UNITED STATES

ENVIRONMENTAL PROTECTION AGENCY

REGION III

STATEMENT OF BASIS

BABCOCK & WILCOX NUCLEAR OPERATIONS GROUP FACILITY

LYNCHBURG, VIRGINIA

EPA ID NO. VAD 046 960 449

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I. Introduction

The United States Environmental Protection Agency (EPA) has prepared this Statement of Basis (SB) to solicit public comment on its proposed remedy for the Babcock & Wilcox (B&W) facility located at 1570 Mt. Athos Road in Lynchburg, Virginia (Facility). EPA's proposed remedy consists of requiring the Facility to maintain a groundwater monitoring program and to develop and maintain use restrictions known as Institutional Controls (ICs). This SB highlights key information relied upon by EPA in making its proposed remedy.

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

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

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

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

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

II. Facility Background

The Facility is located in the northeast corner of Campbell County, Virginia, on an oxbow of the James River (or River) approximately 2 miles northeast of the City of Lynchburg. The *525*-acre property is bounded by the James River on three sides (Figure 1). Lynchburg is located along the James River, upstream of the Facility. The Lynchburg municipal wastewater treatment plant discharges into the James River several

miles upstream of the Facility. Because of the treated water discharge, the water in this section of the James River cannot be used as a public water supply. The Facility ceased using on-site groundwater wells for potable water in 2003, and has been using water supplied by the City since that time.

The Facility currently contains two commercial operations. One is owned and operated by Babcock &Wilcox Nuclear Operations Group, Inc. and referred to as the B&W Property. The other is owned and operated by AREVA Federal Services (AREVA) and is referred to as the AREVA Property.

The B&W site is regulated by the Nuclear Regulatory Commission (NRC). The B&W facility operates under an NRC license (SNM-42) for the management of its special nuclear material and a Commonwealth of Virginia agreement state license for the management of the other radioactive materials. The AREVA facility operates under a Commonwealth of Virginia Radioactive Materials License (680-515-1). NOG-L fabricates fuel-bearing precision components that serve as power units for the nuclear navy. NOG-L is the sole source supplier of these products and services in support of national security, and as such the Facility will remain in operation as long as there is a U.S. nuclear navy. NOG-L operations can be expected to continue well into the twenty-first century. AREVA supports the nation's commercial nuclear utility outage, maintenance, and inspection business. The AREVA Property was formerly owned and operated by B&W.

B&W maintains a decommissioning plan and subsequent standby trust agreement that demonstrates financial assurance for decommissioning for the non-DOE operations performed at the Facility. Adequacy of the decommissioning funding level is evaluated every 3 years. B&W has contracts in place to cover the decommissioning of the DOE operations that are performed at the Facility. During Facility decontamination and decommissioning, B&W will also address any identified environmental issues to ensure that the Facility will not present a risk to human health and/or the environment.

In 1991, EPA issued a Corrective Action Consent Order (Consent Order) to Babcock & Wilcox Company pursuant to RCRA Section 3008(h) which specified that the Facility perform a Resource Conservation and Recovery Act Facility Investigation (RFI), a Corrective Measurement Study (CMS), and any interim measures at the Facility necessary to protect human health and the environment.

III. Summary of Environmental Investigation

A. RCRA Facility Investigation

From 1987 to 1996, B&W performed an RFI focusing on three areas of groundwater containing Volatile Organic Compounds (VOCs), primarily trichloroethylene (TCE), identified during previous investigations. Three main groundwater contaminant plumes were identified: Areas A, B, and C. Numerous groundwater monitoring wells (Figure 2) were installed at the Facility to delineate the three groundwater plumes (37 in Area A, 14 in Area B, and 31 in Area

C). Two small groundwater plumes under Landfill1 (LF1) were also identified and delineated with 14 groundwater monitoring wells. Landfill 1 groundwater plumes are adjacent to the Area A plume. TCE does not dissolve readily in water and will enter the subsurface in the form of an oily liquid, known as a Non-Aqueous Phase Liquid (NAPL). There are two classes of NAPLs: light NAPLs (LNAPLs), such as gasoline, are less dense than water; dense NAPLs (DNAPLs), such as trichloroethylene, are more dense than water. Samples of groundwater, soil, stream sediment, and surface water were analyzed for VOCs and RCRA metals including arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver. Releases of chlorinated solvents were identified and delineated at the following areas:

- Groundwater Area A (Study Area A-1)
- Former Landfill 1 (Study Area A-9)
- Former Burn Area (Study Area A-10) (wholly within the boundary of Groundwater Area A)
- Groundwater Area B (Study Area B-1)
- Groundwater Area C (Study Area C-1).

The groundwater plume in Area C is located under the AREVA Property. Groundwater plumes A and B are located under the B&W Property. The RFI concluded that the constituents of concern (COCs) for the Facility are chlorinated VOCs in groundwater and surface water, primarily trichloroethene (TCE) and tetrachloroethene (PCE), and their degradation products, cis-1,2-dichloroethene (DCE) and vinyl chloride (VC). Nine halogenated VOCs were identified for tracking by RFI and are analyzed in the ongoing water quality monitoring:

- Bromoform
- Chloroform
- cis-1,2-DCE
- trans-1,2-DCE
- 1,1-DCE
- PCE
- TCE
- Trichlorofluoromethane
- Vinyl Chloride

Under the oversight of the Virginia Department of Environmental Quality (DEQ). Landfills 2A and 2B were closed on November 2, 2009 with contaminated soils left in place. The landfills were capped with engineered covers. Post-closure groundwater monitoring is being performed at monitoring wells. Landfill 2A straddles the western margin of the Area A groundwater plume. Both landfills were created in the 1970's, when sludge from the waste water treatment operations was placed in the landfills.

During performance of the RFI, the two Inactive Emergency Ponds (RFI Study Area A-6) were found to be impacted by the groundwater from the Area A plume. The Emergency Ponds when used, were actually surface impoundments for the flow through of spent non-radioactive (Cold) and radioactive (Hot) acidic liquid waste solutions prior to neutralization at waste water treatment facility. The Cold Pond was removed from service in September 1983 and the Hot Pond in May 1984. The Hot Pond was of similar size as the Cold Pond and located immediately

east of it. A Groundwater Recovery System (GWRS) was installed in the Hot Pond prior to its closure in 1998 under the aegis of the NRC. The Cold Pond has been recently investigated by the Facility in order to plan for its closure.

Numerous investigations have been performed since the RFI was completed and are described in the following sections. The James River Instream Studies covered the Areas A and B plumes. All the other subsequent investigations were conducted within the Area A plume or in its vicinity. Several remedial pilot studies/interim measures have been performed by the Facility in the Area A plume area since the completion of the RFI.

B. James River Instream Studies

In 1997 and 1998, several studies were conducted at the Facility to determine if VOC-contaminated groundwater posed a risk to the aquatic and benthic communities of the James River. The places where the Area A and Area B groundwater plumes discharged into the James River were investigated. The studies included sampling River water and sediment for VOCs, a Rapid Bioassessment Protocol (RBP) III study of the riverbed benthic community, and a survey for the endangered James River spiny mussel.

Low levels of VOCs were found in River water and bottom sediment but were judged to indicate no ecological risk to the aquatic biologic community. VOC concentrations in Area B surface water and sediment were below the ecological screening benchmarks. At Area A, surface water VOC concentrations were below ecological screening benchmarks, but sediment at two locations had VOC concentrations greater than the benchmark. Nonetheless, biological sampling found the nearshore benthic macroinvertebrate community to be unimpaired. The James River spiny mussel was not found in the stretch of River around the Facility because the River habitat is not suitable for the spiny mussel to live.

Because the screening assessment for River sediment in Area A had mixed results, an RBP III study was conducted in 1997 and 1998. The RBP III study determined that the health of the James River adjacent to the Area A plume was not adversely impacted by groundwater contamination.

Surface water sampling in Area A is currently part of the annual water monitoring program to ensure VOC levels remain consistent with historical levels.

C. James River Sentinel Wells

In 2001, the groundwater monitoring well networks in Areas A and B were supplemented by the installation of additional sentinel wells near the Riverbank: MWA-38 to MWA-40 in Area A and MWB-15 to MWB-17 in Area B. A fourth sentinel well, MWA-41, was added in Area A in 2004. These sentinel wells monitor groundwater quality as the plume discharges to the James River. They have been included in the annual groundwater monitoring program.

