Final Feasibility Study

COMBE FILL SOUTH LANDFILL
United States Environmental Protection Agency

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List of Acronyms and Abbreviations

1,2-DCA	1,2-Dichloroethane
alpha-BHC	alpha-benzene-hexachloride
AMSL	Above Mean Sea Level
AOP	Advanced oxidation processes
ARAR	Applicable or Relevant and Appropriate Requirement
BOD5	5-Day Biochemical Oxygen Demand
CEA	Classification Exemption Area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CFS	Combe Fill South Landfill
CKE	Currently Known Extent
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
CVI	Clean Venture, Inc.
CY	Cubic Yards
DEHP	di(2-ethylhexyl)phthalate (Bis(2-ethylhexyl) phthalate)
EPA	Environmental Protection Agency
ESNR	Environmentally-sensitive natural resource
ESD	Explanation of Significant Differences
FS	Feasibility Study
GAC	Granular Activated Carbon
gpm	Gallons per minute
GRA	General Response Actions
GWET	Groundwater Extraction and Treatment
GWQC	Groundwater Quality Criterion/Criteria
GWQS	Groundwater Quality Standard
HDR	Henningson, Durham and Richardson Architecture and Engineering, P.C., in association with HDR Engineering, Inc.
HHRA	Human Health Risk Assessment
HI	Hazard Index
HO	hydroxyl radicals
HQ	Hazard Quotient
IC	Institutional Control
ISCO	In-situ Chemical Oxidation
ISCR	In-situ Chemical Reduction
ISTT	In-situ thermal treatment
ITRC	Interstate Technology & Regulatory Council
LEL	Lowest Effects Level

MCL	Maximum Contaminant Level
MNA	Monitored Natural Attenuation
MNR	Monitored Natural Recovery
N.J.A.C.	New Jersey Administrative Code
NCP	National Contingency Plan
NJDEP	New Jersey Department of Environmental Protection
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
O&M	Operations and Maintenance
O2-	superoxide radicals
OD	outer diameter
OU	Operable Unit
PAHs	polycyclic aromatic hydrocarbons
PCB	Polychlorinated Biphenyl
PCP	personal care products
PDI	Pre-Design Investigation
PFD	Process Flow Diagram
POTW	Publicly-Owned Treatment Works
PRG	Preliminary Remediation Goals
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/ FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SBR	sequencing batch reactor
scfm	Standard Cubic Feet per Minute
SLERA	Screening Level Ecological Risk Assessment
SSA	Sole Source Aquifer
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compound
SWQS	Surface Water Quality Standards
TAME	tert-amyl methyl ether (also: 2-methoxy-2-methylbutane)
TBC	To Be Considered (Criteria)
TCE	Trichloroethylene (Trichloroethene)
Tech Memo	Technical Memorandum
THF	Tetrahydrofuran
TOC	total organic carbon
TSS	total suspended solids
TTZ	targeted treatment zone
UIC	Underground Injection Control
UNT	Un-named Tributary
UV	Ultraviolet
VI	Vapor Intrusion

VOC	Volatile Organic Compound
ZVI	Zero-valent Iron

1.0 Introduction

This Final Feasibility Study (FS) for the Combe Fill South Landfill (CFS) Superfund Site ("Site") was prepared by Henningson, Durham & Richardson Architecture and Engineering, P.C. in association with HDR Engineering, Inc. (HDR) under United States Environmental Protection Agency Region 2 (EPA) Contract Number EP-W-09-009, EPA Work Assignment Number 018-RICO-0256. This FS incorporates the Final RI/FS Work Plan scope of work outlined in Task 10 – Remedial Alternatives Screening, Task 11 – Remedial Alternatives Evaluation, Task 12.1 Draft FS and Task 12.2 Final FS.

1.1 Document Review

This FS was created using data, maps, and other source files provided by EPA and NJDEP. The Combe Fill South Landfill Draft and Final Remedial Investigation (RI) Reports (HDR 2017, HDR 2018) were the main sources of information used in the preparation of this document.

1.2 Purpose

The purpose of this FS is to identify and develop remedial alternatives based on Site-specific conditions and results of the RI that will ensure protection of human health and the environment. The FS development includes the following general steps:

- Develop Remedial Action Objectives (RAO);
- Develop General Response Actions (GRAs);
- Identify volumes and/or areas where GRAs will be applied;
- Identify and screen technologies applicable to each GRA;
- Identify and evaluate technology process options to select representative process options for each technology; and
- Assemble combinations of selected process options into Site-wide remedial alternatives.
- Evaluation of alternatives based on the nine NCP screening criteria.

The remedial alternatives were developed in support of a Record of Decision (ROD) amendment for Operable Unit (OU) 1 and the issuance of an interim ROD for OU2. The OU1 ROD amendment will amend the 1986 ROD and will be the final decision document for OU1. The OU2 ROD will be an interim decision document. When the OU1 amended remedy is implemented and there is additional supporting data for the deep aquifer at the Site, a final OU2 ROD will be issued.

1.3 Organization

This document is comprised of ten sections, summarized below.

Section 1 – Introduction: provides general information on the purpose and organization of the document and the criteria and process involved in identifying remedial alternatives.

Section 2 – Site Description and History: includes background information and a description, history, and information on physical characteristics of the Site and potential source areas.

Section 3 – Summary of Remedial Investigations: provides the RI sampling results, information on the nature and extent of contamination, and results of the baseline human health and screening level ecological risk assessments (BHHRA; SLERA).

Section 4 – Remedial Goals and Remedial Action Objectives: develops a list of RAOs and preliminary remedial goals (PRGs) that consider the contaminant characterization, results from the BHHRA and SLERA, and compliance with Applicable or Relevant and Appropriate Requirement (ARARs).

Section 5 – General Response Actions: identifies the GRAs for each medium and screens remedial technologies and process options.

Section 6 – Identification and Screening of Remedial Technologies and Process Options: provides an evaluation of the GRAs against the National Contingency Plan (NCP) criteria, based on what is most appropriate for the source area-specific conditions and contamination, what is technically implementable, and what is capable of achieving source area-specific RAOs. Screening of technologies and process options is also included.

Section 7 – Evaluation of Process Options: describes and evaluates the various soil and groundwater remediation process options assembled from the remedial technologies retained after screening.

Section 8 – Development of Remedial Action Alternatives: provides a detailed development and description of the individual remedial alternatives. This section also provides preliminary design assumptions regarding the alternatives that were retained.

Section 9 – Detailed Evaluation of Remedial Alternatives: provides a detailed description of the NCP criteria and evaluation of the individual remedial alternatives against the criteria. A comparison between the various remedial alternatives is also provided.

Section 10 – References: provides a list of references used to prepare the FS.

2.0 Site Description and History

2.1 Site Description

CFS is being addressed as two separate operable units in this FS. OU1 consists of the landfill boundary and groundwater beneath it and is located at 98 Parker Road, Chester and Washington Townships, Morris County, New Jersey (**Figure 2-1**). OU2 is defined as groundwater, both overburden and bedrock, surface water and sediment near and downgradient of the landfill property boundary. OU1 and OU2 are discussed in greater detail below.

2.1.1 Operable Unit 1

CFS is an inactive municipal landfill consisting of three separate fill areas, which were capped and closed in the mid-1990s (NJDEP 2011a). The landfill property covers approximately 115 acres on four tax parcels (Block 37, Lots 15, 16, and 16.01 and Block 17, Lot 17) and extends into portions of Washington and Chester Townships. OU1 is defined as the landfill property consisting of the four tax parcels, and overburden and bedrock groundwater directly underlying the landfill within the waste management boundary. Within OU1 are an approximately 65-acre multilayered cap, a passive landfill gas venting system, a shallow groundwater recovery and treatment system (groundwater extraction and treatment plant or GWET), security fencing, surface water runoff controls, and a perimeter access road. The shallow groundwater recovery system consists of recovery wells spaced around most of the landfill perimeter (**Figure 2-2**). All but recovery well RW-T are screened at the bottom of the overburden material (approximately 20 to 60 feet below ground surface or bgs), at the saprolite/bedrock interface and discharge raw groundwater through a force main to the GWET operated by a contractor retained by the NJDEP. RW-T is screened from 65 to 115 feet bgs (approximately 50 ft. into competent bedrock). The individual extraction wells are currently being cycled on and off based on the water level measurements, or at the GWET operator's discretion. The system is controlled by a centralized system which allows the operator to control the entire GWET facility and extraction system from the control room or remotely.

The groundwater is treated by physical, chemical and biological processes before being discharged to surface water at East Trout Brook. During the first two full years of operation (1998 and 1999), 39.1 and 31.6 million gallons were extracted and treated, respectively, by the OU1 GWET (O'Brien & Gere 2001). Based on the recent discharge monitoring reports, groundwater is being treated and discharged at a rate of approximately 45 to 70 gallons per minute (gpm). The GWET's permit is for about 120 gpm.

2.1.2 Operable Unit 2

OU2 is shown on **Figure 2-2**. The OU2 investigation area is based on the Currently Known Extent (CKE) of groundwater contamination. According to NJDEP, "CKE areas are geographically defined areas within which the local ground water resources are known to be compromised because the water quality exceeds drinking water and ground water quality standards for specific contaminants. Historically, a number of the CKEs have also been identified as Well Restriction Areas (WRAs). The regulatory authority for developing CKEs is in

N.J.A.C. 7:1J, entitled Processing of Damage Claims Pursuant to the Spill Compensation and Control Act. CKEs are used by NJDEP staff, water purveyors, and local officials to make decisions concerning appropriate treatment and/or replacement of contaminated drinking water supplies" (NJDEP 2018). In addition to the parcels within the CKE boundary, two additional parcels where landfill-related groundwater contamination was detected make up the OU2 investigation area.

During the June 8, 2016 meeting between EPA, NJDEP, and HDR, the project team concluded that an OU2 remedy could not effectively address groundwater contamination without first evaluating the effectiveness of the current OU1 remedy to capture groundwater directly underlying the landfill (EPA 2018). This FS develops remedial alternatives for both OU1 and OU2, which include upgrades to the existing OU1 recovery well network, transfer piping and GWET in support of an OU1 ROD amendment in addition to assembling alternatives supporting an interim OU2 ROD.

2.2 Site History

The chronological history of CFS is as follows:

- **1940s**: The land encompassed by OU1 was owned and operated as a municipal refuse and solid waste landfill. It was also used for the disposal of chemicals, personal care products (PCPs) and pharmaceutical wastes by the pharmaceutical and PCPs industry in northern New Jersey. It is believed that the trench method of disposal was employed. The original fill areas occupied an estimated 15 acres and were located in the northern portion of the current landfill footprint, to the northwest and southeast of the power line right-of-way (**Figure 2-3**).
- **1972**: Ownership and operations changed to Chester Hills, Inc. The landfill design approved by NJDEP in 1972 specified a trench method of waste disposal. Trench excavation reportedly commenced in 1972 in what was termed the "new fill area" and was advanced to the west and southwest of the older sections (to the northwest of the power line right-of-way only), in an area estimated at 50 acres (LMS 1986).
- **1978**: Ownership and operations changed to Combe Fill Corporation.
- **1973 to 1981**: Numerous operating violations were noted including the absence of an initial layer of residual soil on the bedrock prior to waste placement, as well as absent or inadequate final daily cover. Other frequently observed violations included uncontrolled litter, exceedances of the maximum allowable width of operating face, and excavation of previously deposited waste (NJDEP Inspection Reports). The inspection reports also

noted that excavation and breakup of the saprolite, the weathered bedrock layer above competent bedrock, was done during trench excavation.

- **1981:** Landfill operations ceased and the Combe Fill Corporation filed for bankruptcy and was liquidated. According to landfill records summarized in the 1986 RI report for CFS Landfill, prepared by Lawler, Matusky & Skelly Engineers[1] (LMS; LMS 1986), about five million cubic yards (5,000,000 CY) of waste material are buried in the landfill.
- **1981:** NJDEP issued an order to Combe Fill Corporation to discontinue waste disposal operations upon completion of the existing trench.
- **1983**: CFS was listed on the NPL on September 1.
- **1980s**: Water samples collected from private wells by NJDEP in the 1980s indicated that some wells had been impacted by volatile organic compounds (VOCs). A core area with about 325 homes was determined to be in need of an alternate water supply (along Schoolhouse Lane, Parker Road, and parts of Old Farmers Road).
- **1984 to 1985**: A RI was conducted and a wide range of Contaminants of Concern (COCs) consistent with known past disposal practices at the landfill were identified. Most of the COCs were VOCs, including benzene, toluene, 1,2-Dichloroethane (1,2-DCA), chloroform, and methylene chloride.
- **1986**: The ROD for CFS was signed (EPA 1986). The remedy selected in the ROD consisted of an alternate water supply for impacted homes; capping of the landfill in accordance with RCRA requirements; an active collection and treatment system for landfill gases; pumping and on-site treatment of shallow groundwater and leachate with discharge of treated water to Trout Brook; surface water controls; security fencing; and environmental monitoring.
- **1992:** The landfill cap construction documents were completed in February. The final capped area is approximately 65 acres, and another approximately 20 acres are occupied primarily by the groundwater treatment plant, drainage ditches, landfill perimeter roads, and detention basins outside the capped area.
- **1994:** As part of the OU1 remedy design, 65 passive gas vent wells were installed.
- **1994-1995:** Installation of the clay and liner portions of the cap proceeded and the installation of the top soil layer was completed in November 1995.
- **1997:** The GWET began operations in June and was permitted to treat up to 120 gpm (68.4 million gallons per year).

[1] LMS became part of HDR through acquisition in 2005.

- **2003-2004:** A soil investigation was conducted between December 2003 and June 2004 along the northern edge of the landfill after waste materials were encountered during the installation of landfill gas probes. The installation of soil borings and test pits revealed an area outside of the capped landfill that contained a significant volume of pharmaceutical wastes, PCPs, and drums. This area became known as the North Waste Cell.
- **2006:** A large portion of the North Waste Cell was excavated, and about 27,300 tons of non-hazardous soil and debris were disposed off-site. Approximately 500 containers ranging in volume from one to 55 gallons (55-gallon drums) were also recovered. The containers included PCPs, pharmaceutical products, and laboratory and chemical wastes. Representative samples were collected for waste classification prior to off-site disposal. The excavated area was backfilled and the area restored.
- **2008:** Portions of the North Waste Cell were found to extend under the landfill perimeter road but were left in place so that the existing road and landfill cap were not undermined. An extension of the existing landfill cap over this area was constructed between August and October.

2.3 Prior Investigations and Remedial Activities

A number of inspections, investigations, and remedial activities have been completed at CFS beginning in the early 1970s. Previous investigations and remedial activities completed at the Site are listed below. The results of these investigations are discussed in further detail within the RI Report submitted under separate cover.

- **Early Investigations (prior to 1983 NPL Listing)** include the following:
    - Inspections of nearby creeks such as Trout Brook and East Trout Brook, nearby springs, and wells on residential properties were conducted due to environmental concerns related to landfill leachate impacting nearby creeks.
    - In 1974, NJDEP recommended the installation of four groundwater monitoring wells, two of which were installed by Combe Fill Corporation in 1977. Sampling of these wells reportedly continued until May 1981.
    - Beginning in 1980, sampling and analyses of groundwater and leachate at the landfill, local residential wells, and nearby surface waters were conducted by Chester and Washington Townships, NJDEP, and local environmental groups—the Upper Raritan Watershed Association (URWA) and Help Avoid a Landfill Tragedy (HALT).
    - In May and June 1981, HALT organized the sampling and analysis of approximately 90 local residential wells for VOCs. NJDEP collected additional residential well samples in June, July, and September of 1981. This sampling supplemented a Chester Township private well testing program, which was conducted from January through September 1981.

- In August 1982, NJDEP performed a terrain conductivity survey to determine the location and direction of groundwater contamination.

- **1982 Geologic Reconnaissance:** A geologic reconnaissance of CFS and the vicinity was conducted by the NJDEP on June 29 (Germine, 1982).
- **1983 Macroinvertebrate Survey:** A macroinvertebrate survey was conducted to determine if benthic communities in nearby surface waters had been impacted adversely by leachate and surface runoff from the landfill (NJDEP 1983).
- **1984 Stream, Leachate, and Residential Well Sampling:** In February and April, NJDEP collected leachate samples, stream water samples, stream sediment samples, and potable water samples from residential wells and a childcare facility.
- **1984-1986 RI/FS:** The field investigation portion of the 1986 RI/FS (LMS 1986) was conducted from 1984 to 1985 and consisted of a geophysical survey, soil boring and rock coring, installation of shallow overburden and deep bedrock wells, test pit investigation, and aquifer pump testing. The 1986 RI revealed the presence of a wide range of contaminants; most of the COCs were VOCs, including benzene, toluene, 1,2-DCA, chloroform, and methylene chloride.
- **1986 Record of Decision:** A remedy was selected in the ROD to address the landfill and overburden groundwater (EPA 1986).
- **1987 Final FS Report:** The Final FS (LMS 1987) was developed and provided detailed evaluations for identified alternatives and their elements.
- **1991 Remedial Design Field Sampling and Testing Report:** The field testing and sampling program was conducted to collect data for use in the design of the remedial action. Activities included landfill gas testing, condensate testing, fill delineation (geophysical investigation and test pits), materials investigations, landfill cover suitability and stability analyses, subsurface foundation evaluation, aquifer testing, treatability testing, percolation testing, and interim environmental monitoring of air, surface water, sediments, and groundwater.
- **1993 Final Design:** The Final Design Report (O'Brien & Gere 1993) provided the design specifications for the cover system, landfill gas collection and treatment system, the shallow groundwater recovery system and the groundwater treatment system, as well as a groundwater recovery system effectiveness monitoring plan and a preliminary operations and maintenance (O&M) plan.
- **1993-1995 Buried Drum Investigations and Removals:** The recovery of buried drums from three separate areas along the eastern perimeter of the landfill was included in a March 1997 NJDEP file memorandum (Dispoto 1997).
- **2004 Millstone Crossing Well Investigation:** A downhole geophysical investigation of boreholes at a proposed residential development, known as Millstone Crossing, to the northeast of the landfill (now the Chester Township Parker Preserve), was completed by the New Jersey Geological Survey (NJGS) in late 2004 (NJDEP 2005, Herman 2006).
- **2006 Explanation of Significant Differences (ESD) for the Combe Fill South Landfill Superfund Site:** The ESD (EPA 2006) revised one aspect of the ROD for the Site. The ESD modified the provisions for an active landfill gas and condensate collection and treatment system to a passive landfill gas venting system. The change to the passive

system was made based on test results from studies completed after the 1986 ROD. Additional tests were conducted to confirm the appropriateness and protectiveness of the change. Concentrations of landfill gas components were found to be below concentrations suitable for an active treatment system. In addition, the risk associated with landfill emissions was predicted to be below policy limits. Based on this data the NJDEP and EPA accepted the design contractor's recommendation of a passive system.

- **2006-2009 North Waste Cell Removal and Closure:** Non-native fill was encountered outside the cap limits along the northern property boundary in 2001 during the installation of landfill gas probes (NJDEP 2011b). This area of non-native fill, which became known as the North Waste Cell, was investigated and delineated by NJDEP through borings, test pits and trenches (Walshe 2005). NJDEP retained Clean Venture, Inc. (CVI), to excavate the North Waste Cell after the Responsible Parties declined to complete the work.
- **2007-2008 Remedial Investigation and Remedial Action Selection:** The Louis Berger Group, Inc. (Berger), under contract to NJDEP, performed field activities for the OU2 investigation (Berger 2010). Activities performed included borehole logging, downhole imaging, and packer testing at the Millstone Crossing bedrock wells, sampling of landfill piezometers, sampling of stream pore water at Trout Brook and its tributaries, vapor intrusion sampling at four homes on Schoolhouse Lane, and development of a database of historic analytical results.
- **2009 Pump Test:** Handex Consulting & Remediation-Northeast, LLC (Handex), conducted a pump test at well RW-T near the northeastern edge of the landfill in July to determine maximum sustainable yield from the well, drawdown, and hydraulic influence (Handex 2009).
- **2011 Long-Term Pump Test:** Between September 2010 and March 2011, Handex performed a long-term pump test on bedrock recovery well RW-T with nearby observation wells, and sampling of well RW-T for chemical analysis (Handex 2011). The scope of work consisted of pumping recovery well RW-T for an extended period of time to determine the feasibility of remediating groundwater contamination by pumping from the bedrock aquifer. The objectives of the test included determining the maximum long-term sustainable yield of RW-T, the influence of pumping RW-T on the contamination in the bedrock aquifer, and the feasibility of using RW-T as a recovery well based on observed drawdown in the bedrock and overburden aquifers.
- **2010/2011 Potable Well Sampling:** In late 2010 or early 2011, EPA contractor Weston Solutions, Inc. (Weston) sampled potable wells in Chester and Washington Townships within approximately one mile of the landfill, as well as the potable well at the landfill's treatment plant. Analytical results for 1,4-dioxane were evaluated for approximately 168 residential properties located on Parker Road, Schoolhouse Lane, Highland Drive, Peach Tree Lane, East Mill Road (County Route 513 aka State Highway 24); East Gate Road, and East Valley Brook Road.
- **2015 Public Water Supply Extension:** The EPA extended a water line to 73 homes and businesses threatened by contaminated groundwater from the landfill. The water line provides Washington Township Municipal Utilities Authority water to homes and businesses along Parker Road, Schoolhouse Lane, and a small portion of Route 513

(identified in the EPA press release as Route 24). Potable water wells at those properties were abandoned as part of the work (EPA 2015).

2.4 Summary of Remedial Investigation

In February of 2010, EPA issued a work assignment to complete the RI/FS for the deep bedrock aquifer and areas outside the landfill property boundary. The FS would select and identify the viable remediation alternatives to support the selection of an approach for Site remediation and then to use the data in a well-supported ROD. The RI conducted between 2010 and 2015 included the following field activities:

- Installation of 19 bedrock monitoring wells.
- Installation of nine pairs of piezometers and stream gauges.
- Collection of samples from five soil borings.
- Collection of almost 200 groundwater samples, 22 soil samples, 24 surface water samples, 53 potable well water samples, and 24 sediment samples.
- Collection of short- and long-term water level monitoring data.
- Geophysical surveys including resistivity, Willowstick® electromagnetic, magnetic gradient and electromagnetic terrain conductivity to locate preferential flow pathways in bedrock and also possible buried drums in two locations at the landfill.
- Downhole investigations incorporating FLUTe™ hydraulic profiling, packer testing, and downhole geophysical surveys including single-point resistivity, long normal resistivity and short normal resistivity; fluid temperature; fluid resistivity; caliper; natural gamma; heat pulse flow meter; and acoustic televiewer.
- Wetland delineation, wildlife surveys, well condition surveys and land surveys (topographic, boundary, stream cross sections and well/piezometer horizontal and vertical locations).

The RI Report, submitted under separate cover, provides further details of these activities.

2.5 Physical Characteristics

2.5.1 Surface Features

As shown on the topographic map (**Figure 2-4**), an electric utility easement crosses the landfill running southwest to northeast from an approximate elevation of 810 to 820 feet.[2] The landfill surface slopes downward towards the utility easement from both the northwest and the southeast. A large section of the landfill northwest of the utility easement sits on a natural topographic high, with the highest portion of the landfill in the north-central area at

[2]Vertical datum is NAVD88.

approximately 875 feet (**Figure 2-4**) From this topographic high, the land surface dips steeply to the west, northwest, and north, and descends with lesser slope to the south and southeast. The remaining section of the landfill, southeast of the easement, rises to between 840 and 850 feet (the older portions of the landfill). The elevation of the landfill perimeter road ranges from about 800 feet in the west to 875 feet in the north. Rip-rap filled channels capture and divert surface runoff from the landfill to detention basins. Historically, landfill runoff discharged to East Trout Brook to the south, the Lamington River unnamed tributary (UNT) to the north, the Tanners Brook UNT to the northwest, and Trout Brook to the west and southwest.

Two northeast-trending ridges in the area north and northeast of the landfill (referred to as the northwest and northeast ridges, which rise to 895 feet and 880 feet, respectively) are significant surface features. These ridges frame an elongated topographical low leading from the landfill to the residential area on Schoolhouse Lane to the northeast, approximately 1,900 feet from the landfill perimeter. Surface elevations in the low area flanked by the two ridges range from approximately 815 feet at the edge of the landfill to 775 feet at Schoolhouse Lane.

Nearby stream headwaters include East Trout Brook to the southeast, the Lamington River UNT to the northeast, the Tanners Brook UNT to the west, and Trout Brook to the south (**Figure 2-2**).The ridges provide surface and subsurface boundaries that constrain stormwater runoff and groundwater flow in the area north of the landfill towards Schoolhouse Lane and the Lamington River UNT as shown in on the Topographic Map (**Figure 2-4)**.

2.5.2 Land Use

Land use in the vicinity of CFS is primarily low-density residential (lot sizes are generally more than two acres) amidst large parcels of cleared or forested rolling hills. Although some horse husbandry and vegetable, grain, and orchard farming are done in the area, most former farmlands are now fallow.

Immediately northeast of the landfill is the 45-acre Parker Road Preserve, a low-impact recreation park owned by Chester Township. Previously, the area was slated for a residential subdivision, known as Millstone Crossing. The park covers a portion of the area between the two northeast trending ridges and extends north towards the residential properties along Schoolhouse Lane. To the northwest of the landfill is a horse farm. Residential homes and several commercial establishments, including construction and landscaping companies, automotive repair and a small heating oil distributor, are located on Parker Road to the east.

A series of county and state parks, including the Black River County Park and Hacklebarney State Park, lie to the east and south along the Lamington River. These parks border both sides of the Lamington River from approximately the crossing of East Mill Road (County Route 513) to the border with Hunterdon County to the south. An approximately 3,000-foot section of Trout Brook, upstream of its confluence with the Lamington River, borders or lies within Hacklebarney State Park.

2.5.3 Climate

The Site has a continental-type climate where winters are controlled by polar continental air masses and summers by tropical air masses. Throughout most of the year the prevailing winds are from the southwest but during the cooler half of the year (generally from October to April), winds from the northwest are predominant. The average annual temperature is 49 degrees Fahrenheit (°F) with an average July high of 82°F and an average January low of 17°F. The average annual precipitation (rainfall) is 53.23 inches and average annual snowfall is 35 inches (US Climate Data 2015).

2.6 Geology and Hydrogeology

2.6.1 Site Geology

Lithological information from borings advanced during the RI produced cross sections to further evaluate geologic and hydrogeologic conditions. See **Figures 2-5** and **2-6** for selected cross-sections from the RI. Cross-section A-A' spans the distance between monitoring well CF-216D at the Jayne Valley horse farm to the northwest of the landfill to well CF-230D in the wildlife refuge along County Route 513 to the northeast. A second cross-section D-D' is from monitoring well CF-229D located near Parker Road southwest of the landfill, to monitoring well CF-204D at Schoolhouse Lane to the northeast of the landfill. The cross sections illustrate a highly variable bedrock surface with varying thicknesses of overburden and saprolite atop biotite-quartz-feldspar gneiss and hornblende granite, alone or in combination, with the granite significantly more predominant. Bedrock fractures are steeply dipping, almost vertical, in most boreholes.

2.6.1.1 Overburden

Natural (non-fill) overburden material contains unconsolidated sand, silt, clay, and gravel derived from the underlying bedrock. In most areas (with the exception of the ridgelines), the overburden includes saprolite. Overburden thickness ranges from about four feet on the ridges to 100 feet in the low-lying areas. Overburden depths on the northeast trending ridges and at the adjacent horse farm property are shallow, only about 5 to 10 feet thick, whereas overburden depths in the low-lying area between the northeast trending ridges and to the south of the landfill vary between 40 and 100 feet thick. Very permeable soil and saprolite account for most of the infiltration from precipitation to the bedrock aquifer.

2.6.1.2 Reworked Soils and Waste

Historic landfill operations and subsequent closure disturbed or removed most of the previously existing native soil within the landfill footprint. As described in a Site inspection report from 1979, within the waste boundary, the trench excavation disposal practice removed all overburden material above bedrock which was subsequently used to cover the waste (Markewicz 1979).

Observations made during the drilling of well D-6 in the 1980s indicated the presence of numerous voids in the fill, some measuring several feet thick, which provided significant conduits for fluid flow through the fill. On the other hand, finer and tightly compacted fill

materials were also observed, which impeded fluid movement (LMS 1986).

2.6.1.3 Native Soil

Unconsolidated deposits consist of soils formed from old glacial till (pre-Wisconsin Age) and/or from residuum derived from the granitic gneiss bedrock and are often very shallow. Mapped soils (Web Soil Survey, 2012) in the area belong to the following series:

- Annandale Series: This series consists of very deep, well-drained soils that formed in deeply weathered old glacial till (pre-Wisconsin Age) and underlying residuum derived mainly from granitic gneiss. Annandale soils occur on gently sloping to strongly sloping uplands, with slopes ranging from three to 25 percent. These soils have a fragipan in the lower part of the solum. The soil in this series is mostly gravelly loam.
- Califon Series: This series consists of very deep, moderately well- or somewhat poorly-drained soils formed either in old till or on driftless landscapes in the Northern Piedmont in colluvium from granitic gneiss on upland flats or concave slope positions. The saturated hydraulic conductivity is moderately low. Slopes range from zero to 15 percent. The soil in this series is predominantly loam.
- Gladstone Series: This series consists of very deep, well-drained soils formed in residuum and colluvium from granitic gneiss. The saturated hydraulic conductivity is moderately high to high. These soils occur on upland divides and rolling foothills of the Highlands section of the Appalachian province, the Reading Prong section of the New England province and the Gettysburg-Newark Lowland and the Piedmont Upland sections of the Northern Piedmont province. Slopes range from zero to 65 percent. The soil in this series is predominantly gravelly loam.
- Cokesbury Series: This series consists of deep or very deep, poorly-drained soils formed either in old till or on driftless landscapes of the Northern Piedmont in colluvium from granitic gneiss on upland depressions, headslopes or concave footslope and toeslope positions. The saturated hydraulic conductivity is moderately low. Slopes range from zero to eight percent. The soil in this series is gravelly loam.
- Parker Series: This series consists of very deep, somewhat excessively-drained soils that formed in residuum derived from granitic gneiss bedrock. It occurs on gently sloping to very steep slopes of ridges and hills. Slopes range from three to 70 percent. The soil in this series is gravelly loam.

2.6.1.4 Saprolite

Saprolite is a weathered rock derived from the chemical weathering of bedrock. At CFS, it consists of minerals consistent with granitic material. Although commonly less competent than the parent bedrock, saprolite generally retains the parent rock mineralogy and structure. It is green-brown to yellow-brown and consists of silt, fine-to-coarse-grained sand, and many highly weathered granite fragments. The fragments are generally very soft and easily crushable. The thickness of the saprolite varies across CFS; however beneath the buried waste in the landfill, the operator had removed the saprolite and used it as daily cover at the time active landfilling occurred.

2.6.1.5 Bedrock

Several prior investigations as well as the most recent RI characterized the bedrock geology at CFS. Hornblende granite was widely observed during subsurface investigations and is described as a buff to pink-colored, weakly to moderately foliated granite containing quartz, oligoclase, feldspar, and hornblende.

Bedrock Surface

Depth to bedrock measurements were used to generate a bedrock surface map (**Figure 2-7**). The highest bedrock surface elevation is in the northeastern portion of CFS, to the north of the landfill (815 feet) on the two ridges. Within the landfill, to the north and immediately to the south, the bedrock surface slopes to the utility corridor.

The elevation of the bedrock surface in the low-lying area between the two ridges north of the landfill slopes from between 760 and 770 feet at the landfill boundary to 740 and 750 feet near Schoolhouse Lane. Further north, the bedrock surface slopes northeasterly from Schoolhouse Lane towards County Route 513, with elevations around 670 feet. The bedrock surface also slopes to the south from the northern edge of the landfill to 750 feet south of the landfill. Further south, the bedrock surface slopes primarily southeast. Trout Brook follows the general slope of bedrock in this area. From the western portion of the landfill, the bedrock surface slopes from around 790 feet to below 760 feet at the adjoining horse farm.

Bedrock Structure

The regional strike of bedrock is to the northeast and is highly fractured. As described in a previous investigation, it is strongly layered with compositional mineral bands consisting of quartz- and feldspar-rich light layers to dark amphibolite layers. The layering is cut by two sets of fractures or joints. The intersections of fracture planes locally form hydraulic conduits for groundwater flow (NJDEP 2005; Herman 2006).

The RI encountered numerous bedrock fractures. Fractures were frequently large and steeply dipping at depths of over 600 feet bgs and in the range of 45 to 90 degrees, with a large number exceeding 70 degrees. The boreholes for wells CF204D and CF206D to the north of the landfill near Schoolhouse Lane produced artesian flow, confirming that this area has a considerable

pressure head and upward flow. Completion as multi-port wells required extending well casings several feet above the ground surface. The NJGS investigation of the deep bedrock wells installed for the proposed Millstone Crossing development also encountered upward flow in a number of boreholes to the south and east of wells CF204D and CF206D.

2.6.2 Surface Water Hydrology

A large portion of the landfill north of the utility easement sits on a natural topographic high (**Figure 2-4**). The highest portion is in the north-central section, with steep and short slopes to the west, northwest, and north, and more gradual, longer slopes to the south and southeast that direct surface runoff in these directions. To the west-southwest of the landfill near the headwaters of Trout Brook and the Tanners Brook UNT is a hardwood wetland.

Headwaters of several streams originate around the landfill, including East Trout Brook to the southeast, the Lamington River UNT to the northeast, the Tanners Brook UNT to the west, and Trout Brook to the south (**Figure 2-4**). The confluence of East Trout Brook and Trout Brook is approximately one-half mile south of the landfill, south of Parker Road. Trout Brook joins the Lamington River (known locally and referred to as the Black River in several reports of previous investigations) approximately three miles south of CFS in Hacklebarney State Park. Surface drainage from the northeast portion of CFS is towards the Lamington River UNT near Schoolhouse Lane, and the western portion drains towards the Tanners Brook UNT.

Rip-rap lined channels on the landfill cap capture stormwater runoff. From these, runoff flows into a perimeter ditch and into on-site detention basins. Prior to capping, surface runoff and leachate from the landfill drained to the headwaters of the nearby streams. In addition to a portion of the surface water runoff from the landfill perimeter road, East Trout Brook receives the discharge from the on-site GWET. In the absence of heavy precipitation and resulting overland flow, the GWET effluent is the main source of water for the headwaters of this stream.

RI data indicates that the Lamington River UNT and Trout Brook are gaining streams (groundwater contributes to stream flow). Based on water elevation measurements collected as part of the groundwater and surface water interaction investigation, shallow groundwater discharges to surface water along Trout Brook to the south, the wetlands to the west, and the Lamington River UNT along Schoolhouse Lane to the northeast. The upper portion of East Trout Brook to the southeast immediately below where the treatment plant effluent is discharged is a losing stream, while the lower portion is a gaining stream.

2.6.3 Site-Specific Hydrogeology

Two hydraulically connected aquifers, an unconfined overburden/saprolite aquifer (overburden aquifer) and a fractured bedrock aquifer (bedrock aquifer), exist within the OU1 and OU2 investigation areas. The bedrock aquifer is confined (artesian).

2.6.3.1 Overburden Aquifer

Groundwater flow in the overburden aquifer has three major components:

- Horizontal flow outward from the landfill generally follows topography towards surface water bodies (**Figure 2-8**). The horizontal flow direction is nearly radial from higher elevations at and near the landfill. The design intent of the GWET recovery wells installed around the landfill perimeter was to capture overburden groundwater and leachate. Only one recovery well, RW-T, extends approximately 50 feet into the bedrock aquifer. The remaining recovery wells are no deeper than the overburden/bedrock interface.
- Groundwater also flows along the bedrock surface from higher to lower top of bedrock surface elevations at the overburden/bedrock interface. As indicated in RI, two bedrock surface highs beneath the northwest and southeast portions of the landfill frame the sides of a bedrock surface low that developed at the contact between two rock types and crosses CFS from southwest to northeast. The bedrock interface along this low slopes to the northeast and southwest from a divide along the landfill's northern perimeter and marks a major fracture zone. From the divide, groundwater at the overburden-bedrock interface flows either northeast (towards Schoolhouse Lane and the Lamington River UNT) or southwest (towards Trout Brook).
- Vertical flow is towards the bedrock interface into mostly steeply dipping bedrock fractures. Downward flow from the overburden to the bedrock aquifer occurs at the landfill and in the immediate vicinity, whereas upward flow occurs near the streams.

2.6.3.2 Bedrock Aquifer

Once in the bedrock aquifer, groundwater moves downward and horizontally in recharge areas, and predominantly upward and horizontally in discharge areas, emptying into seeps and gaining streams around the landfill (**Figure 2-9**). However, these streams are not boundaries to groundwater flow.

Groundwater flow in the bedrock aquifer is controlled by structure, namely fractures. The FLUTe™ hydraulic profiling, packer testing, and geophysical investigations conducted during the RI concluded that the bedrock fractures were numerous, frequently large, had high (steep) angles and occurred at depths of over 600 feet bgs. These high-angle fractures act as steeply dipping pipes that transport contaminants in groundwater downward and away from the landfill.

Downhole geophysical investigations conducted during the RI determined that the northeast-southwest orientation of the bedrock regional strike results in predominant flow pathways in those directions. Flow in other directions is less pronounced, but not absent. As bedrock groundwater flows in multiple directions away from the landfill, which is a local topographic high, it transitions from downward flow to predominantly upward flow in proximity to the streams. Outside of the landfill, downward flow from the overburden to the bedrock aquifer is also predominant. Geophysical testing during the RI and previous investigations demonstrated downward flows at wells on and in the immediate vicinity of the landfill. Wells further from the landfill, especially in the low-lying area between the landfill and Schoolhouse Lane, and wells closer to discharge features generally demonstrated upward flows. Two deep boreholes installed during the RI near Schoolhouse Lane were found to be artesian and to discharge above the surface.

The Willowstick® Electromagnetic Survey conducted during the RI identified three major preferential flow paths, running southwest to northeast from the north side of the landfill to Schoolhouse Lane and the Lamington River UNT. The flow paths run roughly parallel to one another from the landfill towards Schoolhouse Lane, converge there and turn east as one combined flow path. The three preferential flow paths follow near vertical fracture zones and have both shallow (overburden) and deep (bedrock) components.

Although bedrock groundwater predominantly flows through preferential flow paths along strike NNE towards the Lamington River UNT, it also flows to lesser extents radially from the landfill area, south to East Trout Brook and Trout Brook, and west to the Tanners Brook UNT.

In addition to the natural fracture zone pathways, a number of man-made conduits have facilitated the vertical movement of groundwater and transport of contaminants for over a decade. These include the boreholes for potable wells installed on the former Millstone Crossing property northeast of the landfill in early 2004 which have been re-cased to 200 feet bgs, but are open boreholes from that depth to the bottom (up to 748 feet bgs), and monitoring wells at and in the vicinity of the landfill constructed with variances from the NJDEP well construction regulations. Both could act as conduits for contaminants from the landfill to the overburden and bedrock aquifers (e.g., casing not installed in competent bedrock, and/or long open boreholes serving as direct conduits for vertical movement of groundwater between the overburden and bedrock aquifers).

3.0 Nature and Extent of Contamination

The results of the field surveys, field investigations, and laboratory analysis of the samples collected during the 2010-2015 RI formed the conceptual Site model (CSM), the nature and extent of contamination in groundwater, surface water and sediment, and the human and ecological risks where complete pathways are present. The nature and extent of contamination, as well as the CSM, are briefly summarized below. Further details are in the RI report submitted under separate cover.

The criteria used to evaluate the presence of contaminants in Site media for purposes of delineation are:

- New Jersey Administrative Code (N.J.A.C.) 7:9C Groundwater Quality Standards (GWQS) and interim generic groundwater quality criteria (IGGWQC), January 2018;
- 40 Code of Federal Regulations (CFR) §141.16 maximum contaminant level (MCL) for tritium in aqueous media;
- N.J.A.C. 7:26D Remediation Standards (September 2017) and default Impact to Groundwater Soil Screening Levels (IGWSSLs, November 2013) for soil;
- Lowest Effects Level (LEL) for sediment or the most conservative freshwater sediment quality criterion in the March 2009 NJDEP Ecological Screening Criteria (ESC); and
- N.J.A.C. 7:9B Surface Water Quality Standards (SWQS, October 2016). The Region 5 Ecological Screening Level (August 2003) was considered for 1,4-dioxane in surface water, as New Jersey does not have a SWQS for 1,4-dioxane. However, the current GWQS is more applicable as surface water also recharges groundwater in some areas.

The contaminants of concern (COCs) for purposes of delineation in the RI included those that exceeded promulgated standards or interim criteria at a frequency of five percent or greater of the total number of samples with the exception of sediment, for which there are no standards - only screening criteria. Metals with aqueous standards based on secondary characteristics (i.e. appearance, odor, and taste) being aluminum, iron and manganese, were not treated as COCs for purposes of delineation in groundwater or surface water, although these metals were evaluated in the risk assessments as contaminants of potential concern (COPCs). Cobalt was evaluated as a COPC in the Baseline Human Health Risk Assessment (BHHRA), although cobalt did not exceed the interim GWQC and was not considered a COC for delineation purposes.

