Butanone	560	Adjusted Tap water RSL	50 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-Pentanone	630	Adjusted Tap water RSL	50 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Pyrene	12	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Styrene	100	MCL	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	1,000	MCL	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylenes, Total	10,000	MCL	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

Notes:

B = The analyte was detected in the associated method and/or calibration blank

D = Concentration is based on a diluted sample analysis

E = Concentration exceeds the calibration range

J = The analyte was positively identified: the associated numerical value is the appr

L = The analyte was positively identified, but the associated numerical value may be

R = Concentration difference between the primary and confirmation column > 40%.

U = The analyte was analyzed for, but was not detected above the reported sample

UJ = The analyte was below the reported sample quantitation limit. However, there

UL = The analyte was analyzed for but was not detected. The quantitation limit may

MCL= maximum contaminant level

RSL= regional screening level

mg/L = Milligrams per Liter

µg/L = Micrograms per Liter

Bold indicates the analyte was detected.

Shading indicates the result exceeded screening criteria.

1,4-Dioxane results included under Semi Volatile Organic compounds includes both

Table 4-1. 2018 Detected Results for Ward Hollow Groundwater
2018 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia

Location	Screening Level	Screening Level Source	MW32			MW34			
Sample ID			MW32-GW-032818	MW-32_20180626	MW-32_20181213	MW34-GW-032918	MW-34_20180628	MW-34_20180926	MW-34_20181212
Sample Date			3/28/2018	6/26/2018	12/12/2018	3/29/2018	6/28/2018	9/26/2018	12/12/2018
Analyte									
Metals (mg/L)									
Arsenic	0.01	MCL	**0.0027**	0.004 U	**0.0037**	**0.0025**	**0.0061**	0.002 U	**0.0041**
Barium	2	MCL	**0.222**	**0.153**	**0.175**	**43.2**	**39.3**	**39.5**	**38.5**
Cadmium	0.005	MCL	0.0005 U	0.002 U	0.001 U	0.0005 U	0.002 U	0.001 U	0.001 U
Chromium, total	0.1	MCL	0.015 U	0.03 U	0.015 U	0.015 U	0.15 U	0.015 U	0.015 U
Selenium	0.05	MCL	0.002 U	0.004 U	0.002 U	0.002 U	0.004 U	0.002 U	0.002 U
Semi-Volatile Organic Compounds (µg/L)									
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tap water RSL	0.2 U	0.3 UJ	1 UJ	**43 D**	**63 D**	NA	**80 J**
2,4-Dimethylphenol	36	Adjusted Tap water RSL	5 U	10 U	10 U	**1 R**	**10 R**	**10 R**	**10 R**
2-Methylnaphthalene	3.6	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
3 & 4 Methylphenol	--	--	**5 R**	2 U	2 U	**5 R**	**2 R**	**2 R**	**2 R**
Acenaphthene	53	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Acenaphthylene	--	--	0.5 UJ	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Anthracene	180	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Benzo(a)anthracene	0.03	Adjusted Tap water RSL	0.05 U	0.05 UJ	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Benzo(a)pyrene	0.2	MCL	0.05 U	0.05 UJ	0.05 U	0.05 U	0.05 U	0.05 UJ	**0.05 R**
Benzo(a)fluoranthene	--	--	0.05 U	0.05 UJ	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Benzo(g,h,i)perylene	--	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzyl Butyl Phthalate	16	Adjusted Tap water RSL	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bis(2-chloroethyl) Ether	0.014	Adjusted Tap water RSL	0.05 U	0.07 UJ	0.07 U	0.05 U	0.07 U	0.07 UJ	**0.07 R**
Bis(2-chloroisopropyl) Ether	71	Adjusted Tap water RSL	5 U	2 U	2 U	**22**	**29**	**19**	**27**
Diethyl Phthalate	1,500	Adjusted Tap water RSL	15 U	5 U	5 U	15 U	5 U	5 U	5 U
Fluoranthene	80	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Fluorene	29	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Indeno(1,2,3-cd)pyrene	0.25	Adjusted Tap water RSL	0.05 U	0.05 UJ	0.05 U	0.05 U	0.05 U	0.05 UJ	**0.05 R**
Isophorone	78	Adjusted Tap water RSL	5 UJ	2 U	2 U	5 UJ	2 U	2 U	2 U
Naphthalene	0.17	Adjusted Tap water RSL	**0.07**	0.07 UJ	**0.1**	**0.06**	0.07 U	0.07 U	0.07 U
Phenanthrene	--	--	0.5 UJ	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Phenol	580	Adjusted Tap water RSL	5 U	2 U	2 U	**5 R**	**2 R**	2 U	**2 R**
Volatile Organic Compounds (µg/L)									
1,2-Dichlorobenzene	600	MCL	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	5	MCL	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	5	MCL	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tap water RSL	100 U	100 U	100 U	1,000 U	**180 J**	**100 J**	**140**
Acetone	1,400	Adjusted Tap water RSL	5 U	5 U	**14**	50 U	5 U	5 U	5 U
Benzene	5	MCL	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
Carbon Disulfide	81	MCL	1 U	1 U	1 U	10 U	1 U	1 U	1 U
Chlorobenzene	100	MCL	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
Ethylbenzene	700	MCL	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
2-Butanone	560	Adjusted Tap water RSL	5 U	5 U	5 U	50 U	5 U	5 U	5 U
4-Methyl-2-Pentanone	630	Adjusted Tap water RSL	5 U	5 U	5 U	50 U	5 U	5 U	5 U
Pyrene	12	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Styrene	100	MCL	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
Toluene	1,000	MCL	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
Xylenes, Total	10,000	MCL	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U

Notes:

B = The analyte was detected in the associated method and/or calibration blank

D = Concentration is based on a diluted sample analysis

E = Concentration exceeds the calibration range

J = The analyte was positively identified: the associated numerical value is the appr

L = The analyte was positively identified, but the associated numerical value may be

R = Concentration difference between the primary and confirmation column > 40%.