D. LANDFILL 1 INVESTIGATIONS

Landfill 1 lies west of the Area A plume. Filter cake was buried in eight shallow trenches over an area of approximately one 1 acre. The filter cake was generated by treatment of wastewater from the metal pickling process from 1973 to 1977. The filter cake was covered with soil. The soil has re-vegetated naturally.

The filter cake solids consist approximately of 45 percent calcium fluoride, 40 percent zirconium hydrous oxide, 10 percent calcium hydroxide, and 5 percent calcium sulfate. The filter cake also contains hydroxides of metals such as iron, copper, and aluminum, and possibly zirconium metal chips.

LF1 was investigated as Study Area A-9 during the RFI. Eight soil borings around LF1 were sampled for VOCs and metals. TCE was found in soil at concentrations up to 0.0425 parts per million (ppm) at a depth of 6.5 feet below ground surface (bgs). The soil TCE concentrations were below EPA Regional Screening Level (RSL) for residential soil; however, they were above the soil screening level for the protection of groundwater value of 0.0018 mg/kg.

In 1999, forty-nine (49) shallow borings were drilled to determine the trench locations and landfill cover thickness. These borings confirmed the existence of six covered trenches containing filter cake. Trench soil cover ranges from 2.5 to 7.3 feet thick, with a mean thickness of 4.3 feet. No samples for chemical analysis were collected during these drilling activities. Subsequent groundwater monitoring in the vicinity of LF1 has shown that the water table generally ranges from 4.3 to 8.6 feet bgs, but occasionally is very shallow. A follow up investigation was completed in December 2001 to delineate the limits of two additional trenches at LF1. The existence of waste outside the limits of the original six trenches became apparent when filter cake was encountered while drilling a temporary monitoring well in November 2001. Four (4) waste samples were collected in each trench to characterize the filter cake.

In 2001, a soil gas survey of the LF1 and surrounding area was performed by B&W. It showed PCE and TCE hot spots in Trench 5, Trench 1, and between Trench 1 and monitoring well FL-3. Subsequently, fourteen (14) shallow direct-push borings were advanced to characterize the filter cake in the landfill trenches and soil immediately surrounding LF1. Five (5) of the borings were placed within portions of Trenches 2 and 3 that were subsequently excavated to characterize waste sludge and soil with radioactivity above NRC action levels. NRC determined that only portions of Trench 2 and 3 required excavation. To minimize the volumes of excavated material, B&W identified the specific area slated for removal and surrounded the area with sheet piling driven to bedrock. Using a dewatering system, B&W was able to successfully excavate the soil and waste and complete a NRC survey of the excavated area for its closure.

In 2004, B&W excavated and removed the filter cake. Cobbles (small to large rocks) prevented these direct-push borings from penetrating to the base of the alluvium. Soil and sludge samples were analyzed for VOCs, and the sludge samples were also analyzed for additional constituents important for the radiological removal action. VOCs were detected in four sludge

samples collected within the area. The excavated soil and waste were managed as a Mixed Waste (low-level radioactive and hazardous waste) and shipped to a licensed mixed waste disposal facility. Because low-levels of radioactive remain in soil, LF1 remains under NRC jurisdiction for closure.

Groundwater monitoring at LF1 began in 2001, at the same time as the sludge and soil investigation. Nineteen (19) monitoring wells were installed in the alluvium. Fourteen (14) wells were made permanent and added to the annual water quality monitoring program in 2002. Groundwater sampling results indicated that there are two small solvent plumes in groundwater near LF1. These two small plumes are separate from the Area A plume. One plume originates near well FL-3, a short distance upgradient of the LF1 trenches, and contains mainly PCE. The other less concentrated plume is located east-northeast of the trenches and the only constituent with groundwater concentrations above the Maximum Contaminant Level (MCL) is TCE (maximum concentration 80 micrograms per liter [ug/L], MCL of 5 ug/l). Groundwater VOC concentrations at the leading edges of the two small plumes are low and are not a threat to the James River.

E. Area A - Source Target Area Characterization

The Source Target Area (STA) is located immediately down gradient of the former TCE storage tank, which was the principal source of the Area A plume. The TCE storage tank was located on a high terrace within the protected area of the Facility. From 2006 to 2008, site characterization work to prepare for an in situ remedial pilot test was performed at the Facility. Two successive investigations were performed during that time. Fifteen (15) wells were installed in core-drilled borings. Pumping tests and slug tests were performed to estimate hydraulic conductivities. In 2009, a groundwater tracer test and bench-scale bioremediation treatability tests were performed to better define parameters and constraints for an in situ bioremediation pilot test. A large man-made rock cut about 300 feet northeast of the STA was also examined. Schist bedrock there strikes approximately parallel to the Facility grid north and about 85 degrees towards the east.

The rock cores were photographed and described in detail. The deepest zone of weathering occurred in a narrow area that is being called the "weathered trough." The weathered trough parallels the bedrock strike and presumably is a zone that is less resistant to weathering. On a finer scale, the cores show that zones of severe weathering and slight weathering alternate with depth, presumably as the borings crossed different beds or fracture sets. Pumping tests showed the weathered trough has a relatively high hydraulic conductivity, roughly 3.2 feet per day (1.1 x 10 centimeters per second). Hydraulic conductivity is highest in the direction of bedrock strike.

In the weathered trough, high groundwater TCE concentrations (600,000 to 1,000,000 ug/L) were found in the weathered bedrock and extending deep into the unweathered bedrock. A small volume (5 milliliters) of dense non-aqueous-phase liquid (DNAPL) was collected from near the base of the weathered bedrock at well IWA-0l, located in the STA Area, during well development. Due to the presence of DNAPL in well IWA-01 and the high TCE concentrations in other wells in STA, DNAPL is suspected of being presence in other wells in the weathered

bedrock and deeper into unweathered bedrock.

The bromide tracer test demonstrated that groundwater flow has a significant downward vertical trajectory. This flow is consistent with groundwater levels, which show a strong downward hydraulic gradient. The tracer test measured groundwater flow velocities of 0.55 to 7.5 feet per day (200 to 2,700 feet per year) in the weathered bedrock and 0.5 to 0.8 feet per day (180 to 290 feet per year) in the unweathered bedrock.

The water quality and treatability testing found that weathered bedrock groundwater is slightly acidic to neutral. Deeper unweathered bedrock groundwater is strongly alkaline (pH 11.4 at MWA-42D) and contains elevated concentrations of sodium, sulfate, and total organic carbon. Aerobic conditions predominated in most of the STA groundwater, but portions of the unweathered bedrock were anaerobic.

F. Area A - Boundary Target Area Characterization

The Boundary Target Area (BTA) is the portion of the Area A plume next to the James River. BTA is referred to as the Former Burn Area in the RFI Report. In 2010 and 2011, site characterization work was performed in preparation for an in situ bioremediation pilot test. The investigation focused on the alluvium and, to a lesser degree, the shallow bedrock. Fourteen additional monitoring wells were installed in and around the BTA.

Slug tests were performed on numerous wells to measure formation hydraulic conductivity. The alluvium has a typical hydraulic conductivity of 2.1 feet per day. Groundwater levels show a downward hydraulic gradient from the alluvium to the bedrock. This gradient suggests the likely existence of more permeable zones in either the shallow bedrock or the cobbly zone at the base of the alluvium. One of the shallow bedrock wells is screened in a permeable weathered zone that yields as much water as the alluvium.

VOC contamination in groundwater at the BTA occurs in both the alluvium and bedrock. VOC contamination extends to at least 150 feet bgs at well MWA-33D. The highest TCE and cis-1,2- DCE concentrations in groundwater are in the alluvium (well MWA-63) and in the shallow bedrock (MWA-66D and 67D). Groundwater VOC concentrations fluctuate considerably in the BTA due to hydrological events (e.g., fluctuations in river stage or rainfall). For example, the TCE concentrations in MWA-63 were 19,000 ug/L in 2011 and 11,000 ug/L in 2013, but only 300 ug/L in 2012. Since 2001, TCE concentrations in MWA-16 typically ranged from 2,050 to 7,400 ug/L, but dropped to 420 ug/L in 2010. TCE concentrations in MWA-41 are typically greater than 10,000 ug/L but dropped to 100 ug/L in 2006. The TCE concentration in MWA-15 was 19,000 ug/L in 2002, but has declined significantly since that time and has not exceeded 100 ug/L since 2009. PCE has also been detected in BTA groundwater, at well MWA-41, at concentrations up to 280 ug/L.