3.1.1 Groundwater

Eight target contaminants - 1,4-dioxane, benzene, trichloroethylene (TCE), di(2-ethylhexyl)

phthalate (DEHP), alpha-benzene-hexachloride (alpha- BHC), lead, arsenic, and chromium - exceeded their respective GWQS. Two tentatively identified compounds (TICs) – phenobarbital and 2-methyloxy-methylbutane (also known as tert-amyl methyl ether and hereafter referred to by the acronym TAME) - exceeded the IGGWQC for synthetic organic chemicals (SOCs). 1,4-dioxane and benzene were the most significant organic groundwater contaminants with 1,4-dioxane exceeding the 0.4 microgram per liter (µg/l) GWQS at 20 locations in 95 RI samples[3] with concentrations up to 350 µg/l in a 2017 pump test sample. The horizontal extent of the 1,4-dioxane plume was interpolated because the comparison criterion decreased from 10 µg/l to 0.4 µg/l subsequent to completion of RI sampling and analysis. The analytical method reporting limit of 0.5 µg/l is also above the recently promulgated standard (January 2018). Based on the most recent groundwater analytical data (2014/2017), elevated concentrations of 1,4-dioxane were present in samples from monitoring wells located in the following areas (**Figures 3-1** and **3-2**):

- Northeast of the landfill:
  - Monitoring well CF-209D (290 µg/l during 2014 sampling event and 350 µg/l during 2017 sampling event) at 150-160 feet bgs, located to the northeast of the North Waste Cell.
  - Monitoring wells CF-204D (93 µg/l) at 195-200 feet bgs, CF-227D (42 µg/l) at 110-120 feet bgs, and CF-206D (35 µg/l) at 147-152 feet bgs located further downgradient of well CF-209D.
  - Monitoring well CF-211D (24 µg/l) at 124-131 feet bgs, located along the northeast portion of the landfill perimeter road.
- West of the landfill:
  - Monitoring well CF-216D (44 D µg/l) at 205-210 feet bgs at the horse farm.
  - Monitoring well CF-212D (38 µg/l) at 153-158 feet bgs in the wooded area adjacent to the landfill.
- Southwest of the landfill:
  - Monitoring well CF-225D (23 µg/l) at 106-111 feet bgs.

Other COCs include:

- Benzene exceeded the 1 µg/l GWQS at six locations in 26 samples with concentrations up to 90 J µg/l.
- Lead is the most significant inorganic groundwater contaminant, exceeding the 5 µg/l GWQS at seven locations in 11 samples with concentrations up to 175 µg/l.
- Concentrations of TCE (maximum 4 J µg/l vs. 1 µg/l GWQS), DEHP (maximum 15 µg/l vs. 3 µg/l GWQS), alpha-BHC (maximum 0.073 µg/l vs. 0.02 µg/l GWQS), arsenic (maximum 6.4 J µg/l vs. 3 µg/l GWQS) and chromium (maximum 262 J µg/l vs. 70 µg/l

[3] 95 samples does not include duplicates.

GWQS) exceeded the respective GWQS equal to or less than an order of magnitude in a few locations in 10 or fewer samples.

- The TIC Phenobarbital exceeded the IGGWQC for carcinogenic SOCs of 5 ug/L in 16 RI investigation samples from 9 locations and in 51 NJDEP PCEM samples from 13 locations, for a total of 22 locations.[4]
- The TIC TAME exceeded the IGGWQC for non-carcinogenic SOCs of 100 ug/L in 30 NJDEP PCEM samples from 22 locations. It was not reported or identified as a named TIC in the RI samples.
- All of the COCs except for TCE and the TICs were detected at concentrations exceeding criteria at the deepest intervals in some of the multi-level monitoring wells. Although clean intervals exist below the deepest contaminated zones for some COCs at various well locations, detections of 1,4-dioxane, benzene, DEHP, and chromium at some of the deepest sample locations illustrate that VOCs, semi-volatile organic compounds (SVOCs), and metals in groundwater have migrated via steeply dipping bedrock fractures to the deepest intervals investigated in individual monitoring wells. The vertical extent of groundwater contamination is as deep as the fractures that create the pathways at any single location. The deepest historic detection of CFS-related groundwater contamination was in a Millstone Crossing well at 750 ft. bgs. The deepest detection in the RI wells was 693 ft. bgs.

3.1.2 Surface Water

No VOC, SVOC, pesticide or PCB COCs are associated with the four investigated streams. Copper, lead, silver, and cadmium concentrations exceed the SWQS (**Figure 3-3**). Maximum surface water concentrations for each of these four metals were less than an order of magnitude above the respective SWQS: copper (6.7 J µg/l vs. 2.2 µg/l SWQS), lead (9 J µg/l vs. 5.4 µg/l SWQS), silver (0.54 J µg/l vs. 0.12 µg/l SWQS), and cadmium (0.19 µg/l vs. 0.056 µg/l SWQS).

Background surface water contaminants include one SVOC, DEHP, at 5.9 µg/l vs. 0.3 µg/l SWQS; and two detected pesticides - alpha-chlordane (0.00067 µg/l [no SWQS]) and endrin (0.00047 µg/l vs. 0.036 µg/l SWQS). Background surface water contaminants did not include any of the metal COCs. No correlation is evident between contaminants in the OU2 surface water samples and background surface water samples.

3.1.3 Sediment

In sediment, concentrations of the polycyclic aromatic hydrocarbons (PAHs) anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene,

[4] RI samples and NJDEP PCEM samples collected over the same time periods. NJDEP sample results prior to the RI were not used.

dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene, along with benzyl butyl phthalate in various combinations, exceeded the freshwater LELs at two locations on the Lamington River UNT and at one location on the Tanners Brook UNT (**Figure 3-4**). At intervening sediment sample locations between the landfill and the stream headwaters, these PAH COCs were not detected.

Copper (28.2 J milligrams per kilogram [mg/kg] vs. 16 mg/kg LEL), lead (71.4 J mg/kg vs. 31 mg/kg LEL), silver (0.56 mg/kg vs. 0.5 mg/kg LEL), cadmium (2.6 mg/kg vs. 0.6 mg/kg LEL), arsenic (9.5 mg/kg vs. 6 mg/kg LEL), mercury (0.27 mg/kg vs. 0.17 mg/kg LEL), and manganese (1,400 mg/kg vs. 630 mg/kg) exceeded the respective freshwater sediment LELs by less than an order of magnitude (**Figure 3-5**).

Two VOCs, acetone (0.026J to 0.1 mg/kg) and methyl ethyl ketone (0.019J to 0.082 mg/kg), were detected in the background sediment samples. Neither compound has a criterion. SVOCS were detected in three of the ten background sediment samples. In one of the samples, acetophenone, a compound without a sediment criterion, was reported at 0.047 mg/kg. Two other samples had multiple detections of PAHs; three of which exceeded sediment criteria - benzo(a)anthracene (0.12J to 0.16J mg/kg vs. 0.108 mg/kg LEL), benzo(a)pyrene (0.19J mg/kg vs. 0.15 mg/kg LEL), and pyrene (0.21J to 0.23J mg/kg vs. 0.195 mg/kg LEL). PCBs were not detected in the background sediment samples and none of the concentrations reported for the metals exceeded the LEL criteria. For cyanide, the single reported detection (0.13 mg/kg) exceeded the LEL (0.0001 mg/kg). Although background sediment samples had some of the same PAHs as Site-related samples, these contaminants are ubiquitous and background concentrations are lower than OU2 sediment concentrations.

3.1.4 Soil

Soil samples did not contain VOCs, SVOCs, pesticides, or PCBs at concentrations above applicable criteria. Concentrations of nine metals - aluminum, arsenic, beryllium, cadmium, cobalt, manganese, nickel, silver and vanadium - exceeded criteria in various combinations at all five soil boring locations along the landfill perimeter road. Arsenic was the only metal in soil that is also a groundwater COC.

3.2 Contaminant Fate and Transport Summary

Contamination originating at CFS enters the overburden and bedrock aquifers, shallow and deep groundwater flows transport it outward, and it predominantly discharges to surface water in the surrounding area, although some portion of the contamination remains in the bedrock aquifer. Along the migration pathways, benzene undergoes biodegradation and volatilization from the groundwater table and surface water, while 1,4-dioxane, which is less volatile, does not biodegrade, or sorb to organic matter, does not. Transport of 1,4-dioxane is with minimal attenuation through these migration pathways. TCE is subject to reductive dechlorination, which is not evident at CFS. DEHP tends to sorb strongly to particulates, has low solubility, and will biodegrade in both water and soil under aerobic conditions. Transport of inorganics such as arsenic, chromium and lead, will be via adsorption to particles along the groundwater pathway and will have the potential to accumulate in stream sediments.

Contaminant transport pathways at CFS are complete if humans come into contact with contaminated ground and surface waters or if wildlife comes into contact with contaminated surface water and sediment. Humans previously ingested contaminants when consuming water from potable wells, and inhaled and contacted contaminants when showering. However, connection of affected residences to a municipal water supply severed this pathway. Wildlife ingests contaminated surface water and to a lesser extent, sediment when drinking or feeding on aquatic species.

The soil and soil vapor pathways at CFS are incomplete. The landfill and perimeter road act as a cap on the contaminated soil, preventing direct contact, ingestion, and inhalation. The NJDEP and EPA vapor intrusion investigations found an incomplete soil vapor pathway and no impacts from vapor intrusion to indoor air at residences in areas of contaminated groundwater.

3.3 Risk Assessment Summary

The BHHRA evaluated potential baseline health cancer risks and noncancer hazards for current and future receptor exposure to contaminants in groundwater and surface water.

- Residents are potentially exposed to contaminants in groundwater via drinking water ingestion and dermal contact and inhalation of volatile compounds via their release from water during showering/bathing. For a resident's exposure to Site-wide groundwater, chromium, 1,4-dioxane, arsenic, benzene, DEHP, chloroform, vinyl chloride, 1,4-dichlorobenzene and 1,2-dichloroethane contribute the most to the excess lifetime cancer risk (ELCR) of 1.2E-03. BHC alpha and TCE also contribute in the Core of the Plume evaluation that has an ELCR of 6.9E-03. For noncancer, several COPCs contribute to total HIs greater than one, 4.0E+00 for an adult and 4.9E+00 for a child, but none of the individual HQs for these COPCs are greater than one (arsenic, chromium, cobalt, iron, manganese, benzene, DEHP and TCE), except for 1,4-dioxane with HQs of 1.4E+00 and 1.2E+00 for an adult and child's inhalation route, respectively. For the Core of the Plume evaluation, chromium, 1,4-dioxane, DEHP, TCE and benzene have HQs greater than one, which contribute to total HIs of 1.3E+01 for an adult and 1.5E+01 for a child. Total chromium is evaluated as hexavalent chromium in both receptor scenarios; an evaluation of chromium as trivalent chromium indicates that chromium is no longer a contributor to the hazard and risks, which have decreased, but the hazards and risks remain in the same orders of magnitude. There are several constituents that are identified as COPCs for Site-wide groundwater, but not for Core of the Plume groundwater, as the Core of the Plume evaluation included only the eight COCs identified in the RI. Actual exposure of residents to these COCs in groundwater is expected to be limited, as the 1986 ROD called for an alternate water supply and a municipal water supply has been constructed to serve properties impacted by groundwater contamination. However, not all affected property owners have connected to the municipal supply.
- A child resident's exposure to lead in Site-wide groundwater was evaluated separately using the integrated exposure uptake biokinetic (IEUBK) model. The model predicted 22% of the population of children between the ages of one and six years old would be

expected to have a blood lead concentration above 5 ug/dL, which is greater than the regional threshold of 5%. For the Core of the Plume evaluation, the model predicted 68% of the population.

- Residents are also potentially exposed to contaminants through vapor intrusion. While the initial findings indicate there may be a potential VI concern, residents are unlikely exposed to contaminants through the VI pathway. TCE in indoor air likely originates from sources unrelated to VI, as TCE is not detected in any of the sub-slab soil gas samples nor are there TCE concentrations in groundwater exceeding the groundwater screening level of 2 ug/L within a quarter mile or more of residences or any other structure.
- Recreational users are potentially exposed to contaminants in surface water via incidental ingestion and dermal contact with the surface water and through the ingestion of fish caught in impacted water bodies.
- For a recreational user's exposure to surface water from Trout Brook, Lamington River UNT, and Tanners Brook UNT, consumption of fish with arsenic contributes the most to the ELCR of 5.7E-06. The noncancer HIs for an adult and child are below one. For a recreational user's exposure to surface water from East Trout Brook, downstream from the GWTP permitted discharge, arsenic and 1,4-dioxane contribute most to the ELCR of 8.4E-06. The noncancer HIs are below one. The ELCRs calculated for exposure to COPCs are within EPA's acceptable risk range for surface waters within Trout Brook, Lamington River UNT, Tanners Brook UNT and East Trout Brook. For a child recreator's exposure to lead in surface water, the IEUBK model predicted 16% of the population of children between the ages of one and six years old would be expected to have a blood lead concentration above 5 ug/dL. The Site is less accessible and attractive than other recreational areas in the vicinity (e.g. Hacklebarney State Park); therefore, the expected use for recreation (including fishing, as the stream at Hacklebarney State Park is stocked) and any related exposure to environmental media would be low.

The SLERA was prepared to evaluate potential hazards for aquatic biota, benthic invertebrates, amphibians, and plants as well as wildlife exposure to contaminants present in surface water, seep/spring water, and sediment. Plant exposure to contaminants is via uptake and root absorption while wildlife exposure is via ingestion of water, plants, benthic invertebrates, and fish and incidental ingestion of sediment.

For wildlife exposure via bioaccumulation of COPCs in the food chain, the Step 3A refined evaluation of surface water and sediment exposure pathways from the four local streams (Trout Brook, Lamington River UNT, Tanners Brook UNT, and East Trout Brook) indicates the LOAEL-based HQs less than 1 for all receptor groups, except for a spotted sandpiper's, representing avian invertivores, exposure to vanadium in East Trout Brook with a HQ of 1.7. This HQ is slightly above the acceptable limit of 1.

In summary, the Step 3A wildlife food chain modeling HQs are less than 1, except for one constituent in sediment, vanadium, which is not associated with the CFS Site. Therefore, sediment has not been retained as a medium for remedy selection.

There are surface water exceedances of the ecological benchmarks for the evaluation of benthic invertebrates, biota, amphibians, and plants. Remedy selection includes groundwater alternatives that also address surface water.

3.4 Contaminants of Concern

Results of the BHHRA and SLERA indicate that chemical contamination in groundwater and surface water present potentially unacceptable ecological and human health risks. The primary COCs by medium are:

- Groundwater: 1,4-dioxane, arsenic, benzene, BHC alpha, chloroform, chromium, cobalt, DEHP, 1,4-dichlorobenzene, 1,2-dichloroethane, iron, manganese, TCE, and vinyl chloride
- Surface water: 1,4-dioxane and arsenic

Note this list of COCs is derived from the risk assessments which differs from some of the COCs in the RI that are based solely on comparison to numerical standards.

3.5 Conceptual Site Model

The CSM shows the mechanisms in which the source of contamination (i.e. Combe Fill South Landfill) affects the various media (i.e. groundwater, surface water, and sediment) and the exposure routes that impact human health and the environment. The Human Health and Ecological CSMs are presented in **Figures 3-6** and **3-7**, respectively, and the CSM illustration is presented in **Figure 3-8**.

Waste buried within the confines of the capped landfill is the main source of the COCs. Historic landfilling operations placed waste directly onto fractured bedrock with a portion of the waste sitting within the overburden aquifer. The overburden and bedrock aquifers are hydraulically connected. Contamination enters via the overburden aquifer into the bedrock aquifer, or directly into the bedrock aquifer depending on location.

The GWET currently captures a mixture of contaminated groundwater and landfill leachate from most, but not all, of the overburden aquifer within OU1 and a small portion of the bedrock aquifer within OU1. The GWET consists of one sequencing batch reactor (SBR), one clarification tank (inclined plate settler), sand pack filters and granular activated carbon (GAC) treatment prior to surface water discharge via a National Pollution Discharge Elimination System (NPDES) permit to East Trout Brook (Kimball 2012). The GWET effluent contains an average 1,4-dioxane concentration of approximately 20 µg/l according to monthly discharge monitoring reports. The discharge has the potential to impact groundwater at the losing (upper) portion of the stream as well as surface water.

Groundwater in the overburden aquifer that is not captured by the GWET system flows outward from the landfill (generally following topography towards surface water bodies); along the bedrock surface from higher to lower top of bedrock elevations at the overburden/bedrock interface; and vertically towards the bedrock interface into mostly steeply dipping bedrock

fractures.

In addition to lateral flow, downward flow from the overburden to the bedrock aquifer occurs at the landfill and in the immediate vicinity. Wells further from the landfill, especially in the low-lying area between the landfill and Schoolhouse Lane, and wells closer to discharge features generally demonstrate upward flows. Overburden and a portion of bedrock groundwater discharge to streams in the vicinity of the landfill with the exception of the uppermost portion of East Trout Brook, which is predominantly a losing stream.

In general the vertical head gradients (0 to 0.003 ft./ft.) within the bedrock aquifer are an order of magnitude smaller than horizontal gradients (0.01 to 0.03 ft./ft.) (LMS 1986). Therefore, lateral flow predominates with respect to groundwater movement and chemical transport in the bedrock aquifer; however, vertical flow is still an important component in the CSM.

4.0 Remedial Goals and Remedial Action Objectives

4.1 Applicable and Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) Criteria

Section 121(d) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires federal and state ARARs be met. Subpart E, Section 300.400(g) "Identification of applicable or relevant and appropriate requirements," of the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) describes the process to attain ARARs. EPA last promulgated revisions to the NCP on September 15, 1994.

There are differences between the identification and analysis of applicable vs. relevant and appropriate requirements. Applicability is a legal and jurisdictional determination, while the determination of relevant and appropriate is based on professional judgment, considering the environmental and technical factors specific to a Site.

To be applicable, a requirement must directly address the circumstances at the Site. Applicable requirements are defined as “those cleanup or control standards, or other substantive environmental protection requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA Site" (55 FR 8814). Jurisdictional prerequisites of the requirement must be met in order for the requirement to be applicable.

These jurisdictional prerequisites include:

- The party being subject to the law
- The substances or activities must be under the authority of the law
- The law must be in effect at the time activities occur
- The law requires, limits or protects the types of activity in question

A requirement that is relevant and appropriate may not meet one or more jurisdictional prerequisites for applicability but still make sense at the Site, given the specific circumstances. In evaluating the relevance and appropriateness of a requirement, the eight comparison factors in CFR Title 40, 300.400(g) (2) should be carefully considered.

There is greater flexibility in determining relevant and appropriate requirements; i.e., it may be "relevant," in that it covers situations similar to those at the Site, but may not be "appropriate" and, therefore, may not be well suited to conditions at the Site. Portions of a requirement or regulation may be judged relevant and appropriate; however, if a requirement is deemed applicable, all substantive requirements must be met.

To be considered relevant and appropriate, a requirement must be considered in terms of whether the circumstances at the Site are sufficiently similar to those regulated by the requirement.

"Relevant and appropriate" cleanup standards, or other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law, are those that while not considered applicable, address problems or situations similar to those at the CERCLA Site, and whose use is suited to the Site. The relevance and appropriateness is judged by comparing characteristics of the remedial action, physical circumstances of the Site and other factors with those included in the requirement itself.

This is a two-step process, requiring a determination first of relevance, where the requirement pertains to the type of remedial action being taken, location of the action, or chemicals and related conditions at the Site. Second, a determination of whether it is appropriate focuses on the nature of the items, in question, characteristics of the Site, circumstances of the release, and proposed remedial action. The requirement is appropriate if suited to the particular Site. The facility action must comply with requirements that are determined to be both relevant and appropriate. Once a requirement is determined to be relevant and appropriate, it must be complied with as if applicable.

EPA has classified both types - applicable or relevant and appropriate – of ARARs into three categories, depending on whether the requirement is triggered by the presence of a specific chemical, characteristics of a specific location, or a particular response action.

1. Chemical-specific ARARs are risk-based, numeric cleanup standards, e.g., maximum contaminant levels (MCLs) established under the Safe Drinking Water Act, and federal water quality criteria (FWQC) established under the Clean Water Act.
2. Location-specific ARARs are restrictions on the concentration of hazardous substances or on activities in environmentally sensitive areas, e.g., restrictions within floodplains, wetlands.
3. Action-specific ARARs are technology- or activity-driven requirements, resulting largely from provisions of RCRA and the Clean Water Act.

ARARs are promulgated, legally enforceable federal and state requirements. In contrast, "TBC" values include non-promulgated, non-enforceable criteria, advisories, guidance and proposed standards generated by the federal or a state government. TBCs may assist in interpreting ARARs or determine preliminary remediation goals when ARARs do not exist. Once a TBC is identified and becomes part of a Superfund ROD, it is enforceable within the context of the remedial action that is the subject of the ROD.

Screening criteria consisting of ARARs (promulgated standards) and TBCs (screening criteria) were used as benchmarks to evaluate the nature and extent of contamination at CFS.

4.2 Chemical-Specific ARARs for Groundwater

The ARARs for groundwater results comparison are the NJDEP GWQS and IGGWCC. For tritium only, it is the 40 CFR §141.16 maximum contaminant level, based on average annual concentrations assumed to produce a total body dose of 4 millirem per year. No TBCs were identified for groundwater. The IGGWCC are implemented as constituent standards according to the NJDEP January 2018 Fact Sheet.

4.3 Location-Specific ARARs

The area surrounding and including CFS contains significant ecological and natural resources including Category 1 streams, freshwater wetlands and threatened and endangered species and associated habitat. New Jersey regulates environmentally-sensitive natural resource areas, also known as ESNRs. Both above and below ground construction associated with remedial actions are considered regulated activities within ESNRs. Regulated areas and location specific ARARs at CFS include freshwater wetlands, wetland transition areas and open water (N.J.A.C. 7:7A Freshwater Wetlands Protection Act Rules, N.J.A.C. 7:9B Surface Water Quality Standards, N.J.A.C. 7:14A New Jersey Pollution Discharge Elimination System [NJPDES]); threatened and endangered species and associated habitat (Dept. of Land Use Regulation Program permits); flood hazard area floodway, flood fringe and riparian zone (N.J.A.C. 7:13, Flood Hazard Area Control Act Rules); Highlands Preservation Area (N.J.A.C. 7:38 Highlands Water Protection and Planning Rule); Northwest New Jersey 15 Basin Aquifer system (Sole Source Aquifer/Safe Drinking Water Act); the Endangered Species Act of 1973 (87 Stat. 884, as amended 16 U.S.C. 1531 et seq.), and the Migratory Bird Treaty Act of 1918 (40 Stat. 755, as amended; 16 U.S.C. 703-712). In-situ remedial actions involving use of chemicals, microbiota or nutrients, or discharge of treated water to ground or surface waters, require NJPDES approval. In addition to compliance with the regulations listed above, remedial action construction activities must also comply with the Stormwater Management Rules (N.J.A.C. 7:8) and the Standards for Soil Erosion and Sediment Control in New Jersey (N.J.A.C. 2:90-1.1 et seq.).

4.4 Preliminary Remedial Goals

Preliminary Remedial Goals (PRGs) are initial, chemical-specific concentration goals for specific media. PRGs were derived from Federal and State chemical-specific ARARs and TBCs for groundwater, and take into account Site-specific conditions and recommendations from the BHHRA and SLERA. The PRGs for groundwater are presented in **Table 4-1**.

The RI was primarily an evaluation of groundwater in the deep aquifer; however, as there is groundwater flow to surface water that may impact water quality and therefore, ecological receptors, surface water data were considered during the RI and risk assessments. The RI reported only two contaminants that were found in both groundwater and surface water – 1,4-dioxane (organic) and lead (inorganic). 1,4-dioxane-contaminated groundwater is discharging to surface water in Trout Brook, Lamington River UNT and Tanner's Brook UNT and its presence in East Trout Brook is also a result of the treatment plant discharge. As there is no surface water standard for 1,4-dioxane (Federal or State), there are no surface water exceedances. However, the PRG for the GWET effluent concentration is the same as for groundwater, as the upper portion of East Trout Brook is a losing stream, therefore some of the effluent discharges to groundwater.

The presence of lead in the furthest upstream surface water samples from the Tanners Brook and Lamington River UNTs may be a result of discharge of lead-contaminated groundwater to these streams. Hydraulically capturing contaminated groundwater and upgrading the GWET system will also address surface water impacts.

A portion of the contaminated groundwater and landfill leachate from the overburden aquifer are currently captured by the OU1 GWET system. The GWET was designed and constructed prior to 1,4-dioxane being identified as a COC. In recent years, 1,4-dioxane concentrations in effluent discharged from the OU1 GWET to the East Trout Brook UNT have averaged about 20 µg/l (NJDEP 2014). This is well above the current NJDEP GWQS of 0.4 µg/l.

Review of GWET effluent analytical data reveals that other than 1,4-dioxane, target as well as TIC groundwater contaminants are removed during the treatment process.

The PRGs for CFS include reducing concentrations of Site contaminants in groundwater, and therefore surface water to concentrations below ARARs. To meet these PRGs, hydraulic containment alternatives are being evaluated within this FS that anticipate the extraction of impacted groundwater, with treatment by the OU1 GWET. The GWET was not designed to treat 1,4-dioxane, and the effluent concentrations (average 20 µg/l) are the result of dilution from water extracted from locations where 1,4-dioxane concentrations are low or absent. Treatment of 1,4-dioxane is more difficult than treatment of the other target and TIC COCs which are currently being treated and are absent from the GWET effluent. Therefore, alternatives that treat 1,4-dioxane in groundwater are considered to be the focus of this FS.

4.5 Areas or Volumes of Media to be remediated

4.5.1 Groundwater

OU1 consists of overburden and bedrock aquifers within the landfill property boundary. Groundwater flow direction in the overburden aquifer is radial except in the northern direction where groundwater flows towards the landfill. Recovery wells, 18 in total, are installed around most of the landfill perimeter except on the northern side to capture overburden groundwater and leachate. The extraction wells discharge to a force main connected to the GWET plant, which discharges its effluent to East Trout Brook post treatment.

NJDEP designed the GWET to treat overburden groundwater and leachate for 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), total organic carbon (TOC), ammonia-nitrogen, VOCs, heavy metals, and total phenolics. 1,4-dioxane essentially passes through the GWET untreated, discharging into East Trout Brook at an average concentration of about 20 µg/l (NJDEP 2014a). NJDEP recently conducted treatability and pilot studies to assess the potential for reducing 1,4-dioxane concentrations in plant effluent to below the previous interim specific GWQC of 3 µg/l (NJDEP 2008, Kimball 2012, Kimball 2015, NJDEP 2015a). Upgrading the GWET to treat 1,4-dioxane is included with all active alternatives.

The horizontal extent of contaminated groundwater is longer than it is wide, and is oriented in a northeast-southwest direction. The contamination extends from the overhead transmission lines that run perpendicular to Parker Road to the southwest of the landfill to County Route 513 to the northeast (**Figure 4-1**).

The vertical extent of contaminated groundwater varies significantly across CFS depending on the depths of the steeply dipping fractures, the transmissivities of the fractures, and whether

groundwater flow is downward as it is in recharge areas or upward discharging to streams. In its review of the Draft RI, NJDEP commented "While DEP rules require that the groundwater contamination be horizontally and vertically delineated, BGWPA is willing to view the vertical delineation of the contaminated groundwater at this Site as being technically impracticable. Based on the following facts, installing new wells beyond depths of 700 feet to vertically delineate the ground water contamination will not be required by DEP:

1. A public waterline has recently been installed in the area, eliminating the exposure of residences to contaminated groundwater;
2. The concentrations of the contaminants at the deepest sampled intervals is generally low (with the exception of well CF-218D), and the apparently fracture related inline wells of CF-209D- CF-227- CF204D;
3. The high angle fractures in the local bedrock facilitate the downward migration of the contaminants; and
4. Other Sites in the area have documented their groundwater contamination to exceed depths of 250-300 feet and are having difficulty vertically delineating the contamination."

For purposes of evaluating remedial alternatives, the vertical extent of groundwater contamination is the depth at which the rate of liner eversion during FLUTe™ hydraulic profiling, or transmissivity of the remaining borehole, is near zero, such that the liner will no longer evert; or the greatest depth of contamination based on analytical results unless it is deeper than the maximum depth of eversion. The vertical extent of groundwater contamination is presented in **Table 4-2**. Contamination below liner eversion depths or near zero transmissivity, may be found in smaller fractures or groups of smaller fractures within recharge areas, but is inaccessible for treatment at those depths because of a lack of connectivity between fractures and the extremely low porosity of the rock. It is also possible that groundwater contaminants found deeper than the maximum depth of liner eversion resulted from downhole investigations of the borehole.

4.5.1.1 OU1 Groundwater Contamination Area

Based on the RI findings, groundwater in the overburden aquifer that is not captured by the GWET flows along the bedrock surface from higher to lower top of bedrock elevations at the overburden/bedrock interface; and vertically towards the bedrock interface into mostly steeply dipping bedrock fractures impacting the bedrock aquifer below. The highest concentration of 1,4-dioxane was detected in bedrock monitoring well CF-209D, located to the northeast just outside the landfill property boundary.

Bedrock hydraulic assessments conducted in 2011 (**Figure 4-2**) and 2017 (**Figure 4-3**), geophysical surveys, and the Willowstick® Electromagnetic survey conducted during the RI, confirmed that bedrock groundwater at the landfill predominantly flows northeast towards monitoring well CF-204D, southwest towards CF-225D, and west towards CF-216D. In addition to affirming the results of previous field investigations which suggested the direction and highly preferential nature of the bedrock groundwater flow, the 2017 hydraulic assessment demonstrated an ability to influence bedrock monitoring wells far downgradient of the landfill by pumping from the bedrock located at or near the landfill boundary.

The OU1 groundwater remedial extent includes groundwater within the overburden and bedrock aquifers within the landfill property boundary. The vertical extent of groundwater contamination or the "target treatment depth" was determined, in part, from transmissivity data collected during the RI. The vertical extent generally coincides with the terminal depth of transmissive fractures. For purposes of this FS, the target treatment depth for the three proposed recovery wells within the saprolite/fractured bedrock aquifer is approximately 100 to 350 ft. bgs. The target treatment depth will be further refined as part of the pre-design investigation (PDI).

4.5.1.2 OU2 Groundwater Contamination Area

The Willowstick® Electromagnetic Survey conducted during the RI identified three major preferential flow paths running southwest to northeast from the north side of the landfill to Schoolhouse Lane and the Lamington River UNT. The flow paths run roughly parallel to one another from the landfill towards Schoolhouse Lane, converge there and continue east as one combined flow path. The three preferential flow paths follow near vertical fracture zones and have both shallow (near surface) and deep (bedrock) components. Based on the available groundwater sample analytical data (Section 3.1.1) and bedrock groundwater flow directions identified in the RI, the known extent of OU2 groundwater contamination to the northeast of the landfill is from the edge of the landfill boundary to monitoring well CF-204D near Schoolhouse Lane, then following the Lamington River UNT as a narrow plume to well CF-201D. It is bounded on the east and west by two groundwater divides associated with two ridges that form the valley northeast of the landfill. Proposed groundwater treatment for the northeast portion of the plume is to a target depth of approximately 100 to 350 ft. bgs which corresponds to the maximum depth of groundwater contamination from transmissive fractures observed in CF-209D near the landfill property boundary.

The horizontal extent of OU2 groundwater contamination also extends west-southwest towards monitoring wells CF-216D and CF-225D (**Figure 4-1**). Groundwater contamination with 1,4-dioxane to the west-southwest of the landfill was reported in monitoring wells CF-216D and CF-225D with concentrations of 35 µg/l and 23 µg/l, respectively, at depths ranging from 106 to 275 ft. bgs. The Willowstick® Electromagnetic Survey attempted to locate preferential flow paths to the west between the North Waste Cell and well CF-216D, but the buried waste in the landfill interfered with the survey such that the data gathered was not of any use. Based on the available groundwater sample analytical data (Section 3.1.1) and bedrock groundwater flow directions identified in the RI, the extent of the OU2 groundwater contamination to the west-southwest of the landfill is from the landfill boundary west to monitoring well CF-216D and southwest to monitoring well CF-225D. Proposed groundwater treatment in this area is to a target depth of approximately 100 to 350 ft. bgs.

4.5.2 Soil

Review of written and photographic documentation provided in the RI as well as discussions with NJDEP staff familiar with prior remedial actions undertaken at CFS revealed a known soil and groundwater source area in addition to the landfill. This source area is approximately one-third of the area known as the North Waste Cell that was not previously excavated and remains beneath the landfill perimeter road. The North Waste Cell is identified as an area immediately

outside the landfill cap to the north that was unknown at the time the landfill was capped and properly closed. This area existed outside the cap for 11 years after the landfill was closed (i.e., installation of the cap) and was a continuing source of groundwater contamination until a portion of it was excavated in mid-2006 and capped in 2008. In order not to undermine the landfill perimeter road, soil and solid waste beneath that portion of the North Waste Cell (including buried drums and containers of chemicals, PCPs and pharmaceutical products) were left in place.

Therefore, this FS includes source-area removal of an approximately 10-foot by 450-foot by 23-foot deep section of landfilled waste beneath the perimeter road (as shown in **Figure 4-4**) as a presumptive remedy included with each of the active groundwater remedial alternatives to address the continuing source of groundwater contamination beneath the perimeter road at the North Waste Cell.

4.6 Remedial Action Objectives

Remedial Action Objectives (RAOs) are defined as media-specific goals for protecting human health and the environment. RAOs are developed through an evaluation of data generated during the RI, including: the identified contaminants of concern, impacted media of interest, fate and transport processes, receptors at risk, and the associated pathways of exposure included in the CSM. They also consider PRGs, identified via an evaluation of ARARs, TBCs, and other technical and policy considerations that may be applicable to the Site.

RAOs for OU1:

- Limit migration of contaminated groundwater and leachate from OU1 to OU2;
- Enhance the GWET to reduce concentrations of 1,4-dioxane being discharged to surface water; and
- Reduce the North Waste Cell's impact on groundwater.

RAO for OU2:

- Prevent current and future exposure to human receptors (via ingestion, dermal contact and inhalation) to Site-related contaminants in groundwater and surface water at concentrations in excess of federal and state standards.

The ultimate goal for OU2 is to achieve restoration of the groundwater in order for it to be used as a drinking water source in the future. EPA and NJDEP have promulgated MCLs and NJDEP has promulgated GWQSs, which are enforceable, health-based, protective standards for various drinking water contaminants. The more stringent of the MCLs and GWQSs ultimately will be used as the PRGs for the COCs in the OU2.

5.0 General Response Actions

General Response Actions (GRAs) are broad types of activities that will potentially satisfy the RAOs. Following the development of GRAs, one or more remedial technologies and process options are identified for each GRA category. The technologies and process options remaining after screening in Sections 6 and 7 will be assembled into alternatives that are discussed in Section 8. The alternatives will focus on containing and/or remediating groundwater and soil.

5.1 Groundwater

The GRAs for impacted groundwater include:

- No Action – The no action option is included as a basis for comparison with the active groundwater remediation technologies. If no action is taken, the contaminants will remain in place, and the RAOs will not be met.
- Institutional Controls (ICs) – Restricting the property or resource use through ICs would not reduce the volume of contaminants or eliminate the need for active remediation of groundwater to restore the impacted resource. Long-term monitoring (LTM) would be required in conjunction with the maintenance of existing and/or implementation of additional ICs.
- Monitored Natural Attenuation (MNA) – MNA makes use of naturally occurring bioremediation processes where dilution, volatilization, biodegradation, adsorption, and/or chemical reactions with subsurface materials reduce contaminant concentrations to acceptable levels over time. In accordance with EPA guidance (EPA, 1998d), MNA is always to be used in combination with source control and LTM to assure the effectiveness and protectiveness of the process.
- Containment – Containment options are often implemented to prevent or significantly reduce the migration of contaminants in groundwater. They can be used in conjunction with treatment technologies where restoration of the resource has been identified as an objective. Containment solutions often require LTM. Containment technologies include physical and hydraulic barriers as well as deep well injections.
- Treatment – Treatment of contaminants can be achieved either in-situ or ex-situ and includes several types of technologies that encompass biological, physical/chemical, and thermal treatment approaches.
    - Biological Treatment – Bioremediation consists of the stimulation of microorganisms to promote degradation of contaminants. Biological treatment is generally effective for organic contaminants.
    - Physical/Chemical – Physical/Chemical treatment processes can be used to destroy, separate, or immobilize contaminants in groundwater.
    - Thermal – Thermal treatment processes can be viable strategies to mobilize and remove or destroy contaminants in groundwater.
- Discharge / Disposal – Disposal options for extracted groundwater can include discharge to surface water or groundwater after treatment of the effluent to meet applicable standards.

5.2 Soil

CERCLA Section 121(b)(1), 42 U.S.C. § 9621(b)(1), mandates that remedial actions be protective of human health and the environment, be cost effective, and use permanent solutions and, alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Section 121(b)(1) also establishes a preference for remedial actions which use, as a principal element, treatment to permanently and significantly reduce the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants at a Site. The NCP establishes an expectation that treatment will be used to address the principal threats posed by a Site wherever practicable (40 C.F.R. Section 300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund Site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water or air, or acts as a source for direct exposure. Contaminated ground water generally is not considered to be a source material; however, Non-Aqueous Phase Liquids (NAPLs) in groundwater may be viewed as source material. The groundwater contamination at the CFS Site is not considered principal threat waste. However, the waste material in the North Waste Cell is source material, and is considered principal threat waste. As noted above, CERCLA Section 121(d), 42 U.S.C. §9621(d), specifies that a remedial action must require a level or standard of control of the hazardous substances, pollutants, and contaminants which at least attains ARARs under federal and state laws, unless a waiver can be justified pursuant to CERCLA Section 121(d)(4), 42 U.S.C. §9621(d)(4). Therefore, removal of the remaining source material within the North Waste Cell Area and off-site disposal to a permitted facility is a presumptive remedy for OU1.

6.0 Identification and Screening of Remedial Technologies and Process Options

This section identifies and screens remedial technologies and process options potentially capable of addressing groundwater contamination at CFS. Remedial technologies that are clearly not implementable or effective treatment options are removed from further consideration. Surface water contamination is addressed through groundwater treatment and is not evaluated separately.

Remedial technologies are grouped by GRA (e.g., containment or treatment) and media. Specific technologies and process options for each of the GRAs, including No Action, ICs, MNA/LTM, Containment, Treatment, and Disposal/Discharge are initially screened to identify those that appear to be:

- Most effective in achieving area-specific RAOs and appropriate to the area-specific conditions and contamination;
- Technically implementable; and
- Cost-effective, providing the same level of protection to human health and the environment.

The initial screening considers effectiveness of the technologies for treating the contaminants present at the Site, implementability of the technology given Site-specific conditions, and costs. Remedial technologies that were deemed to be impracticable or cost-prohibitive were removed from further consideration, in accordance with EPA guidance (EPA, 1988).

Site-specific conditions, including contamination type, concentration, location (aerial extent and depth), and estimated quantity were incorporated into the analyses performed during the initial screening process. Treatability studies will be used when needed to refine the assumptions for design used in the FS. The most promising technologies will be combined into remedial alternatives designed to optimize their ability to achieve the RAOs.

6.1 Process Options for Groundwater

Remedial technologies that would address contaminants in groundwater and maybe applicable for use at CFS were identified and are described below. Remedial technologies that were easily screened out as not applicable to the Site (impracticable/ ineffective, etc.) are presented in **Table 6-1** and not discussed further.

The PRGs for groundwater identified in Section 4.2 are for 10 COCs – eight target compounds and two TICs. The OU1 GWET currently treats 9 of the 10 COCs to meet concentrations compliant with GWQS, with the exception of 1,4-dioxane. Remedial alternatives include an upgrade of the OU1 GWET to treat 1,4-dioxane and, for some alternatives, expansion of the OU1 GWET to capture OU2 groundwater and treat the COCs. As 1,4-dioxane is the only COC not currently being treated, and is the most prevalent of the groundwater COCs, the initial screening primarily considers the effectiveness of technologies for treating 1,4-dioxane, both in-

situ and ex-situ, to the new, much lower GWQS of 0.4 µg/l (previously 10 µg/l).

Contaminated groundwater and leachate within OU1 are only partially addressed by the GWET. This FS includes upgrades and enhancements to the OU1 GWET to improve capture of OU1 groundwater and leachate and provide 1,4-dioxane treatment.

6.1.1 No Action

The no action remedial option has been retained as a basis for comparison with other groundwater remediation technologies, as required by the NCP. This option includes no future activities to contain or remediate contaminants, provides no treatment for contaminants, or legal and administrative mechanisms for protection of human health and the environment beyond establishing cleanup criteria and recognizing those mechanisms that are in place (e.g., restrictions on well installation) under other state and/or federal environmental regulatory program (non-Superfund) authority. This option assumes that physical conditions at the Site remain unchanged.

6.1.2 Institutional Controls

ICs are non-engineering measures, such as administrative and/or legal controls, that help minimize the potential for human exposure to contamination and/or protect the integrity of a remedy by limiting Site or resource use. EPA guidance on choosing and implementing ICs (EPA, 2000a) provides that:

- If the cleanup does not result in unrestricted use at a Site, an IC may be appropriate.
- Consider life-cycle strengths, weaknesses, and costs for implementation, monitoring, and enforcement.
- Provide early coordination with state and local governments that may be responsible for ICs.
- ICs are to be assessed as carefully as any other remedial alternative.
- Place ICs in ways to increase their reliability.
- Clearly state IC objectives in decision documents.
- Obtain written assurances from those responsible for implementing, monitoring, and enforcing ICs; select the best ICs available to protect human health and the environment.

ICs are generally to be used in conjunction with, not in lieu of, engineering controls and measures such as treatment or containment. ICs can be used during all stages of the cleanup process to accomplish remedial objectives, and they should be used or implemented in series to provide overlapping protection from contamination. Examples include easements, potable well drilling prohibitions, zoning restrictions, and building permit requirements. ICs could also include health and safety policies and procedures to limit exposure to groundwater contaminants during construction activities via local construction permit programs.

Performance monitoring would include a description of the ICs implemented or planned, verify IC implementation and discuss the IC's ability to meet performance objectives going forward. Actual or pending changes in land or resource use/ownership that may impact the effectiveness

of the ICs should also be included in a performance monitoring report. ICs have been retained for further evaluation for use with another remedial technology, as Site conditions make its use independent of another remedial action unlikely.