U = The analyte was analyzed for, but was not detected above the reported sample

UJ = The analyte was below the reported sample quantitation limit. However, there

UL = The analyte was analyzed for but was not detected. The quantitation limit may

MCL= maximum contaminant level

RSL= regional screening level

mg/L = Milligrams per Liter

µg/L = Micrograms per Liter

Bold indicates the analyte was detected.

Shading indicates the result exceeded screening criteria.

1,4-Dioxane results included under Semi Volatile Organic compounds includes both

Location	Screening Level	Screening Level Source	MW35				Leachate Collection System			
Sample ID			**MW35-GW-032918**	**MW-35_20180628**	**MW-35_20180927**	**MW-35_20181212**	**SW01-GW-032818**	**SW01-GW-062818**	**SW-010_20180926**	**SW010_20181212**
Sample Date			**3/29/2018**	**6/28/2018**	**9/27/2018**	**12/12/2018**	**3/28/2018**	**6/28/2018**	**9/26/2018**	**12/12/2018**
Analyte										
Metals (mg/L)										
Arsenic	0.01	MCL	**0.003**	0.02 U	0.002 U	0.002 UB	**0.0609**	NA	**0.0268**	**0.0229**
Barium	2	MCL	**59.9**	**56.4**	**56**	**55.1 J**	**2.66**	NA	**3.16**	**1.41**
Cadmium	0.005	MCL	0.0005 U	0.01 U	0.001 U	0.001 U	0.0005 U	NA	0.001 U	0.001 U
Chromium, total	0.1	MCL	0.015 U	0.03 U	0.015 U	**0.0166**	0.015 U	NA	0.015 U	0.015 U
Selenium	0.05	MCL	0.002 U	0.004 U	0.002 U	0.002 U	**0.0026**	NA	**0.0035**	0.002 U
Semi-Volatile Organic Compounds (µg/L)										
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tap water RSL	**83 D**	**100 D**	**81 D**	**230 J**	**31 D**	NA	NA	**11 J**
2,4-Dimethylphenol	36	Adjusted Tap water RSL	**1 R**	**10 R**	**10 R**	**11 R**	**20 J**	NA	**24**	**28**
2-Methylnaphthalene	3.6	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 U	**20 J**	NA	**43**	**62**
3 & 4 Methylphenol	--	--	**5 R**	**2 R**	**2 R**	**2 R**	**510 DJ**	NA	**53**	**38**
Acenaphthene	53	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 U	**27 J**	NA	**26**	**38**
Acenaphthylene	--	--	0.5 UJ	0.5 U	0.5 U	0.5 U	**10 J**	NA	**8**	**11 J**
Anthracene	180	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 U	**4 J**	NA	**2**	**3**
Benzo(a)anthracene	0.03	Adjusted Tap water RSL	0.05 U	0.05 U	0.05 U	0.05 UJ	**0.2**	NA	0.05 U	**0.09**
Benzo(a)pyrene	0.2	MCL	0.05 UJ	0.05 UJ	0.05 U	0.05 UJ	0.06 U	NA	0.05 U	0.05 U
Benzo(a)fluoranthene	--	--	0.05 UJ	0.05 U	0.05 U	0.05 UJ	0.06 U	NA	0.05 U	0.05 U
Benzo(g,h,i)perylene	--	--	0.5 U	0.5 U	0.5 U	0.5 U	0.6 U	NA	0.5 U	0.5 U
Benzyl Butyl Phthalate	16	Adjusted Tap water RSL	5 U	5 U	5 U	5 U	6 U	NA	5 U	5 U
Bis(2-chloroethyl) Ether	0.014	Adjusted Tap water RSL	**2 J**	**2 J**	**1**	**4 J**	**0.3**	NA	0.07 U	0.08 U
Bis(2-chloroisopropyl) Ether	71	Adjusted Tap water RSL	**530 D**	**540**	**340**	**1,200 D**	**550 D**	NA	**670**	**1,600 D**
Diethyl Phthalate	1,500	Adjusted Tap water RSL	15 U	5 U	5 U	5 U	19 U	NA	5 U	5 U
Fluoranthene	80	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 U	**2 J**	NA	**0.6**	**1**
Fluorene	29	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 U	**19 J**	NA	**15**	**26**
Indeno(1,2,3-cd)pyrene	0.25	Adjusted Tap water RSL	0.05 UJ	0.05 UJ	0.05 U	0.05 UJ	0.06 U	NA	0.05 U	0.05 U
Isophorone	78	Adjusted Tap water RSL	5 UJ	2 U	2 U	2 U	6 UJ	2 U	2 U	**2**
Naphthalene	0.17	Adjusted Tap water RSL	0.06 UJ	0.07 U	0.07 U	0.07 U	**240 D**	NA	**200 D**	**390 D**
Phenanthrene	--	--	0.5 UJ	0.5 U	0.5 U	0.5 U	**27 J**	NA	**15**	**26**
Phenol	580	Adjusted Tap water RSL	**5 R**	**2 R**	**2 R**	**2 R**	**78**	NA	**130 D**	**290 D**
Volatile Organic Compounds (µg/L)										
1,2-Dichlorobenzene	600	MCL	5 U	0.5 U	0.5 U	0.5 U	5 UJ	2.5 U	**1**	50 U
1,2-Dichloroethane	5	MCL	5 U	0.5 U	0.5 U	0.5 U	5 UJ	**13**	**11**	50 U
1,2-Dichloropropane	5	MCL	5 U	0.5 U	0.5 U	0.5 U	5 UJ	**93**	**55 D**	**80**
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tap water RSL	1,000 U	**310 J**	**140 J**	**230**	1,000 U	500 U	100 UJ	1,000 U
Acetone	1,400	Adjusted Tap water RSL	50 U	**5.3**	5 U	5 U	**410 J**	**240**	**140**	500 U
Benzene	5	MCL	**21**	**24**	**5.9**	**24**	**21 J**	**35**	**25 D**	50 U
Carbon Disulfide	81	MCL	10 U	1 U	1 U	1 U	10 UJ	5 U	1 U	100 U
Chlorobenzene	100	MCL	5 U	0.5 U	0.5 U	0.5 U	5 UJ	**4.1**	**1.9**	50 U
Ethylbenzene	700	MCL	**8**	**9.5**	**2**	**8.7**	**45 J**	**64**	**50 D**	**72**
2-Butanone	560	Adjusted Tap water RSL	50 U	5 U	5 U	5 U	50 UJ	25 U	**8.8**	500 U
4-Methyl-2-Pentanone	630	Adjusted Tap water RSL	50 U	5 U	5 U	5 U	50 U	**36**	**21**	500 U
Pyrene	12	Adjusted Tap water RSL	0.5 UJ	0.5 U	0.5 U	0.5 U	**4 J**	NA	**0.7**	**2**
Styrene	100	MCL	5 U	0.5 U	0.5 U	0.5 U	5 UJ	**15**	**7.4**	50 U
Toluene	1,000	MCL	5 U	**2.1**	**0.6**	**2**	**48 J**	**93**	**43 D**	**51**
Xylenes, Total	10,000	MCL	5 U	**4.7**	**1.2**	**4.4**	**41 J**	**63**	**44**	50 U