Groundwater redox conditions were moderately reducing before the in situ bioremediation pilot test. The widespread presence in groundwater of dechlorination metabolic byproducts like methane, ethane, and ethene is indicative of active biodegradation. The

dechlorinating bacteria, Dehalococcoides, was present in significant amounts at some places, but its distribution was spotty.

G. Interim Measures and Pilot Tests in Area A

The Facility started evaluating potential corrective measures in the early 1990's. Three pilot tests were conducted. The three pilot tests involved were as follows: (1) Soil Vapor Extraction (SVE), (2) Vacuum-Enhanced Pumping (VEP), and (3) In situ Air Sparging (IAS). An SVE system near the former TCE tank source (Area A) began operation in 1993. The SVE system removed more than 14,000 pounds of TCE before the vadose soil at the former tank location became exhausted. The SVE system has achieved its performance objective of removing TCE from the vadose soil and is no longer in operation.

The VEP pilot test was conducted to evaluate the effectiveness of VEP and groundwater extraction methods in removing TCE from the groundwater. The VEP system was located in the center of the Area A groundwater plume, and downgradient from the source area. Operations started in August 1995, and ran for about one year. The system was ineffective due to the VEP recovery wells having very limited and uneven radius of influence on groundwater. The IAS pilot test was conducted to evaluate the effectiveness of in situ air sparging to volatilize and remove dissolved concentrations of TCE from the groundwater at a location adjacent to the James River on the northern edge of the Area A groundwater plume. Operations started in August 1995 and ran thru November 1996. Groundwater data collected during the pilot test indicate that air sparging had no measurable effect on the concentrations of TCE at this location.

The GWRS was installed when the low-level radioactive Inactive Emergency Pond (Hot Pond) was closed under aegis of the NRC in 1998. The Hot Pond is located to the east of the Cold Pond. The early version of the GWRS was originally meant to be a temporary dewatering system to facilitate closure of the Hot Pond, but its design was expanded because the Facility found its location to be advantageous for groundwater recovery in Area A. From around 1998 up through mid-2013, more than 1,600 pounds of TCE have been removed from groundwater. The GWRS intercepts a large portion of the shallow groundwater plume before it can reach the river. The GWRS provides a significant but incomplete interception of the plume, as it does not interdict the bedrock groundwater, and may not capture all the alluvial groundwater on the eastern side of the plume. B&W proposes to continue operating the GWRS as a component of the final remedy for the Facility.

In September 2012, the Facility conducted a pilot test of in situ enhanced anaerobic bioremediation (EAB) at the Boundary Target Area of Area A. Post-injection groundwater sampling was conducted in November 2012 and July 2013, and yielded incomplete degradation of TCE to ethene. Similar tests at the Source Target Area showed degradation in a small area. The results of these pilot tests concluded that in situ EAB is impractical over most of the Facility property due to naturally aerobic groundwater conditions and an excess of competing electron acceptors, such as dissolved oxygen, nitrate, and sulfate. In situ bioremediation in unweathered bedrock is impractical due to the low permeability of the formation, which hinders injection of amendments, and the presence of a strongly alkaline groundwater pH at the STA. As a result,

EAB pilot testing was discontinued in the STA as well as at the BTA.

H. Site wide Groundwater Monitoring

From 2001 to the present, annual site wide monitoring and reporting of groundwater and River water quality has been conducted consistently at the Facility. No other areas of concern have been identified by the monitoring. This twelve (12) years of monitoring have shown that the groundwater plume boundaries are stable and that concentrations of VOCs are generally stable or decreasing.

I. Summary of Baseline Risk Assessment

The baseline risk assessment performed during the RFI evaluated four areas:

- Area A
- Area A10 (Former Burn Area)
- Area B
- Area C

The Cold Pond (Area A-6) soil and sediment were not included in the baseline risk assessment. A separate risk evaluation was performed In July 2011 for the Cold Pond, subsequent to the detailed characterization of the pond soil and water for DEQ. The RFI baseline risk assessment included a human health risk assessment and an ecological risk assessment. The ecological risk assessment evaluated potential risks to terrestrial and aquatic receptors.

J. Exposure Pathways

The human health risk assessment evaluated an industrial exposure scenario, assuming that land use controls would be implemented and maintained to control exposures and restrict future development. Therefore, the human health risk assessment did not evaluate exposure pathways relating to residential land use or exposure to groundwater.

The human health risk assessment examined the following potential receptors:
• Outdoor maintenance worker
• Outdoor construction worker
• Trespassing child.

Exposures to the following environmental media were evaluated:
• Surface soil
• Subsurface soil
• Sediment (in small surface water drainage features)

• Surface water (springs and small surface water drainage features).

In the RFI Report, there was no evaluation of exposure from vapors from VOC-contaminated groundwater plumes under or near occupied buildings. The CMS did evaluate the potential risk to human health from exposure to vapor intrusion into occupied buildings. The vapor intrusion pathway was evaluated during the CMS phase because the potential significance of this exposure pathway was realized after the RFI was completed. See Section III.M below for vapor findings under CMS.

K. RFI Risk Evaluation Results

The RFI human health risk assessment concluded that VOCs and metals posed no significant risks to human health under an industrial land use scenario. The human health risk assessment in the RFI Report evaluated environmental media by Area. The presence of metals in all four Areas were deemed to be background, but were included in the risk evaluation nonetheless. No immediate risks were identified at any of the Areas that would necessitate interim remedial measures.

L. Ecological Risk assessment

The ecological risk assessment in the RFI Report evaluated each study area and concluded that there are no present or future risk to either terrestrial or aquatic receptors.

M. Vapor Intrusion Assessment

There are buildings overlying portions of the groundwater Area A and Area C plumes. In May 2014, during the CMS, the Facility submitted an Indoor Air Quality Assessment Report detailing the results of indoor air sampling conducted in those buildings. The plume contaminants are primarily TCE, cis-1,2-dichloroethene and vinyl chloride.

Sampling was performed on March 8 and 9, 2014. Ten composite samples of indoor air were collected using SUMMA canisters. Only Building K in Area A, near the source Target Area had TCE concentrations exceeding EPA's non-cancer RSL of 8.8 micrograms (ug) per cubic meter of air.

The Facility modified the ventilation intake air for Building K, since the intake is at ground level. The Facility then completed a comprehensive indoor air monitoring on August 31, 2014, after the ventilation system modification was completed. The results from the indoor and ambient air monitoring indicate TCE concentrations below the EPA non cancer RSL of 8.8 ug/cubic meter. The Facility will repeat the monitoring in the winter, when sub-slab vapors may migrate into buildings when the ground is frozen. Additional measures such as introduction of additional ambient air or the design of a sub-slab depressurization system may be necessary to be installed pending results of next indoor air sampling of Building K.

IV. Corrective Action Objectives

EPA's Corrective Action Objectives for the Facility are the following:

A. Soils

EPA has determined that EPA RSL for Industrial Soils for direct contact with soils are protective of human health and the environment for individual contaminants at this Facility, provided that the Facility is not used for residential purposes. Therefore, EPA's Corrective Action Objective for Facility soils is to attain (SLs) for Industrial Soils and to control exposure to the hazardous constituents remaining in soils by requiring the compliance with and maintenance of land use restrictions.

B. Subsurface Vapor Intrusion

EPA's Corrective Action Objective for subsurface vapor intrusion is to attain EPA's Subsurface Vapor Intrusion Guidance screening levels. EPA has determined that those levels are protective of human health and the environment at this Facility provided that the Facility buildings are not used for residential purposes.

C. Groundwater and Technical Impracticability

EPA expects final remedies to return usable groundwater to its maximum beneficial use, where practicable, within a timeframe that is reasonable. Where returning contaminated groundwater to its maximum beneficial use is not technically practicable, EPA generally expects facilities to prevent or minimize the further migration of a plume, prevent exposure to the contaminated groundwater, and evaluate further risk reduction. Technical impracticability (TI) for contaminated groundwater refers to a situation where achieving groundwater cleanup standards associated with final cleanup standards is not practicable from an engineering perspective. The term "engineering perspective" refers to factors such as feasibility, reliability, scale or magnitude of a project, and safety.

EPA has determined that restoration of groundwater to drinking water standards known as Maximum Contaminant Levels (MCLs), promulgated at 40 C.F.R. Part 141 pursuant to Section 1412 of the Safe Drinking Water Act, 42 U.S.C. Section 300g-1, at the Facility is technically impracticable in all three groundwater plume areas for the following reasons:

1) COCs are present as unrecoverable DNAPL.