6.1.3 Monitored Natural Attenuation

Monitored Natural Attenuation (MNA) relies on naturally occurring attenuation processes to achieve RAOs within a reasonable time frame. Natural attenuation processes - including dilution, dispersion, volatilization, biodegradation, adsorption, and chemical reactions with subsurface materials - reduce contaminant concentrations to acceptable levels over time. MNA is always used in combination with LTM to assess the effectiveness and protectiveness of the process. Regulatory approval of this option usually requires modeling and evaluation of contaminant degradation rates and pathways, and predicting contaminant concentrations at potential downgradient receptor points over time (ITRC, 2007).

Generally, modeling is performed to evaluate whether natural processes of contaminant degradation could reduce contaminant concentrations below regulatory standards or risk-based levels before potential exposure pathways are completed or to identify where additional measures (e.g., ICs) may be necessary to protect public health. In addition, LTM (Section 6.1.4) must be conducted throughout the process to confirm that natural attenuation is proceeding at rates consistent with meeting cleanup objectives and the longer remedial timeframe associated with its use. MNA has been retained for further evaluation.

6.1.4 Long-Term Monitoring

Long-term monitoring (LTM) includes periodic sampling and analysis of groundwater. The monitoring program provides an indication of the progress of remedial activities and contaminant migration post-active treatment. Data collected by the LTM program is generally used in five-year reviews.

LTM alone would not be effective in reducing contamination. However, natural attenuation processes such as dilution, dispersion, biodegradation, and volatilization would decrease groundwater contaminant concentrations over time. A comprehensive monitoring network would need to be in place for the LTM program.

A LTM program is a suitable addition to most groundwater alternatives and the existing network of over 150 monitoring wells makes it implementable. The LTM network would be used to assess the contaminated area outside the active treatment area as well as asses the performance of the remediation progress. As contaminant concentrations are reduced, the extent of groundwater contamination is expected to decrease as the plume attenuates to a level below the PRGs. LTM will be implemented to establish baseline conditions and determine the final attainment of Site contaminants. Therefore, LTM has been retained for further evaluation for use with other remedial technologies, as Site conditions make its use independent of another remedial action unlikely.

6.1.5 Containment

Containment barriers are structures installed to reduce contaminant mobility but do not directly impact contaminant toxicity or volume. These barriers are filled with impermeable, semi-permeable, or permeable materials, depending on the contaminants at a Site. Alternately, hydraulic containment, accomplished by installing extraction wells to recover and treat groundwater, can also prevent the migration of contaminant plumes beyond a point of compliance. The treated effluent may be discharged to groundwater via reinjection, discharged to surface water or to a publically-owned treatment works (POTW).

Of these containment technologies, only hydraulic containment has been retained for further analysis. Other containment technologies such as physical barriers and deep well injection have been screened out due to infeasibility of constructing these types of barriers within a deep fractured bedrock matrix.

6.1.5.1 Hydraulic Barrier - Groundwater Extraction and Treatment

Hydraulic barriers achieve containment of contaminated groundwater by pumping from extraction/recovery well(s) at a sufficient rate to influence the regional groundwater gradient such that flow is directed towards a Site, preventing the migration of contaminants. The extracted groundwater is treated ex-situ (extraction and treatment) at a centralized treatment plant. The ex-situ treatment train is typically a series of physical, chemical, or biological processes, with ultimate discharge or disposal of the treated water (FRTR, 2002; EPA, 1994).

The OU1 GWET has a design capacity of 120 gallons per minute (gpm) and is designed to remove inorganics (metals) by pH adjustment and settling and filtration (inclined plate settler, filtration, and sedimentation); ammonia by biological methods using a sequencing batch reactor (SBR); and organics (VOCs and SVOCs) by aeration, SBR and adsorption through the GAC vessels. The OU1 GWET achieves the permitted effluent discharge limits. Although 1,4-dioxane is unaffected by the treatment train, no permit limits apply to 1,4-dioxane as at the present time, an applicable surface water discharge standard or criterion for 1,4-dioxane does not exist. However, since the treatment plant effluent is being discharged to East Trout Brook (a losing stream at the upper reach) which is recharging groundwater, the GWQS of 0.4 µg/l will be used as a basis for the FS Report when developing remedial alternatives with effluent discharges to surface water.

Although, the design flow rate of the OU1 GWET is 120 gpm, it typically operates at an average rate of 45 to 70 gpm. Since groundwater is impacted by 1,4-dioxane, any ex-situ treatment technologies presented in the following subsections will primarily focus on treating 1,4-dioxane, as the other COCs are already being treated and will continue to be treated in any alternative with active treatment technologies. Hydraulic containment consisting of groundwater extraction and treatment has been retained for further analysis.

6.1.6 Treatment

In-situ and ex-situ groundwater treatment technologies include biological, physical/chemical,

and thermal. The ex-situ treatment remedies presented below are for expansion of the OU1 GWET system treatment train to include treatment for 1,4-dioxane.

6.1.6.1 In-situ or Ex-situ Biological Treatment

In-situ bioremediation technologies stimulate and enhance the effects of naturally-occurring degradation mechanisms to accelerate the natural biodegradation process by introducing nutrients, electron acceptors, and/or contaminant-degrading microorganisms to the subsurface. Various bioremediation technologies can be used in-situ to treat groundwater without removing it from the ground. This approach reduces the cost of handling and associated environmental impacts (EPA, 2000a). Technologies that involve the addition of supplemental microbes to the subsurface are referred to as bioaugmentation technologies. Microorganisms may be “seeded” from populations already present or be introduced from cultivated strains of bacteria designed to degrade specific contaminants. The addition of key nutrients (e.g., nitrogen and phosphorus) is used to supplement other bioremediation methods, so the availability of nutrients does not limit the effectiveness of the in-situ bioremediation. Supplemental electron donors are added as a reductant in the redox reaction used by the degrading microorganisms, for example, hydrogen-containing or generating compounds. Electron acceptors add oxygen (for aerobic processes) or an anaerobic oxidant (e.g., nitrate) to support microbial processes that degrade the contamination (EPA, 1996).

The rate of bioremediation can be enhanced by increasing the concentration of oxygen (creating an aerobic condition) or adding a carbon substrate (under anaerobic conditions) to the groundwater. Oxygen enhancement can be achieved by either sparging air below the water table or circulating chemically bound oxygen (i.e., hydrogen peroxide or other oxygen releasing compound) throughout the contaminated groundwater zone (EPA,1996). Under anaerobic conditions, a carbon nutrient or electron source is circulated throughout the groundwater contamination zone to enhance the natural rate and process of bioremediation. In co-metabolism, the contaminant (e.g., 1,4-dioxane) is degraded as a result of a side reaction.

1,4-dioxane is regarded as a relatively stable molecule because of its strong internal chemical bonding, and has generally been considered non-biodegradable. However, recent research has identified specific organisms and environmental conditions which have been favorable for biologic degradation (Mohr, 2010). Several known bacteria strains can degrade 1,4-dioxane; but most of the identified strains are unable to use 1,4-dioxane as the sole carbon source. Co-metabolic biodegradation has been demonstrated as viable with certain bacteria and in the presence of a primary growth substrate such as tetrahydrofuran (THF), short chain alkanes, and toluene (Lippincott et al. 2015).

Further studies would be required to determine the feasibility of implementing a co-metabolic biodegradation treatment technology in deep fractured bedrock. At the present time, there is no evidence supporting this remedial strategy in deep fractured metamorphic rock – both for effectively delivering the substrate to the contaminant mass or having the required contact time needed for the biological processes to occur.

Ex-situ biological treatment may be possible for future use at the Site. Some promising new microbes in laboratory settings demonstrate a proclivity to degrade 1,4-dioxane; however, ex-situ biological treatment of 1,4-dioxane is relatively unproven in large scale applications. Fluctuating conditions and dilute concentrations in groundwater could make this technology operationally challenging. An ex-situ pilot test at a Superfund Site in Colorado reduced 1,4-dioxane concentrations via co-metabolism from 12,000 µg/l to 200 µg/l. In-situ bioremediation has not been retained for further evaluation because of the complexity of delivering substrate to fractured rock, but ex-situ bioremediation is retained as a possible addition to other treatment technologies.

6.1.6.2 In-situ Physical/Chemical Treatment

Physical treatment technologies are those that employ air, water or other means to oxygenate, agitate, or flush contamination through the subsurface to enhance its removal. Chemical treatment options use various processes (e.g., ultraviolet [UV] radiation) to degrade contaminants. These physical and chemical treatment technologies are described below.

In-situ Chemical Oxidation/Reduction

In-situ Chemical Oxidation/Reduction (ISCO/ISCR) chemically converts (oxidizes/reduces) contaminants to less toxic compounds that are more stable, less mobile, and/or inert. It involves introducing a solution of oxidizing agents into the subsurface via injection wells, through slow-release candles, temporary well points or direct placement in excavations (to name a few) to treat dissolved-phased contaminants. The oxidizing agents most commonly used are ozone, hydrogen peroxide, potassium permanganate, hypochlorites, zero valent iron (ZVI), chlorine, and chlorine dioxide. ISCO has been widely used to treat petroleum hydrocarbons and chlorinated VOCs; however, use of ISCO for treatment of complex ethers such as 1,4-dioxane is less proven.

Similar to in-situ bioremediation, the biggest challenge is the delivery method for the ISCO to reach the contaminant mass trapped within bedrock fractures, as well as achieving enough contact time between the trapped contaminant mass and the oxidizers to be effective. The Site conditions (i.e., the deep fractured bedrock and challenges with delivery to contaminant mass and contact time) make it prohibitive for further consideration. For example, the maximum spacing used for slow-release permanganate candles in a plume is three feet. ISCO has not, therefore, been retained for further evaluation.

6.1.6.3 In-situ Thermal Treatment

In-situ thermal treatment (ISTT) involves steam/hot air injection or heating via electrical resistance, fiber optics, radio frequency, or other means that can be utilized to heat the contaminated matrix, thereby increasing the volatilization rate and/or destruction of VOCs and SVOCs and facilitating extraction. ISTT can be used for both contaminated soil and groundwater, and is recognized as being one of the shortest duration treatment technologies.

One example of ISTT is electrical resistance heating (ERH). ERH is an in-situ thermal remediation technology that uses the heat generated by the resistance of the soil or rock matrix

to the flow of electrical current. The matrix is evenly heated at lower temperatures (up to the boiling point of water, 100℃) compared to other heating methods and has demonstrable success in bedrock. ERH applies electricity into the ground through electrodes and current flows between them within the treatment volume. Heat causes the underground contaminants and water to evaporate, creating in-situ steam and vapor. Contaminated vapor and steam are extracted using vacuum extraction wells and treated above ground. ERH has the ability to be used in 1,4-dioxane treatment applications and has been applied at a few fractured rock Sites. Other types of ISTT show promise as well. ISTT can drastically reduce remedial timeframes such as over 99% mass removal within a few months of treatment.

While ISTT could potentially be used at the Site to reduce contaminant concentrations in groundwater, this alternative would be technically impracticable due to the very high installation density required to achieve sufficient energy transfer within the fractured bedrock aquifer at this Site, and due to the depth of installation required. Other, more proven treatment alternatives for fractured rock aquifers, would be more appropriate for use at the Site. For this reason, ISTT has been screened out of further consideration.

6.1.6.4 Ex-situ Physical / Chemical Treatment

The following ex-situ treatment technologies are considered in conjunction with extraction and treatment technology, as it requires the pumping of impacted groundwater to the surface prior to treatment.

Adsorption

Adsorption is the physical adhesion of dissolved organic matter to the surface of a solid. The adsorption process consists of passing contaminated groundwater through a sorbent media such as granular activated carbon (GAC) or a regenerable synthetic adsorbent, where the contaminants are adsorbed to the media, reducing their concentration in the bulk liquid phase. Adsorption mechanisms are generally categorized as physical, chemical, or electrostatic adsorption.

Adsorption can be used to treat the organic fraction of the contaminated groundwater directly. The OU1 GWET utilizes two 20,000-lb. GAC vessels that operate in series; however, GAC is not effective at treating low concentrations of 1,4-dioxane because of its low adsorptive capacity.

In contrast to GAC, re-generable synthetic adsorbents have proven highly effective at treating 1,4-dioxane and other organic contaminants in groundwater, including low part per billion concentrations of 1,4-dioxane. A synthetic adsorbent is a re-generable media used in the same manner as GAC. A pilot test/treatability study was conducted in February 2017 to evaluate the effectiveness of a proprietary synthetic adsorbent at treating 1,4-dioxane in groundwater at the Site. The pilot test used water collected from bedrock monitoring well CF-209D located near the North Waste Cell, which has the highest 1,4-dioxane concentrations. The pilot test demonstrated that a synthetic adsorbent can consistently reduce 1,4-dioxane concentrations to less than 0.4 µg/l. The pilot test/treatability study technical memorandum is provided in Appendix C. Adsorption using a regenerable synthetic adsorbent is a viable ex-situ technology

that is able to treat the Site COCs including 1,4-dioxane and has been retained for further consideration.

Advanced Oxidation Processes

Advanced oxidation processes (AOPs), including the use of UV radiation, catalytic oxidation, ozone, and/or hydrogen peroxide, can destroy organic contaminants in groundwater. AOPs use the formation of radicals such as hydroxyl radicals (HO·) and superoxide radicals (O^{2-}·), among others, which are powerful oxidizers, to sequentially oxidize organic contaminants, including 1,4-dioxane, to carbon dioxide, water, and residual chloride. Pretreatment of the water stream may be needed to minimize maintenance requirements of the oxidation treatment component.

In 2011 and 2012, the NJDEP began looking at potentially upgrading the plant to treat for 1,4-dioxane. They conducted three bench scale treatability studies that all utilized a form of AOPs. The studies included using hydrogen peroxide (H_2O_2) and ozone (O_3) in different combinations and dosages as oxidizing agents, and also using UV light with a titanium dioxide (TiO_2) catalyst for 1,4-dioxane destruction. The results of the bench scale studies showed some potential, but each technology failed to reliably reduce 1,4-dioxane concentrations to 3 µg/l (prior groundwater quality criterion used by NJDEP), so NJDEP decided to continue exploring other treatment alternatives. A copy of the treatability studies conducted by the NJDEP is included in the Appendix D.

Fenton's Reagent is another potentially effective AOP treatment technology. Fenton's Reagent uses H_2O_2 and ferrous iron to generate hydroxyl radicals which oxidize the organic compounds, including 1,4-dioxane. This is a non-proprietary technology that is readily available and implementable. NJDEP plans to conduct a Fenton's reagent pilot study at the OU1 GWET system.

While the effectiveness of AOP technology at the Site is still to be determined, AOPs have generally been considered the standard ex-situ treatment option for 1,4-dioxane contaminated Sites. Therefore, AOPs have been retained for further evaluation.

Groundwater Extraction and Treatment:

Extraction and treatment is a presumptive remedy. Groundwater extraction consists of pumping groundwater from an aquifer to remove dissolved phase contaminants and/or achieve hydraulic containment of contaminated groundwater to prevent migration. Processes typically evaluated or used in extraction and treatment systems include ex-situ physical and chemical treatments. Generally, treatment and monitoring of extracted groundwater is required. A treatment train with multiple unit operations may be required for groundwater with multiple types of contaminants. A groundwater monitoring program is a component of any groundwater extraction system to verify its effectiveness. Potentially long time periods are required for groundwater extraction to achieve remediation goals. Operation and maintenance considerations associated with treatment systems may be more extensive than other treatment technologies.

Groundwater extraction and treatment has been retained for further analysis due to its proven track record as a remediation technology and because the existing GWET can be readily

upgraded and improved.

6.1.7 Discharge/Disposal

Discharge technology options address the means of disposal and/or discharge of groundwater that has undergone ex-situ treatment and is either safe to discharge to the environment as is, or requiring further treatment to protect human health and the environment prior to release to the air, water or a sewer system. There is specific guidance and numerous regulatory requirements related to the disposal or discharge of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) wastes or emissions.

The CERCLA Compliance with Other Laws Manual, Parts I and II (EPA 1988, 1989) provides an analysis of ARARs for Superfund Site discharges, including those related to compliance with the Clean Water Act and NPDES program, for surface water and publicly-owned treatment works (POTW) discharges; the Safe Drinking Water Act and its drinking water (i.e., MCLs), UIC and Sole Source Aquifer programs, as well as RCRA and air quality programs. Many of these Federal regulations apply to the Site RAOs along with those under the purview of NJDEP discussed in Section 4.5.

6.1.7.1 Discharge to Surface Water

The treated groundwater effluent from extraction and treatment at an improved/expanded GWET would consist of returning treated groundwater directly to surface water or using an infiltration/ detention basin to control the volume and timing of discharge. This approach is effective and implementable. The facility's NJPDES permit would need modification and approval, and the design would include evaluation of East Trout Brook's capacity to receive additional water volume above 120 gpm. Discharge to surface water directly or via infiltration/ detention basin has been retained for further evaluation.

6.2 Retained Remedial Technologies

Soil: The presumptive remedy for the soil contamination and solid waste within the remainder of the North Waste Cell is removal and off-site disposal at a permitted facility.

Groundwater: The retained remedial technologies for groundwater include:

- No Action
- ICs
- MNA
- LTM
- Hydraulic Containment
- Treatment
    - Adsorption
    - Advanced Oxidation Processes
    - Biological Treatment
    - Groundwater Extraction and Treatment

- Discharge/Disposal
    - Surface Water
    - Infiltration Basin and Surface Water

7.0 Evaluation of Process Options

A total of 29 groundwater technologies were screened for potential applicability, effectiveness, reduction in toxicity, mobility, or volume of contaminants, and implementation at the Site (**Table 6-1**). Technologies that successfully passed the screening process and have been retained for a more detailed analysis include:

- No Action
- ICs
- MNA
- LTM
- Hydraulic Containment
- Treatment
    - Adsorption
    - Advanced Oxidation Processes
    - Biological Treatment (Bioreactors)
    - Groundwater Extraction and Treatment
- Discharge/Disposal
    - Surface Water
    - Infiltration Basin and Surface Water

These technologies, as well as a presumptive remedial technology for soil/solid waste (removal/disposal), have been incorporated in the remedial alternatives and will be further evaluated based on their applicability to Site conditions and potential effectiveness in meeting the RAOs.

The retained remedial technologies were assembled into process options, which were then evaluated based on effectiveness, reduction of toxicity, mobility, or volume of contamination through treatment, implementability, and general cost. Process options that cannot be effectively implemented at CFS due to Site characteristics or other restrictions were eliminated from further consideration. An evaluation of the remedial technology process options for groundwater is presented in **Table 7-1**.

7.1 Groundwater Process Options

The groundwater process options retained for detailed analysis include LTM/ICs (to be considered for use with other remedial technologies), MNA, hydraulic containment with groundwater extraction and treatment with disposal/discharge options, and ex-situ treatment options.

The no action and institutional control options were also included for evaluation, with institutional controls being recognized as an integral component of any remedy option. Institutional controls are a critical component of the remedy, as the results of the BHHRA indicate that risks from groundwater (via ingestion, dermal contact, and inhalation exposure routes) exceed acceptable

levels for carcinogenic and non-carcinogenic effects in a future scenario that assumes exposure to impacted groundwater (i.e., that the engineering and institutional controls are no longer in-place).

Any remedy proposed for the Site will incorporate the protection of public health and the environment in the short-term via a component that assumes both the maintenance of engineering controls (i.e., treatment of well water for agricultural and non-potable uses and connection to the newly constructed municipal water supply for potable uses) and institutional controls already in place, as these have achieved significant risk reduction and contribute to keeping human exposures under control. These existing controls are enforceable under local, state, and Federal regulatory authority. Additional institutional controls limiting redevelopment of OU1 for non-residential uses only are considered to be a part of any alternative implemented at for OU1. The options are described in the subsections below.

7.1.1 No Action

The no action option has been retained only to provide a basis for comparison with other active remedial process options, as required under CERCLA.

7.1.2 Long-Term Monitoring and Institutional Controls

LTM and institutional controls (ICs) can be combined as a strategy for remediation of the groundwater plume. This remedial option is considered in concert with other technologies, as Site conditions make its independent use unlikely. The use of this option relies on future enforcement of groundwater restrictions and implementation of a long-term groundwater monitoring program.

Elevated concentrations of 1,4-dioxane (i.e., greater than 40 µg/l – 100 times more than the criteria of 0.4 µg/l) are present in both the overburden and bedrock aquifers. LTM is not a standalone option, effective in meeting the RAOs for the Site within a reasonable timeframe. LTM and ICs may be implemented in conjunction with, as an enhancement to, or as a potential contingency/alternative remedy to other remedial technologies. Costs are limited to those associated with sampling and analysis required for LTM. Therefore, LTM and ICs are retained for further evaluation.

7.1.3 Monitored Natural Attenuation

Ten naturally-occurring bacteria have the potential to degrade 1,4-dioxane along with tetrahydrofuran (THF) monooxygenase (MO), a bacterial enzyme (Deng at al. 2018). Coincidentally, THF has been detected in samples from overburden and bedrock wells at CFS at concentrations below the GWQS of 10 µg/l with the exception of 30 µg/l in well MW-19D (data from 2010 through the present). At CFS, 1,4-dioxane concentrations have steadily decreased from an all-time source area high of about 1,000 µg/l to just under 300 µg/l for recent samples. A more likely explanation for the reduction in concentrations is remediation of a portion of the North Waste Cell in 2006 to 2007 along with natural attenuation mechanisms such as dispersion and diffusion. It is possible, however, that indigenous bacteria, THF MO, and source area removal all played a role in the removal of 1,4-dioxane from the overburden and bedrock

aquifers. Recent publications evaluated the prevalence of inadvertent 1,4-dioxane degradation by review of historical data at numerous contaminated Sites as well as experiments on groundwater samples collected from several Sites. Study results indicate substantial reductions in 1,4-dioxane concentrations in the presence of naturally-occurring bacteria found at these Sites, ranging from 0.3 ± 0.1 µg/l per week to 3,449 ± 459 µg/l per week (Li et al. 2015). Given the recent study results, that 1,4-dioxane concentrations at CFS have decreased over time, and the concurrent presence of THF, MNA is worthy of consideration if the presence of 1,4-dioxane degrading bacteria and/or THF MO is confirmed.

MNA is not suitable for a contaminant remedy when the source is still in place, so it will not be retained for OU1. There is the potential for MNA of 1,4-dioxane to occur at OU2; however, there is insufficient evidence to support MNA at this time. Therefore, MNA has not been retained for OU2.

7.1.4 Groundwater Extraction and Treatment

Groundwater extraction and treatment can be effective in contaminant mass removal over a long timeframe as well as establishing hydraulic control of the aquifer, which can reduce or prevent further migration of contaminants.

The existing OU1 GWET system was designed to capture overburden groundwater and landfill leachate. All but one recovery well are screened within the overburden aquifer, and the one deeper extraction well can only capture and contain a small portion of the near-landfill bedrock plume as it's limited by its pumping rate and relatively shallow depth (50 ft. into competent rock). The GWET treatment train does not remove or reduce concentrations of 1,4-dioxane. This process option will establish hydraulic control of OU1 groundwater, preventing further migration of contaminants beyond the OU1 boundary into OU2.

Based on decades of studies including the 2016 Draft RI and pump tests conducted in 2011 and 2017, the unconfined overburden aquifer and fractured bedrock aquifer are hydraulically connected at the Site. During the 2017 pump test at CF-209D, groundwater drawdown was noted at CF-11D, which is located approximately 2,200 feet from CF-209D to the northeast at Schoolhouse Lane. During the 2011 pump test at recovery well RW-T, measurable influence extended nearly 1,200 feet to the northeast and over 1,000 feet to the southwest. Hydraulic control within the highly-transmissive fractured bedrock aquifer can be established by pumping groundwater from bedrock extraction wells installed in preferential flow paths to the northeast and southwest of the landfill or in other downgradient directions where preferential flow paths are identified.

The extracted bedrock groundwater will be conveyed to the existing OU1 GWET system, which will be upgraded to treat 1,4-dioxane. Utilizing the existing Site infrastructure (after upgrades) may make this process option a favorable remedy. The OU1 GWET will continue to discharge treated groundwater effluent to East Trout Brook or a combination of a new infiltration/ detention basin, East Trout Brook and/or other surface water bodies depending on the volume of effluent.

7.1.5 Ex-Situ Treatment

Ex-situ treatment technologies were evaluated for use at the Site to be applied in conjunction with a groundwater extraction and treatment system. Adsorption, AOPs and biological treatment were retained as ex-situ treatments options. These three ex-situ treatments are considered for use as an additional component of the OU1 GWET treatment train. Adsorption and AOPs ex-situ options are readily implementable and effective at reducing 1,4-dioxane concentrations in groundwater to 0.4 µ/l. Bioremediation holds future promise and was retained because of its lower cost and greener footprint as compared to adsorption and AOPs.

8.0 Development of Remedial Action Alternatives

This FS developed remedial alternatives for both OU1 and OU2. The remedial alternatives for OU1 and OU2 groundwater are presented in the following sections.

8.1 Description of Groundwater Alternatives

Preliminary groundwater remedial alternatives for the Site have been developed by combining the remedial technologies and process options that have successfully passed the screening stage into a range of alternatives. Each alternative presented below considers the effectiveness, implementability and cost. Detailed alternative evaluation, cost analysis, and comparison are provided in Section 9.

Groundwater remedial treatment technologies were screened according to applicability, effectiveness, reduction in toxicity, mobility, or volume of contaminants with a particular focus on 1,4-dioxane and implementability at the Site. As indicated previously, 1,4-dioxane is the only groundwater COC untreated by the existing OU1 GWET. The horizontal extent of 1,4-dioxane-contaminated groundwater is widespread; predominantly to the northeast and west-southwest. Remedial alternatives for the Site were developed based on the retained technologies and Site-specific conditions as described above.

The groundwater process options retained for further analyses include:

- No Action
- LTM/ ICs
- Extraction and Ex-Situ Treatment with Discharge

In addition to the various process options, alternatives were assembled to address the most significant source area and provide containment to mitigate further migration of contaminated groundwater from OU1 to OU2.

The ranges of process options that meet the RAOs for OU1 and OU2 based on the screening results are summarized in **Table 7-1**. However, due to the evolving nature of 1,4-dioxane treatment and the desire to have flexibility in technology selection (should a more suitable technology be developed after the FS and prior to remedial design), the remedial alternatives developed in this section will not specify a particular technology. Conservative assumptions using available data will be made and stated for cost estimating purposes. The following remedial alternatives have been developed for OU1 and OU2 groundwater and are described in detail in the following subsections:

OU1:

- OU1-G1: No Action
- OU1-G2: Upgrade OU1 GWET System, Source Area Removal with LTM/ICs
- OU1-G3: Upgrade OU1 GWET System, Additional Groundwater Extraction, Source Area Removal with LTM/ICs

OU2:

- OU2-G1: No Action
- OU2-G2: LTM/ICs
- OU2-G3: Extraction and Treatment of OU2 Groundwater/LTMs/ICs

8.2 Common Components of Alternatives

The alternatives for each OU contain a "No Action" alternative (OU1-G1 and OU2-G1 for OU1 and OU2, respectively). The No Action alternative provides a baseline for comparison with other active remedial alternatives. Because no additional remedial activities would be implemented under the No Action alternative, long-term human health and environmental risks would remain the same as those identified in the BHHRA and SLERA, with the exception of any changes due to incidental natural attenuation. There are no capital, operations/maintenance, or monitoring costs, no permitting or institutional legal restrictions. Under "No Action", the existing GWET system would continue to operate "as-is". The common components are discussed in greater detail below:

8.2.1.1 LTM/ ICs

A CKE groundwater pollution area is mapped for the tax parcels where groundwater contamination is documented within OUs 1 and 2. CKEs are determined by NJDEP pursuant to N.J.A.C. 7:1J-3.7 Processing of Damage Claims Pursuant to the Spill Compensation and Control Act and are specifically established as Spill Fund Claims Areas to provide property owners and others within these areas a means to obtain compensation for damages resulting from groundwater contamination. CKEs are not ICs. The most applicable ICs are Classification Exception Area (CEA) and WRA. "CEAs are established in order to provide notice that the constituent standards for a given aquifer classification are not, or will not, be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA." NJDEP "is obligated to restrict or require the restriction of potable ground water uses within any CEA where there is or will be an exceedance of the Primary Drinking Water Standards (N.J.A.C. 7:10). Therefore, when contaminant concentrations in a CEA exceed MCLs, and designated aquifer use based on classification includes potable use, the Department will identify the CEA as a WRA. The WRA functions as the IC by which potable use restriction can be affected." CEAs require public notice as well as notification to local municipal and health agencies. Publically available GIS files define the horizontal extent of each CEA and may contain information on contaminants and vertical extent of a plume. Controls such as CEAs and WRAs do not reduce the subsurface contamination or promote restoration of the resource, but instead provide notice to future residents and workers of current conditions and provide safeguards against accidental exposure.

LTM will be considered as a contingency and/or adjunct remedy if implementation of an active remediation technology to address contamination does not respond to continued treatment. It may also be considered for implementation in areas of existing lower-level contamination that cannot be cost-effectively remediated with the selected active remediation technology and

where doing so maintains the protectiveness of the remedy. LTM involves monitoring over time for the Site COCs to confirm progress in contaminant reduction to achieve RAOs. Groundwater monitoring will consist of a network of wells located within OUs 1 and 2. It is assumed that this well network will consist of existing monitoring wells. The selection of specific wells will depend on the selected alternative for the Site; the well selection may be adjusted during the remedial design (RD) phase of the project and as determined necessary during implementation, based on reviews of the remedy's effectiveness. Surface water LTM will also be performed. Surface water sampling locations will be determined during the RD phase of the project.

The effectiveness of both ICs and LTM will be assessed over the course of the Site remedial activity. Performance monitoring and natural attenuation will support decisions regarding: continuation and/or revisions to the monitoring program or ICs; the need to implement contingency/alternative remedy options; and/or verification that remedial goals have been met, followed by termination of performance monitoring. Site-specific criteria are to be developed to define triggers for these decisions. Monitoring program changes will be considered should contaminant concentrations increase or spread to new locations (e.g., via mobilization of contaminants in a different direction or along preferential flow paths in the deep bedrock aquifer). Once the Site remedial goals are met, the necessary duration of verification monitoring will be decided.

The FS evaluation of alternatives assumes land and groundwater use within OUs 1 and 2 remain the same over the foreseeable future. Changes in the use of land or groundwater can decrease protectiveness of a ICs/LTM remedy. However, given the Site's location in the NJ Highlands, strict preservation laws severely limit development making changes in land or groundwater use unlikely. LTM/ ICs would be implemented with all the alternatives except the No Action alternatives. ICs include establishing a CEA to limit future use of Site groundwater and establishing deed restrictions. Current LTM involves collecting groundwater and surface water samples to assess groundwater and surface water conditions over time.

8.2.1.2 Pre-Design Investigation

Groundwater modeling and additional field testing, such as pump testing, geophysical surveys, and downhole investigations may be required to refine the hydrogeologic understanding of the Site, particularly the southwestern portion of the plume, and to optimize the OU1 GWET and recovery well network. The extracted groundwater conveyance force mains and electrical power supply to the extraction well field will need to be upgraded, and the existing treatment plant's design capacity increased for the groundwater treatment alternatives that incorporate use of the OU1 GWET.

8.2.1.3 Soil

Groundwater alternatives for OU1 (OU1-G2 and OU1-G3) include the excavation and disposal of source material located within the remaining portion of the North Waste Cell, which is beneath the landfill perimeter road, as a presumptive remedy. The targeted source area is estimated to be a 10-foot by 450-foot by 23-foot deep section of the North Waste Cell containing drums, containers, PCPs, and pharmaceutical wastes mixed with soil (approximately 4,500

square feet; shown in **Figure 8-1**) to be excavated and disposed off-site at a permitted facility. The means and methods for removing the remaining portion of the North Waste Cell will be determined during the RD phase.

8.3 Alternative OU1-G1– No Action

The No Action alternative is required by the NCP to be carried through the screening process. Under this alternative, no additional actions will be taken to improve the existing OU1 GWET system and operations. This alternative will also not involve ICs. Contaminants present in overburden and bedrock groundwater not being captured by the existing OU1 GWET system will remain in place.

The No Action alternative provides a baseline for comparison with other active remedial alternatives. Because no remedial activities would be implemented under the No Action alternative, long term human health and environmental risks would remain the same as those identified in the BHHRA and SLERA with the exception of any changes due to incidental natural attenuation. There are no capital, operations/maintenance, or monitoring costs, no permitting or institutional legal restrictions needed, but this alternative will not meet any of the RAOs for groundwater.

8.4 Alternative OU1-G2 – Upgrade OU1 GWET System, Source Area Removal with LTM/ICs

The OU1 GWET system is not fully capturing the leachate or overburden groundwater from the landfill as the current operation of the system does not achieve its design capacity. All groundwater remedies developed in this FS will have limited success unless the issues with the OU1 GWET system are addressed and the system is optimized. Therefore, Alternative OU1-G2 is a baseline improvement alternative to the existing containment remedy.

Primary components of Alternative OU1-G2 consist of upgrading the groundwater conveyance system and upgrading the OU1 GWET system. These components are described below in detail.

- The conveyance system around the landfill perimeter will be upgraded to accommodate groundwater flow from the existing recovery wells to allow for continuous operation and achieve the intended design capture. This alternative (**Figure 8-2**) includes upgrading Loop 2 from a 2-inch outer diameter (OD) line to a larger line which will allow for additional capacity. Bedrock recovery well RW-T will operate continuously rate rather than in cycles as is the current practice. The 2011 pumping test concluded that the continuous pumping of RW-T would increase hydraulic influence up to 1,800 feet or more to the northeast of the landfill.

- The OU1 GWET will be upgraded from the current treatment capacity of 120 gpm. An evaluation of the existing system and treatment requirements will be conducted during the PDI or RD phase to determine the necessary improvements to upgrade the treatment capacity. The OU1 GWET was designed to treat 120 gpm; however, it treats on average

only 45 to 70 gpm of groundwater flow due to poor recovery well performance and limitations in the diameter of recovery well conveyance piping. The existing system operates in batch-flow and utilizes a SBR to remove the ammonia concentrations that are typically found in landfill leachate, which may not be necessary under the new pumping scenario with additional bedrock water coming from RW-T.

- The OU1 GWET upgrade includes treatment for reducing 1,4-dioxane concentrations at or below the GWQS of 0.4 µg/l. Various treatment technologies, such as adsorption and AOP, have been evaluated and pilot tested for use at the Site. Recent studies into the potential efficacy of biological treatment are also being considered. As such, due to the evolving nature of 1,4-dioxane ex-situ treatment, a final ex-situ treatment option will not be selected until the PDI or RD phase. The proposed OU1 GWET treatment train Process Flow Diagram (PFD) is provided in **Figure 8-3**.

- The LTM program will be modified to include additional overburden and bedrock wells to evaluate the performance of the optimized system. Establishment of a CEA and WRA will limit future groundwater use and prevent installation of wells other than for monitoring within the extent of the landfill property boundary.

8.5 Alternative OU1-G3 – Upgrade OU1 GWET System, Additional Groundwater Extraction, Source Area Removal with LTM/ICs

Alternative OU1-G3 utilizes the OU1 GWET overburden recovery well network, as well as the addition of new bedrock extraction wells to establish hydraulic control at the OU1/OU2 boundary. The OU1 GWET will be upgraded as described in Alternative OU1-G2 plus treatment of added volume from new bedrock extraction wells. The new extraction wells will be installed within preferential flow paths identified via geophysical methods or other means during the PDI and previous investigations (**Figure 8-4)**. For the purposes of cost estimating for this FS, it is assumed that three bedrock extraction wells will be installed within OU1 or at the OU1/OU2 boundary and the design flow rate for the new treatment system is 200 gpm.

It is assumed that pumping from the proposed bedrock recovery well EX-101 near existing monitoring well CF-209D and recovery well RW-U, will provide hydraulic containment for the portion of the plume originating at the North Waste Cell in OU1 and migrating northeast towards Schoolhouse Lane within OU2. It was demonstrated during the February 2017 CF-209D hydraulic assessment test and the 2011 RW-T pump test that pumping from the bedrock aquifer in this area, especially within a preferential flow path, can influence groundwater far downgradient. This hydraulic containment will limit or prevent the migration of contaminants from OU1 to OU2 and reduce concentrations of 1,4-dioxane discharging to surface water. LTM of the monitoring wells downgradient from the landfill are expected to show reduced contaminant concentrations over time from bedrock extraction.

Similarly, it is assumed that pumping from the proposed recovery wells EX-102 (located upgradient of existing well CF-216D) and EX-103 (located upgradient of existing well CF-225D), will establish hydraulic containment of the portion of the plume moving to the west-southwest of

the landfill. However, additional investigation is warranted in these areas including location of preferential flow paths and pump tests to verify this assumption. The PDI will determine the locations, number and construction of the recovery wells.

Primary components of Alternative OU1-G3 include installation of a bedrock aquifer recovery well network and upgrades to the OU1 GWET and conveyance systems. These components are described below in detail.

- Bedrock recovery wells will be installed around the landfill perimeter near the existing OU1 GWET recovery wells (as shown on **Figure 8-4**).
    - Recovery well EX-101 is to be installed on the northeastern side of the landfill in the vicinity of CF-209D/RW-U to a target depth of approximately 350 ft. bgs and will be open borehole construction from 100 to 350 ft. bgs. The recovery well depth is estimated based on the FLUTe™ hydraulic profile logs and downhole geophysical logs collected during the RI and will be further refined as part of the PDI. For the purposes of this FS we estimate EX-101 will be pumped at a flow rate of approximately 50 gpm based on the 2017 pump test flow rate able to achieve the desired drawdown. EX-101 will recover contaminant mass and establish hydraulic control of the portion of the plume originating at the North Waste Cell and to depths up to 350 ft. bgs.
    - Recovery wells EX-102 and EX-103 are to be installed on the western and southwestern sides of the landfill to a target depth of approximately 100 to 350 ft. bgs and will be open borehole construction. For purposes of this FS we estimate EX-102 and EX-103 will be pumped at a flow rate of approximately 25 gpm each to recover contaminant mass and establish hydraulic control of the portion of the plume moving west-southwest away from the landfill. A pump test and additional hydraulic and geophysical assessments must be completed as part of the PDI to locate preferential flow paths and collect the bedrock hydrogeology data needed to complete the RD of the recovery system and refine the recovery well depths.
    - EX-101, EX-102 and EX-103 combined will also recover some contaminant mass and establish hydraulic control within the predominant portions of the OU2 plume.

- The conveyance system around the landfill perimeter will be upgraded to accommodate combined groundwater flow from the overburden recovery wells and new bedrock recovery wells. This alternative includes upgrading Loop 2 from a 2-inch OD line to allow for additional capacity as well as flow from pumping recovery well RW-T at a continuous rate rather than in cycles as is the current practice. It is assumed that RW-T will operate continuously at 50 gpm and the remaining existing recovery wells will contribute an additional 50 gpm.

- An evaluation of the existing system will be conducted during the RD phase to determine the necessary improvements to increase treatment system capacity, and to effectively treat 1,4-dioxane. The GWET was designed to treat 120 gpm; however, it treats on average only 45 to 70 gpm of groundwater flow. The OU1 GWET will be upgraded from

the current treatment capacity to meet the flow requirements determined during the RD. For the purposes of the FS, 200 gpm is the assumed design flow rate with:

- EX-101 at 50 gpm;
- EX-102 and EX-103 at 25 gpm each;
- RW-T at 50 gpm; and,
- Remaining recovery wells contributing 50 gpm total

- The existing system operates in batch-flow and utilizes a SBR to remove ammonia concentrations that are typically found in landfill leachate. Groundwater samples collected during the CF-209D hydraulic assessment reported non-detectable concentrations of ammonia. It is assumed that groundwater from the proposed bedrock recovery wells will have relatively low ammonia concentrations and that biological treatment using the SBR may no longer be necessary under this alternative.

- The OU1 GWET upgrade includes treatment for 1,4-dioxane. A final treatment technology will be selected during the PDI/RD. The proposed OU1 GWET treatment train PFD is provided in **Figure 8-3**.

- Establishment of a CEA and WRA will limit future groundwater use and prevent installation of wells other than for monitoring within the extent of the landfill property boundary.

8.6 Alternative OU2-G1– No Action

Similar to Alternative OU1-G1, the No Action alternative is required by the NCP to be carried through the screening process for OU2. Under this alternative, no action, beyond what is performed in OU1, will be taken to remediate the contaminated groundwater in OU2.This alternative will also not involve ICs. Contaminants present in the groundwater will remain in place.

The No Action alternative provides a baseline for comparison with other active remedial alternatives. Because no remedial activities would be implemented under the No Action alternative, long term human health and environmental risks would remain the same as those identified in the BHHRA and SLERA with the exception of any changes due to incidental natural attenuation. There are no capital, operations/maintenance, or monitoring costs, no permitting or institutional legal restrictions needed, but this alternative will not meet any of the RAOs for groundwater.

8.7 Alternative OU2-G2 LTM/ICs

Alternative OU2-G2 consists of implementing a LTM/ICs program to monitor the effects of the OU1 remedy at OU2. Alternative OU2-G2 assumes an active groundwater remedial alternative, OU1-G2 or OU1-G3, is selected for OU1.

The effectiveness of LTM/ICs will be assessed over the course of the Site remedial activity. LTM will support decisions regarding continuation and/or revisions to the monitoring program; the

need to implement contingency/alternative remedy options; and/or verification that remedial goals have been met, followed by termination of performance monitoring. Site-specific criteria are to be developed to define triggers for these decisions.