Notes:

B = The analyte was detected in the associated method and/or calibration blank

D = Concentration is based on a diluted sample analysis

E = Concentration exceeds the calibration range

J = The analyte was positively identified: the associated numerical value is the appr

L = The analyte was positively identified, but the associated numerical value may b

R = Concentration difference between the primary and confirmation column > 40%.

U = The analyte was analyzed for, but was not detected above the reported sample

UJ = The analyte was below the reported sample quantitation limit. However, there

UL = The analyte was analyzed for but was not detected. The quantitation limit may

MCL= maximum contaminant level

RSL= regional screening level

mg/L = Milligrams per Liter

µg/L = Micrograms per Liter

Bold indicates the analyte was detected.

Shading indicates the result exceeded screening criteria.

1,4-Dioxane results included under Semi Volatile Organic compounds includes both

Table 4-2. 2018 Detected Results for Greenhouse Area Groundwater
2018 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia

Location	Screening Level	Screening Level Source	MW-104A	WVU-MW04
Sample ID			MW-04A_20180628	WVUMW04-GW_20180628
Sample Date			6/28/2018	6/28/2018
Analyte				
Volatile Organic Compounds (µg/L)				
Chloroform	80	MCL	0.5 U	**3.4**
cis-1,2-Dichloroethene	70	MCL	**0.5**	0.5 U
Tetrachloroethene	5	MCL	**0.7**	**7.1**
Trichloroethene	5	MCL	0.5 U	**1**

Notes:

A few analytes had reporting limits higher than screening levels; however, the sampling objectives were still achieved and these instances do not affect our ability to effectively monitor groundwater conditions at the site.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

µg/L = Micrograms per Liter

MCL= maximum contaminant level

Bold indicates the analyte was detected.

Shading indicates the result exceeded screening criteria.

FIGURES

MKE Z:\GISPROJECTS_ENV\DOW_DEER_PARK\TECH PARK\MXD\FIGURE 1 - SITE LOCATION MAP.MXD SKI01076 1/18/2019 5:45:37 PM

Legend

- Former Brine Well
- Facility Boundary
- Landfill Boundary
- Building
- Paved Surface
- Surface Water

N

0 1,000 2,000
Feet

UCC Technology Park
South Charleston, West Virginia

SITE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-1

Path: Z:\GISPROJECTS_ENV\DOW_DEER_PARK\TECH PARK\MXD\FIGURE 03-01 - GW MONITORING PLAN WATER LEVEL AND GW SAMPLING LOCATIONS.MXD SKI010076 2/26/2019 4:57:56 PM

MW-30
MW-32
SG-02
MW-31
MW-27
MW-28
MW-26
MW-24
MW-23
SG-01
MW-25
MW-20
MW-21
MW-22
MW-35
WVU-MW01
Ward Hollow
MW-34
MW-01
Leachate Collection System
MW-02
P-13 P-14
MW-104A
WVU-MW02
MW-33
WVU-MW04
WVU-MW03
Greenhouse Area
P-11
MW-06
MW-29
MW-05
Lower Ward Landfill
WVU-MW06
WVU-MW05
P-06
MW-04
Ward A Landfill
Ward B Landfill

Notes:
1. Water level measurements were planned for all wells, piezometers, and staff gauges.
2. 2015 Aerial Photography

Legend

- Staff Gauge
- Monitoring Well
- Piezometer
- Leachate Collection System
- Greenhouse Area Sampling Location
- Ward Hollow Sampling Location
- Paved Surface
- Surface Water
- Facility Boundary
- Building

N

0 500 1,000
Feet

UCC Technology Park
South Charleston, West Virginia

WATER LEVEL AND GROUNDWATER SAMPLING LOCATIONS
2018 GROUNDWATER MONITORING REPORT

ARCADIS Design & Consultancy for natural and built assets

FIGURE
3-1

MW-32
569.15
SG-02
580.65
MW-31
576.56
MW-30
596.27
KANAWHA TURNPIKE
I64
MW-27
590.29
MW-28
590.55
MW-26
607.57
MW-24
597.12
MW-23
600.65
MW-25
596.41
MW-20
608.50
SG-01
598.65
MW-21
607.89
MW-22
600.03
MW-35
609.06
Ward Branch
MW-34
614.35
MW-01
620.64
MW-02
693.73
P-13
670.23
P-14
725.95
P-11
761.22
MW-06
741.08
MW-29
NM
MW-05
767.14
P-06
774.90
MW-04
761.93
Davis Creek
Tributary