2) Steeply dipping rock bedding planes and a downward hydraulic gradient promote deep penetration of contamination.

3) In the bedrock, low permeability and unpredictability of water-producing fractures makes pumping for extraction or injection for in situ treatment infeasible.

4) TCE DNAPL has been confirmed in bedrock at the STA in Area A and is suspected at several other locations, including Landfill 1 and Area C, based on elevated groundwater concentrations. PCE DNAPL is suspected at Area B based on the high concentrations of PCE in bedrock groundwater wells.

5) TCE and PCE are trapped in the primary and secondary porosity of bedrock. The trapped VOCs will be a continuing source of groundwater contamination for many years as it slowly diffuses back out of the rock.

6) Matrix storage of TCE and PCE in fractured rock is suspected over large areas and to depths greater than 100 feet, making the scope of groundwater cleanup technically impracticable.

Therefore, EPA's Corrective Action Objectives for Facility groundwater are to control exposure to the hazardous constituents remaining in the groundwater; protect the current existing receptors, namely bedrock and the James River, from unacceptable concentrations from COC impacts; ensure that the dissolved groundwater plume is contained and will not migrate beyond the extent of the current groundwater plume; demonstrate mass loss of the contaminated groundwater plume over time or distance from known source areas; and ensure that no groundwater discharge concentrations would result in surface water concentrations that are above the VADEQ surface water criteria.

V. Proposed Remedy

The proposed remedy for the Facility consists of land and groundwater use restrictions, known as institutional controls (ICs), and the continued implementation of the GWRS until groundwater clean-up standards are met. The goal of the proposed remedy is to ensure the overall protection of human health and the environment.

A. Soils

Based on the available information, there are currently no unacceptable risks to human health and the environment via the soil for the present and anticipated use of the property (Industrial use). Because contaminants will remain in Facility soils above levels appropriate for residential uses, the proposed remedy for soils is land use restrictions (See Section D below) to restrict the Facility to non-residential uses.

B. Subsurface Vapor Intrusion

Buildings located above a contaminated groundwater plume are vulnerable to subsurface vapor intrusion coming from the plume and entering through cracks, joints and utilities openings. In 2014, B&W did conduct a vapor intrusion assessment of buildings located over the Areas A and C groundwater plumes. Based on those results, B&W modified the ventilation system in Building K and conducted a comprehensive indoor air monitoring in that building after the modification was completed. Analytical results from the indoor air sampling collected on

August 31, 2014, showed TCE indoor levels below the EPA non cancer RSL of 8.8 ug/cubic meter. Another round of indoor air sampling will be conducted in February 2015 to monitor vapor movements during the colder months. In addition, due to the known presence of VOC contamination in the groundwater beneath the Facility, EPA will require that all new buildings have vapor control systems installed.

C. Groundwater – TI Zones with Long Term Monitoring

Given the elevated levels and the non-aqueous phase liquid (NAPLs) characteristics of the VOC contamination and the constraints of the hydrogeological conditions (i.e., fractures and bedding planes in the bedrock) at the Facility, EPA has concluded that it is technically impracticable to attain MCLs throughout the three groundwater plume Areas and LF1 within the Facility property boundaries. It is often necessary to remove virtually all NAPL before concentration levels in groundwater near the source of the contamination can approach concentration levels commensurate with the MCLs. Presently, there are no technologies which have been proven to be economical and capable of removing all NAPL in groundwater from large facilities where NAPL is widely distributed laterally and vertically, and where the stratigraphy is highly heterogeneous and complex as presented at the Site. EPA evaluated over twelve years of Site groundwater data and regional hydrogeology investigation to conclude that total removal of VOC contamination in bedrock fractures is effectively impossible and that attainment of MCLs within the three groundwater plumes within the property boundaries is technically impracticable. Additional details of the Facility analyses and evaluation of the VOC groundwater data in heterogeneous bedrock fractures are presented in the Final RFI Report.

Because of the constraints of VOC contamination in groundwater and the hydrogeological conditions at the Site that prevent MCL attainment throughout the groundwater plume, EPA is proposing that continued operation of the existing groundwater pump and treat system in the A Area and groundwater monitoring in all three Areas and LF1, along with the establishment of four Technical Impracticability Zones (TI Zones) will be the most practical and economical remedy that will continue to be protective of human health and the environment. These TI zones will define the area of hydraulic control that will ensure groundwater contamination stability within the Facility property. Long-term monitoring is proposed through performance sampling and gauging of the proposed TI Boundary monitoring well network.

The proposed TI Zones will include the groundwater plumes and associated contaminated surface water such as, springs and small streams. Specifically, the proposed TI Zone areas are:

- Area A plume, both alluvium and bedrock, springs, and small surface water drainage features (Figure 3)
- LF1 plume, both alluvium and bedrock (Figure 4)
- Area B plume, both alluvium and bedrock, and small surface water drainage features (Figure 5)
- Area C plume, both alluvium and bedrock. (Figure 6)

Based on the data collected during the CMS, the groundwater plume appears to be stable (not migrating), and concentrations of constituents of concern are stable and declining over time.

Groundwater is not used on the Facility for drinking water, and there are no down gradient users of off-site groundwater located between the Facility boundary and the James River. Therefore, the proposed remedy for the groundwater is the combination of groundwater use restrictions (See Section D, below), establishment of TI Zones, surface water monitoring, and a groundwater monitoring program for COC's within the TI Zones to ensure groundwater outside these TI Zones remain below MCLs.

D. Institutional Controls

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

EPA is proposing the following use restrictions be implemented at the Facility:

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

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

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

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

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

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

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

E. Development and Implementation of a Materials Management Plan

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

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

F. Implementation

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

In addition, the Commonwealth of Virginia State Board of Health Private Well Regulations, 12 VAC 5-630-10 et seq. (Regulations) and its implementing statute set forth at the Code of Virginia, Title 32.1 (Health), Chapter 6 (Environmental Health Services), Va. Code §32.1 is an institutional control mechanism that will reduce potential human exposure to contaminated groundwater attributable to the Facility. Pursuant to Section 12 VAC 5-630-30, the purpose of these Regulations is to "ensure that all private wells are located, constructed and

maintained in a manner which does not adversely affect ground water resources, or the public welfare, safety and health."

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

VI. Evaluation of EPA's Proposed Remedy

This section provides a description of the criteria EPA used to evaluate the proposed remedy consistent with EPA guidance titled, "Corrective Action for Releases From Solid Waste Management Units at Hazardous Waste Management Facilities; Proposed Rule," 61 Fed. Reg. 19431, May 1, 1996. The criteria are applied in two phases. In the first phase, EPA evaluates three remedy threshold criteria as general goals. In the second phase, for those remedies which meet the threshold criteria, EPA then evaluates seven balancing criteria.

A. Threshold Criteria

1. Protect Human Health and the Environment

With respect to groundwater, while contaminants remain in the groundwater beneath the Facility in areas designated as TI Zones, the contaminants are contained in the aquifer and are not migrating beyond the areas on the Facility property. For this reason, the area of contaminated groundwater is contained. Groundwater monitoring of contaminants within the TI Zones will ensure groundwater outside these TI Zones remain below MCLs. The Facility has been using city water since 2003, therefore groundwater is not used at the Facility for potable use. With respect to future uses, the proposed remedy requires groundwater use restrictions for groundwater in the TI Zone to minimize the potential for human exposure to contamination and protect the integrity of the remedy.

With respect to Facility soils, all contaminated soil is below the surface and contained within Facility property. There is no direct exposure of industrial workers to subsurface soil under current land use. With respect to future uses, EPA proposes to limit the Facility to industrial use in order to minimize the potential for human exposure to contamination. Because of the existing RCRA regulated Landfill 2, NRC managed Landfill 1, as well as ongoing operations at the Facility with nuclear components, an industrial use designation for the property is appropriate.

2. Achieve Media Cleanup Objectives

The Facility has achieved the EPA's RSL for industrial soils. For groundwater, site geologic conditions (i.e. fractured bedrock) and presence of DNAPL within those fractures makes achieving MCLs not practicable from an engineering perspective. Under the proposed remedy, groundwater with COC levels that exceed MCLs will remain within the TI Zones. Long-term monitoring is proposed through performance sampling and gauging of the proposed TI Boundary monitoring well network. Long term groundwater monitoring will ensure contaminated groundwater remains in the TI Zones The groundwater plume appears to be stable (not migrating), and COCs though above MCLs are either stable or declining over time. Groundwater outside the TI zones meets drinking water standards. EPA's proposed remedy requires the implementation and maintenance of institutional controls to ensure that Facility property is not used for residential purposes and groundwater beneath Facility property is not used for any purpose except to conduct the operation, maintenance, and monitoring activities required by VADEQ and/or EPA.