Monitoring program changes will be considered should contaminant concentrations increase or spread to new locations (e.g., via mobilization of contaminants in a different direction or along preferential flow paths in the deep bedrock aquifer). Once OU2 remedial goals are met, the necessary duration of verification monitoring will be decided. The FS evaluation of alternatives assumes land and groundwater use in the OU2 area remains the same over the foreseeable future. Should LTM/ICs be less effective than needed to protect public health and the environment, remedies relying upon this alternative outside of the active remediation area may incorporate a contingent remedy. Alternative remedies will be considered if the current remedy fails to perform as anticipated. Criteria for determining when a contingency or alternative remedy is invoked are part of the remedial decision process; specific criteria based on OU2's RAOs will trigger implementation of a contingency or alternative remedy (EPA, 1998d).

Establishment of a CEA and WRA will limit future groundwater use and prevent installation of wells other than for monitoring within the known extent of OU2 and within the area served by the recent municipal water connection.

8.8 Alternative OU2-G3 Extraction and Treatment, LTMs/ICs

Alternative OU2-G3 consists of pumping groundwater from OU2 bedrock recovery wells. For the purposes of the FS, it is assumed that three recovery wells will be installed; one to the northeast and two to the west-southwest within the most predominant groundwater flow directions, which will establish hydraulic control of the OU2 plume (**Figure 8-5**). The bedrock recovery wells (EX-201, 202, and 203) will be constructed to an estimated depth of 100 to 350 ft. bgs.

The three bedrock recovery wells proposed in this alternative would be in addition to the alternative selected for OU1. The recovered groundwater will be pumped to and treated at the OU1 GWET, which will be updated and expanded as described in Alternative OU1-G2 or OU1-G3. The treated groundwater effluent will either be discharged to East Trout Brook at the existing OU1 GWET effluent location and at a new infiltration/ detention basin, returned to the streams nearest the recovery wells, or a combination of discharge locations to maintain the hydrology of the streams and avoid adverse impacts to open water and wetlands. Recovery well design, the need for an infiltration/ detention basin, and water discharge will be determined during the RD. For purposes of this FS, costs for direct discharge to surface water bodies nearest to the OU2 extraction wells have been assumed.

This alternative is contingent on the remedy selected to address the OU1 groundwater deficiencies. It is assumed that the OU1 GWET system will be upgraded to accept the additional volume from Alternative OU2-G3. LTM and a CEA/WRA as described previously are also components of this alternative.

9.0 Detailed Evaluation of Remedial Alternatives

This section presents the detailed evaluation of the remedial alternatives described in Section 8.0. The purpose of the evaluation is to identify the advantages and disadvantages of each alternative as well as key trade-offs among the alternatives. The detailed evaluation of alternatives consists of an individual analysis of each alternative against the evaluation criteria and a comparative analysis among the alternatives to assess the relative performance of each alternative with respect to the evaluation criteria.

9.1 Evaluation Criteria

The evaluation was based on criteria established under Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA 1988b).The nine evaluation criteria have been developed to address CERCLA requirements and to address the additional technical and policy considerations that have proven to be important for selecting among remedial alternatives. The evaluation criteria are as follows:

Overall Protection of Human Health and the Environment: This criterion is an evaluation of the alternative's ability to protect public health and the environment, assessing how risks posed through each existing or potential pathway of exposure identified in the human health risk assessment are eliminated, reduced or controlled through removal, treatment, engineering controls or institutional controls. The alternative's ability to achieve each of the RAOs is evaluated.

Compliance with ARARs: This criterion evaluates how the alternative complies with the ARARs, if an ARAR waiver is required and the justification for a waiver, if needed.

Long Term Effectiveness and Permanence: Each alternative is evaluated for its long-term effectiveness after implementation. If contamination or treated residuals remain after the selected remedy has been implemented, the following items are evaluated:

- The magnitude of the remaining risks (i.e., will there be any significant threats, exposure pathways, or risks to the community and environment remaining);
- The adequacy of the engineering and institutional controls intended to mitigate the risk;
- The reliability of these controls, and
- The ability of the remedy to continue to meet RAOs in the future.

Should the results of this evaluation indicate concerns with the risks or reliability of the remedy, the utilization of technological enhancement, contingencies and/or alternative remedies may need to be considered.

Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment: The alternative's ability to reduce the toxicity, mobility and/or volume of contamination is evaluated.

Preference should be given to remedies that permanently and significantly reduce the toxicity, mobility, or volume of the contamination at the Site.

Short Term Impacts and Effectiveness: The potential short-term adverse impacts and risks of the remedy upon the community, workers, and the environment during the construction and/or implementation are evaluated. A discussion of how the identified potential adverse impacts to the community or workers at the Site will be controlled, and the effectiveness of the controls, should be presented. A discussion of engineering controls that could be used to mitigate short term impacts (e.g., dust control measures) is provided. The length of time needed to achieve the remedial objectives is also estimated.

Implementability: The technical and administrative feasibility of implementing each alternative is evaluated for this criterion. Technical feasibility includes such things as the difficulties associated with construction and the ability to monitor the effectiveness of the remedy. For administrative feasibility, the availability of the necessary personnel and material is evaluated along with potential difficulties in for example, obtaining specific operating approvals or access for construction and implementation of the remedy.

Cost: This criterion evaluates the estimated capital, operations, maintenance, and monitoring costs for each alternative. Costs are estimated and presented on a Net Present Value basis assuming in inflation rate of 3% and a capital appreciation (interest) rate of 7%.

State Acceptance: NJDEPs comments, concerns and overall perception of the remedy are evaluated in a format that responds to all questions that are raised (i.e., a responsiveness summary).

Community Acceptance: The public's comments, concerns and overall perception of the remedy are evaluated in a responsiveness summary.

The eighth and ninth criteria, State and Community acceptance, will be evaluated following comment on the RI/FS report and the proposed plan and will be addressed in preparing the ROD.

9.2 Individual Analysis of Groundwater Remedial Alternatives

The individual analysis of the groundwater remedial alternatives with respect to the seven criteria is presented below. A comparative analysis of the remedial alternatives is provided within **Table 9-1**.

9.2.1 Alternatives OU1-G1: No Action

Overall Protection of Human Health and the Environment – Alternative OU1-G1 provides no control of exposure to contaminated groundwater and no reduction in risk to human health and the environmental. This alternative allows for the potential continued migration of contaminated groundwater downgradient and further degradation of the groundwater and surface water quality.

Compliance with ARARs – ARARs (federal MCLs for groundwater) will not be met under this alternative. Chemical-specific ARARs would continue to be in exceedance in OU1.

Long Term Effectiveness and Permanence – No long term management or controls for exposure are included in Alternative OU1-G1. Long term potential risks would remain unchanged.

Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment – Alternative OU1-G1 provides no reduction in toxicity, mobility, or volume of the contaminated overburden or bedrock groundwater within OU1.

Short Term Impacts and Effectiveness – Alternative OU1-G1 does not result in disruption of OU1 and therefore there are no additional risks posed to the community, workers, or the environment as no remedial actions will occur.

Implementability – There are no implementability concerns posed by this remedy as no remedial actions are being implemented.

Cost – Because this is a no action alternative, the capital, O&M, and net present worth costs are estimated to be $0. The estimated costs for Alternative OU1-G1 is summarized in **Table 9-1** and Appendix A.

9.2.2 Alternative OU1-G2: Upgrade OU1 GWET System, Source Area Removal with LTM/ICs

Overall Protection of Human Health and the Environment – This alternative is protective of human health and the environment. It would meet the RAOs by preventing migration of contaminated overburden groundwater and leachate to bedrock within OU1 and from OU1 to OU2, reducing concentrations of 1,4-dioxane at or below the 0.4 µg/l GWQS before being discharged to the environment, and reducing the impact of the North Waste Cell as a source of groundwater contamination.

The OU1 GWET system will be improved to better capture overburden groundwater by increasing the Loop 2 force main pipe diameter which conveys extracted water from the eastern side of the landfill to the treatment plant and by upgrading the treatment plant to allow for additional treatment capacity and 1,4-dioxane treatment capabilities. Operating at a higher capacity and fully treating all of the known contaminants in the water (e.g. 1,4-dioxane) will help to hydraulically contain OU1 and reduce contaminant migration into OU2. Sampling and analysis for 1,4-dioxane degrading microbes and enzymes would be conducted periodically to measure the continuing potential to achieve remedial goals. A long-term monitoring program will be used to assess the groundwater quality and operational time frame required for this alternative.

Compliance with ARARs – Remedial activities for Alternative OU1-G2 will be continued until the PRGs are met. Alternative OU1-G2 is expected to achieve compliance with ARARs over time; however, it is intended as a containment remedy rather than a restoration remedy for OU1

overburden groundwater.

Long Term Effectiveness and Permanence – This alternative will have long-term effectiveness and permanence. Extraction and treatment of contaminated overburden groundwater will limit migration to the underlying bedrock aquifer as well as from OU1 to OU2. Long-term groundwater monitoring will be implemented to monitor the groundwater quality during the remediation period of 30 years.

Extraction and treatment systems are a proven technology. ICs, if properly enforced, will be considered reasonably adequate and reliable for protection of human health.

This alternative will provide adequate control of risks to human health and the environment. The long-term effectiveness of this alternative will be assessed through routine groundwater monitoring and five-year reviews to verify that human health and ecological resources are not at risk.

Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment – The extraction and treatment system will reduce the toxicity and volume of contaminants in overburden groundwater through recovery of contaminated groundwater and treatment prior to discharge. As a containment remedy, it will also reduce mobility of contaminants between OU1 and OU2.

Short Term Impacts and Effectiveness – Site work and installation of the new Loop 2 force main and treatment plant upgrades will be performed without risk to the community as all construction activities will be contained within the landfill property boundary. Through required training, Site workers will wear appropriate personal protective equipment (PPE) to minimize exposure to contamination and as a protection from physical hazards. Construction best practices to control dust, noise and vibration related to construction will be used. These precautions will provide effective protection for the Site workers and community from the impacts related to construction.

The estimated period for the construction for the new force main and upgrading the treatment system is one year. For cost estimating purposes, it is assumed that overburden groundwater extraction and treatment will be active for a period of 30 years.

Implementability – This alternative is technically implementable using conventional construction methods and equipment. No technical difficulties are anticipated for the construction of the treatment system or upgrade of the force main. The services and materials needed to execute this alternative are readily available. Competitive bids can be obtained from a number of equipment vendors and remediation contractors. No major problems are foreseen for the implementation and enforcement of the institutional controls, or for monitoring associated with MNA and LTM.

Cost – The present worth cost of Alternative OU1-G2 is estimated to be **$20,936,217**. The capital cost is estimated to be **$9,828,414**, the total present value of O&M costs is estimated to be **$11,052,300** and the periodic costs is **$55,503**. The capital cost is primarily the cost of system construction. The estimated cost for Alternative OU1-G2 and supporting assumptions

are summarized in **Table 9-1** and **Appendix A**.

9.2.3 Alternative OU1-G3: Upgrade OU1 GWET System, Additional Groundwater Extraction, Source Area Removal with LTM/ICs

Overall Protection of Human Health and the Environment – This alternative is protective of human health and the environment. It would meet the RAOs over time by preventing migration of contaminated overburden and bedrock groundwater and leachate from OU1 to OU2, reducing concentrations of 1,4-dioxane at or below the 0.4 µg/l GWQS before being discharged to the environment, and reducing the impact of the North Waste Cell as a source of groundwater contamination.

The OU1 GWET system will be improved to better capture the OU1 overburden groundwater by increasing the Loop 2 force main pipe diameter which conveys extracted water from the eastern side of the landfill to the treatment plant. The OU1 GWET system will be upgraded to allow for additional treatment capacity and 1,4-dioxane treatment capabilities, and bedrock recovery wells will be installed in key areas along the landfill perimeter to capture bedrock groundwater within OU1 and near portions of OU2.

Operating at a higher capacity and fully treating all of the known contaminants in the water including 1,4-dioxane will help to hydraulically contain OU1 and reduce migration of contamination to OU2. A long-term monitoring program will be used to assess the groundwater quality and operational time frame required for the OU1 GWET system.

Compliance with ARARs – Remedial activities for Alternative OU1-G3 will be continued until the PRGs are met. Alternative OU1-G3 is expected to achieve compliance with ARARs over time; however, it is intended as a containment remedy rather than a restoration remedy for OU1 overburden and bedrock groundwater.

Long Term Effectiveness and Permanence – This alternative will have long-term effectiveness and permanence. Extraction and treatment of contaminated overburden and bedrock groundwater will limit downgradient migration of the contaminants and reduce groundwater contamination in OU1 and, as a result, also groundwater and surface water contamination in OU2. Long-term groundwater monitoring will be implemented to monitor the groundwater quality during the remediation period.

Extraction and treatment systems are a proven technology. During the RD, detailed groundwater calculations will be performed to determine the exact locations of recovery well screen intervals and pumping rates necessary to capture the bedrock plume within OU1. ICs, if properly enforced, will be considered reasonably adequate and reliable for protection of human health.

This alternative will provide adequate control of risks to human health and the environment. The long-term effectiveness of this alternative will be assessed through routine groundwater monitoring and five-year reviews to verify that human health and ecological resources are not at risk.

Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment – The extraction and treatment system will reduce the toxicity and volume of contaminants in overburden and bedrock groundwater through extraction and treatment through recovery of contaminated groundwater and treatment prior to discharge. As a containment remedy, it will also reduce mobility of contaminants between OU1 and OU2.

Short Term Impacts and Effectiveness – Site work and installation of the new Loop 2 force main, treatment plant upgrades, and bedrock recovery well installation will be performed without significant risk to the community, although some disruption to private property may occur if bedrock recovery wells extend outside the OU1 property boundary. Through required training, Site workers will wear appropriate personal protective equipment (PPE) to minimize exposure to contamination and as a protection from physical hazards. Construction best practices to control dust, noise and vibration related to construction will be used. These precautions will provide effective protection to the Site workers and the community from the impacts related to construction.

The estimated period for the construction for the new force main, upgrading the treatment system and installing bedrock recovery wells is 1 year. For cost estimating purposes, it is assumed that groundwater extraction and treatment will be active for a period of 30 years.

Implementability – This alternative is technically implementable using conventional construction methods and equipment. No technical difficulties are anticipated for upgrading the groundwater treatment system, Loop 2 force main, or bedrock recovery wells. Services and materials for implementation of this alternative are readily available. Competitive bids can be obtained from a number of equipment vendors and remediation contractors. No major problems are foreseen for the implementation and enforcement of the institutional controls.

Cost – The present worth cost of Alternative OU1-G3 is estimated to be **$21,933,592**. The capital cost is estimated to be **$10,457,289**, the total present value of O&M costs is estimated to be **$11,420,800**, and the total present value for periodic costs is **$55,503**. The capital cost is primarily the cost of OU1 GWET upgrades, the Loop 2 upgrades, and the bedrock recovery well installation. The estimated cost for Alternative OU1-G3 and supporting assumptions are summarized in **Table 9-1** and **Appendix A**.

9.2.4 Alternatives OU2-G1: No Action

Overall Protection of Human Health and the Environment – Alternative OU2-G1 provides no control of exposure to contaminated groundwater and no reduction in risk to human health and the environmental. This alternative allows for the potential continued migration of contaminated groundwater downgradient and further degradation of the groundwater and surface water quality.

Compliance with ARARs – ARARs for groundwater and surface water will not be met under this alternative. Chemical-specific ARARs would continue to be in exceedance in OU2.

Long Term Effectiveness and Permanence – No long term management or controls for

exposure are included in Alternative OU2-G1. Long term potential risks would remain unchanged.

Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment – Alternative OU2-G1 provides no reduction in toxicity, mobility, or volume of the contaminated groundwater or surface water.

Short Term Impacts and Effectiveness – Alternative OU2-G1 does not result in disruption of OU2 and therefore there are no additional risks posed to the community, workers, or the environment as no remedial actions will occur.

Implementability – There are no implementability concerns posed by this remedy as no remedial actions are being implemented.

Cost – Because this is a no action alternative, the capital, O&M, and net present worth costs are estimated to be $0. The estimated costs for Alternative OU2-G1 is summarized in **Table 9-1** and **Appendix A**.

9.2.5 Alternative OU2-G2: LTM/ICs

Overall Protection of Human Health and the Environment – This alternative is contingent on the successful implementation of an OU1 active remedy to be protective of human health and the environment for OU2 groundwater. It would meet the OU2 groundwater and surface water RAOs over time by natural attenuation of contaminant concentrations in OU2 overburden and bedrock groundwater as the active OU1 remedy takes effect.

Compliance with ARARs – Alternative OU2-G2 is expected to achieve compliance with ARARs over time. Remedial activities for Alternative OU2-G2 will continue until the PRGs are met.

Long Term Effectiveness and Permanence –Long-term groundwater monitoring will be implemented to monitor the groundwater quality during the remediation period. This alternative will provide adequate control of risks to human health and the environment through the implementation of the ICs. ICs, if properly enforced, will be considered reasonably adequate and reliable for protection of human health and ecological resources.

The long-term effectiveness of this alternative will be assessed through routine groundwater monitoring and five-year reviews to verify that human health is not at risk and the environment is being restored.

Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment – MNA will reduce the toxicity and volume of contaminants by degradation in groundwater over time. It will not reduce mobility.

Short Term Impacts and Effectiveness – This alternative can be performed without risk or short term impacts to the community. It is assumed that the OU2 LTM period is 20 years when combined with an active OU1 remedy.

Implementability – This alternative is technically and administratively implementable. No major problems are foreseen for the implementation and enforcement of the institutional controls.

Cost – The present worth cost of Alternative OU2-G2 is estimated to be **$781,100** which is in addition to the cost for an active OU1 remedy (either OU1-G2 or OU1-G3). The cost for this alternative is entirely captured under the O&M section to implement the annual LTM/ICs program. The estimated cost for Alternative OU2-G2 and the supporting assumptions are summarized in **Table 9-1** and **Appendix A**

9.2.6 Alternative OU2-G3: Extraction and Treatment of OU2 Groundwater/LTMs/ICs

Overall Protection of Human Health and the Environment – This alternative is protective of human health and the environment. It provides the most aggressive approach by recovering groundwater within distant portions of OU2.

This alternative builds upon an active remedy selected for OU1 (either OU1-G2 or OU1-G3) in addition to OU2 groundwater recovery wells that will convey the groundwater to the OU1 GWET system. The OU2 recovery wells, coupled with the hydraulic containment of OU1, will restore the OU2 groundwater to drinking water quality over time. A long-term monitoring program will be used to assess the groundwater quality and operational time frame required for the GWET system.

Compliance with ARARs – Alternative OU2-G3 is expected to achieve compliance with ARARs within OU2 by restoring groundwater and surface water over time. Remedial activities for Alternative OU2-G3 will be continued until the PRGs are met.

Long Term Effectiveness and Permanence – This alternative will have long-term effectiveness and permanence. Extraction and treatment of contaminated groundwater within OU2 will limit further migration of the plume beyond the OU2 investigation area, reducing both groundwater and surface water contamination. Long-term groundwater monitoring will be implemented to monitor the groundwater quality during the remediation period. This alternative will provide adequate control of risks to human health and the environment.

Extraction and treatment systems are a proven technology. During the PDI and RD, detailed groundwater calculations will be done to determine the exact locations of recovery well screen intervals and pumping rates necessary to capture the OU2 plume while maintaining sufficient groundwater discharge to surface water to maintain stream hydrology and wetlands habitat. ICs, if properly enforced, will be considered reasonably adequate and reliable for protection of human health.

The long-term effectiveness of this alternative will be assessed through routine groundwater monitoring and five-year reviews to verify that human health and ecological resources are not at risk.

Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment – The recovery

wells within OU2 connected to the OU1 treatment system will reduce the toxicity, mobility and volume of the contaminants in groundwater in OU2 as well as surface water.

Short Term Impacts and Effectiveness – Site work and installation of the new bedrock recovery wells and force main connecting to the OU1 GWET system will be performed without significant risk to the community, although disruption to private properties will occur during installation of OU2 recovery wells and associated conveyance piping. Through required training, site workers will wear appropriate personal protective equipment (PPE) to minimize exposure to contamination and as a protection from physical hazards. Construction best practices to control dust, noise and vibration related to construction will be used. These precautions will provide effective protection to the site workers and the community from the impacts related to construction.

The estimated period for the construction for the bedrock recovery wells, conveyance piping and the force main connecting to the OU1 GWET system is one year. For cost estimating purposes, it is assumed that groundwater extraction and treatment will be active for a period of 20 years.

Implementability – This alternative is technically implementable using conventional construction methods and equipment. Technical difficulties may be encountered during the siting and construction of the OU2 bedrock recovery wells. The recovery wells will likely need to be located on private property or utility easements which may cause administrative challenges. Services and materials for implementation of this alternative are readily available. Competitive bids can be obtained from a number of equipment vendors and remediation contractors. No major problems are foreseen for the implementation and enforcement of the institutional controls.

Relative Cost – The present worth cost of Alternative OU2-G3 is estimated to be **$10,784,639** which is in addition to the cost for an active OU1 remedy (either OU1-G2 or OU1-G3). The capital cost is estimated to be **$9,056,339** and the total present value of O&M costs is estimated to be **$1,728,300**. The capital cost is primarily the cost of installing the OU2 bedrock recovery wells and groundwater conveyance piping to the existing OU1 GWET system. The estimated cost for Alternative OU2-G3 and supporting assumptions are summarized in **Table 9-1** and **Appendix A**.

9.3 Comparative Analysis of Alternatives

9.3.1 Soil

Excavation of the remaining source material associated with the North Waste Cell underlying the landfill perimeter road is the presumptive soil remedy included in OU1-G2 and G3. No alternate soil remedies to address the remaining portion of the North Waste Cell were developed in this FS based on discussions with EPA.

The anticipated costs for source removal, disposal, and restoration are approximately **$1.4M** and include the following:

- PDI to define the excavation limits
- Mobilization/ Demobilization of construction equipment
- Soil Excavation
- Analytical Sampling
- Lab Packs/ Drum Overpacking
- Transportation and Disposal (T&D)
- Backfill, Compaction, and Grading
- Surveying
- Landfill Cap Repair
- Surface Restoration

9.3.2 Groundwater

Table 9-1 summarizes the comparison of the three OU1 and three OU2 groundwater alternatives against the seven criteria. The cost tables are provided in **Appendix A**.

Overall Protection of Human Health and the Environment

Alternatives OU1-G1 and OU2-G1 would not meet the RAOs and would not be protective of human health and the environment since no actions would be taken. For OU1, the existing treatment plant would remain, but it primarily treats leachate and some shallow groundwater, and deeper bedrock groundwater would continue to migrate from the landfill to downgradient areas uncontrolled. OU2 contamination would remain in groundwater for a long time in the future, while no mechanisms would be implemented to prevent exposure to contaminated groundwater, or to reduce the toxicity, mobility, or volume of contamination except through natural processes, which would not be monitored.

For Alternatives OU1-G2 and OU1-G3, RAOs would be met over time and would provide protection to human health and the environment through treatment processes, ICs, and LTM. The implementation of a deed restriction would provide a greater degree of overall protection of human health and the environment by providing limited use of the Site. Alternative OU1-G3 would be more protective compared to Alternative OU1-G2 as it would provide a more comprehensive hydraulic control remedy with the addition of bedrock extraction wells for OU1 and would capture both overburden and bedrock contaminated groundwater underlying the landfill property to a depth of approximately 350 feet bgs. Additional protection would occur based on the excavation and off-site disposal of source material in the North Waste Cell as part of both Alternatives OU1-G2 and OU1-G3.

For OU2, Alternatives OU2-G2 and OU2-G3 would meet RAOs and would provide protection to human health and the environment through the implementation of either long-term monitoring (OU1-G2) or groundwater extraction and treatment (OU1-G3). Alternative OU2-G3 would actively treat contaminated groundwater in the OU2 area of the Site, which may be more protective than the LTM called for in OU2-G2. However, the bedrock extraction wells which are part of Alternative OU1-G3, are expected to capture a portion of the OU2 bedrock plume, which

depending on the success of the OU1 remedy, may provide similar protectiveness compared with OU2-G3. Further, streams and wetlands in the OU2 area could be negatively impacted by extraction and discharge of treated OU2 groundwater.

Compliance with ARARs

Alternatives OU1-G1 and OU2-G1 would not achieve drinking water standards for the aquifer. Action-specific ARARs do not apply to these No Action alternatives since no remedial action would be conducted.

Alternatives OU1-G2 and OU1-G3 could meet the RAOs within the active treatment areas over the long term. Alternatives OU2-G2 and OU2-G3 would meet the RAO for OU2 over the long term, provided that an active remedy for OU1 is effective. OU2-G2 would likely take longer than OU2-G3 to achieve compliance with ARARs within OU2.

Alternatives OU1-G2, OU1-G3, and OU2-G3 would meet action-specific and location-specific ARARs for example, by complying with substantive National Pollution Discharge Elimination System requirements for discharge of the treatment plant effluent to surface water and/or groundwater, implementing Resource Conservation Recovery Act requirements, and the Clean Water Act requirements. Locating extraction wells and conveyance piping within regulated areas, such as freshwater wetlands, would be avoided to the extent practicable. Alternative construction techniques such as directional drilling vs. open trenching of conveyance piping would be evaluated for greater compliance with location-specific ARARs for Alternative OU2-G3.

Excavation of contaminated soils and solid waste from the North Waste Cell as part of Alternatives OU1-G2 and OU1-G3 would achieve compliance with soil standards. Excavated materials would be disposed of at an off-site permitted facility.

Long-Term Effectiveness and Permanence

Alternatives OU1-G1 and OU2-G1 would not be effective or permanent since there would be no mechanisms to prevent or monitor migration and exposure to contaminated groundwater. Alternatives OU1-G2 and OU1-G3 would provide long-term effectiveness and permanence by hydraulically containing the contaminant mass within the overburden in the case of OU1-G2 and, in the case of OU1-G3, overburden and bedrock aquifers within OU1 and treating the contaminated groundwater ex-situ. Alternative OU1-G3 would provide more hydraulic control and additionally in the bedrock aquifer compared to OU1-G2. Additionally, ICs and deed restrictions would ensure continued protection of human health receptors in the long-term under both Alternative OU1-G2 and OU1-G3 by providing protection against potential exposures to low-level threat buried landfill materials is maintained. Eliminating the source material remaining in the North Waste Cell area would help achieve long-term effectiveness and permanence as part of both Alternatives OU1-G2 and OU1-G3.

Alternatives OU2-G2 and OU2-G3 are both contingent on the successful implementation of an active OU1 remedy. Alternative OU2-G2 would rely on the implementation of either OU1-G2 or OU1-G3, for long-term effectiveness. Alternative OU2-G3 will use extraction from OU2 extraction wells and treatment at the OU1 plant to restore the OU2 aquifer to PRGs. The bedrock OU2 extraction wells in alternative OU2-G3 may expedite removal of contaminant mass from OU2. Both OU2 alternatives are expected to improve groundwater quality outside the landfill and bring the Site closer to the long-term goal of restoration. The final remedy for OU2 would be later considered based on the effectiveness of the OU1 amended remedy and OU2 selected interim remedy.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternatives OU1-G1 and OU2-G1 would not provide any reduction of toxicity, mobility or volume of contaminants since no remedial action would be conducted.

Alternatives OU1-G2 and OU1-G3 would provide reduction of toxicity, mobility, and volume through treatment and removal of contaminants in OU1. Alternative OU1-G3 would be more effective compared to OU1-G2 in reducing toxicity, mobility and volume of contamination in groundwater by hydraulically controlling and treating more contaminated groundwater, from both the overburden and bedrock zones underlying the landfill. Both OU1-G2 and OU1-G3 would reduce the toxicity, mobility, and volume of 1,4-dioxane by addition of treatment elements to the existing GWET system to address this contaminant, which is not currently being treated by the GWET. The reduction of toxicity, mobility, and volume of source material would be achieved by the removal of the remaining source material from the North Waste Cell area under both Alternative OU1-G2 and OU1-G3.

Alternatives OU2-G2 and OU2-G3 would both see the reduction of contaminant toxicity, mobility, and volume through the successful implementation of an active OU1 remedy which would improve hydraulic control of contamination in the OU1 area and therefore limit migration of contaminants to the OU2 area. Alternative OU2-G3 would be the most effective in reducing toxicity, mobility and volume of contamination in groundwater through extraction and treatment at the furthest

Short-Term Impacts and Effectiveness

Alternatives OU1-G1 and OU2-G1 would not have short-term impacts since no action would be implemented.

There would be minimal short-term impacts to the local community and workers for Alternatives OU1-G2 and OU1-G3 due to the fact that associated construction, operation and treatment activities would occur within the OU1 property boundary. In addition, there would be minimal short-term impacts related to the removal of the source material in the North Waste Cell area.

Alternative OU2-G2 could be performed with limited impact to Site workers or the community. Coordination and access would be required for construction of the OU2 extraction wells and pumping in Alternative OU2-G3.

For Alternatives OU1-G2, OU1-G3, and OU2-G3, Site workers would undergo required training and would wear appropriate personal protective equipment to minimize exposure to contamination and as a protection from physical hazards. Best construction practices to control dust, noise and vibration related to construction would be used. These precautions would provide effective protection to the Site workers and the community from the impacts related to construction.

Implementability

All groundwater alternatives developed for OU1 and OU2 are implementable. Alternatives OU1-G1 and OU2-G1 would be the easiest to implement as no work would be performed.

For OU1, Alternatives OU1-G2 and OU1-G3 would be similarly implementable. Services, materials and experienced vendors are readily available. During RD Site-specific design parameters for Alternatives OU1-G2 and OU1-G3 and substantive requirements of otherwise required state and local permits would be met for on-site work. The North Waste Cell source area removal is implementable by using standard practices for excavating wastes material. In accordance with CERCLA, no permits would be required for on-site work (although such activities would comply with substantive requirements of otherwise required permits). Permits would be obtained as needed for off-site work. For OU1, ICs, requiring the establishment of a deed restriction, the performance of five-year reviews and continued monitoring and maintenance, are easily implementable.

For OU2 groundwater, Alternative OU2-G2 would be technically and administratively easier to implement than Alternative OU2-G3 as it only includes sampling, while OU2-G3 involves construction of extraction wells and extensive piping from the OU2 area back to the OU1 plant. While implementable, this work would be more difficult to implement compared to OU2-G2. For OU2-G3, it is possible that groundwater extraction from these proposed locations would have a negative hydraulic impact (i.e. dewater) on the nearby streams and wetlands. Since these water bodies are headwaters to trout streams, it is likely that this alternative would include returning the treated water to those streams to mitigate any hydraulic disturbances. This would involve constructing two miles of conveyance lines. Getting the hydraulic balance right would be challenging and would require significant modeling in the design phase.

Cost

A comparative summary of the cost estimates for each alternative is presented in Table 9-1, and Appendix A. The costs for the OU1 Alternatives are:

Alternative	Duration (years)	Capital Cost	Annual O&M Cost	Total O&M Cost	Periodic Cost	Total Present Value
OU1-G1	0	$0	$0	$0	-$0	**$0**
OU-1-G2	30	$9,828,414	$890,660	$11,052,300	$55,503	**$20,936,217**
OU1-G3	30	$10,457,289	$920,360	$11,420,800	$55,503	**$21,933,592**

For OU1, Alternative OU1-G2 is approximately $1M less than Alternative OU1-G3 with a total present value estimated at **$20,936,217** and **$21,933,592**, respectively. The added costs for Alternative OU1-G3 are a result of the drilling (capital cost) and operation (O&M cost) of the bedrock recovery wells.

The costs for the OU2 Alternatives are:

Alternative	Duration (years)	Capital Cost	Annual O&M Cost	Total O&M Cost	Periodic Cost	Total Present Value
OU2-G1	0	$0	$0	$0	$0	**$0**
OU2-G2	10	$0	$111,200	$781,100	$0	**$781,100**
OU2-G3	10	$9,056,339	$246,060	$1,728,300	$0	**$10,784,639**

For OU2, Alternative OU2-G2 is substantially less expensive than Alternative OU2-G3 with a total present value of **$781,100** and **$10,784,639**, respectively. The major costs associated with Alternative OU2-G3 are from the recovery well installation and the groundwater conveyance to, and treated water from, the GWET system. It is assumed that groundwater extraction from these proposed locations will have a negative hydraulic impact (i.e. dewater) on the nearby streams and tributaries. Since these water bodies are headwaters to trout streams, it is assumed that this remedy would have to include returning the treated water to those streams to

mitigate any hydraulic disturbances. The water conveyance and restoration for Alternative OU2-G3 is approximately 2 miles and represents a significant cost.

9.4 Uncertainties

Development of remedial alternatives for the containment of groundwater at OU1 and the restoration of groundwater at OU2 in Section 8 required a number of reasonable assumptions to be made based on available information. There is a degree of uncertainty associated with several of the key factors that serve as the basis for the alternatives. These factors include a range of source constraints, hydrogeological constraints, and Site constraints.

To account for potential uncertainties that may arise during implementation of the selected remedy, each remedial option includes a contingency line-item. A 25% contingency was assumed for capital costs and a 10% contingency was assumed for annual O&M and periodic costs. These contingencies are based off of EPA's guide to develop and document cost estimates during the FS (EPA, 2000). The costs developed in this FS are an order-of-magnitude estimate with the objective of estimating within -30% and +50% of the actual cost to implement the remedy.

9.4.1 Source Constraints

The extent and distribution of contaminant mass was not fully defined during the RI, mostly because the GWQS changed by more than an order of magnitude during the RI time period (10 µg/l to 0.4 µg/l). The PDI will include additional delineation, hydrogeologic and geophysical investigations, particularly to the west-southwest of the landfill, to verify FS assumptions and address data gaps. The treatment area may be adjusted based on the PDI results. There is also uncertainty associated with the location of contaminant transport pathways, due to the complexity of the groundwater flow system in the fractured bedrock aquifer. An additional magnetometric resistivity survey or comparable is necessary to locate preferential groundwater flow paths to the west-southwest of the landfill.

The remedial cleanup time for OU1 and OU2 was assumed to be 30 years and 20 years, respectively. Groundwater modeling will be performed during the PDI to refine the estimated cleanup times. For purposes of the FS, it is assumed that the effectiveness of the chosen remedy would need to be re-evaluated in a minimum 5-year period.

9.4.2 Hydrogeological Constraints

The results from the most recent RI revealed that the current OU1 extraction and treatment system is not fully capturing the groundwater from OU1. The deficiencies of the existing OU1 remedy have been discussed in detail in this FS. The alternatives that were proposed aim to upgrade the existing OU1 hydraulic containment remedy and restore OU2 groundwater.

Capture zones in fractured rock aquifers are difficult to estimate because of the inherent heterogeneity and anisotropy in these systems. Estimates of potential capture zones for the FS were made using previous pumping tests performed at CFS – notably the 2017 HDR study conducted at monitoring well CF-209D and the 2011 Handex study conducted at recovery well

RW-T. The 2017 study at CF-209D was a constant rate pumping test over one month at approximately 70 gallons per minute (**Appendix B**). This test yielded a groundwater response in monitoring wells up to 3,000 feet away to the northeast/ southwest and 500 feet away in the northwest/ southeast directions. The 2011 Handex study at RW-T ran for 163 days with a final flow rate of 63 gpm, which yielded up to 10 feet of drawdown in monitoring wells 630 feet to the northeast, 750 feet to the southwest and 200 feet in the northwest-southeast orientation (**Figure 4-2**).

The existing OU1 GWET influent volume averages between 45 to 70 gpm, with the OU1 recovery wells cycling on and off due to system constraints. Alternatives OU1-G2, OU1-G3 and OU2-G3 propose operating the recovery wells (existing and proposed for OU1-G3 and OU2-G3) on a constant rate basis to increase the yield. The underlying assumption is that additional yield can be obtained with greater drawdown and that the existing wells (particularly RW-T) are capable of yielding higher rates. The increase in yield will theoretically increase the capture zone and performance of the containment remedy for OU1 and help restore OU2.

The proposed alternatives were developed and based on the available data. Reasonable approximations of the system requirements were made for purposes of the FS. However, the final design and capture zone analysis should be refined during the PDI.

9.4.3 Site Constraints

Site related constraints at CFS may pertain to Alternative OU2-G3. Potential constraints include access to private properties and utility corridors for siting potential recovery wells, force mains, electrical connections and discharging treated effluent into local streams and tributaries. It is possible that pumping from the proposed OU2 recovery wells will have negative hydrologic effects on the local streams and tributaries. A certain volume of water must be maintained so as not to adversely impact open water and freshwater wetlands. Ensuring the proper water balance is maintained would need to be included in the RD for OU2-G3, if that alternative were to be selected.

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TABLES

Table 4-1 Groundwater Preliminary Remediation Goals
Combe Fill South RI/FS (018-RICO-0256)
Chester and Washington Townships, New Jersey

Constituents	EPA National Primary Drinking Water Standards[1] MCLs (µg/l)	NJGWQS[2] (µg/l)	PRGs[3] (µg/l)	Maximum Detected Concentration (µg/l)
Inorganics				
Arsenic	10	3	3	6.4 J
Chromium, total	100	70	70	262 J
Lead	15	5	5	175
Organics				
Alpha-BHC	NL	0.02	0.02	0.073
Benzene	5	1	1	90
Bis(2-ethylhexyl) Phthalate (DEHP)	NL	3	3	15
1,4-dioxane	NL	0.4	0.4	350
Trichloroethylene (TCE)	5	1	1	4 J
Tentatively Identified Compounds (TICs)[4]				
Phenobarbital	NL	5	5	37
2-methoxy-2-methylbutane	NL	100	100	480
n,n-dimethylformamide	NL	5	5	110

Acronyms:
µg/l - micrograms per liter
J - Estimated value
PRGs - Preliminary Remediation Goals
NJGWQS- New Jersey Groundwater Quality Standards
NL - not listed

Notes:

1 - EPA National Primary Drinking Water Standards (web page), http://www.epa.gov/safewater/consumer/pdf/mcl.pdf.

2 - Groundwater is compared to the NJ Ground Water Quality Standards N.J.A.C. 7:9C, last amended January 16, 2018.
3 - PRGs are the lowest of the EPA MCLs and NJGWQS
4 - Synthetic organic chemicals defined as carcinogens (5 µg/l) or non-carcinogens (100 µg/l)

Table 4-2 Vertical Extent of Groundwater Contamination
Combe Fill South RI/FS (018-RICO-0256)
Chester and Washington Townships, New Jersey

Well/Total Depth (ft. bgs)	Surface Elevation (site benchmark datum)	Depth to Competent Bedrock (ft. bgs)	Maximum Depth of Liner Eversion (ft. bgs)	Elevation in Rock of Liner Eversion (site benchmark datum)	Maximum Depth of Liner Eversion (ft. below competent rock surface)	Remaining Transmissivity at Maximum Liner Eversion Depth (cm^2/ second)	Maximum Depth Range for Concentrations above Criteria[1] (ft. bgs)	Vertical Flow Direction
CF-201D/571	690.7	30	570	120.7	540.0	0.28	235-311	Upwards
CF-204D/700	777.1	56	205	572.1	149.0	0.15	433-438	Artesian
CF-205D/198	856.4	6	173	683.4	167.0	0.025	160-173	Down or none
CF-206D/561	798.4	70	561	237.4	491.0	1.75	558-561	Artesian
CF-207D/561	791.4	40	490	301.4	450.0	0.6	604-609	Down or none
CF-209D/700	834.6	65	480	354.6	415.0	0.076	335-345	Down or none
CF-211D/499	823.1	87	359	464.1	272.0	0.12	360-365	Down or none
CF-212D/500	803.8	50	220	583.8	170.0	0.16	158-220	Down or none
CF-215D/200	859.8	15	68	791.8	53.0	0.021	No COCs	Down or none
CF-216D/700	797.1	0	539	258.1	539.0	0.13	500-539	Upwards
CF-218D/700	775.2	67	698	77.2	631.0	0.2	693-698	Upwards
CF-222D/200	805.6	60	200	605.6	140.0	0	170-200	Down or none
CF-223D/201	812.6	38	195	617.6	157.0	0.025	160-195	Upwards
CF-224D/200	818.9	27	140	678.9	113.0	0.038	145-160	Upwards
CF-225D/500	794.5	45	177	617.5	132.0	0.095	357-362	Upwards
CF-226D/200	867.0	3	94	773.0	91.0	0.026	No COCs	Down or none
CF-227D/480	816.9	75	480	336.9	405.0	0.22	475-482	Down or none
CF-228D/499	823.6	35	428	395.6	393.0	0.035	419-428	Down or none
CF-229D/197	782.8	35	197	585.8	162.0	0.37	No COCs	Down or none
		Average:	330.2	476.6	287.9			

Acronyms:
ft. bgs - feet below grade surface
COCs- contaminants of concern

Notes:
[1]Not including aluminum, iron or manganese.