570 580 590 600 610 620 630 640 650 660 670 680 690 700 710 720 730 740 750 760 770

Notes:
1. 761.93 = Groundwater Elevation (ft amsl).
2. MW-01, MW-02, MW-04, MW-05, MW-06, MW-22, SG-01, SG-02 and P-13 were not used for potentiometric mapping because the wells are screened in a different unit or because observed elevations are not consistent with the elevations in adjacent monitoring wells.
3. ft amsl = feet above mean sea level.
4. NM = Not measured

Legend

- Monitoring Well
- Piezometer
- Staff Gauge
- Groundwater Elevation (dashed where inferred)
- Groundwater Flow
- Facility Boundary
- Paved Surface
- Building
- Surface Water

N

0 300 600
Feet

UCC Technology Park
South Charleston, West Virginia

DECEMBER 2018 WARD HOLLOW UPPER FREEPORT POTENTIOMETRIC SURFACE MAP 2018 GROUNDWATER MONITORING REPORT

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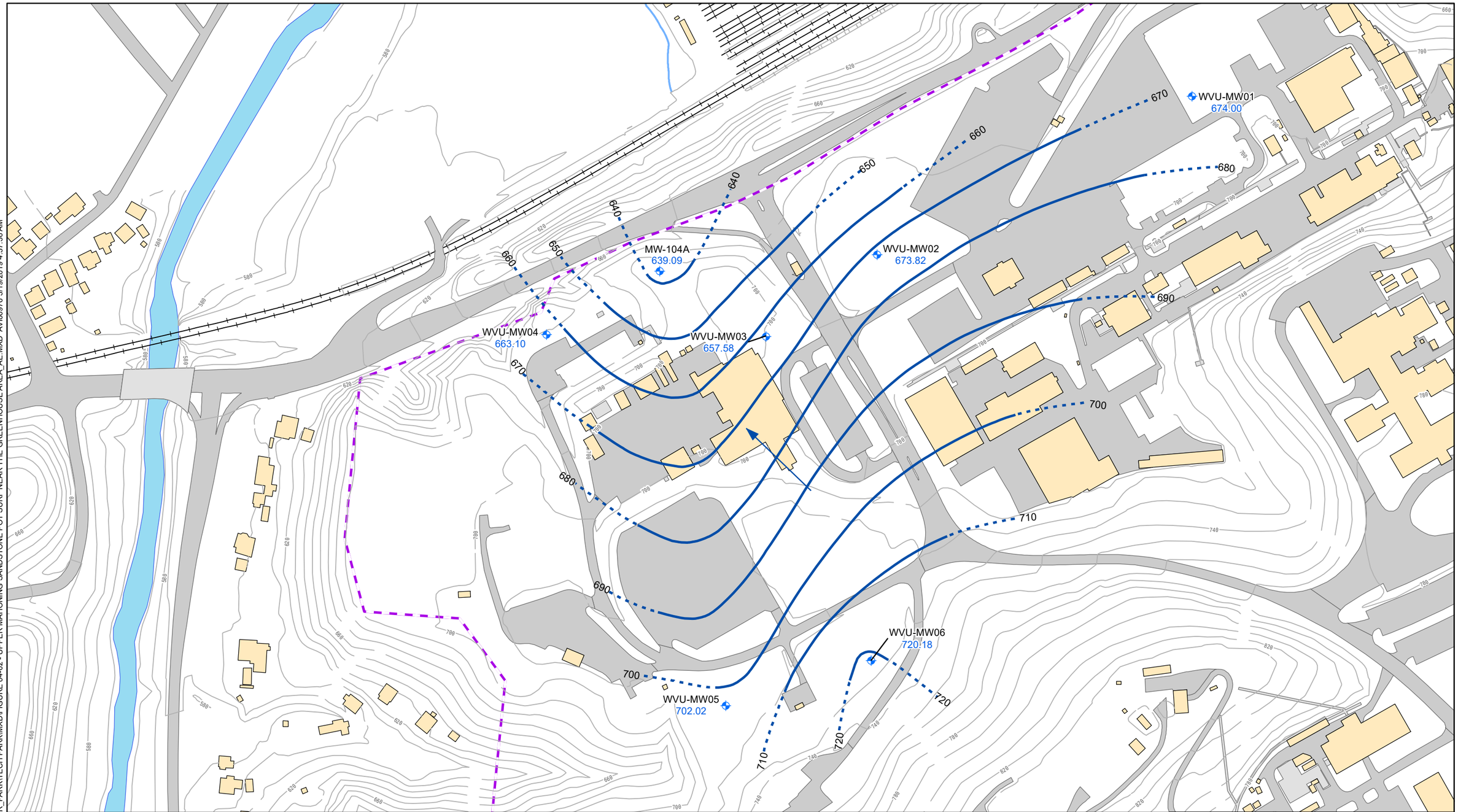
FIGURE 4-1

MKE Z:\GISPROJECTS_ENV\DOW_DEER_PARK\TECH PARK\MXD\FIGURE 04-01 - WARD HOLLOW ALLUVIAL AND UPPER FREEPORT POT SURF MAP.MXD TYARBROUGH 3/31/2019 5:48:44 PM



Legend

- Monitoring Well
- Groundwater Elevation (dashed where inferred)
- Groundwater Flow
- Ground Surface Elevation Contour (10 ft interval)
- Facility Boundary
- Paved Surface
- Building
- Surface Water

Notes:
1. 720.18 = Groundwater Elevation (ft amsl).
2. WVU-MW05 was not used for potentiometric mapping because the well is screened in a different unit.
3. ft amsl = feet above mean sea level.