3. Remediating the Source of Releases

In all proposed remedies, EPA seeks to eliminate or reduce further releases of hazardous wastes and hazardous constituents that may pose a threat to human health and the environment. There are no remaining large, discrete sources of waste from which constituents would be released to the environment. With respect to existing releases at the Facility, remediating groundwater COCs to applicable their MCLs has been demonstrated to be technically impracticable. The existing GWRS will assist in protecting the James River from concentrations that would cause unacceptable risk from COCs. Therefore, EPA has determined that this criterion has been met.

B. Balancing/Evaluation Criteria

1. Long-Term Effectiveness

The proposed use restrictions will maintain protection of human health and the environment over time by controlling exposure to the hazardous constituents remaining in soils and groundwater. EPA anticipates that the land use and groundwater use restrictions will be implemented through an order, permit and/or an environmental covenant under UECA to be recorded in the chain of title for the Facility property. If the mechanism is to be an environmental covenant, the environmental covenant will run with the land and as such, will be enforceable by EPA. In addition, a groundwater monitoring program already in place will continue until groundwater clean-up standards are met. The existing GWRS will assist in protecting the James River from concentrations that would cause unacceptable risk from COCs.

has already been achieved, as demonstrated by the groundwater monitoring data showing that the plume appears to be stable (not migrating), and concentrations of constituents of concern (COCs) are either stable or declining over time. In addition, a groundwater monitoring program already in place will continue to monitor the groundwater contamination stability in the TI zones. The existing GWRS will assist in protecting the James River from concentrations that would cause unacceptable risk from COCs.

3. Short-Term Effectiveness

EPA's proposed remedy does not involve any activities, such as construction or excavation that would pose short-term risks workers, residents, and the environment. A groundwater monitoring program already in place will continue until groundwater clean-up standards are met. In addition, EPA anticipates that the land use and groundwater use restrictions will be fully implemented shortly after the issuance of the FDRTC.

4. Implementability

EPA's proposed remedy is readily implementable. EPA proposes to implement the use restrictions through an enforceable mechanism such as an order, permit or an Environmental Covenant pursuant to UECA.

5. Cost-Effectiveness

Because EPA has determined that TI applies to groundwater in three Areas and at LF1, the costs associated with implementing this proposed remedy are the most cost effective. If the IC mechanism to be selected is an environmental covenant, the cost to record an environmental covenant in the chain of title of the Facility property is minimal.

6. Community Acceptance

EPA will evaluate community acceptance of the proposed remedy during the public comment period, and it will be described in the FDRTC.

7. State/Support Agency Acceptance

EPA has solicited VADEQ input and involvement throughout the investigation process at the Facility. VADEQ is reviewing EPA's proposed remedy for the Facility and will comment or concur during the public comment period.

VII. Environmental Indicators

EPA sets national goals to measure progress toward meeting the nation's major environmental goals. For Corrective Action, EPA evaluates two key environmental indicators for each Facility: (1) current human exposures under control and (2) migration of contaminated groundwater under control. EPA determined that the Facility met these indicators on February 25, 2000.

VIII. Financial Assurance

B&W will be required to demonstrate and maintain financial assurance for completion of the remedy pursuant to the standards contained in Federal regulations 40 C.F.R. § 264.145 and 40 CFR § 264.143

IX. Public Participation

Before EPA makes a final decision on its proposal for the Facility, the public may participate in the remedy selection process by reviewing this SB and documents contained in the Administrative Record (AR) for the Facility. The AR contains all information considered by EPA in reaching this proposed remedy. It is available for public review during normal business hours at:

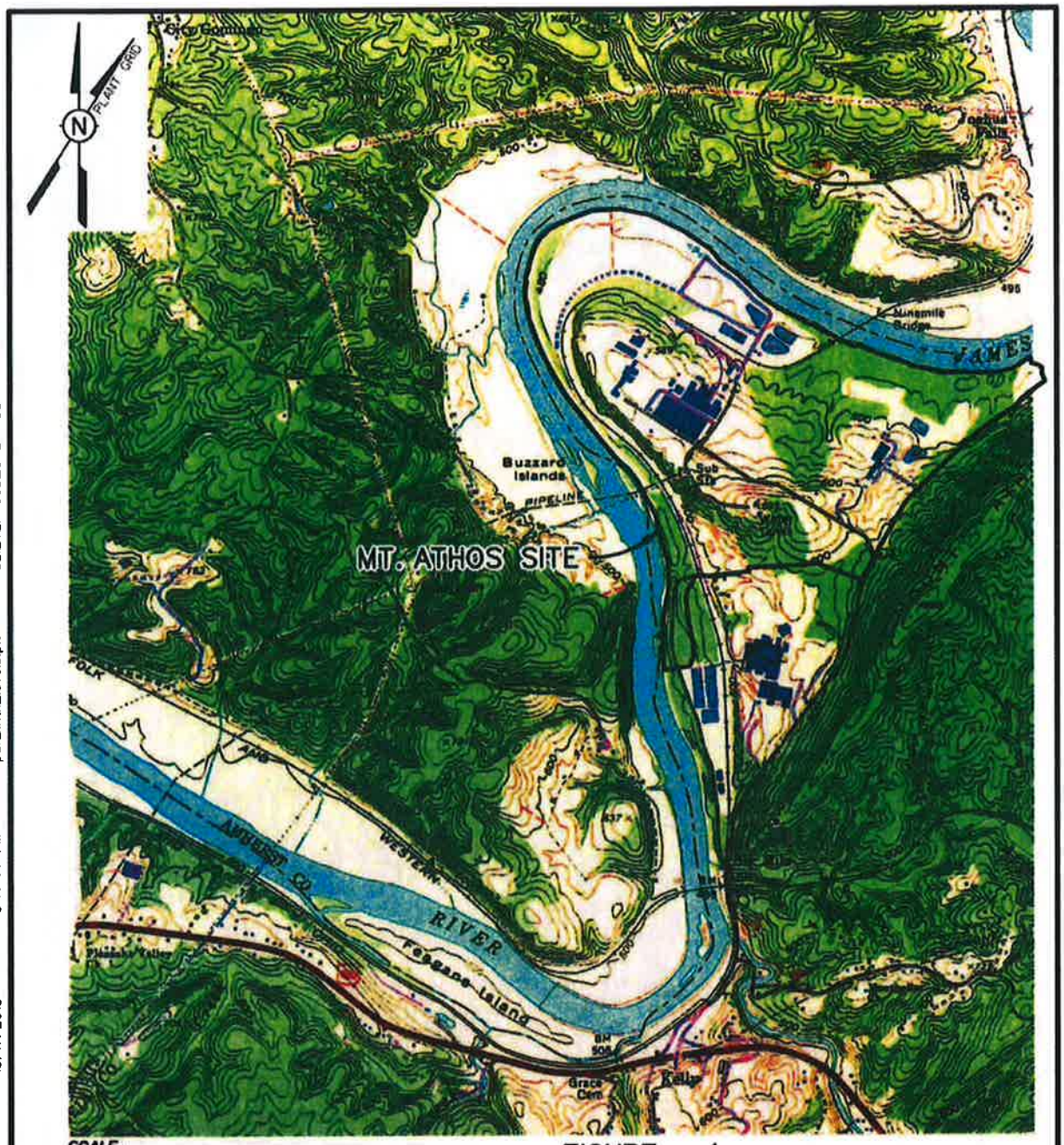
U.S. EPA Region III
1650 Arch Street
Philadelphia, PA 19103
Contact: Mike Jacobi
Phone: (215) 814-3435
Fax: (215) 814-3113
Email: Jacobi.Mike@epa.gov

Interested parties are encouraged to review the AR and comment on EPA's proposed remedy. The public comment period will last thirty (30) calendar days from the date that notice is published in a local newspaper. You may submit comments by mail, fax, or e-mail to Mike Jacobi. EPA will hold a public meeting to discuss this proposed remedy upon request. Requests for a public meeting should be made to Mike Jacobi.

EPA will respond to all relevant comments received during the comment period. If EPA determines that new information warrant a modification to the proposed remedy, EPA will modify the proposed remedy or select other alternatives based on such new information and/or public comments. EPA will announce its final decision and explain the rationale for any changes in a FDRTC. All persons who comment on this proposed remedy will receive a copy of the FDRTC. Others may obtain a copy by contacting Mike Jacobi at the address listed above.