Table 6-1 Groundwater Technology Screening
Combe Fill South RI/FS (018-RICO-0256)
Chester Washington Townships, New Jersey

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
No Action	No Action	Not Applicable	No remedial action.	**Retained** - No Action is required for consideration by NCP.
Institutional Controls (ICs)	Not Applicable	ICs - Non-Engineering (Administrative/ Legal) Controls	ICs are non-engineering measures that help minimize the potential for human exposure to contamination and/ or protect the integrity of a remedy by limiting site or resource use.	**Retained** - ICs will be considered and developed in conjunction with all active remedial alternatives.
Monitored Natural Attenuation with Long Term Monitoring	Not Applicable	Monitored Natural Attenuation	Natural subsurface processes (e.g., dilution, volatilization, biodegradation, adsorption, and chemical reactions) with subsurface materials reduce contaminant concentrations to acceptable levels.	**Retained** - MNA will be considered and developed alone and in conjunction with active remedial alternatives.
		Long Term Monitoring	Monitoring to assess performance and risk mitigation. Does not reduce contamination.	**Retained** - LTM will be considered and developed in conjunction with active remedial alternatives.
Containment	Physical Barriers	~~Slurry Wall~~	Trench around areas of contamination is filled with a soil (or cement) bentonite slurry.	**Not Retained** - Not applicable at the Site due to the depth of groundwater contamination and site-specific geology (groundwater contamination in deep bedrock aquifer)
		~~Grout Curtain~~	Pressure injection of grout in a regular pattern of drilled holes.	**Not Retained** - Not applicable at the Site due to the depth of groundwater contamination and site-specific geology (groundwater contamination in deep bedrock aquifer)
		~~Funnel & Gate~~	Sheet piles with injection of slurry as beam is withdrawn. Impermeable sheet pile wall (funnel) to direct water to a permeable reactive barrier (gate) for treatment.	**Not Retained** - Not applicable at the Site due to the depth of groundwater contamination and site-specific geology (groundwater contamination in deep bedrock aquifer)
		~~Block Displacement~~	In conjunction with vertical barriers, injection of slurry in notched injection holes.	**Not Retained** - Not applicable at the Site due to the depth of groundwater contamination and site-specific geology (groundwater contamination in deep bedrock aquifer)
	Hydraulic Barrier	Groundwater Extraction and Treatment	Consists of pumping groundwater from an aquifer to remove dissolved phase contaminants and/or achieve hydraulic containment of contaminated groundwater to prevent migration, with subsequent treatment and disposal/discharge.	**Retained** - Groundwater extraction and treatment will be developed as a remedial alternative for the Site.
	Deep Well Injection	~~Geologic Sequestration~~	Waste disposal technology using injection wells to place treated or untreated liquid waste into geologic formations that have little potential to allow migration of contaminants.	**Not Retained** - Regulatory hurdles under the Underground Injection Control (UIC) and other environmental programs, community acceptance issues, not practicable for the Site.

Table 6-1 Groundwater Technology Screening
Combe Fill South RI/FS (018-RICO-0256)
Chester Washington Townships, New Jersey

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Treatment	In Situ Biological Treatment	~~Enhanced Bioremediation~~	Process to accelerate the natural biodegradation process by introducing nutrients, electron acceptors, and/or competent contaminant-degrading microorganisms to the subsurface.	**Not Retained** - Enhanced bioremediation is not suitable for use at the Site due to the site-specific geology (fractured rock). Concerns over treatment effectiveness (contact time and delivery to the contaminant mass) are why this technology was screened out of further consideration.
		~~Phytoremediation~~	Set of processes that use plants to remove, transfer, stabilize and / or destroy contamination in groundwater.	**Not Retained** - Phytoremediation is generally limited to treating shallow groundwater with lower contaminant concentrations and requires a large area of land for remediation. Therefore, phytoremediation is not applicable for treating groundwater at the Site.
	In Situ Physical/ Chemical/ Thermal Treatment	~~Air Sparging~~	Injected air traverses horizontally and vertically in channels through the soil column, creating a subsurface "air stripper" that removes contaminants by volatilization.	**Not Retained** - The site-specific geology (groundwater contamination in fractured bedrock) and the physical and chemical properties of the organic COCs (1,4 -dioxane) preclude air sparging.
		~~Bioslurping~~	Combines the two remedial approaches of bioventing and vacuum-enhanced free-product recovery.	**Not Retained** - Bioslurping is traditionally used to remediate contamination by petroleum products with a LNAPL layer, which is not present at the Site.
		~~ISCO~~	Chemically converts contaminants to less toxic compounds that are more stable, less mobile, and/or inert.	**Not Retained** - ISCO is not suitable for use at the Site due to the site-specific geology (fractured rock). Concerns over treatment effectiveness (contact time and delivery to the contaminant mass) are the reasons this technology has been screened out of further consideration.
		~~Dual Phase Extraction~~	Technology that utilizes a high vacuum system to remove various combinations of contaminated groundwater, separate-phase product (NAPL), and soil vapor from the subsurface.	**Not Retained** - Dual Phase Extraction is traditionally used to remediate NAPL contamination, which is not present at the Site.
		~~In-situ Thermal Treatment (ISTT)~~	ISTT thermally destroys the contaminant mass in-situ by a variety of methods. The three most common ISTT technologies are electrical resistance heating (ERH), electrical conductive heating (ECH), and steam injections.	**Not Retained** - ISTT has been ruled out of consideration due to implementability and cost considerations.
		~~In Well Air Stripping~~	Air is injected into a vertical well that has been screened at two depths.	**Not Retained** - In Well Air Stripping is not applicable for use at the Site due to the site-specific geology (groundwater contamination in fractured bedrock aquifer) and due to the physical and chemical properties of the organic COCs (1,4 - Dioxane).
		~~Passive/ Reactive Treatment Barriers~~	Use of PRBs consisting of iron with a bulking agent to treat groundwater contaminated with chlorinated solvents. A PRB is installed across the flow path of a contaminant plume, allowing the water portion of the plume to passively move through the wall. Use of horizontal wells could also deliver reagents to contaminated areas.	**Not Retained** - PRBs are not applicable for use at the Site due to the depth of groundwater contamination and site-specific geology (groundwater contamination in fractured bedrock aquifer).
		~~In Situ Flushing~~	In-situ flushing involves the injection of chemicals like surfactants into a subsurface contaminated zone. The solution then flows through the contaminated zone and the resulting effluent is extracted downgradient where it is treated and discharged.	**Not Retained** - In Situ Flushing is not applicable at the Site due to the due to the depth of groundwater contamination.
	Ex-Situ Biological Treatment	Bioreactors	Contaminants in extracted groundwater are put into contact with microorganisms in attached or suspended growth biological reactors.	**Retained** - Ex-situ biological treatment has been retained to be used with other technologies.
		~~Constructed Wetlands~~	The constructed wetlands-based treatment technology uses natural geochemical and biological processes inherent in an artificial wetland ecosystem to accumulate and fixate / remove metals and other contaminants from influent waters.	**Not Retained** - Constructed wetlands requires a large area of land for remediation.

Table 6-1 Groundwater Technology Screening
Combe Fill South RI/FS (018-RICO-0256)
Chester Washington Townships, New Jersey

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Treatment (Continued)	Ex-Situ Physical/ Chemical Treatment	Adsorption	Contaminants are adsorbed onto treatment media, reducing their concentration in the aqueous phase.	**Retained** - Adsorption using a carbonaceous resin can treat the organic COCs, particularly 1,4-dioxane and be applied with other treatment technologies (the existing OU-1 treatment plant) to remove the remaining contaminants.
		Advanced Oxidation Processes (AOP's)	Ultraviolet (UV) radiation, ozone, and/or hydrogen peroxide are used to destroy organic contaminants as impacted water is pumped into a treatment vessel. Fenton's Reagent is scheduled to be pilot tested at the Site.	**Retained** - Advanced Oxidation (e.g., Fenton's Reagent, UV, ozone, hydrogen peroxide) can treat the organic COCs, particularly 1,4-dioxane and be applied with other treatment technologies (the existing treatment plant) to remove the remaining contaminants.
		~~Ex-Situ Air Stripping~~	Mass transfer of volatile contaminants from water to air.	**Not Retained** - The existing treatment plant is able to treat all of the Site contaminants with the exception of 1,4-dioxane; therefore, ex-situ treatment alternatives as focused on their ability to remove/ reduce 1,4-dioxane from the water. Due to the relatively low Henry's Law constant of 1,4-dioxane, technologies such as air stripping are generally ineffective .
Discharge/ Disposal	On-Site Discharge	Surface Water	Extracted water treated and discharged to East Trout Brook.	**Retained** - Discharge to surface water requires regulatory compliance and further design evaluation. The existing treatment plant currently discharges to nearby East Trout Brook which is the preferred discharge location.
		Detention/ Surface Water	Treated water discharged into infiltration/ detention basin prior to surface water discharge.	**Retained -** Discharge to infiltration/ detention basin has been retained
	Off-Site Discharge	~~POTW~~	Extracted water pre-treated and/or discharged to POTW.	**Not Retained** - POTW hook up near the Site is not available.

Table 7-1 Groundwater Process Options Evaluation
Combe Fill South RI/FS (018-RICO-0256)
Chester Washington Townships, New Jersey

General Response Actions	Remedial Technology	Process Options	Description	Effectiveness (RAOs, COCs, Impacts to HHE, Reliability)	Implementability (Technical & Administrative)	Relative Cost	Screening Comment
No Action	No Action	No Action	COCs in groundwater are left untreated.	**Poor.** Not effective, because no active measures are taken to address the COCs.	**Poor.** Technically implementable; however, No Action can't be selected under CERCLA.	**None.**	**Retained** per NCP.
Institutional Control (ICs)	Not Applicable	ICs - Non-Engineering (Administrative/ Legal) Controls	Exposure pathways are controlled by administrative controls.	**Moderate.** Requires administrative measures to limit exposure to contaminated groundwater. Institutional Controls are an effective supplement to engineering controls.	**Moderate**. Readily implementable under EPA guidance (EPA 540-F-00-005), but requires homeowners concurrence.	**Low.**	**Retained** in conjunction with active remedies to treat the groundwater.
Monitored Natural Attenuation (MNA)	Not Applicable	MNA	MNA utilizes natural subsurface processes (e.g., dilution, volatilization, biodegradation, adsorption, and chemical reactions) with subsurface materials reduce contaminant concentrations to acceptable levels.	**Undetermined.** MNA is dependent on naturally-occurring microbiota, co-contaminants and subsurface conditions favorable to support degradation. Effectiveness varies from poor to high.	**High.** Implementing an MNA programs is technically and administratively achievable.	**Low**	**Not Retained.** MNA is not suitable for use at OU1 where the source (the landfill) will remain in place. At this time, MNA is unproven at OU2 and cannot be carried through at this time.
Long Term Monitoring (LTM)	Not Applicable	LTM	LTM evaluates the groundwater conditions	**High.** LTM is used to evaluate the effectiveness of other remedial actions at the Site and to understand how the conditions are changing over time.	**High.** Implementing an LTM program is technically and administratively achievable.	**Low.**	**Retained** in conjunction with other remedies to treat groundwater.
Containment and Discharge/Disposal	Hydraulic Barrier and on-Site discharge	Groundwater extraction, treatment, and discharge.	Hydraulic containment is the process of prohibiting further migration of contaminants beyond the source area by installing a series of recovery wells and capturing groundwater flow. Extracted water will be treated and discharged to surface water directly or via an infiltration/ detention basin.	**Moderate.** Hydraulic containment is a widely accepted and implementable remedy; however, containment in fractured rock conditions can be challenging.	**Moderate**. The OU-1 treatment infrastructure is in place; a retrofit and upgrade to the system would be relatively straightforward.	**High.** O&M costs for hydraulic containment would be similar to current OU-1 treatment operations.	**Retained** for groundwater source control.
Ex-situ Treatment	Groundwater Extraction and Treatment	Biological Treatment/Bioreactors	Ex-situ groundwater treatment using biological reactors with microbes capable of removing organic contaminants from the waste stream.	**Moderate.** Biological treatment of 1,4-dioxane is largely unproven in large scale applications. However, some promising new microbes are being developed and tested in laboratory settings and are showing a proclivity to degrade 1,4-dioxane.	**High.** This technology is technically and administratively implementable.	**High.** High capital and O&M costs are associated with this technology.	**Retained** for treatment evaluation. Propose to utilize and retrofit the existing OU-1 treatment plant. This treatment technology is solely focused on its ability to treat 1,4-dioxane since the existing plant is able to remove all other COC's to satisfactory concentrations.
		Adsorption	Ex-situ groundwater treatment using adsorption mechanisms passes contaminated groundwater through a series of treatment vessels containing a carbonaceous resin which removes the organic contaminants from the waste stream.	**High**. The existing treatment plant is able to successfully treat all COCs with the exception of 1,4-dioxane. The 2017 Pilot Study using the carbonaceous resin demonstrated its ability to successfully reduce elevated 1,4-dioxane concentrations to levels below the NJ GWQS of 0.4 µg/l.	**High.** This technology is technically and administratively implementable.	**High.** High capital and O&M costs are associated with this technology.	**Retained** for treatment evaluation. Propose to utilize and retrofit the existing OU-1 treatment plant. This treatment technology is solely focused on its ability to treat 1,4-dioxane since the existing plant is able to remove all other COC's to satisfactory concentrations.
		Advance Oxidation Process (AOP)	Ex-situ groundwater treatment using AOP chemistry passes contaminated groundwater through reactor vessels where the water is dosed with chemicals that generate strong oxidizing conditions to treat organic contaminants from the waste stream.	**Moderate.** NJDEP pilot tested three AOP technologies and are in the process of planning and testing Fenton's Reagent. There are operational and site chemistry challenges associated with AOP; however, the kinetic principals demonstrate effectiveness at treating 1,4-dioxane.	**High.** This technology is technically and administratively implementable.	**High.** High capital and O&M costs are associated with this technology.	**Retained** for treatment evaluation. Propose to utilize and retrofit the existing OU-1 treatment plant. This treatment technology is solely focused on its ability to treat 1,4-dioxane since the existing plant is able to remove all other COC's to satisfactory concentrations.

Table 9-1 Comparative Analysis of Groundwater Alternatives
Combe Fill South RI/FS (018-RICO-0256)
Chester Washington Townships, New Jersey

Alt. No.	Alternative Name	Overall Protection of Public Health and the Environment	Compliance with ARARs	Long Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment	Short Term Impacts and Effectiveness	Implementability	Cost Effectiveness	
OU1-G1	No Action	-Will not meet any of the RAOs and will not be protective of human health and the environment.	-This alternative would not achieve drinking water standards for the aquifer. Action-specific ARARs do not apply to the No Action Alternative since no remedial action would be conducted.	- No long term management or controls for exposure are included in the No Action Alternatives. - Long term potential risks would remain unchanged under the No Action Alternatives.	-This alternative does not provide any reduction of toxicity, mobility or volume of contaminants since no remedial action would be conducted.	- Does not result in disruption of operations or pose a short term threat to public health or the environment. - No remedial timeframe is associated with this alternative.	- No technical or administrative difficulties or constraints.	**Capital Cost:** **Total O&M:** **Total Present Value Cost:**	**$0** **$0** **$0**
OU1-G2	Upgrade OU1 GWET System, Source Area Removal with LTM/ ICs	-RAOs would be met over time and would provide protection to human health and the environment through treatment processes, ICs, and LTM. The implementation of a deed restriction would provide a greater degree of overall protection of human health and the environment by providing limited use of the Site. -Additional protection would occur based on the excavation and off-site disposal of source material in the North Waste Cell.	-This alternative could meet the RAOs within the active treatment area over the long term. -This alternative would meet action-specific and location-specific ARARs for example, by complying with substantive National Pollution Discharge Elimination System requirements for discharge of the treatment plant effluent to surface water and/or groundwater, implementing Resource Conservation Recovery Act requirements, and the Clean Water Act requirements. -Excavation of contaminated soils and solid waste from the North Waste Cell would achieve compliance with soil standards. Excavated materials would be disposed of at an off-site permitted facility.	-This alternative would provide long-term effectiveness and permanence by hydraulically containing the contaminant mass within the overburden and treating the contaminated groundwater ex-situ. -ICs and deed restrictions would ensure continued protection of human health receptors in the long-term. -This alternative provides protection against potential exposures to low-level threat buried landfill materials is maintained. Eliminating the source material remaining in the North Waste Cell area would help achieve long-term effectiveness and permanence.	-This alternative would provide reduction of toxicity, mobility, and volume through treatment and removal of contaminants in OU1. -This alternative would reduce mobility, and volume of 1,4-dioxane by addition of treatment elements to the existing GWET system to address this contaminant, which is not currently being treated by the GWET. -The reduction of toxicity, mobility, and volume of source material would be achieved by the removal of the remaining source material from the North Waste Cell area.	-Site work and installation of the new force main and treatment plant upgrades will be performed without risk to the community as all construction activities will be contained within the landfill property boundary. There would be minimal short-term impacts related to the removal of the source material in the North Waste Cell area. -Short term impacts and effectiveness will be mitigated by requiring site workers to be trained prior to beginning work and required to wear the appropriate PPE to minimize exposure to contamination and as a precaution from physical hazards. Construction best practices to control dust, noise and vibration related to construction will be used. These precautions provide effective protection to the site workers and community from the impacts related to construction. -The estimated period for construction is one year and the remedial timeframe is 30 years.	-This alternative is technically implementable using conventional construction methods and equipment. -No technical difficulties are anticipated for the installation of the force main and upgrading the groundwater extraction and treatment system equipment. -Services and materials for implementation of this alternative are readily available.	**Capital Cost:** **Total O&M:** **Periodic Costs:** **Total Present Value Cost:**	**$ 9,828,414** **$ 11,052,300** **$ 55,503** **$ 20,936,217**

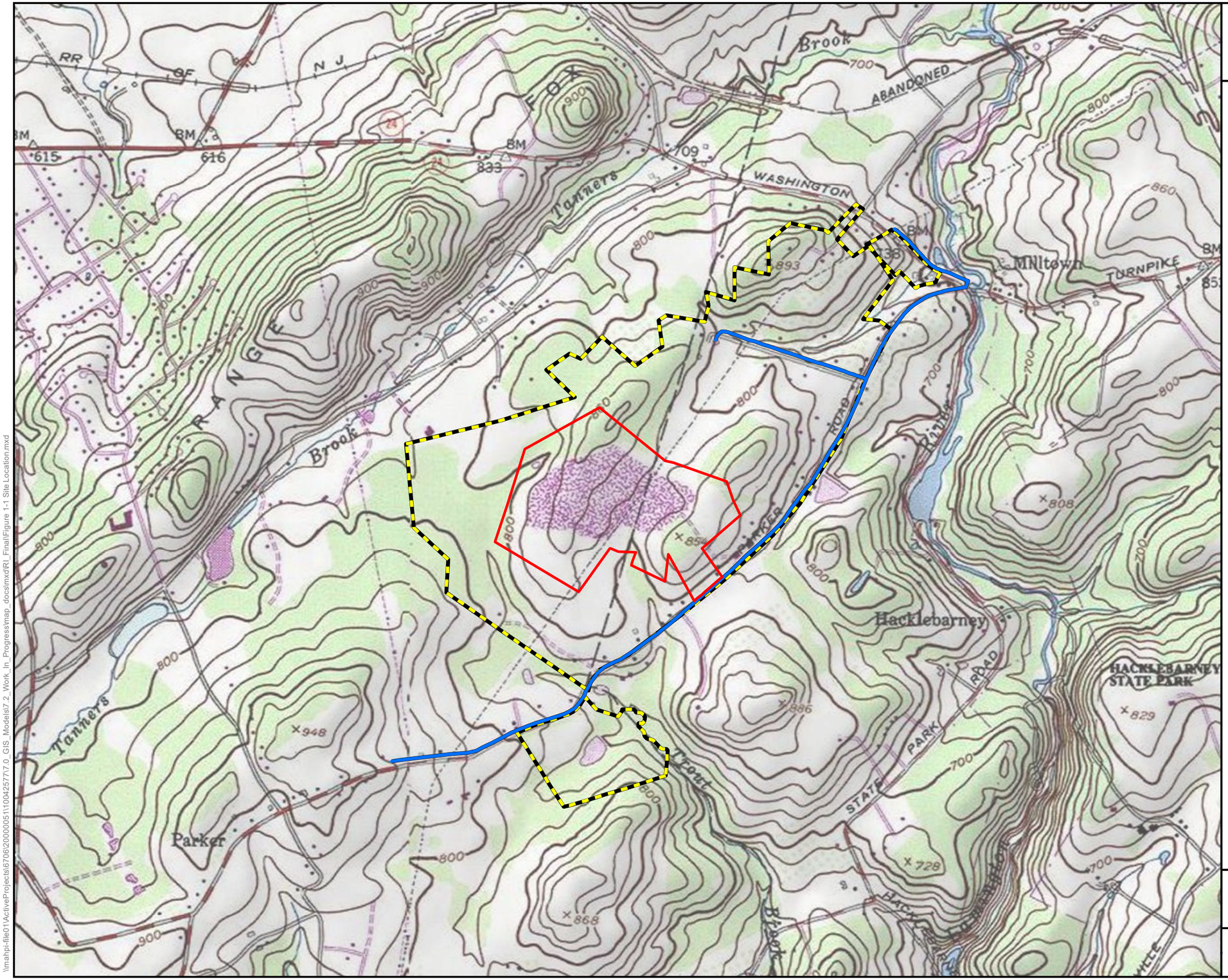
Table 9-1 Comparative Analysis of Groundwater Alternatives
Combe Fill South RI/FS (018-RICO-0256)
Chester Washington Townships, New Jersey

Alt. No.	Alternative Name	Overall Protection of Public Health and the Environment	Compliance with ARARs	Long Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment	Short Term Impacts and Effectiveness	Implementability	Cost Effectiveness	
OU1-G3	**Upgrade OU1 GWET System, Additional Groundwater Extraction, Source Area Removal with LTM/ ICs**	-This alternative would be more protective compared to Alternative OU1-G2 as it would provide a more comprehensive hydraulic control remedy with the addition of bedrock extraction wells for OU1 and would capture both overburden and bedrock contaminated groundwater underlying the landfill property to a depth of approximately 350 feet bgs. -Additional protection would occur based on the excavation and off-site disposal of source material in the North Waste Cell.	-This alternative could meet the RAOs within the active treatment area over the long term. -This alternative would meet action-specific and location-specific ARARs for example, by complying with substantive National Pollution Discharge Elimination System requirements for discharge of the treatment plant effluent to surface water and/or groundwater, implementing Resource Conservation Recovery Act requirements, and the Clean Water Act requirements. -Excavation of contaminated soils and solid waste from the North Waste Cell would achieve compliance with soil standards. Excavated materials would be disposed of at an off-site permitted facility.	-This alternative would provide long-term effectiveness and permanence by hydraulically containing the contaminant mass within the overburden and bedrock and treating the contaminated groundwater ex-situ. -ICs and deed restrictions would ensure continued protection of human health receptors in the long-term. -This alternative provides protection against potential exposures to low-level threat buried landfill materials is maintained. Eliminating the source material remaining in the North Waste Cell area would help achieve long-term effectiveness and permanence.	-This alternative would provide reduction of toxicity, mobility, and volume through treatment and removal of contaminants in OU1. -This alternative would reduce mobility, and volume of 1,4-dioxane by addition of treatment elements to the existing GWET system to address this contaminant, which is not currently being treated by the GWET. -The reduction of toxicity, mobility, and volume of source material would be achieved by the removal of the remaining source material from the North Waste Cell area.	-Site work and installation of the new force main, new bedrock extraction wells and treatment plant upgrades will be performed without risk to the community as all construction activities will be contained within the landfill property boundary. There would be minimal short-term impacts related to the removal of the source material in the North Waste Cell area. -Short term impacts and effectiveness will be mitigated by requiring site workers to be trained prior to beginning work and required to wear the appropriate PPE to minimize exposure to contamination and as a precaution from physical hazards. Construction best practices to control dust, noise and vibration related to construction will be used. These precautions provide effective protection to the site workers and community from the impacts related to construction. -The estimated period for construction is one year and the remedial timeframe is 30 years.	-This alternative is technically implementable using conventional construction methods and equipment. -No technical difficulties are anticipated for the installation of the force main and upgrading the groundwater extraction and treatment system equipment. -Services and materials for implementation of this alternative are readily available.	**Capital Cost:** **Total O&M:** **Periodic Costs:** **Total Present Value Cost:**	**$ 10,457,289** **$ 11,420,800** **$ 55,503** **$ 21,933,592**
OU2-G1	**No Action**	-Will not meet any of the RAOs and will not be protective of human health and the environment.	-This alternative would not achieve drinking water standards for the aquifer. Action-specific ARARs do not apply to the No Action Alternative since no remedial action would be conducted.	-No long term management or controls for exposure are included in the No Action Alternatives. -Long term potential risks would remain unchanged under the No Action Alternatives.	-This alternative does not provide any reduction of toxicity, mobility or volume of contaminants since no remedial action would be conducted.	-Does not result in disruption of operations or pose a short term threat to public health or the environment. -No remedial timeframe is associated with this alternative.	-No technical or administrative difficulties or constraints.	**Capital Cost:** **Total O&M:** **Total Present Value Cost:**	**$0** **$0** **$0**

Table 9-1 Comparative Analysis of Groundwater Alternatives
Combe Fill South RI/FS (018-RICO-0256)
Chester Washington Townships, New Jersey

Alt. No.	Alternative Name	Overall Protection of Public Health and the Environment	Compliance with ARARs	Long Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment	Short Term Impacts and Effectiveness	Implementability	Cost Effectiveness	
OU2-G2	LTM/ ICs	-This alternative would meet RAOs and would provide protection to human health and the environment through the implementation of a long-term monitoring program.	-This alternative would meet the RAO for OU2 over the long term, provided that an active remedy for OU1 is effective. -This alternative would likely take longer than OU2-G3 to achieve compliance with ARARs within OU2.	-This alternative is contingent on the successful implementation of an active OU1 remedy for long-term effectiveness. -The bedrock OU2 extraction wells in alternative OU2-G3 may expedite removal of contaminant mass from OU2. -This alternative is expected to improve groundwater quality outside the landfill and bring the site closer to the long-term goal of restoration. -The final remedy for OU2 would be later considered based on the effectiveness of the OU1 amended remedy and OU2 selected interim remedy.	-This alternative would observe a reduction of contaminant toxicity, mobility, and volume through the successful implementation of an active OU1 remedy which would improve hydraulic control of contamination in the OU1 area and therefore limit migration of contaminants to the OU2 area.	-No adverse impacts to habitats or vegetation are anticipated from this alternative. -The remedial timeframe for this alternative is 10 years.	-This alternative is technically and administratively implementable.	**Capital Cost:** **Total O&M:** **Periodic Costs:** **Total Present Value Cost:**	**$0** **$ 781,100** **$0** **$ 781,100**
OU2-G3	**Extraction and Treatment of OU2 Groundwater/ LTMs/ ICs**	-This alternative would meet RAOs and would provide protection to human health and the environment through groundwater extraction and treatment. -This alternative may be more protective than the LTM called for in OU2-G2. However, the bedrock extraction wells which are part of Alternative OU1-G3, are expected to capture a portion of the OU2 bedrock plume, which depending on the success of the OU1 remedy, may provide similar protectiveness compared with OU2-G3. Further, streams and wetlands in the OU2 area could be negatively impacted by extraction and discharge of treated OU2 groundwater.	-This alternative would meet the RAO for OU2 over the long term, provided that an active remedy for OU1 is effective. -This alternative would meet action-specific and location-specific ARARs for example, by complying with substantive National Pollution Discharge Elimination System requirements for discharge of the treatment plant effluent to surface water and/or groundwater, implementing Resource Conservation Recovery Act requirements, and the Clean Water Act requirements.	-This alternative is contingent on the successful implementation of an active OU1 remedy for long-term effectiveness. -This alternative is expected to improve groundwater quality outside the landfill and bring the site closer to the long-term goal of restoration. -This alternative will use extraction from OU2 extraction wells and treatment at the OU1 plant to restore the OU2 aquifer to PRGs. The bedrock OU2 extraction wells in alternative OU2-G3 may expedite removal of contaminant mass from OU2. -The final remedy for OU2 would be later considered based on the effectiveness of the OU1 amended remedy and OU2 selected interim remedy.	-This alternative would observe a reduction of contaminant toxicity, mobility, and volume through the successful implementation of an active OU1 remedy which would improve hydraulic control of contamination in the OU1 area and therefore limit migration of contaminants to the OU2 area. -Alternative OU2-G3 would be the most effective in reducing toxicity, mobility and volume of contamination in groundwater through extraction and treatment at the furthest downgradient portions of the OU2 plume.	-Site work and installation of the new force main connecting to the existing OU1 GWET force mains and new bedrock extraction wells will be performed without risk to the community as all construction activities will be contained within the landfill property boundary. -Short term construction impacts will be mitigated by requiring site workers to be trained prior to beginning work and required to wear the appropriate PPE to minimize exposure to contamination and as a precaution from physical hazards. Construction best practices to control dust, noise and vibration related to construction will be used. These precautions provide effective protection to the site workers and community from the impacts related to construction. -The estimated period for construction is one year and the remedial timeframe is 10 years.	-This alternative is technically implementable using conventional construction methods and equipment. -Services and materials for the implementation of this alternative are readily available.	**Capital Cost:** **Total O&M:** **Periodic Costs:** **Total Present Value Cost:**	**$ 9,056,339** **$ 1,728,300** **$0** **$ 10,784,639**

FIGURES



Combe Fill South Landfill Superfund Site RI/FS

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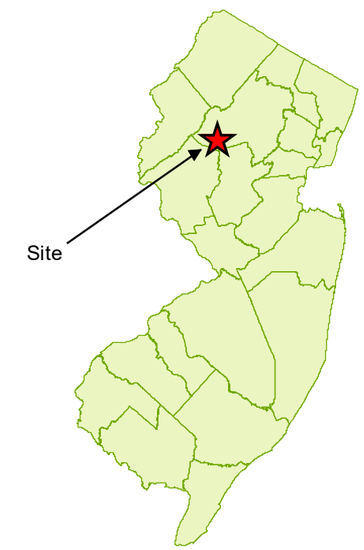
Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet
Projection: Transverse Mercator
Datum: North American 1983
Units: Foot US



Legend

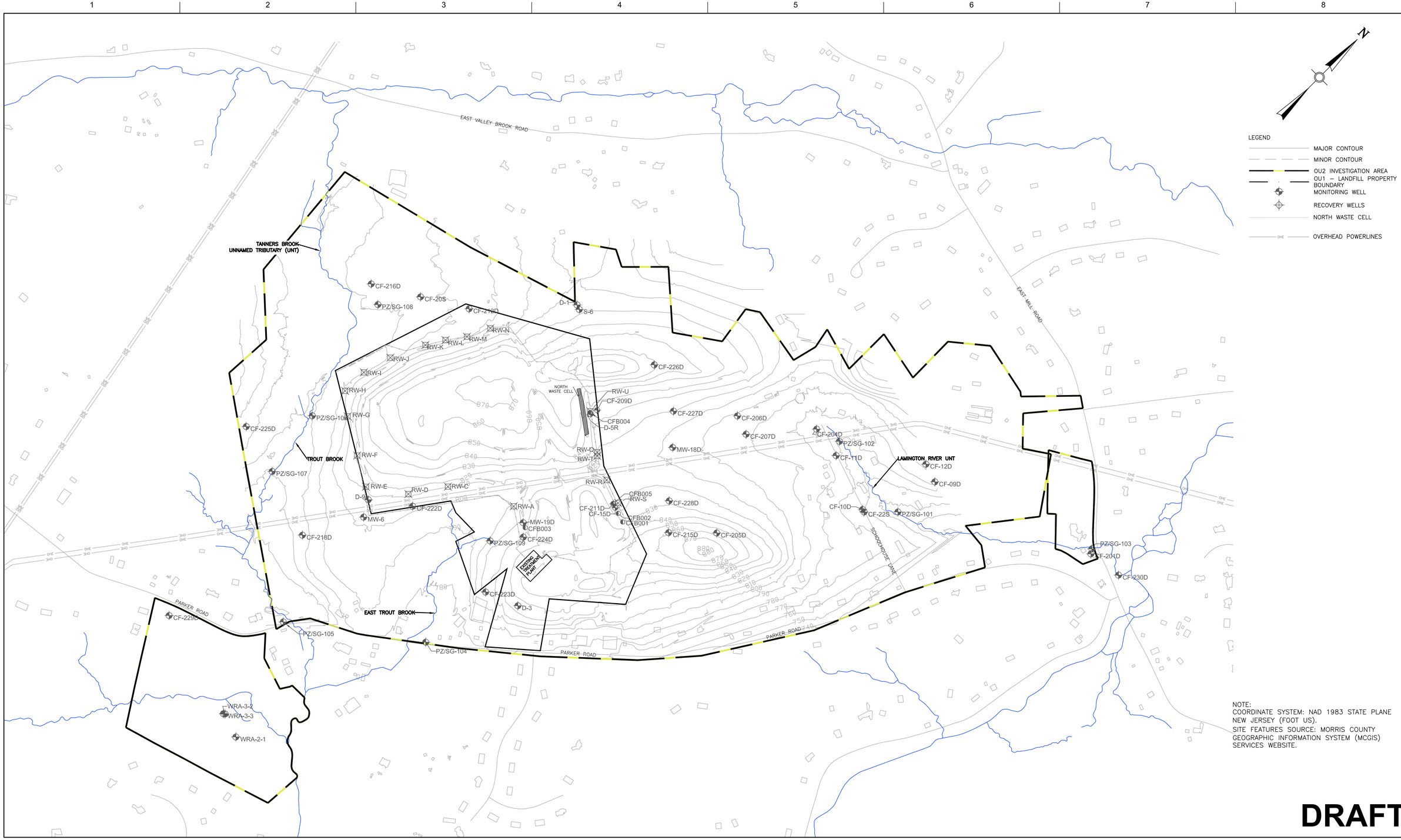
- OU1 - Landfill Property Boundary
- OU2 Investigation
- Approximate Extent of 2015 Water Main Extension

0 0.25 Miles

Site Location and Overview

Figure 2-1
August, 2018

\\mahpi-file01\ActiveProjects\6706\2000005111004257717.0_GIS_Models\7.2_Work_In_Progress\map_docs\mxd\RI_Final\Figure 1-1 Site Location.mxd



PROJECT MANAGER	P. PARVIS
LEAD DESIGN PROF.	E. ZIMMERMAN
DESIGN ENGINEER	A. WATSON
PROJECT NUMBER	10042577

ISSUE DATE DESCRIPTION

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

CONTRACT NO. EP-W-09-009
WORK ASSIGNMENT NO. 018-RICO-0256

FEASIBILITY STUDY

COMBE FILL SOUTH LANDFILL SUPERFUND SITE
CHESTER & WASHINGTON TOWNSHIP
MORRIS COUNTY, NEW JERSEY

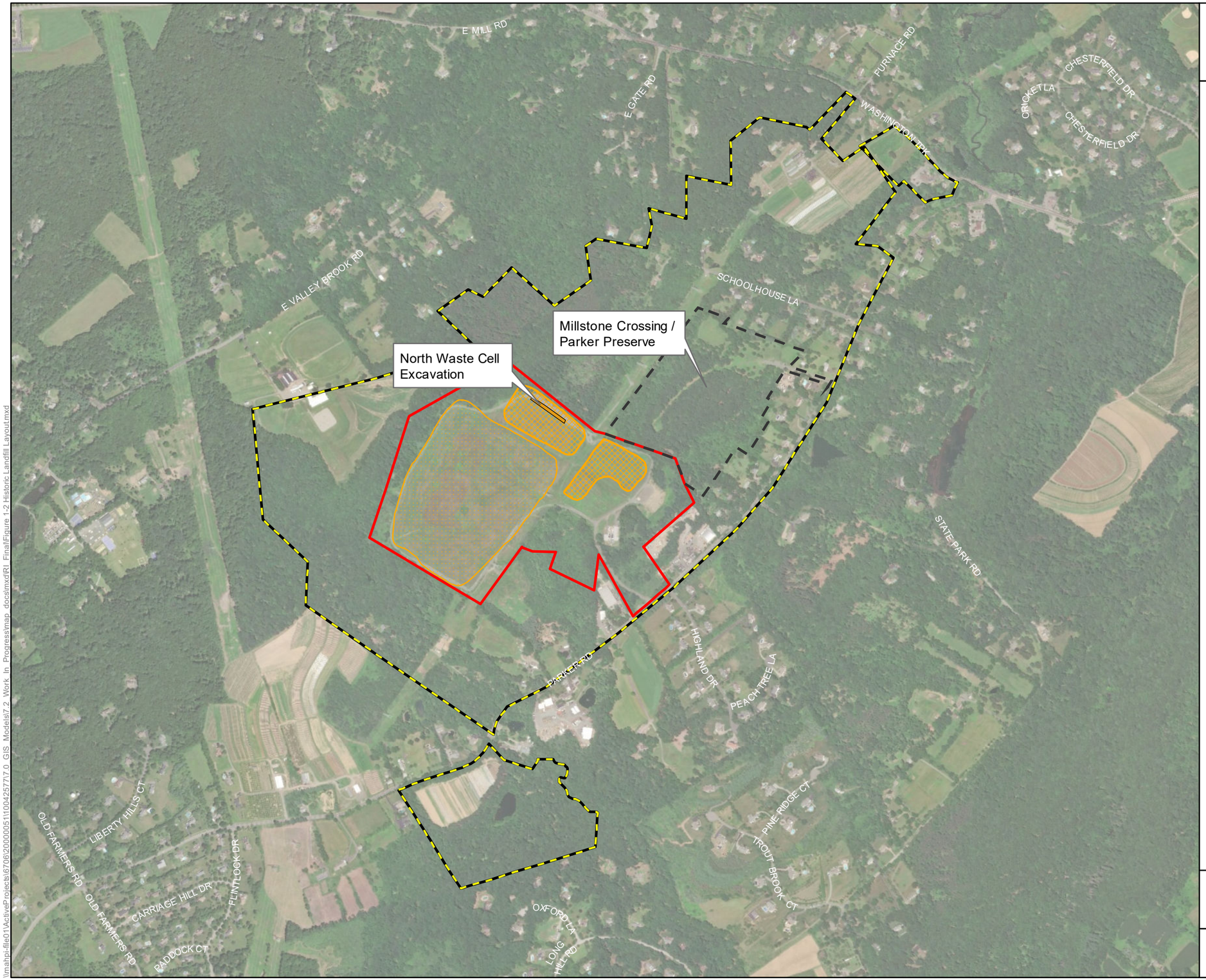
GENERAL SITE PLAN

0 400 800

FILENAME

SCALE 1"=400'

SHEET 2–2



Combe Fill South Landfill Superfund Site RI/FS

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Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet
Projection: Transverse Mercator
Datum: North American 1983
Units: Foot US

Legend

- OU1 - Landfill Property Boundary
- OU2 Investigation Area
- Millstone Crossing / Parker Preserve

Historic Landfill Activity Areas

- Pre 1972
- Post 1972
- North Waste Cell Excavation

Notes

Historic landfill activity areas mapped by geo-reference of Figure 1-4 of the 1986 LMS RI/FS Report.

LMS 1986. Lawler, Matusky & Skelly Engineers (LMS). Final Remedial Investigation Report, Remedial Investigation/Feasibility Study, Combe Fill South Landfill, Volumes I and II. Prepared for the New Jersey Department of Environmental Protection and Energy. May 1986.