N

0 200 400
Feet

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DECEMBER 2018 GREENHOUSE AREA MAHONING SANDSTONE POTENTIOMETRIC SURFACE MAP 2018 GROUNDWATER MONITORING REPORT

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FIGURE 4-2

Z:\GIS\PROJECTS_ENV\DOW_DEER_PARK\TECH PARK\MXD\FIGURE 04-02 - UPPER MAHONING SANDSTONE POT SURF NEAR THE GREENHOUSE AREA_AE.MXD AV\00976 3/19/2019 4:37:36 AM

MW-32
1 UJ

MW-31
6 J

MW-30
NS

KANAWHA TURNPIKE

MW-27
NS

MW-28
150 J

MW-26
200 J

MW-24
NS

MW-23
220 J

MW-25
NS

MW-20
NS

MW-21
220 J

MW-22
NS

MW-35
230 J

MW-34
80 J

MW-01
200 J

MW-02
NS

MW-33
NS

P-13 P-14

Lower Ward Landfill

0.46

100

580 620 660 700 740 780

Notes:
1. isoconcentration boundaries are based on analytical data and the site conceptual model.
2. The screening level for 1,4-Dioxane is 0.46 ug/L.
3. Groundwater concentrations are in ug/L.
4. NS = Not Sampled
5. U = Value is below reporting limit.
6. ug/L - micrograms per liter
7. J - Analyte was positively identified; however, value is approximate.

Legend

- Monitoring Well
- Piezometer
- Ground Surface Elevation Contour (10 ft interval)
- Isoconcentration Contour (dashed where inferred)
- Greater than 0.46 µg/L
- Greater than 100 µg/L
- Lower Ward Landfill
- Facility Boundary
- Paved Surface
- Building
- Surface Water

Note: Figure developed using the 8270 SIM Isotope Dilution Method.

N

0 200 400
Feet

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DECEMBER 2018 1,4-DIOXANE ISOCONCENTRATION MAP 2018 GROUNDWATER MONITORING REPORT

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FIGURE 4-3

MKE Z:\GIS\PROJECTS_ENV\DOW_DEER_PARK\TECH PARK\MXD\FIGURE 04-03 - 1_4-DIOXANE ISOCONCENTRATION MAP.MXD LBALOGH 3/29/2019 1:31:08 PM

Z:\GISPROJECTS_ENV\DOW_DEER_PARK\TECH PARK\MXD\FIGURE 04-04 - BIS(2-CHLOROISOPROPYL)ETHER ISOCONCENTRATION MAP.MXD SKI01076 2/26/2019 5:09:19 PM

MW-32
2 U

MW-31
2 U

MW-30
NS

KANAWHA TURNPIKE

MW-27
NS

MW-28
93

MW-26
950 D

MW-24
NS

MW-23
790 D

MW-25
NS

MW-20
NS

MW-21
1,000

MW-22
NS

MW-35
1,200 D

MW-34
27

MW-01
1,100

MW-02
NS

P-13 P-14

Lower Ward Landfill

71

300

Notes:
1. Isoconcentration boundaries are based on analytical data and the site conceptual model.
2. The screening level for Bis(2-chloroisopropyl)ether is 71 µg/L.
3. Groundwater concentrations are in µg/L.
4. NS = Not sampled.
5. U = Value is below reporting limit.
6. µg/L = Micrograms per Liter.
7. D = Concentration is based on a diluted sample analysis.

Legend

- Monitoring Well
- Piezometer
- Ground Surface Elevation Contour (10 ft interval)
- Isoconcentration Contour (dashed where inferred)
- Greater than 71 µg/L
- Greater than 300 µg/L
- Lower Ward Landfill
- Facility Boundary
- Paved Surface
- Building
- Surface Water

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South Charleston, West Virginia