Date: 11.3.14

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

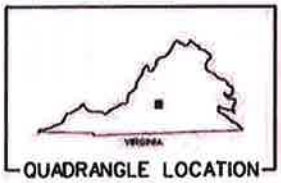


SCALE:

0 2000 4000 FEET

FIGURE 1
SITE LOCATION MAP

SOURCE:
KELLY, VIRGINIA QUADRANGLE USGS
7.5 MINUTE TOPOGRAPHIC MAP



QUADRANGLE LOCATION

FINAL CORRECTIVE MEASURES STUDY
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NUCLEAR OPERATIONS GROUP
MT. ATHOS SITE
LYNCHBURG, VIRGINIA

Shaw Environmental, Inc.
(A CB&I Company)

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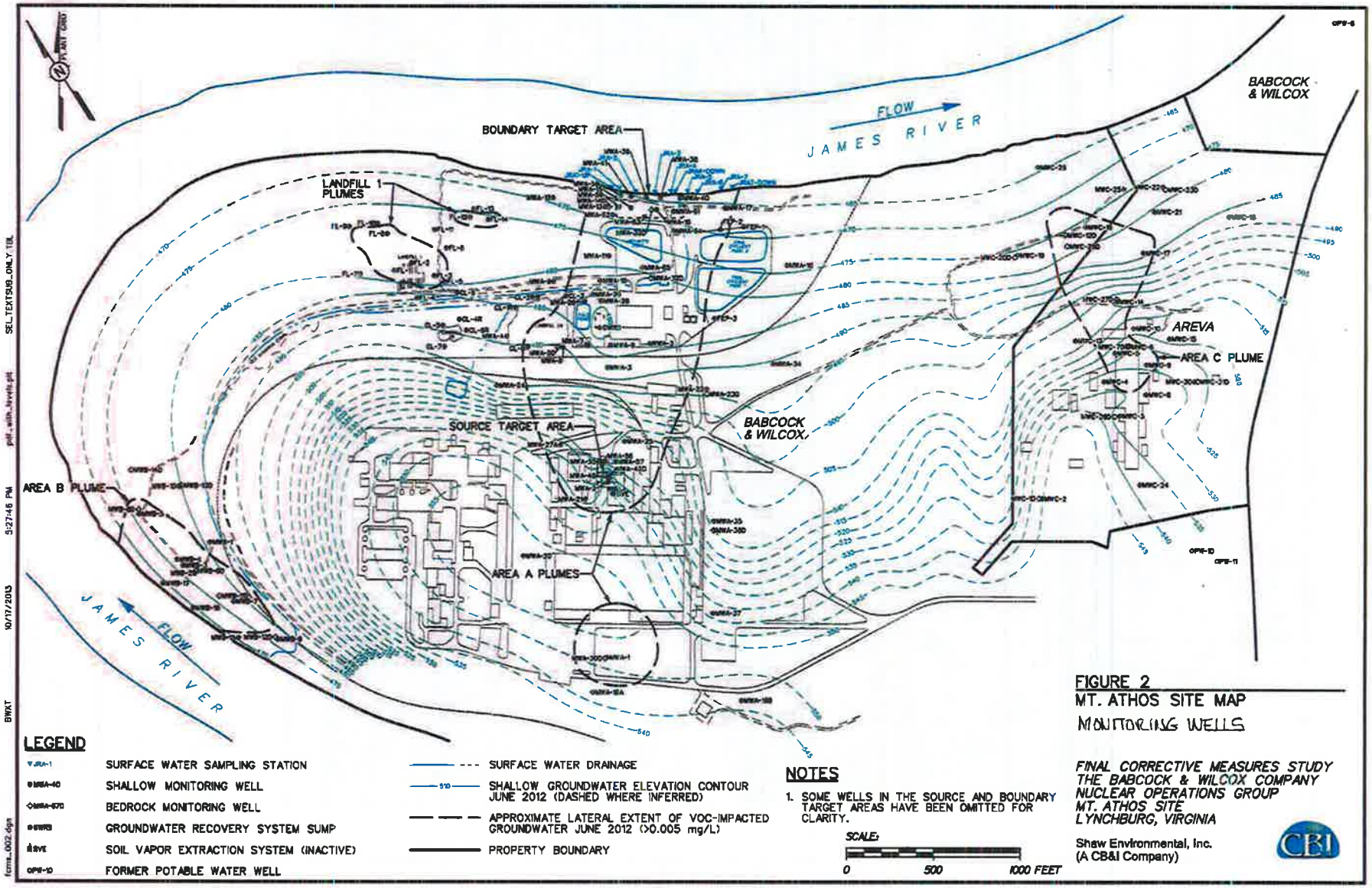

FIGURE 2
MT. ATHOS SITE MAP
MONITORING WELLS

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NUCLEAR OPERATIONS GROUP
MT. ATHOS SITE
LYNCHBURG, VIRGINIA

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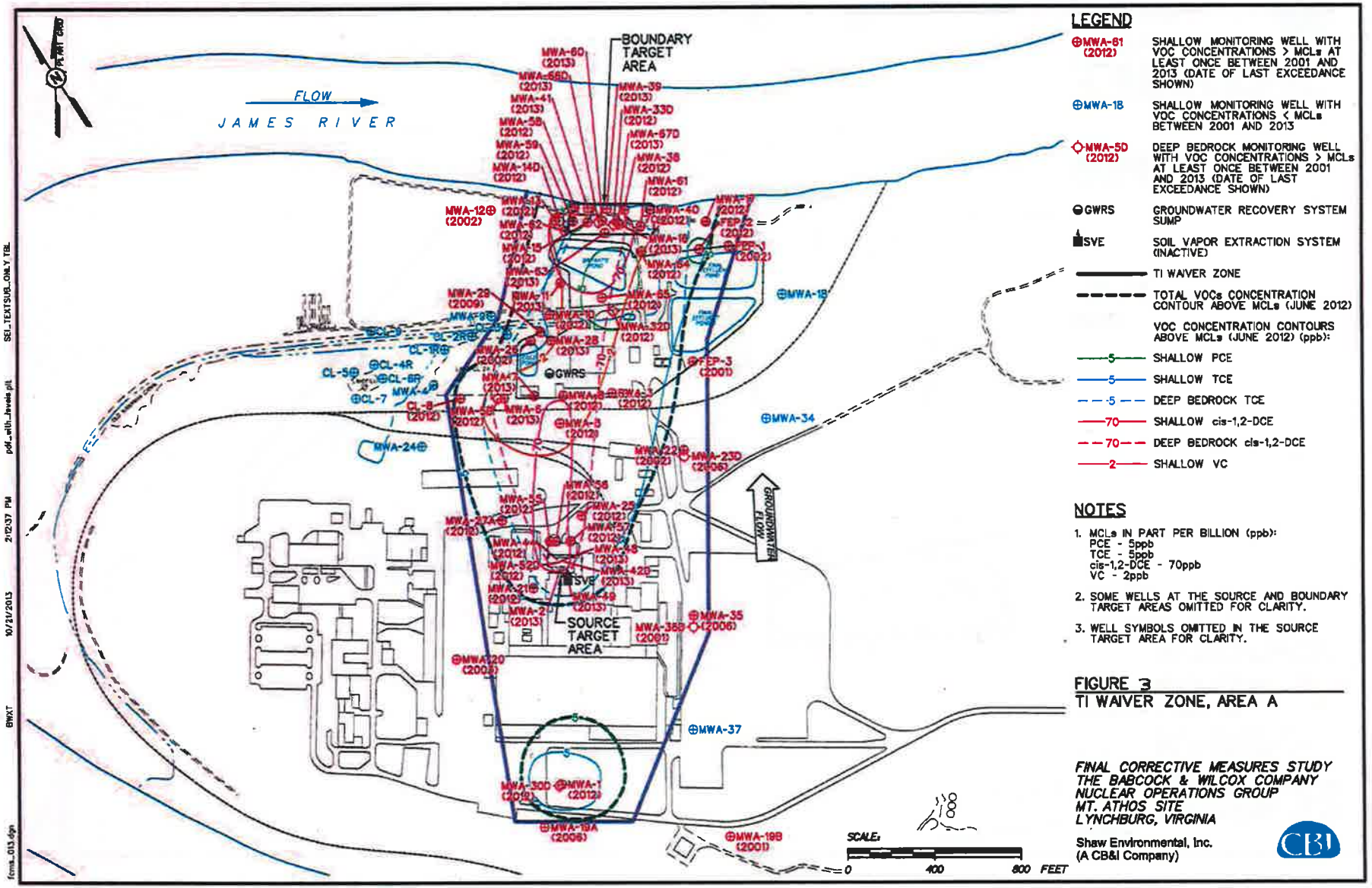