0 500 1,000 Feet

Approximate Historic Landfill Activity Areas

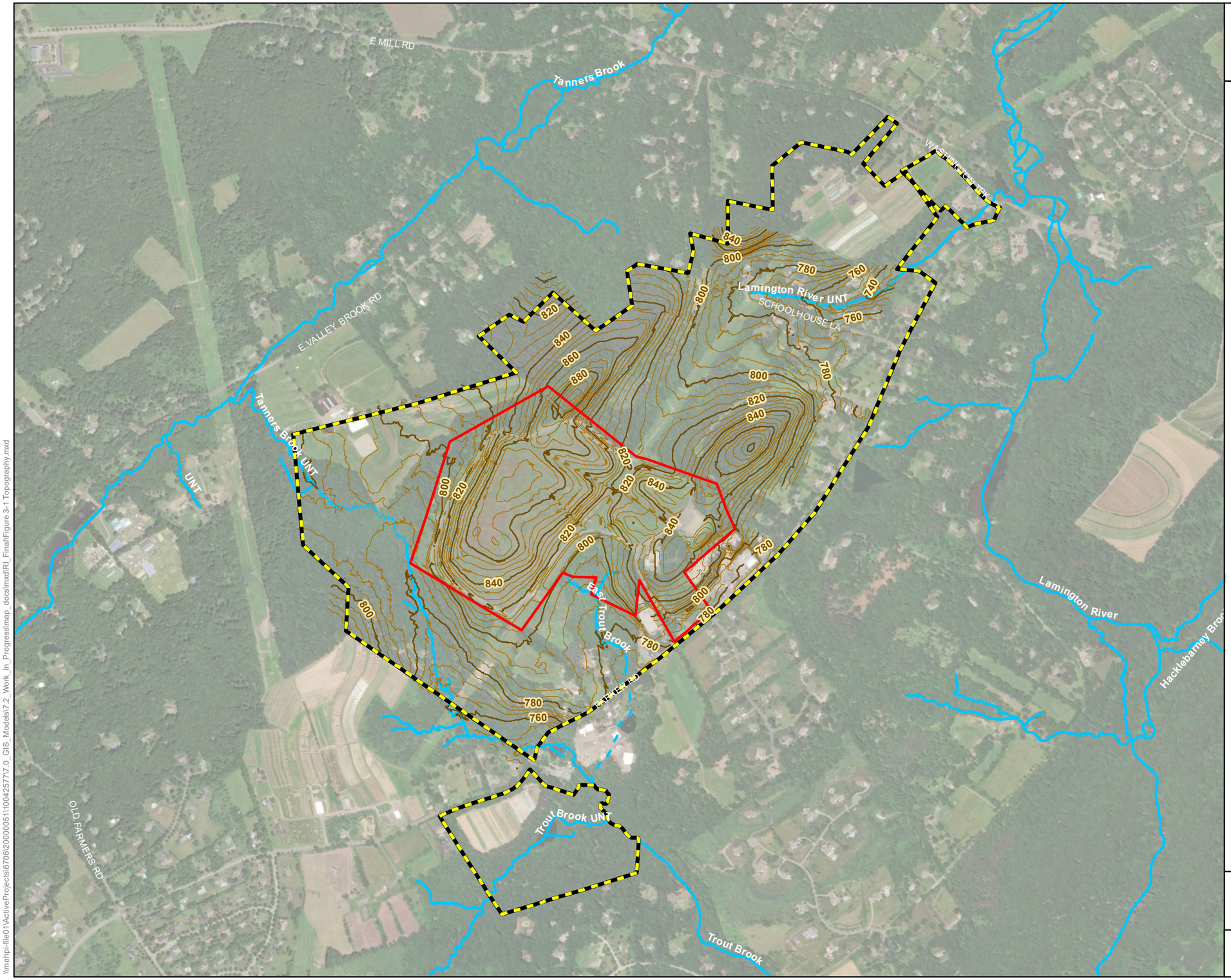
Figure 2-3
August, 2018

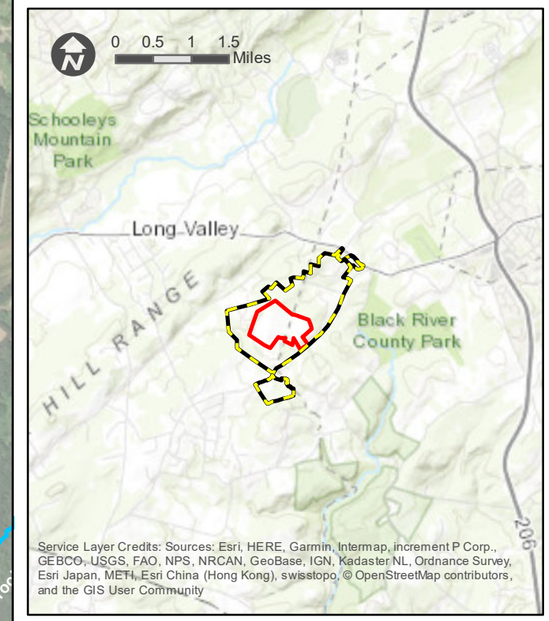
\\mahpi-file01\ActiveProjects\6706\2000005110042577\7.0 GIS Models\7.2 Work In Progress\map docs\mxd\RI Final\Figure 1-2 Historic Landfill Layout.mxd

Combe Fill South Landfill Superfund Site RI/FS

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS,

Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet
Projection: Transverse Mercator
Datum: North American 1983
Units: Foot US





Legend

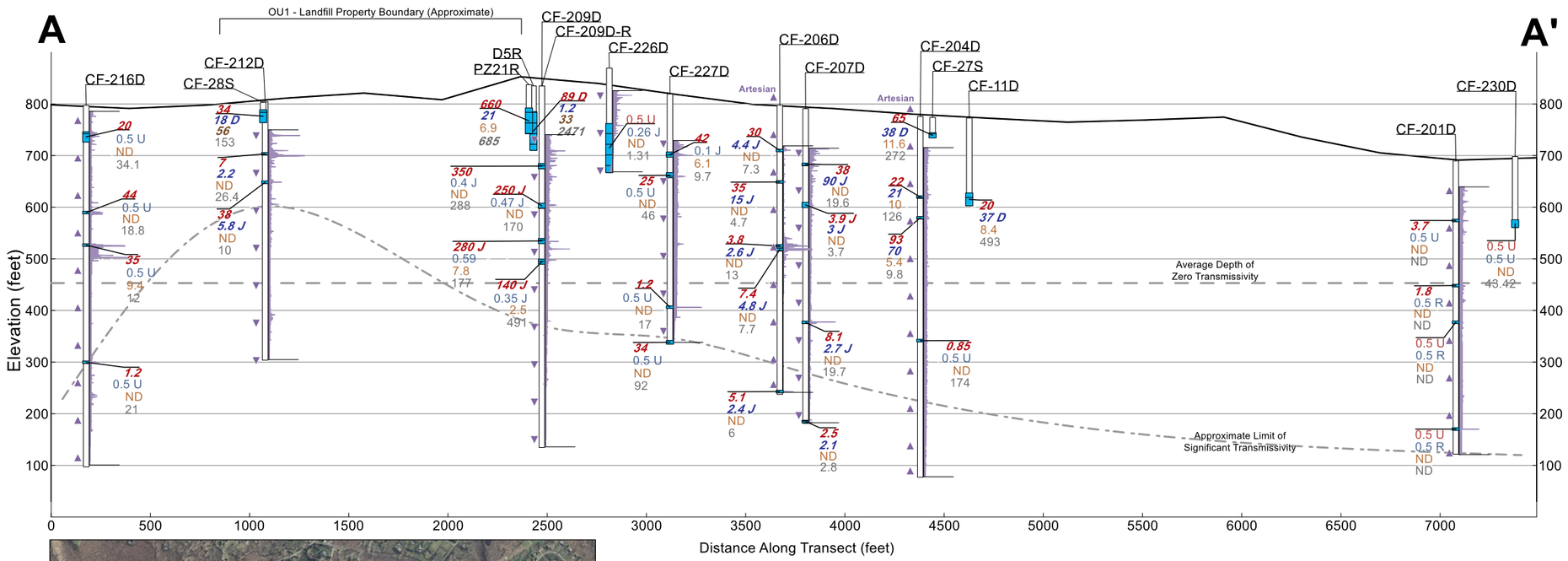
- OU1 - Landfill Property Boundary
- OU2 Investigation Area
- 5 ft Elevation Contour
- 20 ft Elevation Contour
- Surface Water

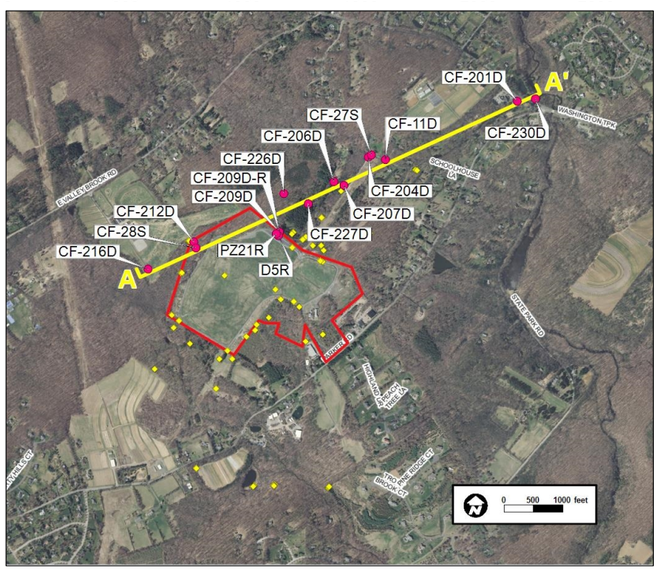
0 500 1,000 Feet

Site Topography

Figure 2-4
August, 2018

\\mahpi-file01\ActiveProjects\6706\20000051\100425777.0_GIS_Models\7.2_Work_In_Progress\map_docs\mxd\RI_Final\Figure 3-1 Topography.mxd





Analytical Data Sources:
HDR OU2 Remedial Investigation Groundwater Samples (2011 to 2015, 2017)
NJDEP Post-Construction Environmental Monitoring (PCEM) Program Samples (Q4 2011 to Q4 2015)

Approximate Limit of Significant Transmissivity Notes:
CF-204D excluded from interpolation due to artesian nature of aquifer unit at this location.
CF-226D excluded from interpolation due to shallow installation depth.

Average site-wide depth of zero transmissivity calculated using OU2 RI geophysical data.

Geophysical Data Source:
Downhole Geophysical Report (see RI Appendix K)
(NOTE: Downhole geophysical survey not completed at CF-230D.)

Transmissivity Data Source:
FLUTe Hydraulic Profiling Report (see RI Table 4-1 and RI Appendix T)

Well	Total Depth (ft bgs)	Depth to Competent Rock (ft bgs)	Maximum Depth of Liner Eversion (ft bgs)	Vertical Flow Direction
CF-201D	571	30	570	Upwards
CF-204D	700	56	205	Artesian
CF-206D	561	70	561	Artesian
CF-207D	561	40	490	Down or none
CF-209D	700	65	480	Down or none
CF-212D	500	50	220	Down or none
CF-216D	700	0	539	Upwards
CF-226D	200	3	94	Down or none
CF-227D	480	75	480	Down or none

Combe Fill South Landfill
Superfund Site RI/FS

Legend (Inset Map)

- Well Location On Section
- Other Well Location
- OU1 - Landfill Property Boundary

Cross Section Legend

- 20 — 1,4-Dioxane
- 37 D — Benzene
- 8.4 — Total Carcinogenic TICs
- 493 — Total Non-Carcinogenic TICs

Generalized Vertical Flow Direction
Well Casing
Borehole Caliper Reading (Relative Width of Hole) Spikes indicate potential fracture zones.
Well Screen or Sample Port Zone

Notes:

Constituents are presented in the same order adjacent to the sample location.

Concentrations shown in ug/L.

Bold Italics indicates exceedance of applicable NJGWQS.

Constituent	GWQS
1,4-Dioxane	0.4
Benzene	1
Total Carcinogenic SOCs *	25
Total Non-Carcinogenic SOCs *	500

NJAC 7:9C Ground Water Quality Standards, Tables 1 & 2
** Interim Generic Criteria for Synthetic Organic Chemicals*

Synthetic Organic Chemicals (SOCs) are purposefully produced organic chemical compounds defined in NJAC 7:9C-1.4. SOCs do not have a specific groundwater quality criterion. Criteria for individual carcinogenic and non-carcinogenic are 5 ug/L and 100 ug/L respectively. The criteria for totals of each are 25 ug/L and 500 ug/L respectively.

Tentatively Identified Compounds (TICs) are non-target analytes for which there is presumptive evidence of their presence. Some TICs are unidentifiable and reported as unknowns. SOC TICs were grouped based on their carcinogenicity listed by the International Agency for Research on Cancer (IARC, March 2018).

Unknown TICs, non-SOCs, and TICs for which there is a promulgated standard in Table 1 of NJAC 7:9C are excluded from summations.

Maximum detected concentration occurring within the study duration is shown. Sample dates range from 4th Quarter 2011 through 4th Quarter 2015; and 1st Quarter 2017 (CF-209D and CF-209D-R). Samples collected by NJDEP and HDR.

CROSS SECTION A - A'

Figure 2-5
August, 2018

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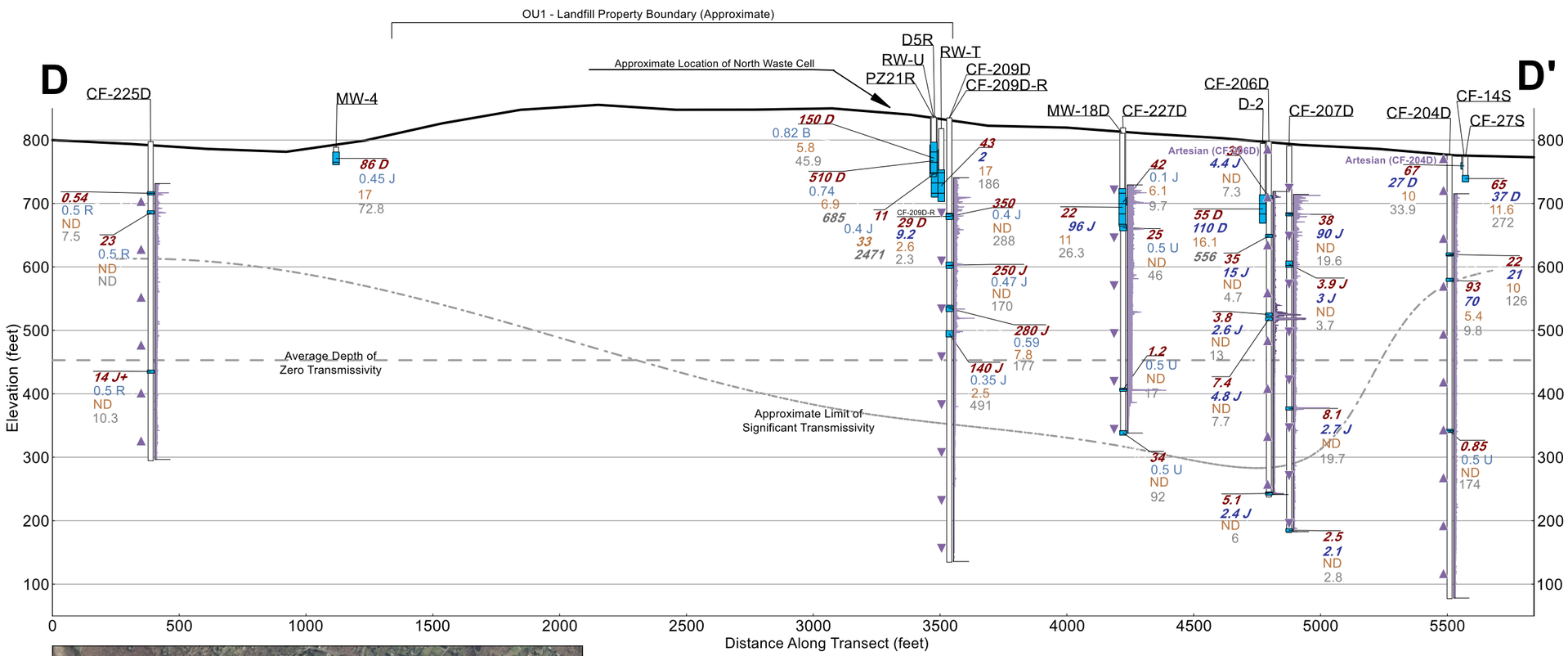
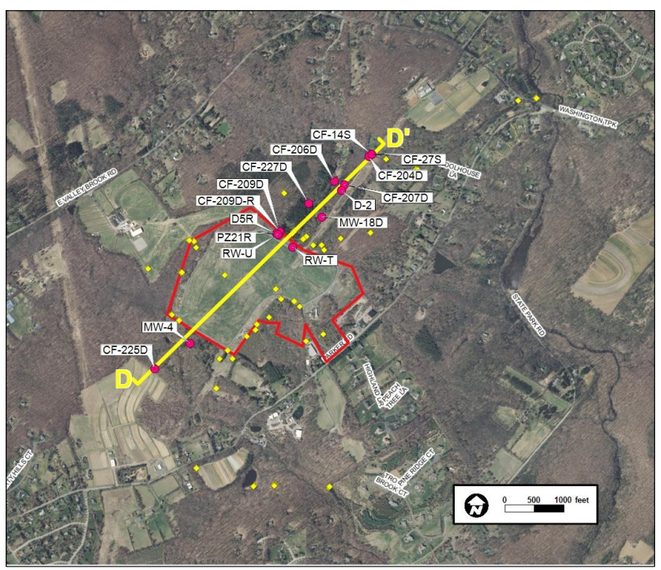




Analytical Data Sources:
HDR OU2 Remedial Investigation Groundwater Samples (2011 to 2015, 2017)
NJDEP Post-Construction Environmental Monitoring (PCEM) Program Samples (Q4 2011 to Q4 2015)

Average site-wide depth of zero transmissivity calculated using OU2 RI geophysical data.

Geophysical Data Source:
Downhole Geophysical Report (see RI Appendix K)

Transmissivity Data Source:
FLUTe Hydraulic Profiling Report (see RI Table 4-1 and RI Appendix T)

Well	Total Depth (ft bgs)	Depth to Competent Rock (ft bgs)	Maximum Depth of Liner Eversion (ft bgs)	Vertical Flow Direction
CF-204D	700	56	205	Artesian
CF-206D	561	70	561	Artesian
CF-207D	561	40	490	Down or none
CF-209D	700	65	480	Down or none
CF-225D	500	45	177	Upwards
CF-227D	480	75	480	Down or none

Combe Fill South Landfill
Superfund Site RI/FS

Legend (Inset Map)

- Well Location On Section
- Other Well Location
- OU1 - Landfill Property Boundary

Cross Section Legend

- 20 — 1,4-Dioxane
- 37 D — Benzene
- 8.4 — Total Carcinogenic TICs
- 493 — Total Non-Carcinogenic TICs

Generalized Vertical Flow Direction
Well Casing
Borehole Caliper Reading (Relative Width of Hole) Spikes indicate potential fracture zones.
Well Screen or Sample Port Zone

Notes:

Constituents are presented in the same order adjacent to the sample location.

Concentrations shown in ug/L.

Bold Italics indicates exceedance of applicable NJGWQS.

Constituent	GWQS
1,4-Dioxane	0.4
Benzene	1
Total Carcinogenic SOCs *	25
Total Non-Carcinogenic SOCs *	500

NJAC 7:9C Ground Water Quality Standards, Tables 1 & 2
** Interim Generic Criteria for Synthetic Organic Chemicals*

Synthetic Organic Chemicals (SOCs) are purposefully produced organic chemical compounds defined in NJAC 7:9C-1.4. SOCs do not have a specific groundwater quality criterion. Criteria for individual carcinogenic and non-carcinogenic are 5 ug/L and 100 ug/L respectively. The criteria for totals of each are 25 ug/L and 500 ug/L respectively.

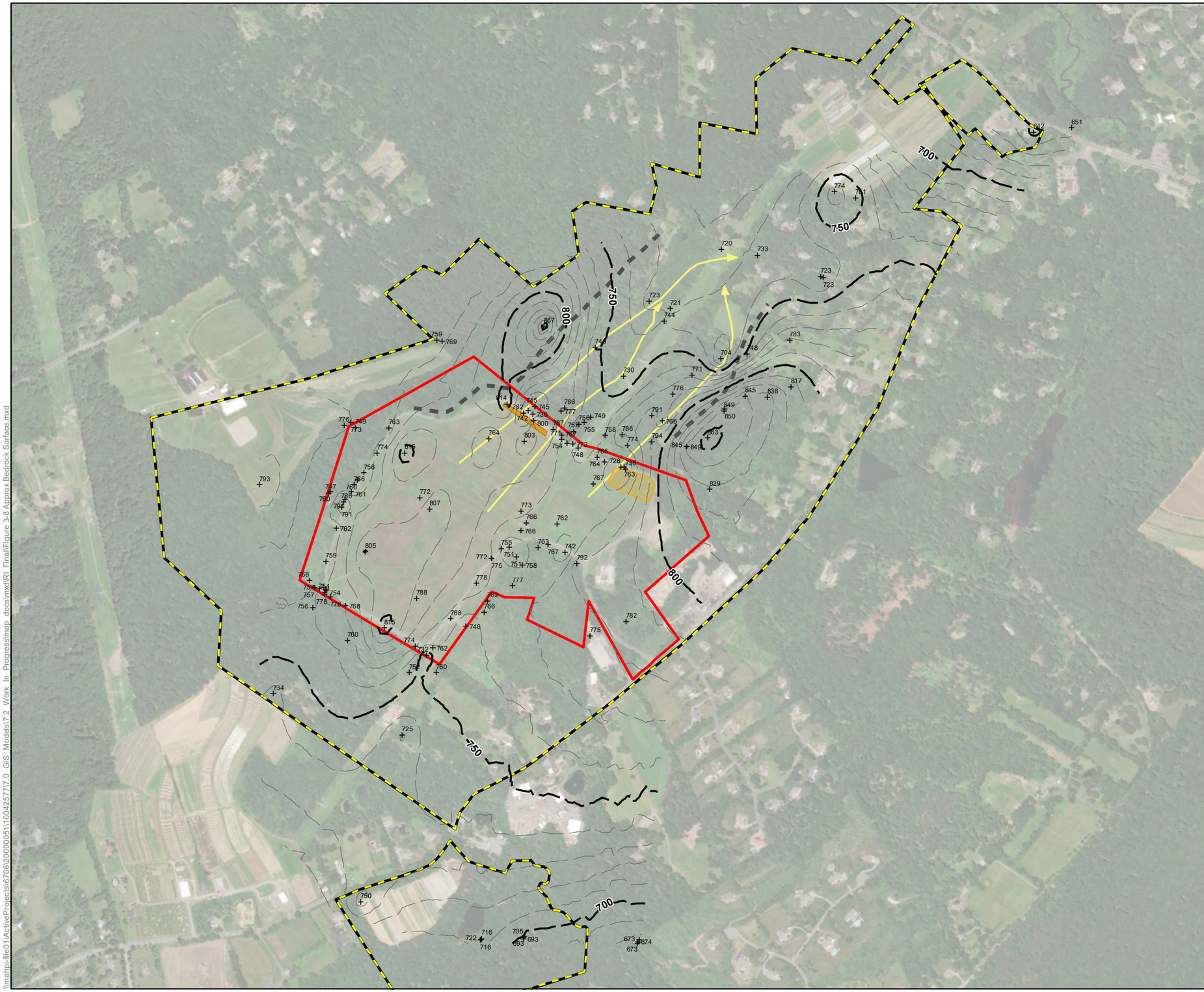
Tentatively Identified Compounds (TICs) are non-target analytes for which there is presumptive evidence of their presence. Some TICs are unidentifiable and reported as unknowns. SOC TICs were grouped based on their carcinogenicity listed by the International Agency for Research on Cancer (IARC, March 2018).

Unknown TICs, non-SOCs, and TICs for which there is a promulgated standard in Table 1 of NJAC 7:9C are excluded from summations.

Maximum detected concentration occurring within the study duration is shown. Sample dates range from 4th Quarter 2011 through 4th Quarter 2015; and 1st Quarter 2017 (CF-209D and CF-209D-R). Samples collected by NJDEP and HDR.

CROSS SECTION D - D'

Figure 2-6
August, 2018



Combe Fill South Landfill Superfund Site RI/FS

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet
Projection: Transverse Mercator
Datum: North American 1983
Units: Foot US

Legend

- OU1 - Landfill Property Boundary
- OU2 Investigation Area
- North Waste Cell Excavation Area
- Approximate Area of NJDEP Drum Removals (1993-1995)
- Geologic Data Point
- Approximate Bedrock Elevation Contour (10 ft)
- Approximate Bedrock Elevation Contour (50 ft)
- Aquitard (Source: Willowstick report)
- Preferential Flow Path (Source: Willowstick report)

Geologic data collected from both HDR and NJDEP installed monitoring wells as well as well records for private irrigation and potable wells. Interpolation developed using Kriging.

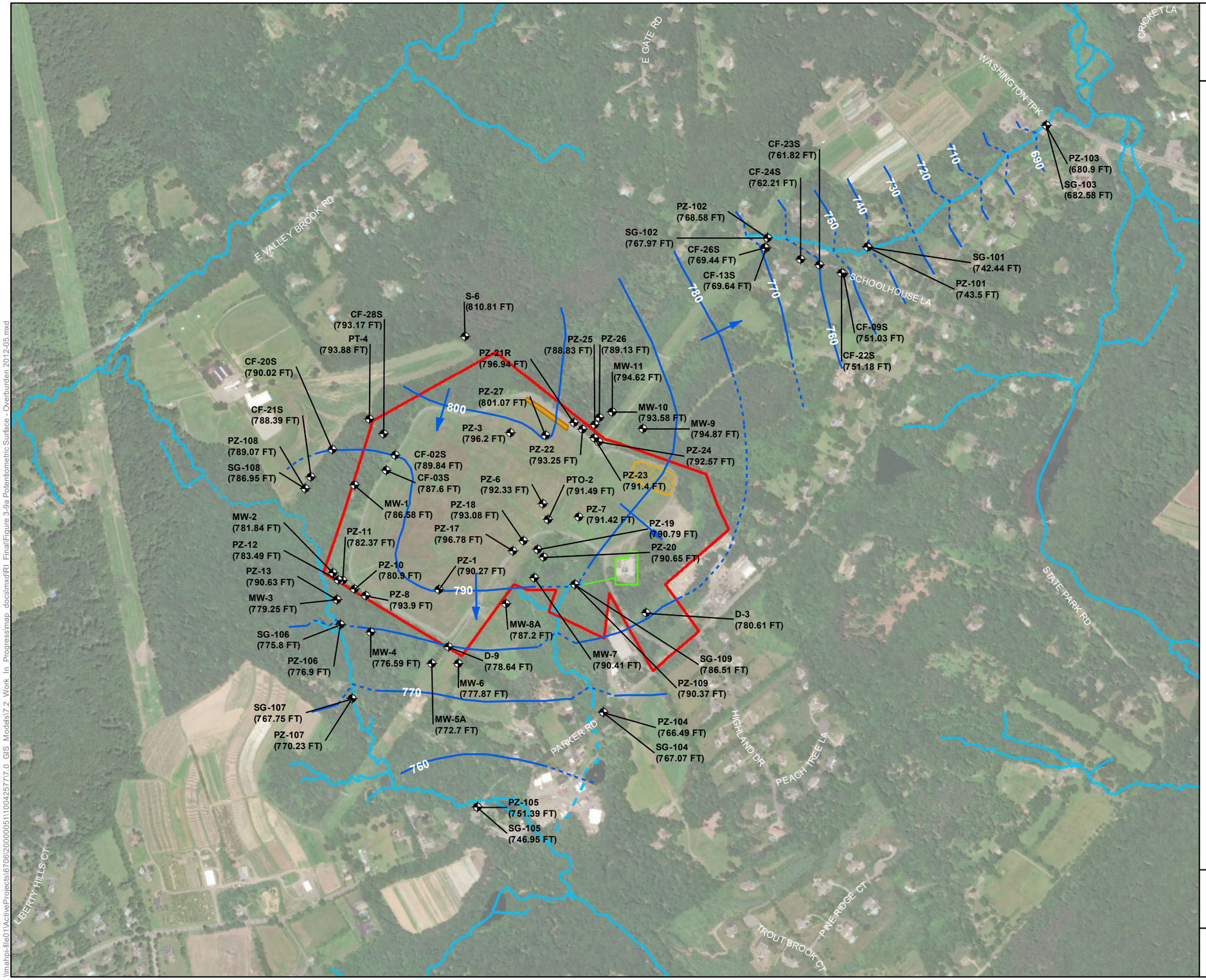
Elevations in feet above mean sea level (ft amsl).

0 400 800 Feet

Approximate Bedrock Surface Elevation

Figure 2-7
August, 2018

\\mahpi-file01\ActiveProjects\670\120000051\100425777.0 GIS Models\7.2 Work In Progress\map docs\mxd\RI Final\Figure 3-8 Approx Bedrock Surface.mxd



Combe Fill South Landfill Superfund Site RI/FS

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet
Projection: Transverse Mercator
Datum: North American 1983
Units: Foot US

Legend

- OU1 - Landfill Property Boundary
- OU2 Investigation Area
- Well location used for interpretation of potentiometric surface
- Potentiometric Surface Elevation Contour
- Contour dashed where inferred.
- Groundwater Flow Direction
- North Waste Cell Excavation
- Approximate Area of NJDEP Drum Removals (1993-1995)
- Treatment Plant
- Surface Water

Notes

Potentiometric surface elevation contours based on measurements of groundwater depth collected in May, 2012.

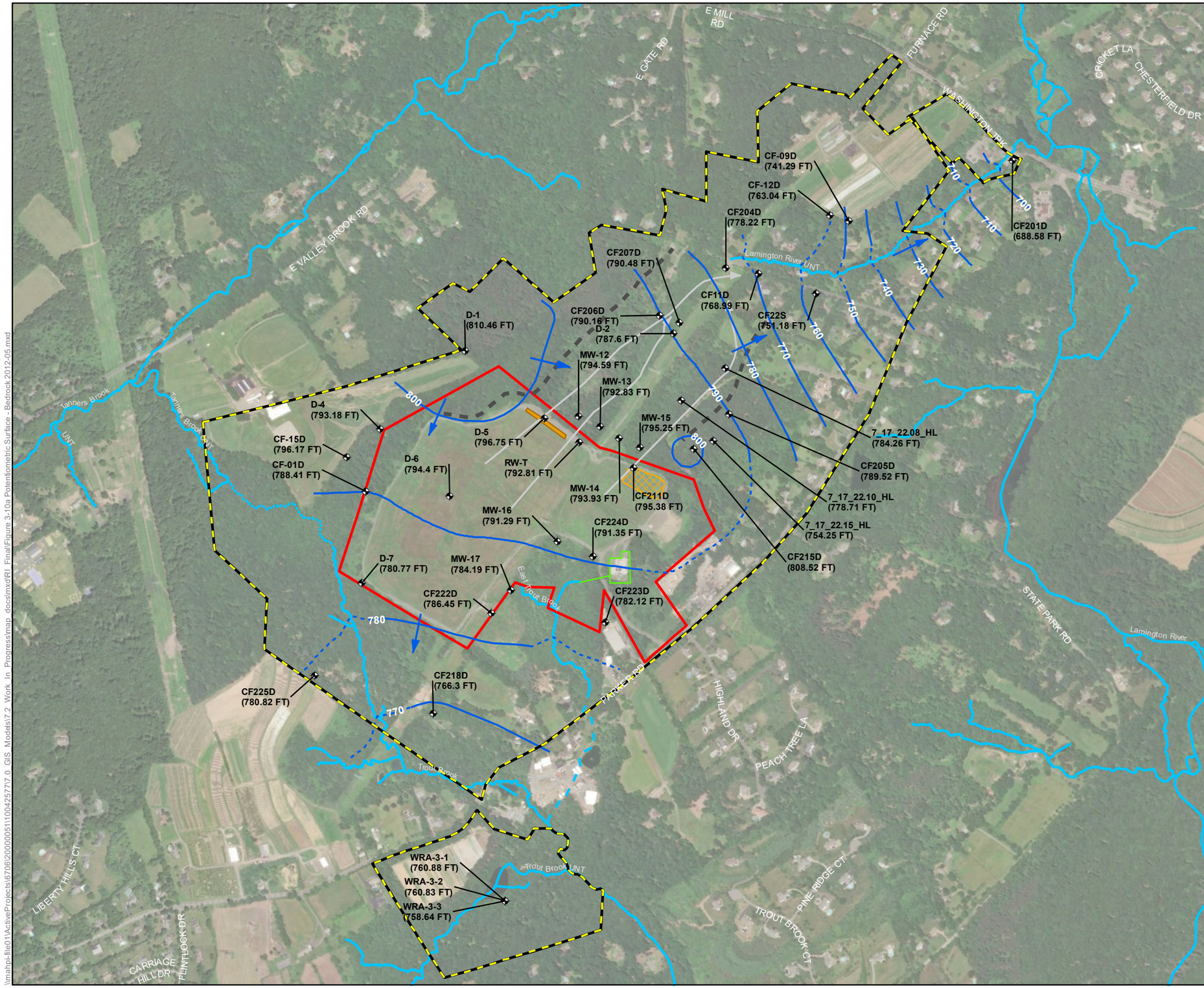
Elevations shown in feet above mean sea level (ft amsl).

0 400 800 Feet

Potentiometric Surface Elevation Overburden Aquifer (May, 2012)

Figure 2-8
August, 2018

\\mahpi-file01\ActiveProjects\670\0\20000051\100425777.0 GIS Models\7.2 Work In Progress\map docs\mxd\RI Final\Figure 3-9a Potentiometric Surface - Overburden 2012-05.mxd



Combe Fill South Landfill Superfund Site RI/FS

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet
Projection: Transverse Mercator
Datum: North American 1983
Units: Foot US

Legend

- OU1 - Landfill Property Boundary
- OU2 Investigation Area
- Monitor well location used for interpretation of potentiometric surface
- Potentiometric Surface Elevation Contour
- Contour dashed where inferred
- Groundwater Flow Direction
- North Waste Cell Excavation
- Approximate Area of NJDEP Drum Removals (1993-1995)
- Treatment Plant & Conveyance
- Surface Water
- Aquitard (Source: Willowstick report)
- Preferential Flow Path (Source: Willowstick report)

Notes

Potentiometric surface elevation contours based on measurements of groundwater depth collected in May, 2012.

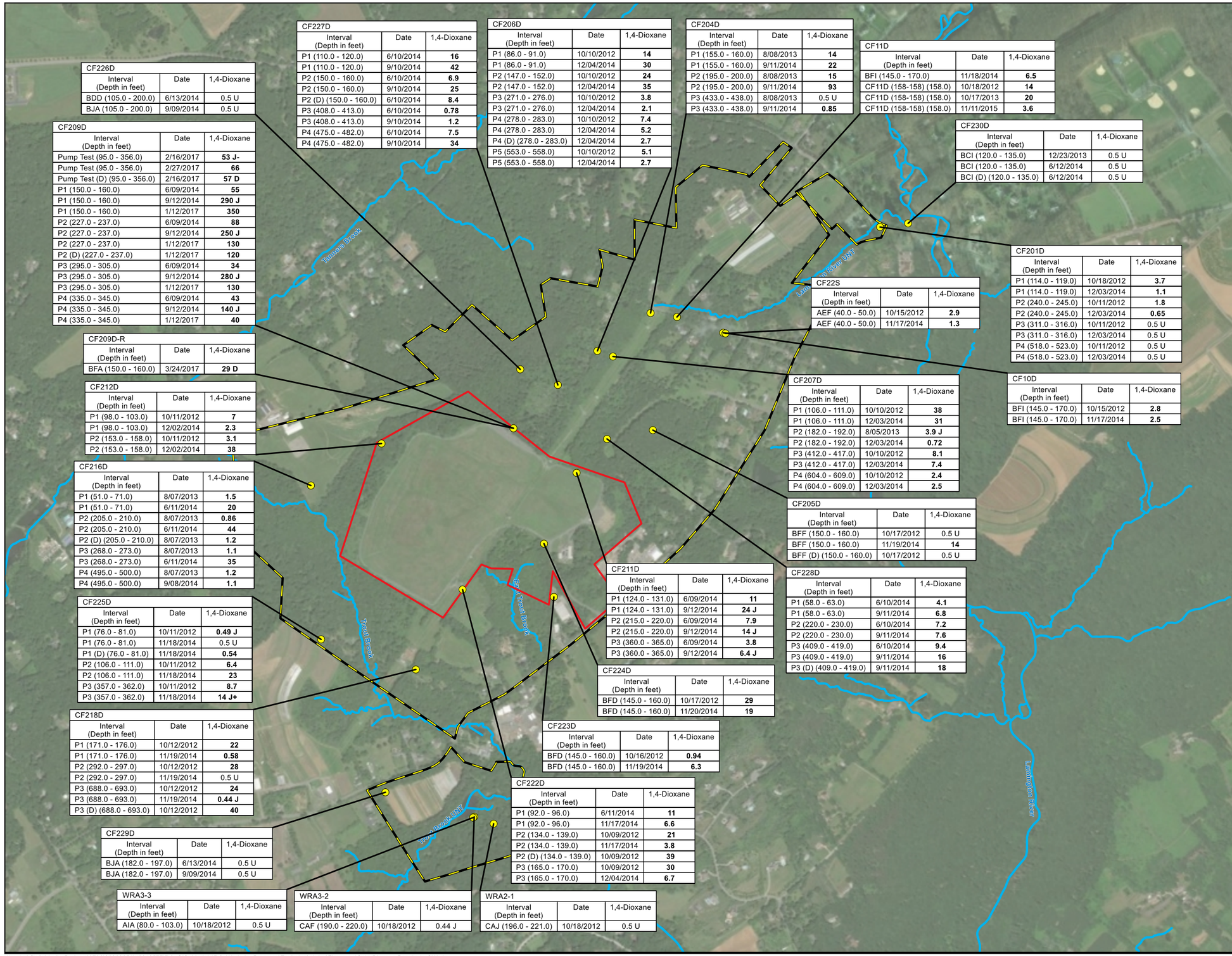
Elevations shown in feet above mean sea level (ft amsl).

0 400 800 Feet

Potentiometric Surface Elevation Bedrock Aquifer (May, 2012)

Figure 2-9
August, 2018

\\mahpi-file01\ActiveProjects\67062000005\1100425771.0_GIS_Models\7.2_Work_In_Progress\map_docs\mxd\RI_Final\Figure 3-10a Potentiometric Surface - Bedrock 2012-05.mxd



CF226D		
Interval (Depth in feet)	Date	1,4-Dioxane
BDD (105.0 - 200.0)	6/13/2014	0.5 U
BJA (105.0 - 200.0)	9/09/2014	0.5 U

CF209D		
Interval (Depth in feet)	Date	1,4-Dioxane
Pump Test (95.0 - 356.0)	2/16/2017	**53 J-**
Pump Test (95.0 - 356.0)	2/27/2017	**66**
Pump Test (D) (95.0 - 356.0)	2/16/2017	**57 D**
P1 (150.0 - 160.0)	6/09/2014	**55**
P1 (150.0 - 160.0)	9/12/2014	**290 J**
P1 (150.0 - 160.0)	1/12/2017	**350**
P2 (227.0 - 237.0)	6/09/2014	**88**
P2 (227.0 - 237.0)	9/12/2014	**250 J**
P2 (227.0 - 237.0)	1/12/2017	**130**
P2 (D) (227.0 - 237.0)	1/12/2017	**120**
P3 (295.0 - 305.0)	6/09/2014	**34**
P3 (295.0 - 305.0)	9/12/2014	**280 J**
P3 (295.0 - 305.0)	1/12/2017	**130**
P4 (335.0 - 345.0)	6/09/2014	**43**
P4 (335.0 - 345.0)	9/12/2014	**140 J**
P4 (335.0 - 345.0)	1/12/2017	**40**

CF209D-R		
Interval (Depth in feet)	Date	1,4-Dioxane
BFA (150.0 - 160.0)	3/24/2017	**29 D**

CF212D		
Interval (Depth in feet)	Date	1,4-Dioxane
P1 (98.0 - 103.0)	10/11/2012	**7**
P1 (98.0 - 103.0)	12/02/2014	**2.3**
P2 (153.0 - 158.0)	10/11/2012	**3.1**
P2 (153.0 - 158.0)	12/02/2014	**38**

CF216D		
Interval (Depth in feet)	Date	1,4-Dioxane
P1 (51.0 - 71.0)	8/07/2013	**1.5**
P1 (51.0 - 71.0)	6/11/2014	**20**
P2 (205.0 - 210.0)	8/07/2013	**0.86**
P2 (205.0 - 210.0)	6/11/2014	**44**
P2 (D) (205.0 - 210.0)	8/07/2013	**1.2**
P3 (268.0 - 273.0)	8/07/2013	**1.1**
P3 (268.0 - 273.0)	6/11/2014	**35**
P4 (495.0 - 500.0)	8/07/2013	**1.2**
P4 (495.0 - 500.0)	9/08/2014	**1.1**

CF225D		
Interval (Depth in feet)	Date	1,4-Dioxane
P1 (76.0 - 81.0)	10/11/2012	**0.49 J**
P1 (76.0 - 81.0)	11/18/2014	0.5 U
P1 (D) (76.0 - 81.0)	11/18/2014	**0.54**
P2 (106.0 - 111.0)	10/11/2012	**6.4**
P2 (106.0 - 111.0)	11/18/2014	**23**
P3 (357.0 - 362.0)	10/11/2012	**8.7**
P3 (357.0 - 362.0)	11/18/2014	**14 J+**

CF218D		
Interval (Depth in feet)	Date	1,4-Dioxane
P1 (171.0 - 176.0)	10/12/2012	**22**
P1 (171.0 - 176.0)	11/19/2014	**0.58**
P2 (292.0 - 297.0)	10/12/2012	**28**
P2 (292.0 - 297.0)	11/19/2014	0.5 U
P3 (688.0 - 693.0)	10/12/2012	**24**
P3 (688.0 - 693.0)	11/19/2014	**0.44 J**
P3 (D) (688.0 - 693.0)	10/12/2012	**40**

CF229D		
Interval (Depth in feet)	Date	1,4-Dioxane
BJA (182.0 - 197.0)	6/13/2014	0.5 U
BJA (182.0 - 197.0)	9/09/2014	0.5 U

WRA3-3		
Interval (Depth in feet)	Date	1,4-Dioxane
AIA (80.0 - 103.0)	10/18/2012	0.5 U

WRA3-2		
Interval (Depth in feet)	Date	1,4-Dioxane
CAF (190.0 - 220.0)	10/18/2012	0.44 J

WRA2-1		
Interval (Depth in feet)	Date	1,4-Dioxane
CAJ (196.0 - 221.0)	10/18/2012	0.5 U

CF227D		
Interval (Depth in feet)	Date	1,4-Dioxane
P1 (110.0 - 120.0)	6/10/2014	**16**
P1 (110.0 - 120.0)	9/10/2014	**42**
P2 (150.0 - 160.0)	6/10/2014	**6.9**
P2 (150.0 - 160.0)	9/10/2014	**25**
P2 (D) (150.0 - 160.0)	6/10/2014	**8.4**
P3 (408.0 - 413.0)	6/10/2014	**0.78**
P3 (408.0 - 413.0)	9/10/2014	**1.2**
P4 (475.0 - 482.0)	6/10/2014	**7.5**
P4 (475.0 - 482.0)	9/10/2014	**34**

CF206D		
Interval (Depth in feet)	Date	1,4-Dioxane
P1 (86.0 - 91.0)	10/10/2012	**14**
P1 (86.0 - 91.0)	12/04/2014	**30**
P2 (147.0 - 152.0)	10/10/2012	**24**
P2 (147.0 - 152.0)	12/04/2014	**35**
P3 (271.0 - 276.0)	10/10/2012	**3.8**
P3 (271.0 - 276.0)	12/04/2014	**2.1**
P4 (278.0 - 283.0)	10/10/2012	**7.4**
P4 (278.0 - 283.0)	12/04/2014	**5.2**
P4 (D) (278.0 - 283.0)	12/04/2014	**2.7**
P5 (553.0 - 558.0)	10/10/2012	**5.1**
P5 (553.0 - 558.0)	12/04/2014	**2.7**

CF204D		
Interval (Depth in feet)	Date	1,4-Dioxane
P1 (155.0 - 160.0)	8/08/2013	**14**
P1 (155.0 - 160.0)	9/11/2014	**22**
P2 (195.0 - 200.0)	8/08/2013	**15**
P2 (195.0 - 200.0)	9/11/2014	**93**
P3 (433.0 - 438.0)	8/08/2013	0.5 U
P3 (433.0 - 438.0)	9/11/2014	**0.85**

CF11D		
Interval (Depth in feet)	Date	1,4-Dioxane
BFI (145.0 - 170.0)	11/18/2014	**6.5**
CF11D (158-158) (158.0)	10/18/2012	**14**
CF11D (158-158) (158.0)	10/17/2013	**20**
CF11D (158-158) (158.0)	11/11/2015	**3.6**

CF230D		
Interval (Depth in feet)	Date	1,4-Dioxane
BCI (120.0 - 135.0)	12/23/2013	0.5 U
BCI (120.0 - 135.0)	6/12/2014	0.5 U
BCI (D) (120.0 - 135.0)	6/12/2014	0.5 U

CF201D		
Interval (Depth in feet)	Date	1,4-Dioxane
P1 (114.0 - 119.0)	10/18/2012	**3.7**
P1 (114.0 - 119.0)	12/03/2014	**1.1**
P2 (240.0 - 245.0)	10/11/2012	**1.8**
P2 (240.0 - 245.0)	12/03/2014	**0.65**
P3 (311.0 - 316.0)	10/11/2012	0.5 U
P3 (311.0 - 316.0)	12/03/2014	0.5 U
P4 (518.0 - 523.0)	10/11/2012	0.5 U
P4 (518.0 - 523.0)	12/03/2014	0.5 U

CF22S		
Interval (Depth in feet)	Date	1,4-Dioxane
AEF (40.0 - 50.0)	10/15/2012	**2.9**
AEF (40.0 - 50.0)	11/17/2014	**1.3**

CF10D		
Interval (Depth in feet)	Date	1,4-Dioxane
BFI (145.0 - 170.0)	10/15/2012	**2.8**
BFI (145.0 - 170.0)	11/17/2014	**2.5**

CF207D		
Interval (Depth in feet)	Date	1,4-Dioxane
P1 (106.0 - 111.0)	10/10/2012	**38**
P1 (106.0 - 111.0)	12/03/2014	**31**
P2 (182.0 - 192.0)	8/05/2013	**3.9 J**
P2 (182.0 - 192.0)	12/03/2014	**0.72**
P3 (412.0 - 417.0)	10/10/2012	**8.1**
P3 (412.0 - 417.0)	12/03/2014	**7.4**
P4 (604.0 - 609.0)	10/10/2012	**2.4**
P4 (604.0 - 609.0)	12/03/2014	**2.5**

CF205D		
Interval (Depth in feet)	Date	1,4-Dioxane
BFF (150.0 - 160.0)	10/17/2012	0.5 U
BFF (150.0 - 160.0)	11/19/2014	**14**
BFF (D) (150.0 - 160.0)	10/17/2012	0.5 U

CF228D		
Interval (Depth in feet)	Date	1,4-Dioxane
P1 (58.0 - 63.0)	6/10/2014	**4.1**
P1 (58.0 - 63.0)	9/11/2014	**6.8**
P2 (220.0 - 230.0)	6/10/2014	**7.2**
P2 (220.0 - 230.0)	9/11/2014	**7.6**
P3 (409.0 - 419.0)	6/10/2014	**9.4**
P3 (409.0 - 419.0)	9/11/2014	**16**
P3 (D) (409.0 - 419.0)	9/11/2014	**18**

CF211D		
Interval (Depth in feet)	Date	1,4-Dioxane
P1 (124.0 - 131.0)	6/09/2014	**11**
P1 (124.0 - 131.0)	9/12/2014	**24 J**
P2 (215.0 - 220.0)	6/09/2014	**7.9**
P2 (215.0 - 220.0)	9/12/2014	**14 J**
P3 (360.0 - 365.0)	6/09/2014	**3.8**
P3 (360.0 - 365.0)	9/12/2014	**6.4 J**

CF224D		
Interval (Depth in feet)	Date	1,4-Dioxane
BFD (145.0 - 160.0)	10/17/2012	**29**
BFD (145.0 - 160.0)	11/20/2014	**19**

CF223D		
Interval (Depth in feet)	Date	1,4-Dioxane
BFD (145.0 - 160.0)	10/16/2012	**0.94**
BFD (145.0 - 160.0)	11/19/2014	**6.3**

CF222D		
Interval (Depth in feet)	Date	1,4-Dioxane
P1 (92.0 - 96.0)	6/11/2014	**11**
P1 (92.0 - 96.0)	11/17/2014	**6.6**
P2 (134.0 - 139.0)	10/09/2012	**21**
P2 (134.0 - 139.0)	11/17/2014	**3.8**
P2 (D) (134.0 - 139.0)	10/09/2012	**39**
P3 (165.0 - 170.0)	10/09/2012	**30**
P3 (165.0 - 170.0)	12/04/2014	**6.7**

Combe Fill South Landfill
Superfund Site RI/FS

Aerial Background Credits: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, IGN, and the GIS User Community.

Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet

Legend

- Groundwater Sample Location
- OU1 - Landfill Property Boundary
- OU2 Investigation Area
- Surface Water
- Aquitard (Source: Willowstick Report)
- Preferential Flow Path (Source: Willowstick Report)

CONSTITUENT	CRITERION (1)
1,4-Dioxane	0.4

Notes

- Results shown in ug/L.
- UNT = Unnamed Tributary

1. New Jersey Department of Environmental Protection (NJDEP) NJAC 7:9C Ground Water Quality Standards (updated January 16, 2018).

Wells identified as CF### (example CF209D) were installed for this RI/FS. Others predate this RI/FS.

Well CF-209D was a multi-port FLUTe well constructed in 2014 and decomissioned in January, 2017. It was replaced in March, 2017 with a conventional well screened from 150 to 160 feet bgs that was constructed in the same borehole.

Samples from CF-209D collected in February, 2017 were collected from the open borehole during a pumping test.

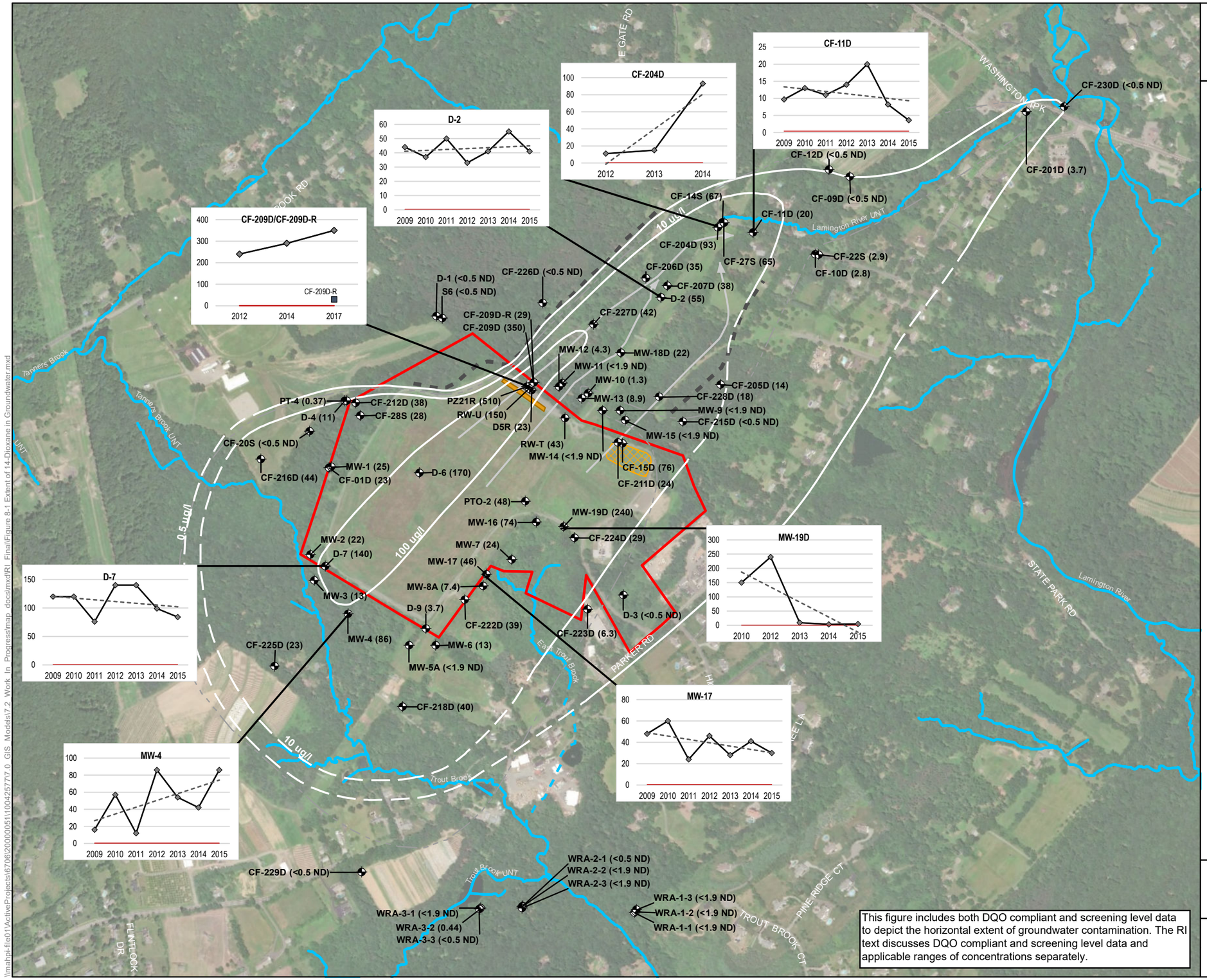
Sample intervals in databox are indicated by sample port number (P#) or using sample depth codes (A=0, B=1, C=2, etc.).

0 500 1000 feet
Not To Scale

1,4-Dioxane Results in Groundwater
OU2 RI Samples (2011 - 2015, 2017)

Figure 3-1
August, 2018

\\mahpi-file01\ActiveProjects\6706\20000051\10042577\7.0_GIS_Models\7.2_Work_In_Progress\EnviroInsite\vizx\Figure 4-1C 14-Dioxane Results in GW.vizx



This figure includes both DQO compliant and screening level data to depict the horizontal extent of groundwater contamination. The RI text discusses DQO compliant and screening level data and applicable ranges of concentrations separately.

Combe Fill South Landfill Superfund Site RI/FS

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet
Projection: Transverse Mercator
Datum: North American 1983
Units: Foot US

Legend

- OU1 - Landfill Property Boundary
- Monitoring Well
- Isoconcentration Line (white)
- Interpreted Where Dashed
- North Waste Cell Excavation
- Approximate Area of NJDEP Drum Removals (1993-1995)
- Surface Water
- Aquitard (Source: Willowstick report)
- Preferential Flow Path (Source: Willowstick report)

Notes
Concentrations in ug/L.
ND = Constituent not detected above the analytical reporting limit.

For contouring, the maximum detected concentration of the constituent being mapped was used regardless of depth or sampling date in order to conceptualize the approximate extent of detections of the mapped constituent.

For 1,4-Dioxane, the lowest reporting limit (SVOC-SIM analysis) of 0.5 ug/l was contoured.

Wells MW-9 through MW-15 are overburden and shallow bedrock wells. Contaminant migration is thought to occur in the deeper bedrock in the area of these wells.

Analytical Data Sources
- OU2 Remedial Investigation Sampling (HDR, 2011-2015)
- OU2 Monitoring Well Packer Results (HDR, 2011)
- OU2 FS Pump Test (HDR, 2017)
- Post-Construction Environmental Monitoring (PCEM) Program Samples (NJDEP, Q4 2011 to Q4 2015)
- Results from potable well sampling conducted by EPA in 2011 included in approximation of extent of contaminants (VOCs only). Individual results not shown due to sensitive nature of residential sampling.

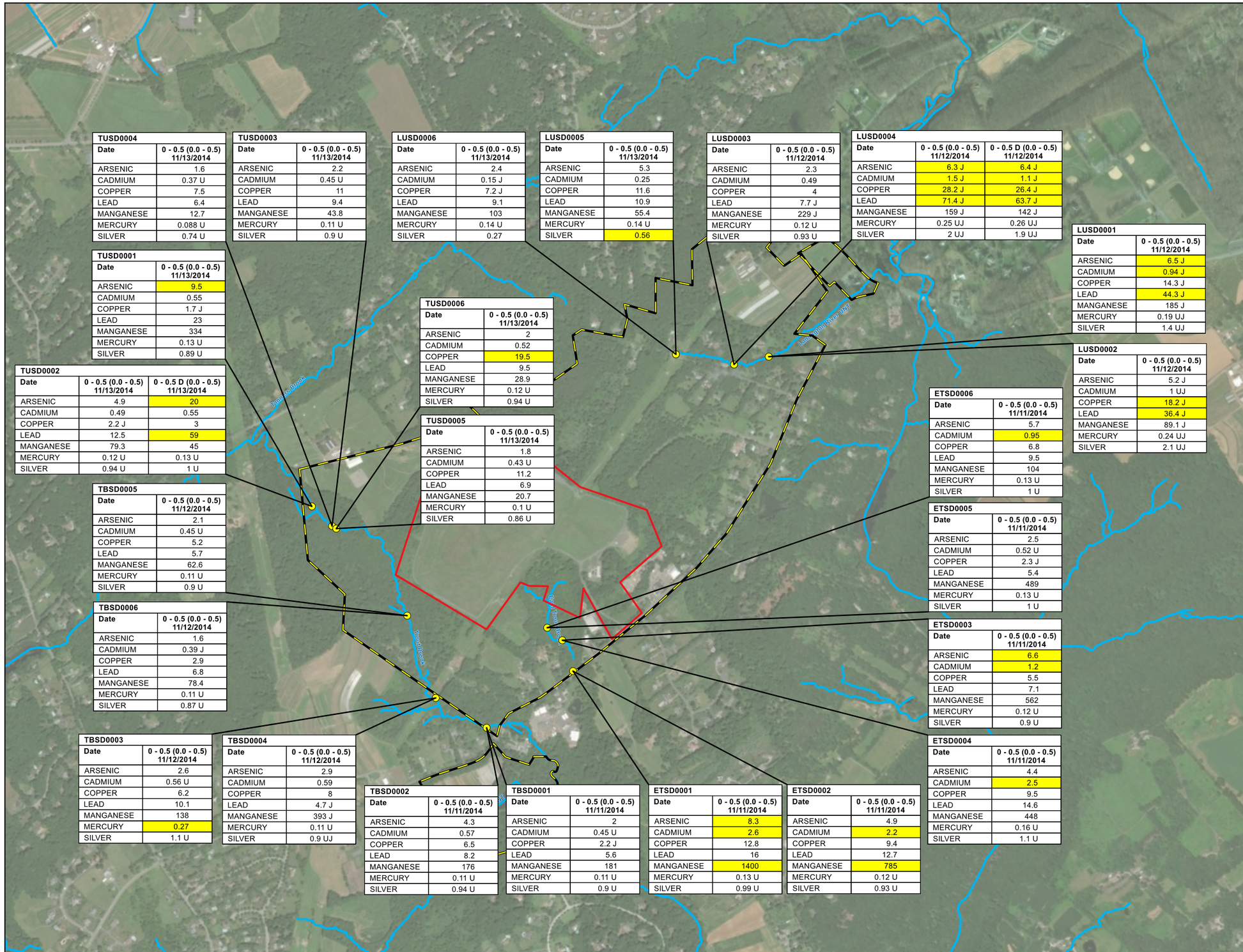
Chart Notes
- Horizontal red line represents GWQS.
- Trend charts for representative wells shown may include data collected prior to the RI period. Some of the pre-RI concentrations were higher than those observed during the RI.

0 400 800 Feet

Estimated Extent of 1,4-Dioxane in Groundwater

Figure 3-2
August, 2018

\\mahpi-file01\ActiveProjects\67062000005\1\004257717.0 GIS Models\7.2 Work In Progressmap docs\mxd\RI Final\Figure 8-1 Extent of 14-Dioxane in Groundwater.mxd



TUSD0004

Date	0 - 0.5 (0.0 - 0.5) 11/13/2014
ARSENIC	1.6
CADMIUM	0.37 U
COPPER	7.5
LEAD	6.4
MANGANESE	12.7
MERCURY	0.088 U
SILVER	0.74 U

TUSD0003

Date	0 - 0.5 (0.0 - 0.5) 11/13/2014
ARSENIC	2.2
CADMIUM	0.45 U
COPPER	11
LEAD	9.4
MANGANESE	43.8
MERCURY	0.11 U
SILVER	0.9 U

LUSD0006

Date	0 - 0.5 (0.0 - 0.5) 11/13/2014
ARSENIC	2.4
CADMIUM	0.15 J
COPPER	7.2 J
LEAD	9.1
MANGANESE	103
MERCURY	0.14 U
SILVER	0.27

LUSD0005

Date	0 - 0.5 (0.0 - 0.5) 11/13/2014
ARSENIC	5.3
CADMIUM	0.25
COPPER	11.6
LEAD	10.9
MANGANESE	55.4
MERCURY	0.14 U
SILVER	0.56

LUSD0003

Date	0 - 0.5 (0.0 - 0.5) 11/12/2014
ARSENIC	2.3
CADMIUM	0.49
COPPER	4
LEAD	7.7 J
MANGANESE	229 J
MERCURY	0.12 U
SILVER	0.93 U

LUSD0004

Date	0 - 0.5 (0.0 - 0.5) 11/12/2014	0 - 0.5 D (0.0 - 0.5) 11/12/2014
ARSENIC	6.3 J	6.4 J
CADMIUM	1.5 J	1.1 J
COPPER	28.2 J	26.4 J
LEAD	71.4 J	63.7 J
MANGANESE	159 J	142 J
MERCURY	0.25 UJ	0.26 UJ
SILVER	2 UJ	1.9 UJ

LUSD0001

Date	0 - 0.5 (0.0 - 0.5) 11/12/2014
ARSENIC	6.5 J
CADMIUM	0.94 J
COPPER	14.3 J
LEAD	44.3 J
MANGANESE	185 J
MERCURY	0.19 UJ
SILVER	1.4 UJ

LUSD0002

Date	0 - 0.5 (0.0 - 0.5) 11/12/2014
ARSENIC	5.2 J
CADMIUM	1 UJ
COPPER	18.2 J
LEAD	36.4 J
MANGANESE	89.1 J
MERCURY	0.24 UJ
SILVER	2.1 UJ

TUSD0001

Date	0 - 0.5 (0.0 - 0.5) 11/13/2014
ARSENIC	9.5
CADMIUM	0.55
COPPER	1.7 J
LEAD	23
MANGANESE	334
MERCURY	0.13 U
SILVER	0.89 U

TUSD0006

Date	0 - 0.5 (0.0 - 0.5) 11/13/2014
ARSENIC	2
CADMIUM	0.52
COPPER	19.5
LEAD	9.5
MANGANESE	28.9
MERCURY	0.12 U
SILVER	0.94 U

TUSD0002

Date	0 - 0.5 (0.0 - 0.5) 11/13/2014	0 - 0.5 D (0.0 - 0.5) 11/13/2014
ARSENIC	4.9	20
CADMIUM	0.49	0.55
COPPER	2.2 J	3
LEAD	12.5	59
MANGANESE	79.3	45
MERCURY	0.12 U	0.13 U
SILVER	0.94 U	1 U

TUSD0005

Date	0 - 0.5 (0.0 - 0.5) 11/13/2014
ARSENIC	1.8
CADMIUM	0.43 U
COPPER	11.2
LEAD	6.9
MANGANESE	20.7
MERCURY	0.1 U
SILVER	0.86 U

ETSD0006

Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ARSENIC	5.7
CADMIUM	0.95
COPPER	6.8
LEAD	9.5
MANGANESE	104
MERCURY	0.13 U
SILVER	1 U

TBSD0005

Date	0 - 0.5 (0.0 - 0.5) 11/12/2014
ARSENIC	2.1
CADMIUM	0.45 U
COPPER	5.2
LEAD	5.7
MANGANESE	62.6
MERCURY	0.11 U
SILVER	0.9 U

ETSD0005

Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ARSENIC	2.5
CADMIUM	0.52 U
COPPER	2.3 J
LEAD	5.4
MANGANESE	489
MERCURY	0.13 U
SILVER	1 U

TBSD0006

Date	0 - 0.5 (0.0 - 0.5) 11/12/2014
ARSENIC	1.6
CADMIUM	0.39 J
COPPER	2.9
LEAD	6.8
MANGANESE	78.4
MERCURY	0.11 U
SILVER	0.87 U

ETSD0003

Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ARSENIC	6.6
CADMIUM	1.2
COPPER	5.5
LEAD	7.1
MANGANESE	562
MERCURY	0.12 U
SILVER	0.9 U

TBSD0003

Date	0 - 0.5 (0.0 - 0.5) 11/12/2014
ARSENIC	2.6
CADMIUM	0.56 U
COPPER	6.2
LEAD	10.1
MANGANESE	138
MERCURY	0.27
SILVER	1.1 U

TBSD0004

Date	0 - 0.5 (0.0 - 0.5) 11/12/2014
ARSENIC	2.9
CADMIUM	0.59
COPPER	8
LEAD	4.7 J
MANGANESE	393 J
MERCURY	0.11 U
SILVER	0.9 UJ

TBSD0002

Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ARSENIC	4.3
CADMIUM	0.57
COPPER	6.5
LEAD	8.2
MANGANESE	176
MERCURY	0.11 U
SILVER	0.94 U

TBSD0001

Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ARSENIC	2
CADMIUM	0.45 U
COPPER	2.2 J
LEAD	5.6
MANGANESE	181
MERCURY	0.11 U
SILVER	0.9 U

ETSD0001

Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ARSENIC	8.3
CADMIUM	2.6
COPPER	12.8
LEAD	16
MANGANESE	1400
MERCURY	0.13 U
SILVER	0.99 U

ETSD0002

Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ARSENIC	4.9
CADMIUM	2.2
COPPER	9.4
LEAD	12.7
MANGANESE	785
MERCURY	0.12 U
SILVER	0.93 U

ETSD0004

Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ARSENIC	4.4
CADMIUM	2.5
COPPER	9.5
LEAD	14.6
MANGANESE	448
MERCURY	0.16 U
SILVER	1.1 U

Combe Fill South Landfill Superfund Site RI/FS

Aerial Background Credits: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, IGN, and the GIS User Community.

Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet

Legend

- Sediment Sample Location
- OU2 Investigation Area
- OU1 - Landfill Property Boundary
- Surface Water

CONSTITUENT	CRITERION (1)
Arsenic	6
Cadmium	0.6
Copper	16
Lead	31
Manganese	630
Mercury	0.174
Silver	0.5

Notes

- Results and criteria shown in mg/kg.
- Exceedances shown with yellow highlighting.
- Only constituents with one or more exceedances are shown.
- UNT = Unnamed Tributary
- Inorganics analyzed from 0 to 0.5 foot interval only. Organics collected from both 0 to 0.5 and 0.5 to 1.0 foot intervals.
- Sample intervals marked with "D" indicate field duplicate.

1. New Jersey Department of Environmental Protection Ecological Screening Criteria - Freshwater Criteria for Sediment, Lowest Effects Level (LEL). (March 2009)

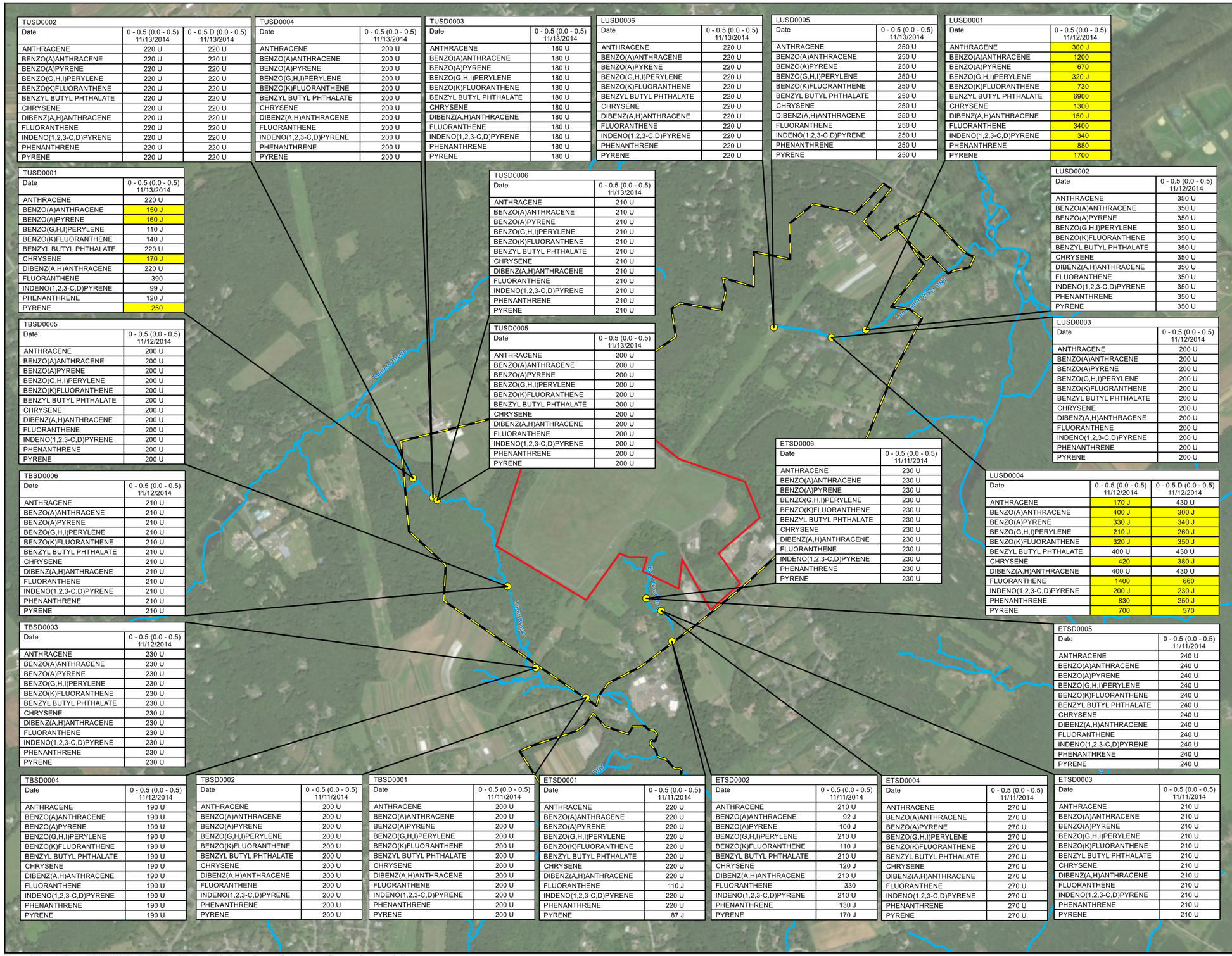
Note: Odd numbered samples (i.e. TUSD0001) were collected at approximately mid-channel. Even numbered samples were collected from a depositional area on the bank adjacent to the mid-channel sample. LUSD0005 and LUSD0006 were both collected on the bank of a pooled section of the stream.

0 1500 3000 feet
Not To Scale

2014 Inorganic Sample Results Exceeding Criteria in Sediment

Figure 3-3
August, 2018

\\mahpi-file01\ActiveProjects\6706\20000051\1004257\7.0_GIS_Models\7.2_Work_In_Progress\EnviroInsite\vizx\Figure 4-5 Inorganics in Sediment.vizx



TUSD0002		
Date	0 - 0.5 (0.0 - 0.5) 11/13/2014	0 - 0.5 D (0.0 - 0.5) 11/13/2014
ANTHRACENE	220 U	220 U
BENZO(A)ANTHRACENE	220 U	220 U
BENZO(A)PYRENE	220 U	220 U
BENZO(G,H,I)PERYLENE	220 U	220 U
BENZO(K)FLUORANTHENE	220 U	220 U
BENZYL BUTYL PHTHALATE	220 U	220 U
CHRYSENE	220 U	220 U
DIBENZ(A,H)ANTHRACENE	220 U	220 U
FLUORANTHENE	220 U	220 U
INDENO(1,2,3-C,D)PYRENE	220 U	220 U
PHENANTHRENE	220 U	220 U
PYRENE	220 U	220 U

TUSD0004	
Date	0 - 0.5 (0.0 - 0.5) 11/13/2014
ANTHRACENE	200 U
BENZO(A)ANTHRACENE	200 U
BENZO(A)PYRENE	200 U
BENZO(G,H,I)PERYLENE	200 U
BENZO(K)FLUORANTHENE	200 U
BENZYL BUTYL PHTHALATE	200 U
CHRYSENE	200 U
DIBENZ(A,H)ANTHRACENE	200 U
FLUORANTHENE	200 U
INDENO(1,2,3-C,D)PYRENE	200 U
PHENANTHRENE	200 U
PYRENE	200 U

TUSD0003	
Date	0 - 0.5 (0.0 - 0.5) 11/13/2014
ANTHRACENE	180 U
BENZO(A)ANTHRACENE	180 U
BENZO(A)PYRENE	180 U
BENZO(G,H,I)PERYLENE	180 U
BENZO(K)FLUORANTHENE	180 U
BENZYL BUTYL PHTHALATE	180 U
CHRYSENE	180 U
DIBENZ(A,H)ANTHRACENE	180 U
FLUORANTHENE	180 U
INDENO(1,2,3-C,D)PYRENE	180 U
PHENANTHRENE	180 U
PYRENE	180 U

LUSD0006	
Date	0 - 0.5 (0.0 - 0.5) 11/13/2014
ANTHRACENE	220 U
BENZO(A)ANTHRACENE	220 U
BENZO(A)PYRENE	220 U
BENZO(G,H,I)PERYLENE	220 U
BENZO(K)FLUORANTHENE	220 U
BENZYL BUTYL PHTHALATE	220 U
CHRYSENE	220 U
DIBENZ(A,H)ANTHRACENE	220 U
FLUORANTHENE	220 U
INDENO(1,2,3-C,D)PYRENE	220 U
PHENANTHRENE	220 U
PYRENE	220 U

LUSD0005	
Date	0 - 0.5 (0.0 - 0.5) 11/13/2014
ANTHRACENE	250 U
BENZO(A)ANTHRACENE	250 U
BENZO(A)PYRENE	250 U
BENZO(G,H,I)PERYLENE	250 U
BENZO(K)FLUORANTHENE	250 U
BENZYL BUTYL PHTHALATE	250 U
CHRYSENE	250 U
DIBENZ(A,H)ANTHRACENE	250 U
FLUORANTHENE	250 U
INDENO(1,2,3-C,D)PYRENE	250 U
PHENANTHRENE	250 U
PYRENE	250 U

LUSD0001	
Date	0 - 0.5 (0.0 - 0.5) 11/12/2014
ANTHRACENE	300 J
BENZO(A)ANTHRACENE	1200
BENZO(A)PYRENE	670
BENZO(G,H,I)PERYLENE	320 J
BENZO(K)FLUORANTHENE	730
BENZYL BUTYL PHTHALATE	6900
CHRYSENE	1300
DIBENZ(A,H)ANTHRACENE	150 J
FLUORANTHENE	3400
INDENO(1,2,3-C,D)PYRENE	340
PHENANTHRENE	880
PYRENE	1700

TUSD0001	
Date	0 - 0.5 (0.0 - 0.5) 11/13/2014
ANTHRACENE	220 U
BENZO(A)ANTHRACENE	150 J
BENZO(A)PYRENE	160 J
BENZO(G,H,I)PERYLENE	110 J
BENZO(K)FLUORANTHENE	140 J
BENZYL BUTYL PHTHALATE	220 U
CHRYSENE	170 J
DIBENZ(A,H)ANTHRACENE	220 U
FLUORANTHENE	390
INDENO(1,2,3-C,D)PYRENE	99 J
PHENANTHRENE	120 J
PYRENE	250

TUSD0006	
Date	0 - 0.5 (0.0 - 0.5) 11/13/2014
ANTHRACENE	210 U
BENZO(A)ANTHRACENE	210 U
BENZO(A)PYRENE	210 U
BENZO(G,H,I)PERYLENE	210 U
BENZO(K)FLUORANTHENE	210 U
BENZYL BUTYL PHTHALATE	210 U
CHRYSENE	210 U
DIBENZ(A,H)ANTHRACENE	210 U
FLUORANTHENE	210 U
INDENO(1,2,3-C,D)PYRENE	210 U
PHENANTHRENE	210 U
PYRENE	210 U

LUSD0002	
Date	0 - 0.5 (0.0 - 0.5) 11/12/2014
ANTHRACENE	350 U
BENZO(A)ANTHRACENE	350 U
BENZO(A)PYRENE	350 U
BENZO(G,H,I)PERYLENE	350 U
BENZO(K)FLUORANTHENE	350 U
BENZYL BUTYL PHTHALATE	350 U
CHRYSENE	350 U
DIBENZ(A,H)ANTHRACENE	350 U
FLUORANTHENE	350 U
INDENO(1,2,3-C,D)PYRENE	350 U
PHENANTHRENE	350 U
PYRENE	350 U

TBSD0005	
Date	0 - 0.5 (0.0 - 0.5) 11/12/2014
ANTHRACENE	200 U
BENZO(A)ANTHRACENE	200 U
BENZO(A)PYRENE	200 U
BENZO(G,H,I)PERYLENE	200 U
BENZO(K)FLUORANTHENE	200 U
BENZYL BUTYL PHTHALATE	200 U
CHRYSENE	200 U
DIBENZ(A,H)ANTHRACENE	200 U
FLUORANTHENE	200 U
INDENO(1,2,3-C,D)PYRENE	200 U
PHENANTHRENE	200 U
PYRENE	200 U

TUSD0005	
Date	0 - 0.5 (0.0 - 0.5) 11/13/2014
ANTHRACENE	200 U
BENZO(A)ANTHRACENE	200 U
BENZO(A)PYRENE	200 U
BENZO(G,H,I)PERYLENE	200 U
BENZO(K)FLUORANTHENE	200 U
BENZYL BUTYL PHTHALATE	200 U
CHRYSENE	200 U
DIBENZ(A,H)ANTHRACENE	200 U
FLUORANTHENE	200 U
INDENO(1,2,3-C,D)PYRENE	200 U
PHENANTHRENE	200 U
PYRENE	200 U

LUSD0003	
Date	0 - 0.5 (0.0 - 0.5) 11/12/2014
ANTHRACENE	200 U
BENZO(A)ANTHRACENE	200 U
BENZO(A)PYRENE	200 U
BENZO(G,H,I)PERYLENE	200 U
BENZO(K)FLUORANTHENE	200 U
BENZYL BUTYL PHTHALATE	200 U
CHRYSENE	200 U
DIBENZ(A,H)ANTHRACENE	200 U
FLUORANTHENE	200 U
INDENO(1,2,3-C,D)PYRENE	200 U
PHENANTHRENE	200 U
PYRENE	200 U

ETSD0006	
Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ANTHRACENE	230 U
BENZO(A)ANTHRACENE	230 U
BENZO(A)PYRENE	230 U
BENZO(G,H,I)PERYLENE	230 U
BENZO(K)FLUORANTHENE	230 U
BENZYL BUTYL PHTHALATE	230 U
CHRYSENE	230 U
DIBENZ(A,H)ANTHRACENE	230 U
FLUORANTHENE	230 U
INDENO(1,2,3-C,D)PYRENE	230 U
PHENANTHRENE	230 U
PYRENE	230 U

LUSD0004		
Date	0 - 0.5 (0.0 - 0.5) 11/12/2014	0 - 0.5 D (0.0 - 0.5) 11/12/2014
ANTHRACENE	170 J	430 U
BENZO(A)ANTHRACENE	400 J	300 J
BENZO(A)PYRENE	330 J	340 J
BENZO(G,H,I)PERYLENE	210 J	260 J
BENZO(K)FLUORANTHENE	320 J	350 J
BENZYL BUTYL PHTHALATE	400 U	430 U
CHRYSENE	420	380 J
DIBENZ(A,H)ANTHRACENE	400 U	430 U
FLUORANTHENE	1400	660
INDENO(1,2,3-C,D)PYRENE	200 J	230 J
PHENANTHRENE	830	250 J
PYRENE	700	570

TBSD0006	
Date	0 - 0.5 (0.0 - 0.5) 11/12/2014
ANTHRACENE	210 U
BENZO(A)ANTHRACENE	210 U
BENZO(A)PYRENE	210 U
BENZO(G,H,I)PERYLENE	210 U
BENZO(K)FLUORANTHENE	210 U
BENZYL BUTYL PHTHALATE	210 U
CHRYSENE	210 U
DIBENZ(A,H)ANTHRACENE	210 U
FLUORANTHENE	210 U
INDENO(1,2,3-C,D)PYRENE	210 U
PHENANTHRENE	210 U
PYRENE	210 U

TBSD0003	
Date	0 - 0.5 (0.0 - 0.5) 11/12/2014
ANTHRACENE	230 U
BENZO(A)ANTHRACENE	230 U
BENZO(A)PYRENE	230 U
BENZO(G,H,I)PERYLENE	230 U
BENZO(K)FLUORANTHENE	230 U
BENZYL BUTYL PHTHALATE	230 U
CHRYSENE	230 U
DIBENZ(A,H)ANTHRACENE	230 U
FLUORANTHENE	230 U
INDENO(1,2,3-C,D)PYRENE	230 U
PHENANTHRENE	230 U
PYRENE	230 U

ETSD0005	
Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ANTHRACENE	240 U
BENZO(A)ANTHRACENE	240 U
BENZO(A)PYRENE	240 U
BENZO(G,H,I)PERYLENE	240 U
BENZO(K)FLUORANTHENE	240 U
BENZYL BUTYL PHTHALATE	240 U
CHRYSENE	240 U
DIBENZ(A,H)ANTHRACENE	240 U
FLUORANTHENE	240 U
INDENO(1,2,3-C,D)PYRENE	240 U
PHENANTHRENE	240 U
PYRENE	240 U

TBSD0004	
Date	0 - 0.5 (0.0 - 0.5) 11/12/2014
ANTHRACENE	190 U
BENZO(A)ANTHRACENE	190 U
BENZO(A)PYRENE	190 U
BENZO(G,H,I)PERYLENE	190 U
BENZO(K)FLUORANTHENE	190 U
BENZYL BUTYL PHTHALATE	190 U
CHRYSENE	190 U
DIBENZ(A,H)ANTHRACENE	190 U
FLUORANTHENE	190 U
INDENO(1,2,3-C,D)PYRENE	190 U
PHENANTHRENE	190 U
PYRENE	190 U

TBSD0002	
Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ANTHRACENE	200 U
BENZO(A)ANTHRACENE	200 U
BENZO(A)PYRENE	200 U
BENZO(G,H,I)PERYLENE	200 U
BENZO(K)FLUORANTHENE	200 U
BENZYL BUTYL PHTHALATE	200 U
CHRYSENE	200 U
DIBENZ(A,H)ANTHRACENE	200 U
FLUORANTHENE	200 U
INDENO(1,2,3-C,D)PYRENE	200 U
PHENANTHRENE	200 U
PYRENE	200 U

TBSD0001	
Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ANTHRACENE	200 U
BENZO(A)ANTHRACENE	200 U
BENZO(A)PYRENE	200 U
BENZO(G,H,I)PERYLENE	200 U
BENZO(K)FLUORANTHENE	200 U
BENZYL BUTYL PHTHALATE	200 U
CHRYSENE	200 U
DIBENZ(A,H)ANTHRACENE	200 U
FLUORANTHENE	200 U
INDENO(1,2,3-C,D)PYRENE	200 U
PHENANTHRENE	200 U
PYRENE	200 U

ETSD0001	
Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ANTHRACENE	220 U
BENZO(A)ANTHRACENE	220 U
BENZO(A)PYRENE	220 U
BENZO(G,H,I)PERYLENE	220 U
BENZO(K)FLUORANTHENE	220 U
BENZYL BUTYL PHTHALATE	220 U
CHRYSENE	220 U
DIBENZ(A,H)ANTHRACENE	220 U
FLUORANTHENE	110 J
INDENO(1,2,3-C,D)PYRENE	220 U
PHENANTHRENE	220 U
PYRENE	87 J

ETSD0002	
Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ANTHRACENE	210 U
BENZO(A)ANTHRACENE	92 J
BENZO(A)PYRENE	100 J
BENZO(G,H,I)PERYLENE	210 U
BENZO(K)FLUORANTHENE	110 J
BENZYL BUTYL PHTHALATE	210 U
CHRYSENE	120 J
DIBENZ(A,H)ANTHRACENE	210 U
FLUORANTHENE	330
INDENO(1,2,3-C,D)PYRENE	210 U
PHENANTHRENE	130 J
PYRENE	170 J

ETSD0004	
Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ANTHRACENE	270 U
BENZO(A)ANTHRACENE	270 U
BENZO(A)PYRENE	270 U
BENZO(G,H,I)PERYLENE	270 U
BENZO(K)FLUORANTHENE	270 U
BENZYL BUTYL PHTHALATE	270 U
CHRYSENE	270 U
DIBENZ(A,H)ANTHRACENE	270 U
FLUORANTHENE	270 U
INDENO(1,2,3-C,D)PYRENE	270 U
PHENANTHRENE	270 U
PYRENE	270 U

ETSD0003	
Date	0 - 0.5 (0.0 - 0.5) 11/11/2014
ANTHRACENE	210 U
BENZO(A)ANTHRACENE	210 U
BENZO(A)PYRENE	210 U
BENZO(G,H,I)PERYLENE	210 U
BENZO(K)FLUORANTHENE	210 U
BENZYL BUTYL PHTHALATE	210 U
CHRYSENE	210 U
DIBENZ(A,H)ANTHRACENE	210 U
FLUORANTHENE	210 U
INDENO(1,2,3-C,D)PYRENE	210 U
PHENANTHRENE	210 U
PYRENE	210 U

HDR

Combe Fill South Landfill
Superfund Site RI/FS

Aerial Background Credits: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, IGN, and the GIS User Community.

Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet

Legend

- Sediment Sample Location
- OU2 Investigation Area
- OU1 - Landfill Property Boundary
- Surface Water

CONSTITUENT	CRITERION (1)
Anthracene	57.2
Benzo(a)anthracene	108
Benzo(a)pyrene	150
Benzo(g,h,i)perylene	170
Benzo(k)fluoranthene	240
Benzyl Butyl Phthalate	1970
Chrysene	166
Dibzneo(a,h)anthracene	33
Fluoranthene	423
Indeno(1,2,3-cd)pyrene	200
Phenanthrene	204
Pyrene	195

Notes

- Results and criteria shown in ug/kg.
- Exceedances shown with yellow highlighting.
- Only constituents with one or more exceedances are shown.
- UNT = Unnamed Tributary
- Inorganics analyzed from 0 to 0.5 foot interval only. Organics collected from both 0 to 0.5 and 0.5 to 1.0 foot intervals.
- Sample intervals marked with "D" indicate field duplicate.