**DECEMBER 2018 BIS(2-CHLOROISOPROPYL)ETHER ISOCONCENTRATION MAP
2018 GROUNDWATER MONITORING REPORT**

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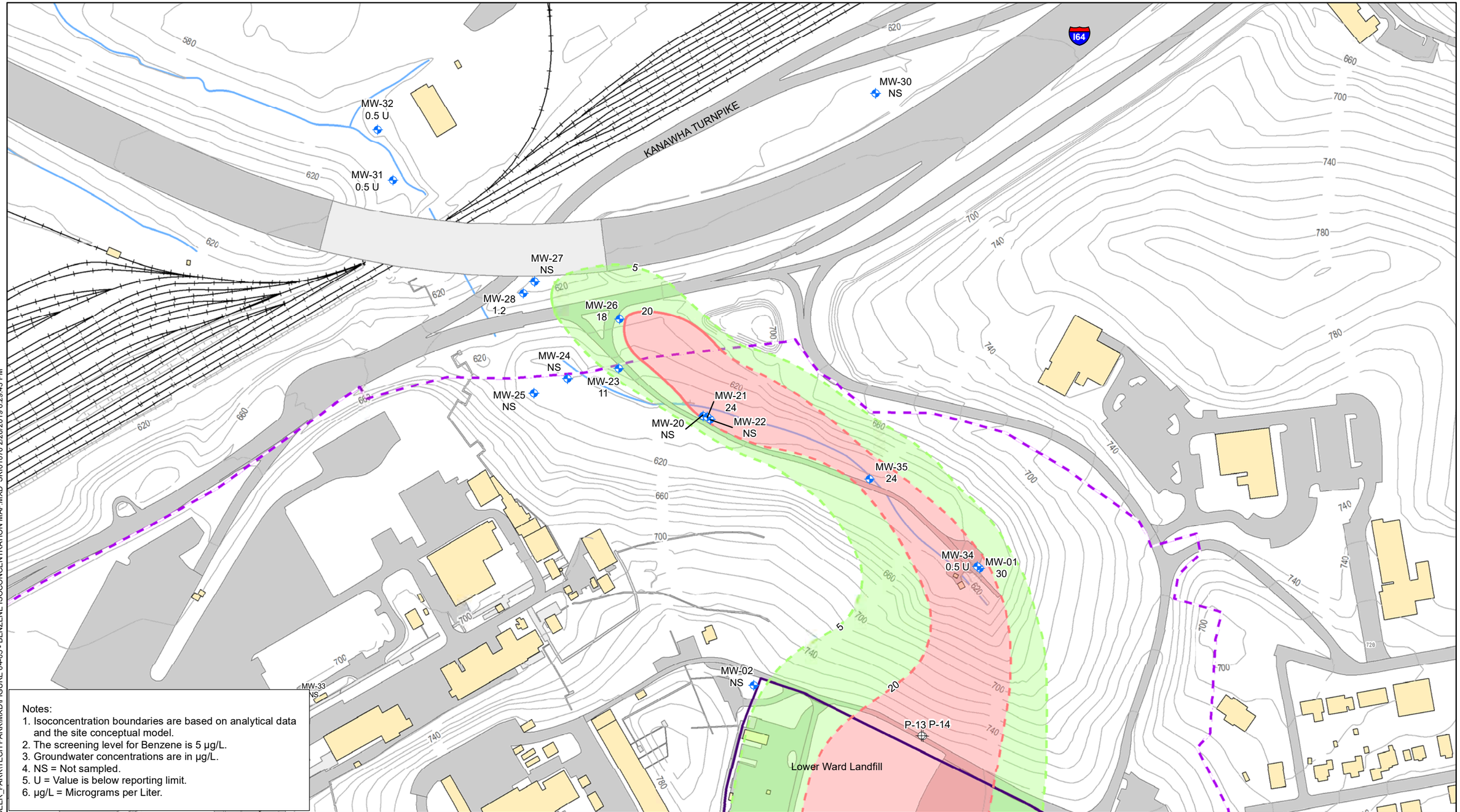
FIGURE
4-4



Notes:
1. Isoconcentration boundaries are based on analytical data and the site conceptual model.
2. The screening level for Benzene is 5 µg/L.
3. Groundwater concentrations are in µg/L.
4. NS = Not sampled.
5. U = Value is below reporting limit.
6. µg/L = Micrograms per Liter.

Legend

- Monitoring Well
- Piezometer
- Ground Surface Elevation Contour (10 ft interval)
- Isoconcentration Contour (dashed where inferred)
- Greater than 5 µg/L
- Greater than 20 µg/L
- Lower Ward Landfill
- Facility Boundary
- Paved Surface
- Building
- Surface Water

N

0 200 400
Feet

UCC Technology Park
South Charleston, West Virginia

DECEMBER 2018 BENZENE ISOCONCENTRATION MAP
2018 GROUNDWATER MONITORING REPORT

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FIGURE 4-5

Z:\GIS\PROJECTS_ENV\DOW_DEER_PARK\TECH PARK\MXD\FIGURE 04-05 - BENZENE ISOCONCENTRATION MAP.MXD SK101076 2/26/2019 6:29:43 PM

MW-32
0.175

MW-31
0.283

KANAWHA TURNPIKE

I64

MW-30
NS

MW-27
NS

MW-28
28.3

MW-26
55.1

MW-24
NS

MW-23
52.7 J

MW-25
NS

MW-20
NS

MW-22
NS

MW-21
57.6 J

MW-35
55.1 J

MW-34
38.5

MW-01
50.4

MW-33
NS

MW-02
NS

P-13 P-14

Lower Ward Landfill

P-11

Notes:
1. Isoconcentration boundaries are based on analytical data and the site conceptual model.
2. The screening level for Barium is 2 mg/L.
3. Groundwater concentrations are in mg/L.
4. J = Analyte was positively identified, however, value is approximate.
5. NS = Not sampled.
6. mg/L = Milligrams per Liter.

Legend

- Monitoring Well
- Piezometer
- Ground Surface Elevation Contour (10 ft interval)
- Isoconcentration Contour (dashed where inferred)
- Greater than 2 mg/L
- Greater than 20 mg/L
- Greater than 40 mg/L
- Lower Ward Landfill
- Facility Boundary
- Paved Surface
- Building
- Surface Water