LEGEND

- ⊕MWA-81 (2012) — SHALLOW MONITORING WELL WITH VOC CONCENTRATIONS > MCLs AT LEAST ONCE BETWEEN 2001 AND 2013 (DATE OF LAST EXCEEDANCE SHOWN)
- ⊕MWA-18 — SHALLOW MONITORING WELL WITH VOC CONCENTRATIONS < MCLs BETWEEN 2001 AND 2013
- ◇MWA-5D (2012) — DEEP BEDROCK MONITORING WELL WITH VOC CONCENTRATIONS > MCLs AT LEAST ONCE BETWEEN 2001 AND 2013 (DATE OF LAST EXCEEDANCE SHOWN)
- ⊖GWRS — GROUNDWATER RECOVERY SYSTEM SUMP
- ■SVE — SOIL VAPOR EXTRACTION SYSTEM (INACTIVE)
- TI WAIVER ZONE
- TOTAL VOCs CONCENTRATION CONTOUR ABOVE MCLs (JUNE 2012)

VOC CONCENTRATION CONTOURS ABOVE MCLs (JUNE 2012) (ppb):

- 5 — SHALLOW PCE
- 5 — SHALLOW TCE
- 5 — DEEP BEDROCK TCE
- 70 — SHALLOW cis-1,2-DCE
- 70 — DEEP BEDROCK cis-1,2-DCE
- 2 — SHALLOW VC

NOTES

1. MCLs IN PART PER BILLION (ppb):
   PCE - 5ppb
   TCE - 5ppb
   cis-1,2-DCE - 70ppb
   VC - 2ppb
2. SOME WELLS AT THE SOURCE AND BOUNDARY TARGET AREAS OMITTED FOR CLARITY.
3. WELL SYMBOLS OMITTED IN THE SOURCE TARGET AREA FOR CLARITY.

FIGURE 3
TI WAIVER ZONE, AREA A

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LYNCHBURG, VIRGINIA

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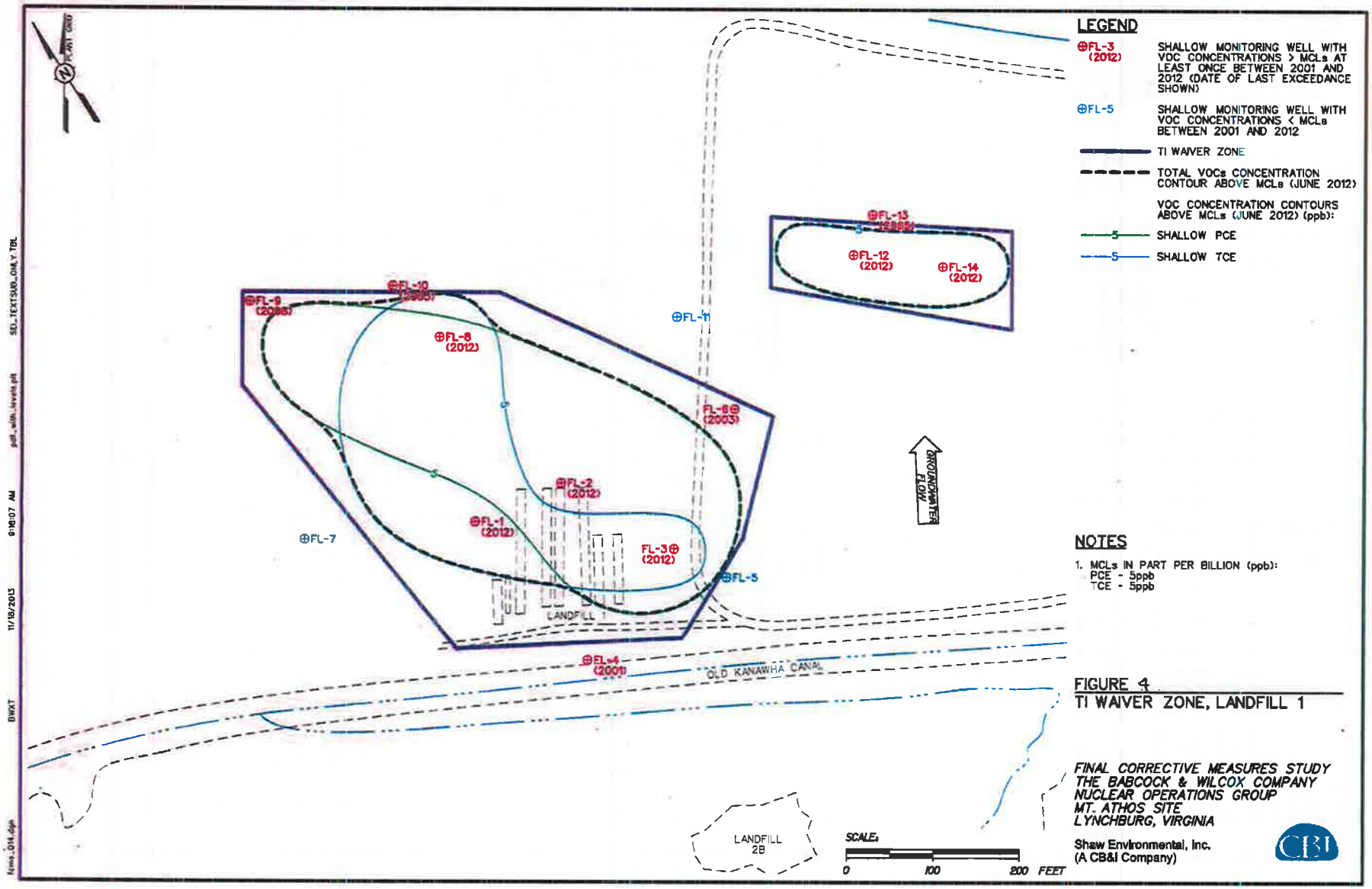
LEGEND
⊕FL-3 (2012) SHALLOW MONITORING WELL WITH VOC CONCENTRATIONS > MCLs AT LEAST ONCE BETWEEN 2001 AND 2012 (DATE OF LAST EXCEEDANCE SHOWN)
⊕FL-5 SHALLOW MONITORING WELL WITH VOC CONCENTRATIONS < MCLs BETWEEN 2001 AND 2012
TI WAIVER ZONE
TOTAL VOCs CONCENTRATION CONTOUR ABOVE MCLs (JUNE 2012)
VOC CONCENTRATION CONTOURS ABOVE MCLs (JUNE 2012) (ppb):
5 SHALLOW PCE
5 SHALLOW TCE
⊕FL-13
⊕FL-12 (2012)
⊕FL-14 (2012)
⊕FL-11
⊕FL-10
⊕FL-9 (2006)
⊕FL-8 (2012)
FL-6⊕ (2003)
⊕FL-2 (2012)
⊕FL-1 (2012)
⊕FL-7
FL-3⊕ (2012)
⊕FL-5
LANDFILL
GROUNDWATER FLOW
⊕FL-4 (2001)
OLD KANAWHA CANAL
LANDFILL 2B
SCALE:
0 100 200 FEET
NOTES
1. MCLs IN PART PER BILLION (ppb):
PCE - 5ppb
TCE - 5ppb
FIGURE 4
TI WAIVER ZONE, LANDFILL 1
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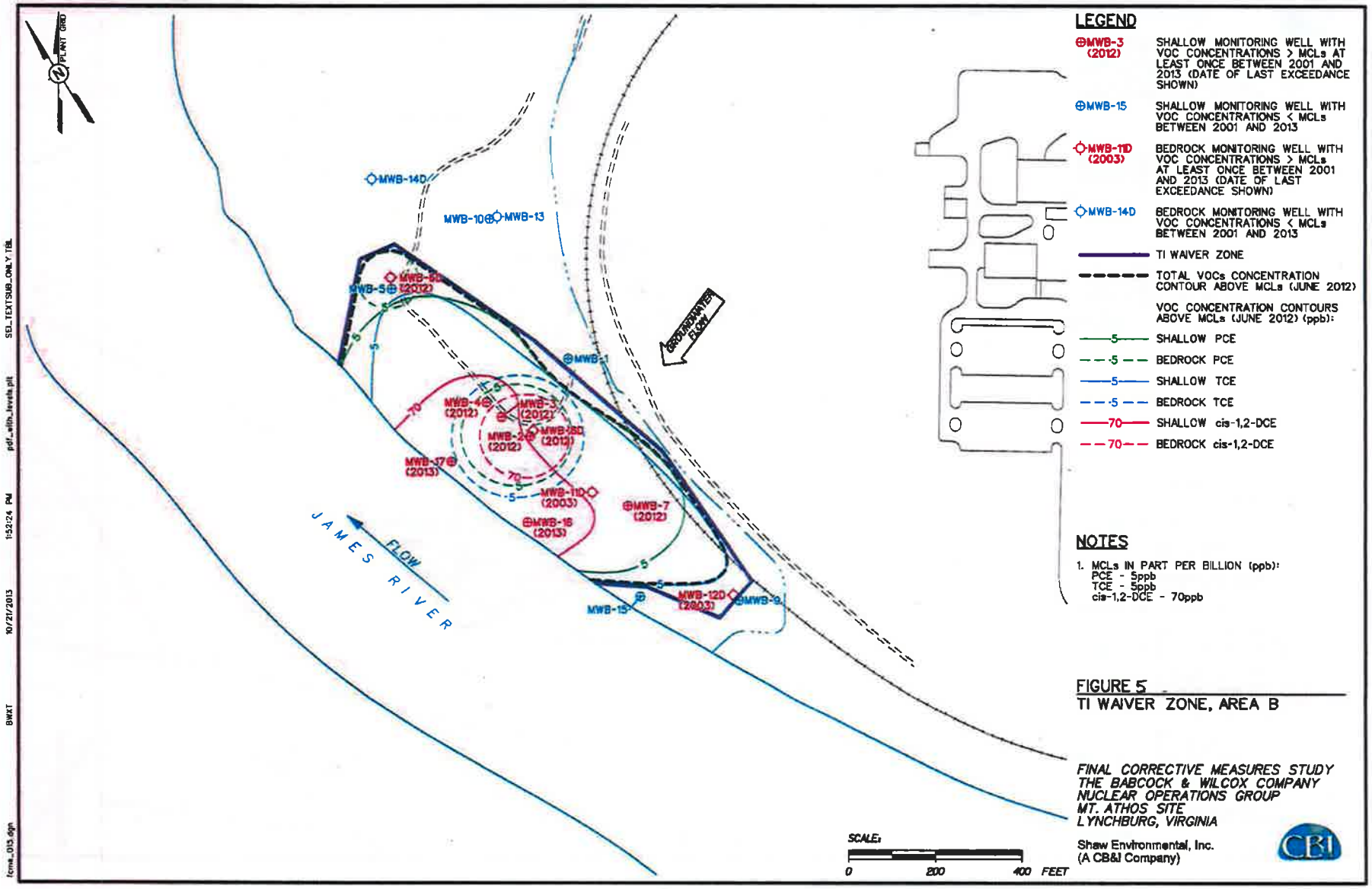