N

0 200 400
Feet

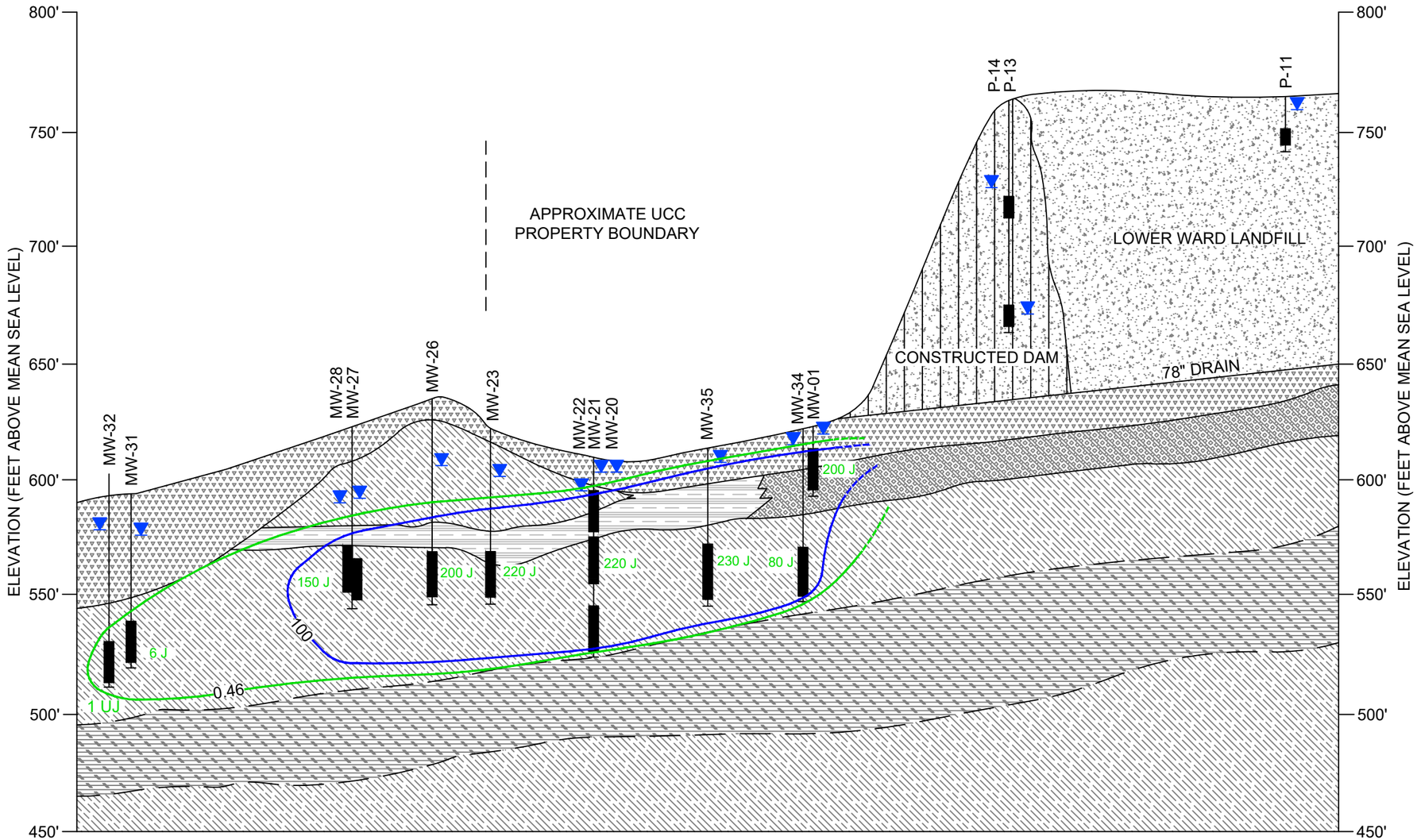
UCC Technology Park
South Charleston, West Virginia

**DECEMBER 2018 DISSOLVED BARIUM ISOCONCENTRATION MAP
2018 GROUNDWATER MONITORING REPORT**

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-6

MKE Z:\GIS\PROJECTS_ENV\DOW_DEER_PARK\TECH PARK\MXD\FIGURE 04-06 - DISSOLVED BARIUM ISOCONCENTRATION MAP.MXD PBI00964 3/25/2019 11:49:05 PM



LEGEND

- SOIL BORING/ (MONITORING WELL)
- SAMPLE INTERVAL
- GROUNDWATER ELEVATION
- SCREENED INTERVAL
- EXTENT OF BORING/WELL

- GREY SHALE, CLAYSTONE AND SILTSTONE
- OVERBURDEN CLAY, SILT AND SAND
- SANDSTONE
- CLAYSTONE
- SHALE
- LOWER WARD LANDFILL
- U — VALUE IS BELOW REPORTING LIMIT
- 0.46 CONTOUR
- 100 CONTOUR
- MSL — MEAN SEA LEVEL

NOTES:

1. CONCENTRATIONS ARE IN ug/L (MICROGRAMS PER LITER).
2. THE SCREENING LEVEL FOR 1,4-DIOXANE IS 0.46 ug/L.
3. DASHED LINES INDICATE THESE LITHOLOGY CHANGES ARE INFERRED.

SCALE

VERTICAL SCALE FEET: 50'
HORIZONTAL SCALE FEET: 25'

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2018 GROUNDWATER MONITORING REPORT

DECEMBER 2018 1,4-DIOXANE VERTICAL EXTENT MAP

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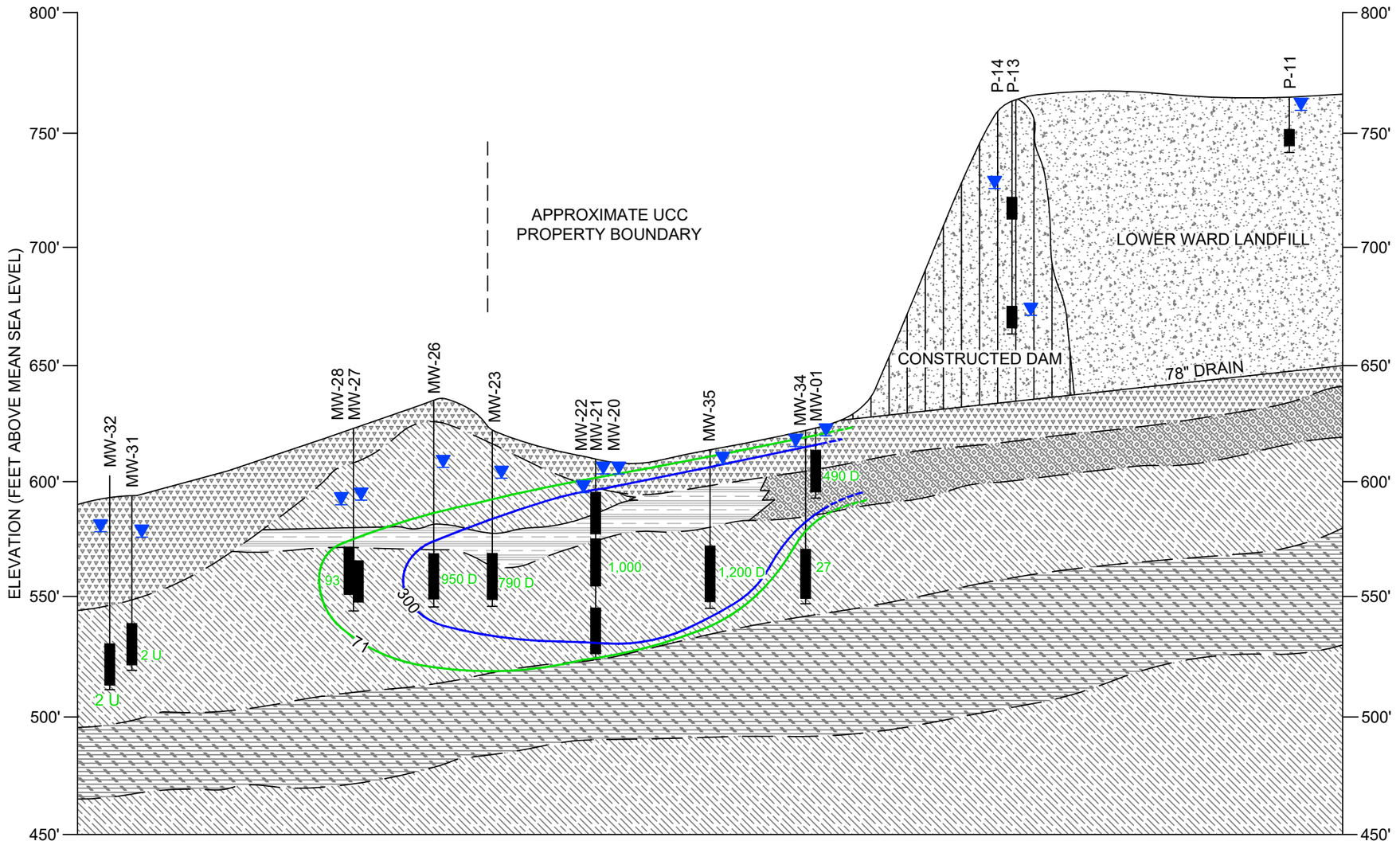
FIGURE 4-7

CITY: MANCHESTER DIV/GROUP: ENVCAD DB: B.SMALL PM: TM:
G:\Project\PROJ\Stormwater Resources\DOW\Cross Section AA' - 4-7 - 1,4-Dioxane Vertical Extent Map_ver2017_jeb.dwg LAYOUT: 1 SAVED: 3/29/2019 5:51 PM ACADVER: 21.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ACAD.CTB PLOTTED: 3/29/2019 5:52 PM BY: PERTUNEN, BRETT



LEGEND

- SOIL BORING/ (MONITORING WELL)
- SAMPLE INTERVAL
- GROUNDWATER ELEVATION
- SCREENED INTERVAL
- EXTENT OF BORING/WELL

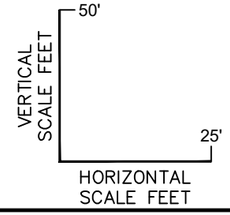
- GREY SHALE, CLAYSTONE AND SILTSTONE
- OVERBURDEN CLAY, SILT AND SAND
- SANDSTONE
- CLAYSTONE
- SHALE
- LOWER WARD LANDFILL

U	VALUE IS BELOW REPORTING LIMIT
J	VALUE IS APPROXIMATE
E	CONCENTRATION EXCEEDS THE CALIBRATION RANGE
D	CONCENTRATION IS BASED ON A DILUTED SAMPLE ANALYSIS
	71 CONTOUR
	300 CONTOUR
MSL	MEAN SEA LEVEL

NOTES:

1. CONCENTRATIONS ARE IN ug/L (MICROGRAMS PER LITER).
2. THE SCREENING LEVEL FOR BIS(2-CHLOROISOPROPYL) ETHER IS 71 ug/L.
3. DASHED LINES INDICATE THESE LITHOLOGY CHANGES ARE INFERRED.

SCALE



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SOUTH CHARLESTON, WEST VIRGINIA
2018 GROUNDWATER MONITORING REPORT

DECEMBER 2018 BIS(2-CHLOROISOPROPYL)ETHER VERTICAL EXTENT MAP

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FIGURE
4-8

Analyte	Screening Level (µg/L)	Screening Level Source
cis-1,2-Dichloroethene	70	MCL
Tetracholoethene	5	MCL
Trichloroethene	5	MCL
Chloroform	80	MCL

MW-104A	
Date	6/28/2018
Tetracholoethene	**0.7**
cis- 1,2-Dichloroethene	**0.5**

WVU-MW04	
Date	6/28/2018
Tetracholoethene	**7.1**
Trichloroethene	**1**
Chloroform	**3.4**

WVU-MW01
NS

WVU-MW02
NS

MW-33
NS

WVU-MW03
NS

WVU-MW06
NS

WVU-MW05
NS

Legend

- Monitoring Well
- Ground Surface Elevation Contour (10 ft interval)
- Facility Boundary
- Paved Surface
- Building
- Surface Water

Notes:
1. ▒ = Result exceeded the screening criteria.
2. NS = Not sampled.
3. MCL = Maximum contaminant level.
4. All concentrations are in Micrograms per Liter (µg/L)

N

0 200 400
Feet

UCC Technology Park
South Charleston, West Virginia

JUNE 2018 GREENHOUSE AREA GROUNDWATER DETECTIONS AND EXCEEDANCES 2018 GROUNDWATER MONITORING REPORT

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FIGURE 4-9

Z:\GIS\PROJECTS_ENV\DOW_DEER_PARK\TECH PARK\MXD\FIGURE 04-09 - GREENHOUSE AREA GROUNDWATER DETECTIONS AND EXCEEDANCES.MXD SKI01076 2/26/2019 7:37:50 PM