FIGURE 5
TI WAIVER ZONE, AREA B

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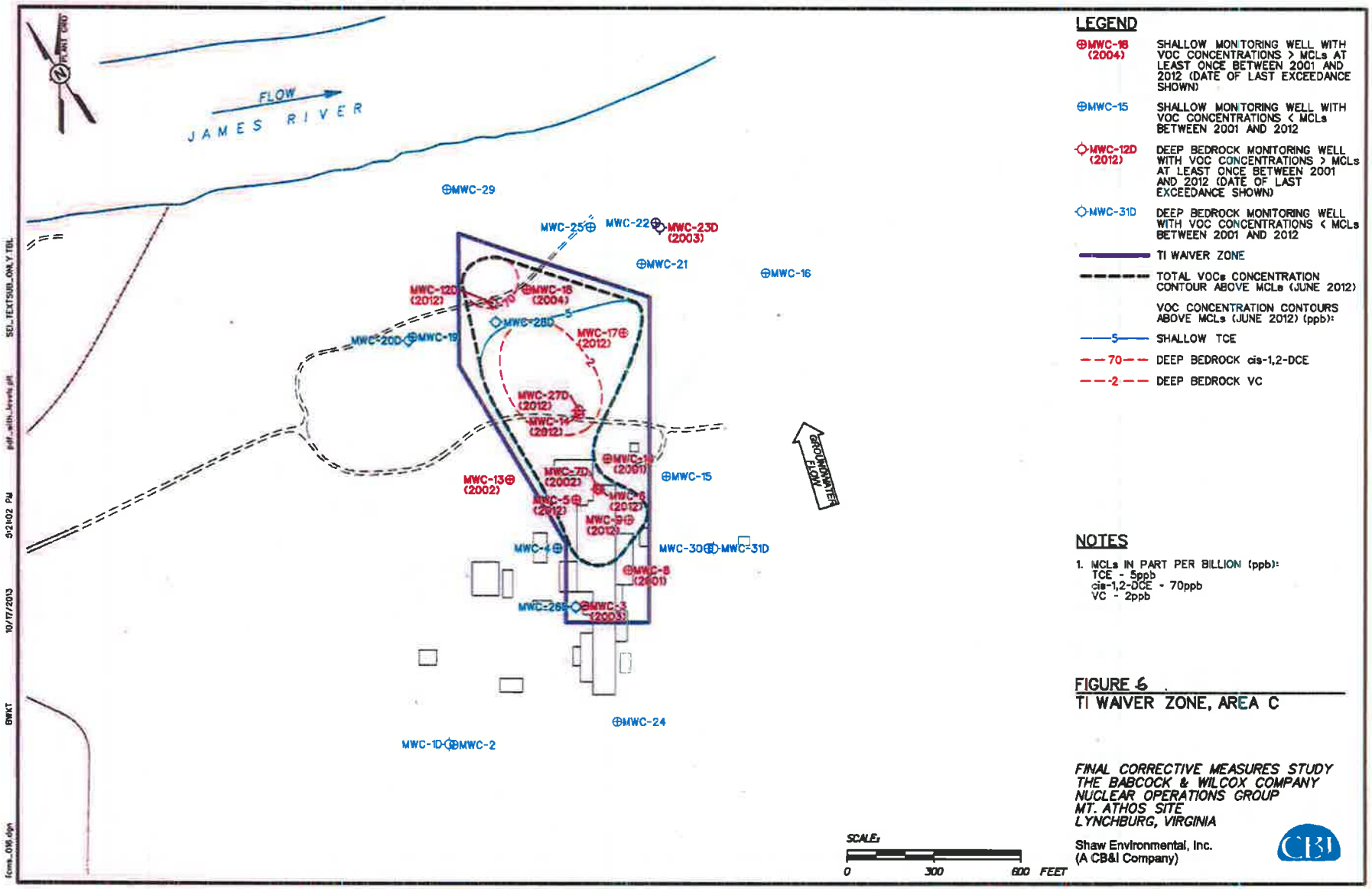

LEGEND

- ⊕MWC-18 (2004) — SHALLOW MONITORING WELL WITH VOC CONCENTRATIONS > MCLs AT LEAST ONCE BETWEEN 2001 AND 2012 (DATE OF LAST EXCEEDANCE SHOWN)
- ⊕MWC-15 — SHALLOW MONITORING WELL WITH VOC CONCENTRATIONS < MCLs BETWEEN 2001 AND 2012
- ◇MWC-12D (2012) — DEEP BEDROCK MONITORING WELL WITH VOC CONCENTRATIONS > MCLs AT LEAST ONCE BETWEEN 2001 AND 2012 (DATE OF LAST EXCEEDANCE SHOWN)
- ◇MWC-31D — DEEP BEDROCK MONITORING WELL WITH VOC CONCENTRATIONS < MCLs BETWEEN 2001 AND 2012
- TI WAIVER ZONE
- TOTAL VOCs CONCENTRATION CONTOUR ABOVE MCLs (JUNE 2012)

VOC CONCENTRATION CONTOURS ABOVE MCLs (JUNE 2012) (ppb):

- —5— SHALLOW TCE
- --70-- DEEP BEDROCK cis-1,2-DCE
- --2-- DEEP BEDROCK VC

NOTES

1. MCLs IN PART PER BILLION (ppb):
   TCE - 5ppb
   cis-1,2-DCE - 70ppb
   VC - 2ppb

FIGURE 6
TI WAIVER ZONE, AREA C

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