1. New Jersey Department of Environmental Protection Ecological Screening Criteria - Freshwater Criteria for Sediment, Lowest Effects Level (LEL). (March 2009)

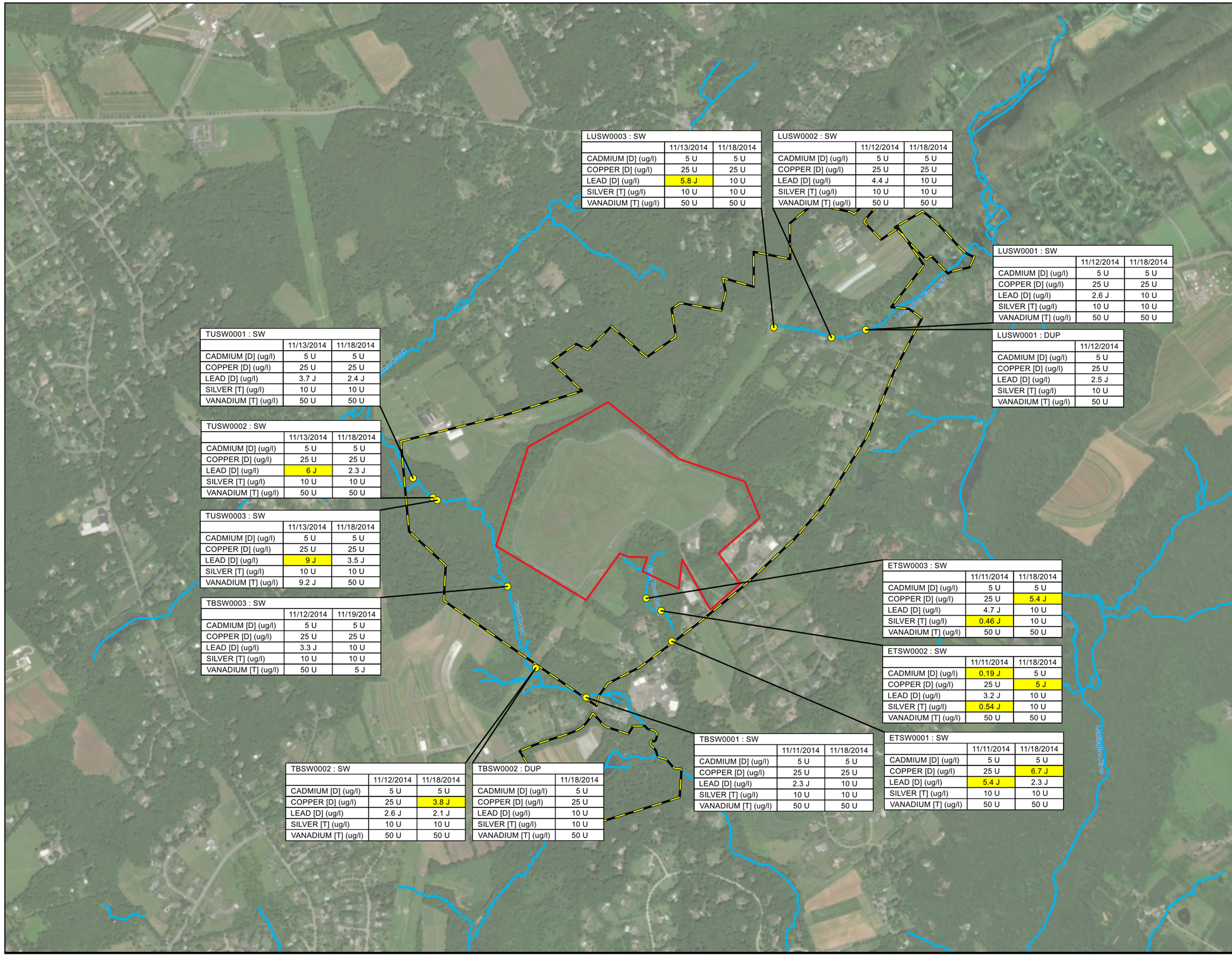
Note: Odd numbered samples (i.e. TUSD0001) were collected at approximately mid-channel. Even numbered samples were collected from a depositional area on the bank adjacent to the mid-channel sample. LUSD0005 and LUSD0006 were both collected on the bank of a pooled section of the stream.

0 1500 3000 feet
Not To Scale

2014 Organic Sample Results Exceeding Criteria in Sediment

Figure 3-4
August, 2018

\\mahpi-file01\ActiveProjects\6706\2000000511\100425771\7.0_GIS_Models\7.2_Work_In_Progress\EnviroInsite\vizx\Figure 4-4 Organics in Sediment.vizx



LUSW0003 : SW	11/13/2014	11/18/2014
CADMIUM [D] (ug/l)	5 U	5 U
COPPER [D] (ug/l)	25 U	25 U
LEAD [D] (ug/l)	5.8 J	10 U
SILVER [T] (ug/l)	10 U	10 U
VANADIUM [T] (ug/l)	50 U	50 U

LUSW0002 : SW	11/12/2014	11/18/2014
CADMIUM [D] (ug/l)	5 U	5 U
COPPER [D] (ug/l)	25 U	25 U
LEAD [D] (ug/l)	4.4 J	10 U
SILVER [T] (ug/l)	10 U	10 U
VANADIUM [T] (ug/l)	50 U	50 U

LUSW0001 : SW	11/12/2014	11/18/2014
CADMIUM [D] (ug/l)	5 U	5 U
COPPER [D] (ug/l)	25 U	25 U
LEAD [D] (ug/l)	2.6 J	10 U
SILVER [T] (ug/l)	10 U	10 U
VANADIUM [T] (ug/l)	50 U	50 U

LUSW0001 : DUP	11/12/2014
CADMIUM [D] (ug/l)	5 U
COPPER [D] (ug/l)	25 U
LEAD [D] (ug/l)	2.5 J
SILVER [T] (ug/l)	10 U
VANADIUM [T] (ug/l)	50 U

TUSW0001 : SW	11/13/2014	11/18/2014
CADMIUM [D] (ug/l)	5 U	5 U
COPPER [D] (ug/l)	25 U	25 U
LEAD [D] (ug/l)	3.7 J	2.4 J
SILVER [T] (ug/l)	10 U	10 U
VANADIUM [T] (ug/l)	50 U	50 U

TUSW0002 : SW	11/13/2014	11/18/2014
CADMIUM [D] (ug/l)	5 U	5 U
COPPER [D] (ug/l)	25 U	25 U
LEAD [D] (ug/l)	6 J	2.3 J
SILVER [T] (ug/l)	10 U	10 U
VANADIUM [T] (ug/l)	50 U	50 U

TUSW0003 : SW	11/13/2014	11/18/2014
CADMIUM [D] (ug/l)	5 U	5 U
COPPER [D] (ug/l)	25 U	25 U
LEAD [D] (ug/l)	9 J	3.5 J
SILVER [T] (ug/l)	10 U	10 U
VANADIUM [T] (ug/l)	9.2 J	50 U

TBSW0003 : SW	11/12/2014	11/19/2014
CADMIUM [D] (ug/l)	5 U	5 U
COPPER [D] (ug/l)	25 U	25 U
LEAD [D] (ug/l)	3.3 J	10 U
SILVER [T] (ug/l)	10 U	10 U
VANADIUM [T] (ug/l)	50 U	5 J

ETSW0003 : SW	11/11/2014	11/18/2014
CADMIUM [D] (ug/l)	5 U	5 U
COPPER [D] (ug/l)	25 U	5.4 J
LEAD [D] (ug/l)	4.7 J	10 U
SILVER [T] (ug/l)	0.46 J	10 U
VANADIUM [T] (ug/l)	50 U	50 U

ETSW0002 : SW	11/11/2014	11/18/2014
CADMIUM [D] (ug/l)	0.19 J	5 U
COPPER [D] (ug/l)	25 U	5 J
LEAD [D] (ug/l)	3.2 J	10 U
SILVER [T] (ug/l)	0.54 J	10 U
VANADIUM [T] (ug/l)	50 U	50 U

TBSW0001 : SW	11/11/2014	11/18/2014
CADMIUM [D] (ug/l)	5 U	5 U
COPPER [D] (ug/l)	25 U	25 U
LEAD [D] (ug/l)	2.3 J	10 U
SILVER [T] (ug/l)	10 U	10 U
VANADIUM [T] (ug/l)	50 U	50 U

ETSW0001 : SW	11/11/2014	11/18/2014
CADMIUM [D] (ug/l)	5 U	5 U
COPPER [D] (ug/l)	25 U	6.7 J
LEAD [D] (ug/l)	5.4 J	2.3 J
SILVER [T] (ug/l)	10 U	10 U
VANADIUM [T] (ug/l)	50 U	50 U

TBSW0002 : SW	11/12/2014	11/18/2014
CADMIUM [D] (ug/l)	5 U	5 U
COPPER [D] (ug/l)	25 U	3.8 J
LEAD [D] (ug/l)	2.6 J	2.1 J
SILVER [T] (ug/l)	10 U	10 U
VANADIUM [T] (ug/l)	50 U	50 U

TBSW0002 : DUP	11/18/2014
CADMIUM [D] (ug/l)	5 U
COPPER [D] (ug/l)	25 U
LEAD [D] (ug/l)	10 U
SILVER [T] (ug/l)	10 U
VANADIUM [T] (ug/l)	50 U

Combe Fill South Landfill
Superfund Site RI/FS

Aerial Background Credits: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, IGN, and the GIS User Community.

Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet

Legend

- Surface Water Sample Location
- OU2 Investigation Area
- OU1 - Landfill Property Boundary
- Surface Water

CONSTITUENT	CRITERION (1)
Cadmium [D] (2)	0.056
Copper [D] (2)	2.2
Lead [D] (3)	5.4
Silver [T]	0.12
Vanadium [T]	12

Notes

- Results shown in ug/L.
- Exceedances shown with yellow highlighting.
- Only constituents with one or more exceedances are shown.
- [T] indicates total fraction.
- [D] indicates dissolved fraction.
- UNT = Unnamed Tributary
- Samples collected between 11/11/14 and 11/13/14 are dry weather samples (baseflow).
- Samples collected between 11/18/14 and 11/19/14 are wet weather samples collected after >1 inch of rain fell in the area on 11/17/14.

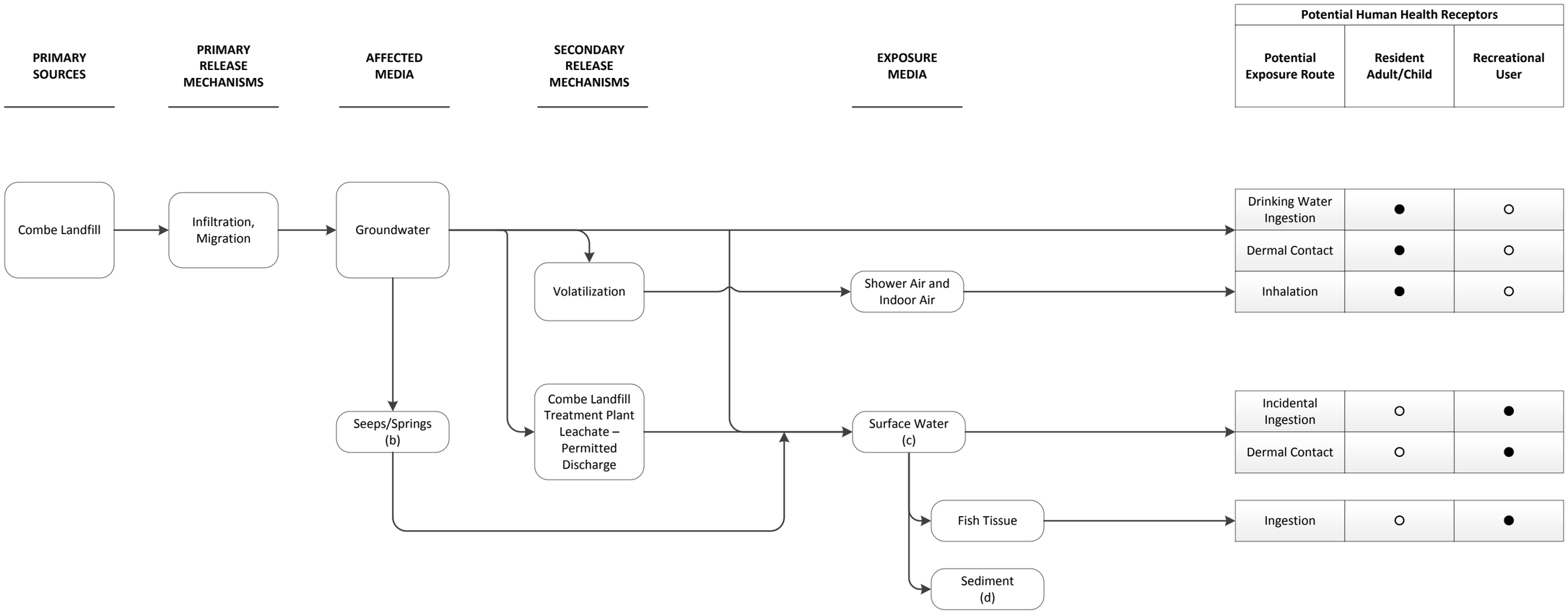
1. New Jersey Department of Environmental Protection (NJDEP) NJAC 7:9B Surface Water Quality Standards (re-adopted October 2016; amended January 2011). Fresh Water Class 2 (FW2) Surface Water Criteria Chronic.
2. Cadmium and Copper criteria are hardness dependent calculated criteria for the dissolved fraction. Criteria calculated using formluas provided in NJAC 7:9B.
3. Lead criteria is promulgated standard for dissolved fraction.

0 1500 3000 feet
Not To Scale

2014 Inorganic Sample Results Exceeding Criteria in Surface Water

Figure 3-5
August, 2018

\\mahpi-file01\ActiveProjects\6706\20000051\10042577\7.0_GIS_Models\7.2_Work_In_Progress\EnviroInsite\vizx\Figure 4-6 Inorganics in Surface Water.vizx



NOTES

● Pathway assumed to be complete.

○ Pathway assumed to be incomplete or insignificant.

(a) Exposure pathways are based on the current understanding of the Site and are subject to change.

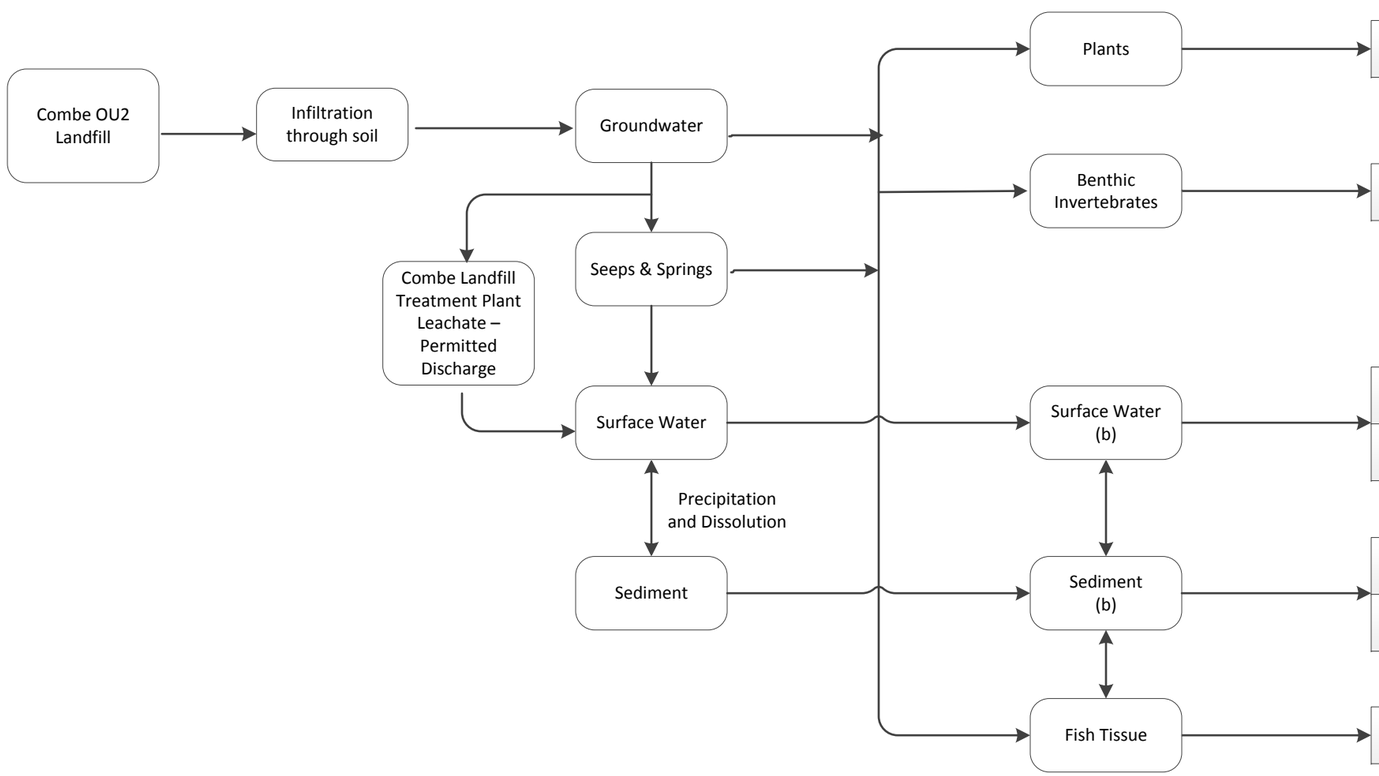
(b) Seeps and springs are not evaluated separately as they are considered to be groundwater, which is evaluated, and exposure to COPCs at seeps and springs is considered *de minimis*.

(c) Surface water was evaluated for the nearby water bodies:
Trout Brook, East Trout Brook, a Lamington River unnamed tributary (UNT) and a Tanners Brook UNT.
East Trout Brook represents impacts downstream of the permitted discharge from the Treatment Plant.

(d) Sediment is not evaluated. Upon review of the sediment analytical data, site use and conditions, potential for bioaccumulation and exposure pathways, it was determined that minimal and infrequent contact with sediment is expected.

U.S. Environmental Protection Agency
Combe Fill South Landfill RI/FS
Chester & Washington Townships, New Jersey

Figure 3-6
Human Health Conceptual Site Model
August, 2018



	AQUATIC / RIPARIAN					
EXPOSURE ROUTE	Biota (fish)	Benthic Invertebrate	Plants	Avian / Mammalian Herbivore	Avian / Mammalian Invertivore	Avian / Mammalian Piscivore (c)
Ingestion	○	○	○	●	○	○
Ingestion	●	●	○	○	●	○
Ingestion	●	*	○	●	●	●
Direct Contact	●	●	●	*	*	*
Ingestion	●	●	○	●	●	●
Direct Contact	*	●	●	*	*	*
Ingestion	○	○	○	○	○	●

NOTES:

● Pathway assumed to be complete.

○ Pathway assumed to be incomplete.

* Pathway assumed to be insignificant.

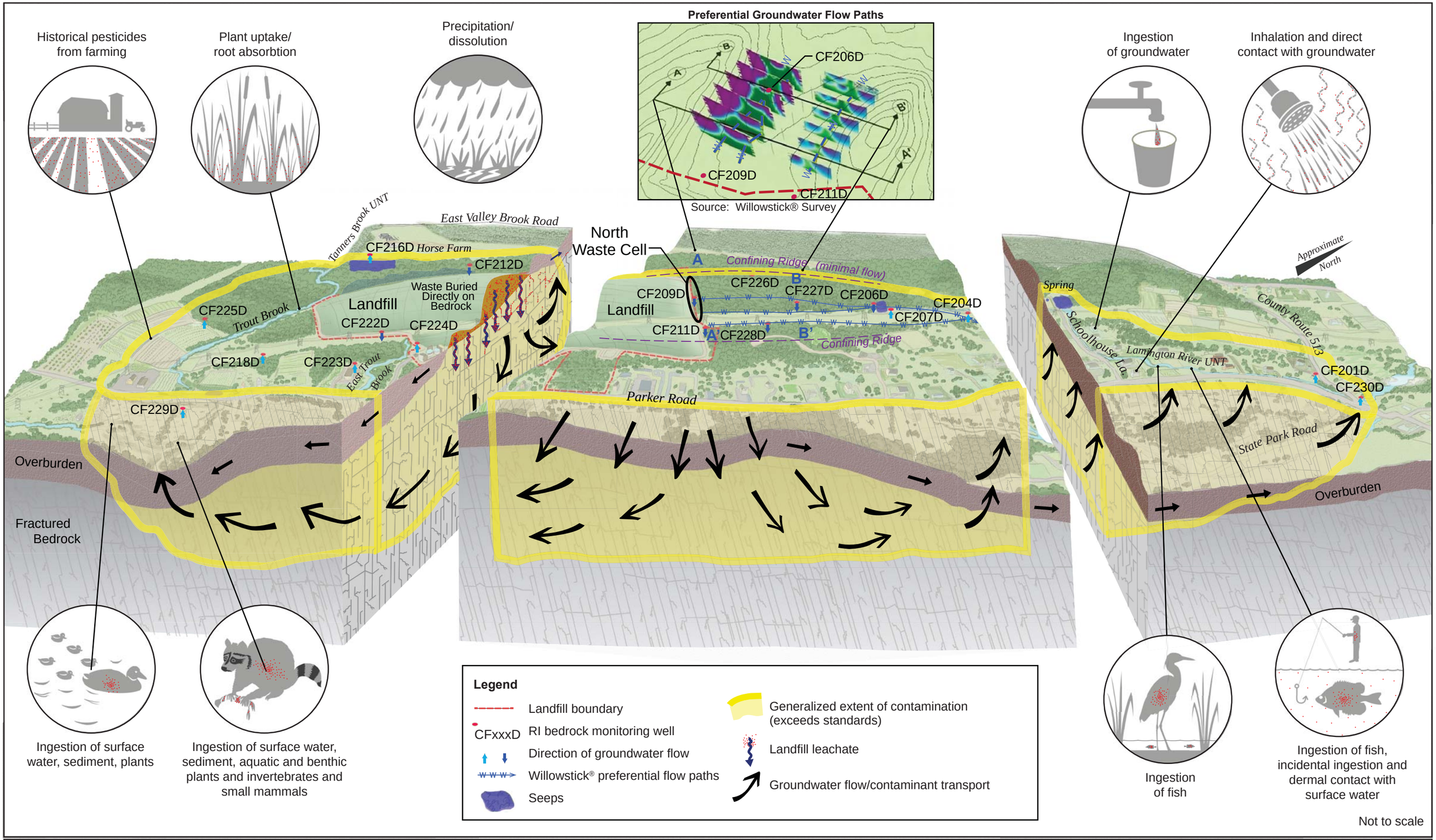
(a) Exposure pathways are based on the current understanding of the Site and are subject to change.

(b) Surface water and sediment was evaluated for the nearby water bodies:
Trout Brook, East Trout Brook, Lamington River unnamed tributary (UNT) and Tanners Brook UNT.
East Trout Brook represents impacts downstream of the permitted discharge from the Treatment Plant.

(c) For piscivores, no fish tissue samples were collected; bioconcentration factors were used to model surface water concentrations to fish tissue concentrations.

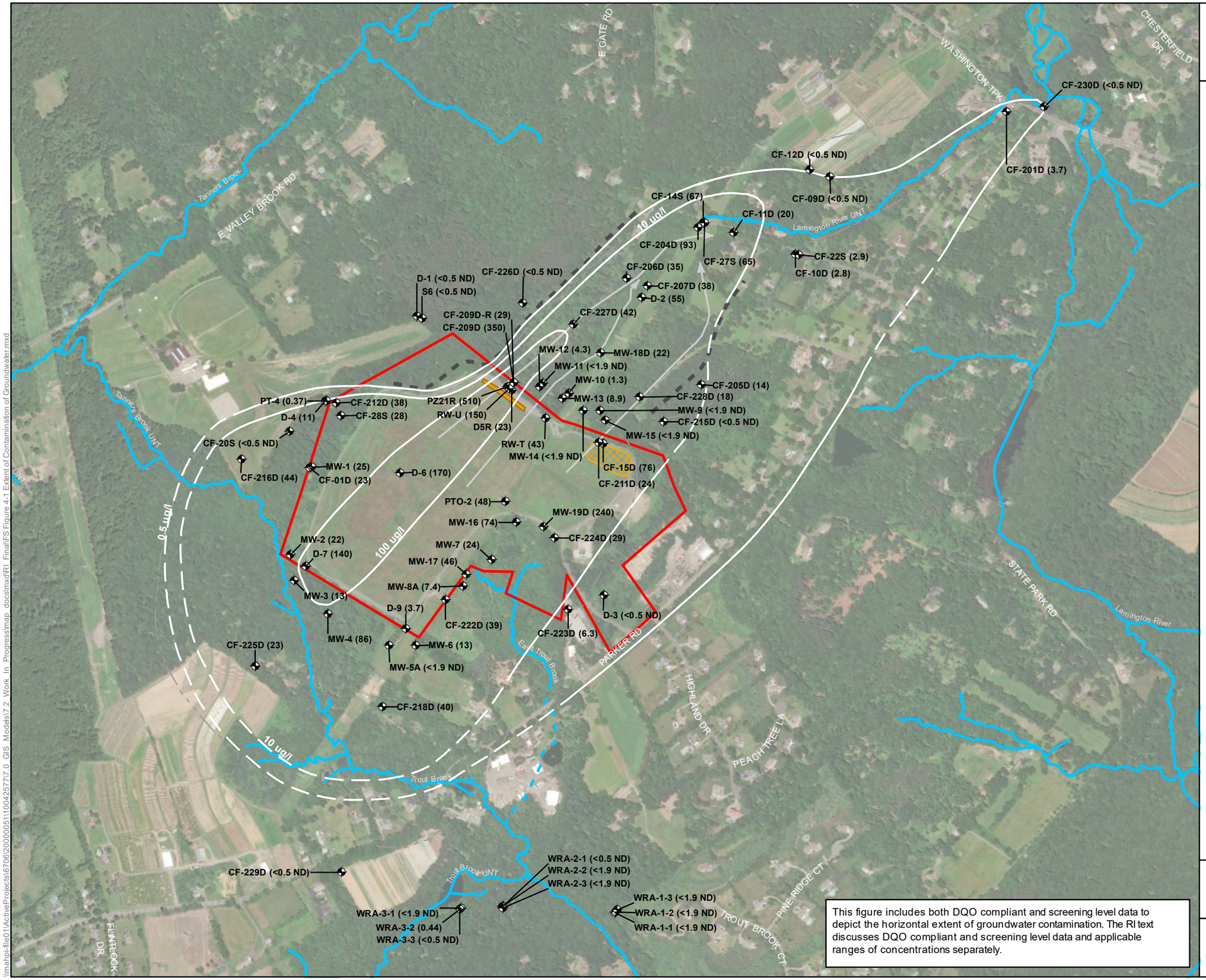
U.S. Environmental Protection Agency
Combe Fill South Landfill RI/FS
Chester & Washington Townships, New Jersey

Figure 3-7
Ecological Conceptual Site Model
August, 2018



U.S. Environmental Protection Agency
Combe Fill South Landfill RI/FS
Chester & Washington Townships, New Jersey

Figure 3-8
Conceptual Site Model Illustration
August 2018



This figure includes both DQO compliant and screening level data to depict the horizontal extent of groundwater contamination. The RI text discusses DQO compliant and screening level data and applicable ranges of concentrations separately.

Combe Fill South Landfill Superfund Site RI/FS

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet
Projection: Transverse Mercator
Datum: North American 1983
Units: Foot US

Legend

- OU1 - Landfill Property Boundary
- Monitoring Well
- Isoconcentration Line (white)
- Interpreted Where Dashed
- North Waste Cell Excavation
- Approximate Area of NJDEP Drum Removals (1993-1995)
- Surface Water
- Aquitard (Source: Willowstick report)
- Preferential Flow Path (Source: Willowstick report)

Notes

Concentrations in ug/L.
ND = Constituent not detected above the analytical reporting limit.

For contouring, the maximum detected concentration of the constituent being mapped was used regardless of depth or sampling date in order to conceptualize the approximate extent of detections of the mapped constituent.

For 1,4-Dioxane, the lowest reporting limit (SVOC-SIM analysis) of 0.5 ug/l was contoured.

Wells MW-9 through MW-15 are overburden and shallow bedrock wells. Contaminant migration is thought to occur in the deeper bedrock in the area of these wells.

Analytical Data Sources

- OU2 Remedial Investigation Sampling (HDR, 2011-2015)
- OU2 Monitoring Well Packer Results (HDR, 2011)
- OU2 FS Pump Test (HDR, 2017)
- Post-Construction Environmental Monitoring (PCEM) Program Samples (NJDEP, Q4 2011 to Q4 2015)
- Results from potable well sampling conducted by EPA in 2011 included in approximation of extent of contaminants (VOCs only). Individual results not shown due to sensitive nature of residential sampling.

Chart Notes

- Horizontal red line represents GWQS.
- Trend charts for representative wells shown may include data collected prior to the RI period. Some of the pre-RI concentrations were higher than those observed during the RI.

0 400 800 Feet

Estimated Extent Contamination in Groundwater

Figure 4-1
August, 2018

\\mahpi-file01\ActiveProjects\67061200000511\004257717.0_GIS_Models\7.2_Work_In_Progress\map_docs\mxd\RI_Final\FS Figure 4-1 Extent of Contamination of Groundwater.mxd

Combe Fill South Landfill Superfund Site RI/FS

THE LEGEND ITEMS AND NOTES CONTAINED IN THIS FIGURE ARE BASED ON FIGURE 3 FROM THE 2011 HANDEX PUMP TEST SUMMARY REPORT.

HANDEX 2011. Handex Consulting and Remediation, LLC. Pump Test Summary NJDEP - Combe Fill South, Chester, Morris County, NJ. September 2010 - March 2011. Prepared for New Jersey Department of Environmental Protection.

Elevation Difference

- 5ft - 10ft
- 10ft - 15ft
- 15ft - 20ft
- > 20ft

Dashed lines are inferred.

- Gas Sampling Location
- Monitoring Well Location
- Recovery Well Location
- Chain Link Fence
- Approximate Landfill Boundary
- Stream / River

PZ-27 was not used in the contours.

NOTES:

1. HORIZONTAL DATUM - NORTH AMERICAN DATUM 1983 (NAD1983) FROM CONTROL MONUMENTS "A" AND "B" PROVIDED BY LJCE SURVEY CREW IN THE FIELD (IN NAD27 DATUM) AND CONVERTED TO NAD83 USING CORPSCON6.

2. VERTICAL DATIUM - NATIONAL GEODETIC VERTICAL DATUM 1927 (NGVD27). FROM CONTROL MONUMENTS PROVIDED TO LJCE SURVEY CREW IN THE FIELD. MONUMENT "A" ELEV. = 817.61. MONUMENT "B" ELEV.=877.31.

3. WELL LOCATION AS SHOWN IN THE WELL TABLE WERE LOCATED BY LJCE SURVEY CREW ON MAY 6, 2011.

4. ALL WELLS SHOWN ON THIS PLAN THAT ARE NOT IN THE WELL TABLE ARE GRAPHICALLY FROM INFORMATION PROVIDED TO LJCE FROM HANDEX. THIS PLAN DOES NOT CERTIFY TO THE LOCATION OF ANY WELL NOT SHOWN IN THE WELL TABLE.

5. THE BOUNDARY SHOWNON THIS PLAN WAS TAKEN FROM INFORMATION PROVIDED TO LJCE FROM HANDEX. LJCE MAKES NO CLAIMS AS TO THE ACCURACY OF THE BOUNDARY SHOWN HEREIN. THIS IS NOT A SURVEY CONVEYANCE.

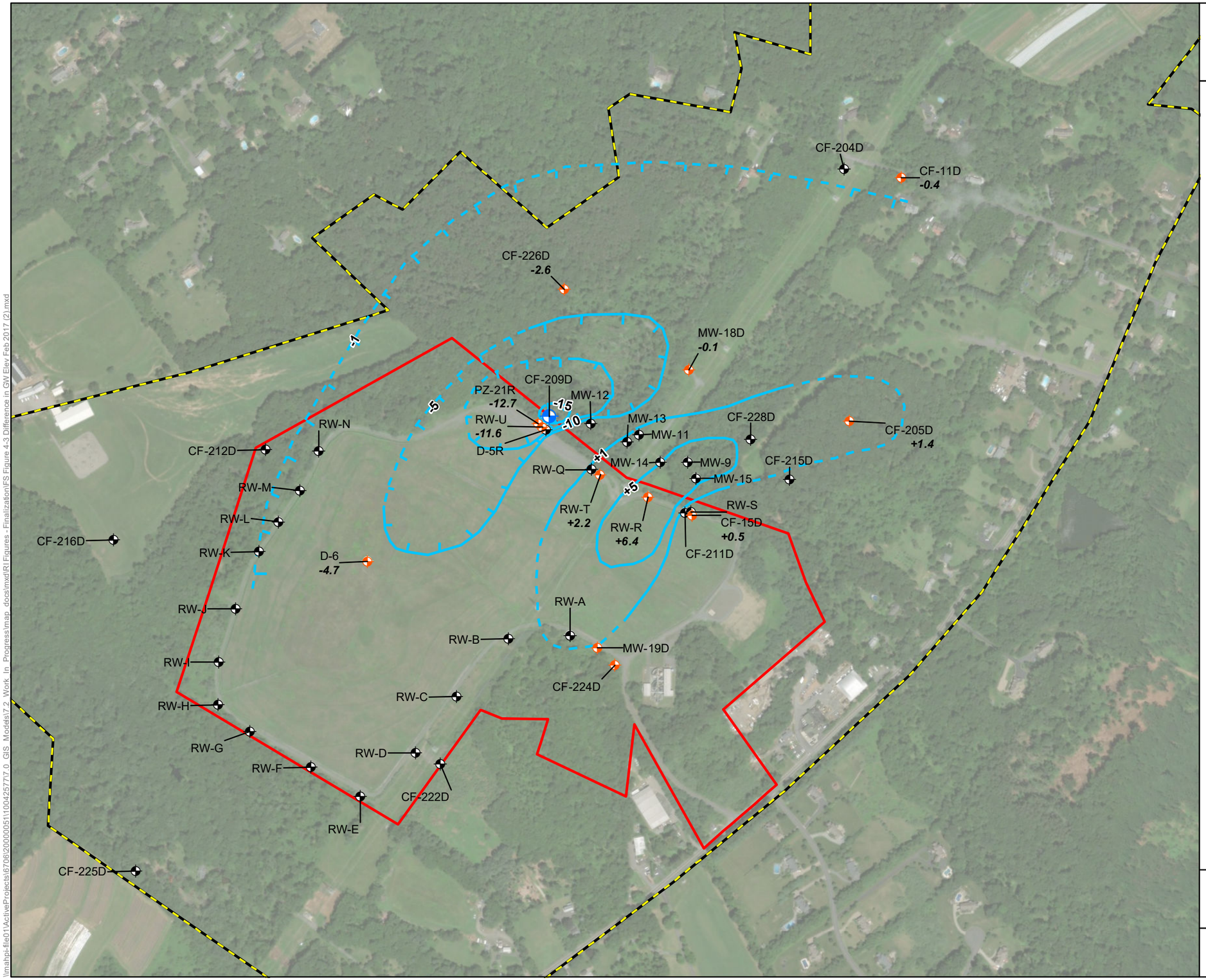
6. MW6 AND MW-8A ARE APPROXIMATE LOCATIONS BASED ON MAP PROVIDED BY THE LOUIS BERGER GROUP, INC. MAP.

0 125 250 Feet

2011 Pump Test Drawdown

Figure 4-2
August, 2018

\\mahpi-file01\ActiveProjects\670\2000005\1100425777.0 GIS Models\7.2 Work In Progress\map docs\mxd\RI Final\Figure 3-14 2011 Pump Test Drawdown.mxd



Combe Fill South Landfill Superfund Site RI/FS

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Coordinate System: NAD 1983 2011 StatePlane New Jersey FIPS 2900 Ft US
Projection: Transverse Mercator
Datum: NAD 1983 2011
Units: Foot US

Legend

- OU1 - Landfill Property Boundary
- OU2 Investigation Area
- Pumping Well
- Transducer Wells
- Other Wells
- Difference in Elevation
- Dashed where inferred

Groundwater elevation differential observed over the course of the February 2017 CF-209D pumping test.

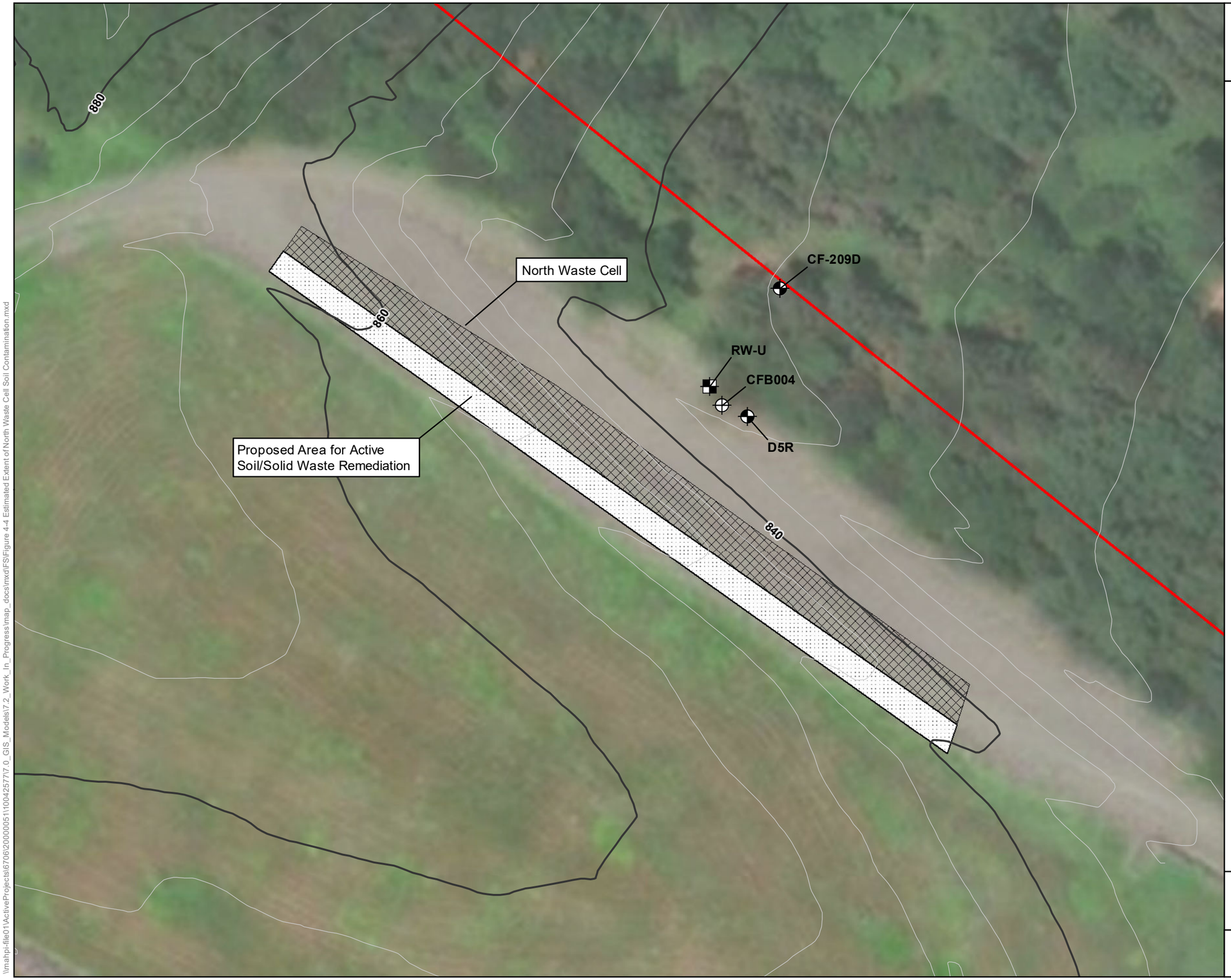
Pump test conducted in between February 2 and Feburary 27, 2017.

0 250 500 Feet

Difference in Groundwater Elevation February 2, 2017 to February 27, 2017

Figure 4-3
August, 2018

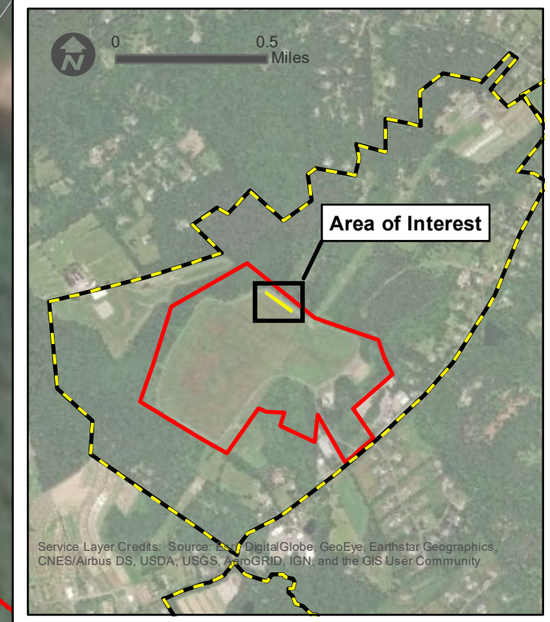
\\mahpi-file01\ActiveProjects\6706\20000051\100425777.0 GIS Models\7.2 Work In Progress\map docs\mxd\RI Figures - Finalization\FS Figure 4-3 Difference in GW Elev Feb 2017 (2).mxd



Combe Fill South Landfill Superfund Site RI/FS

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet
Projection: Transverse Mercator
Datum: North American 1983
Units: Foot US



Legend

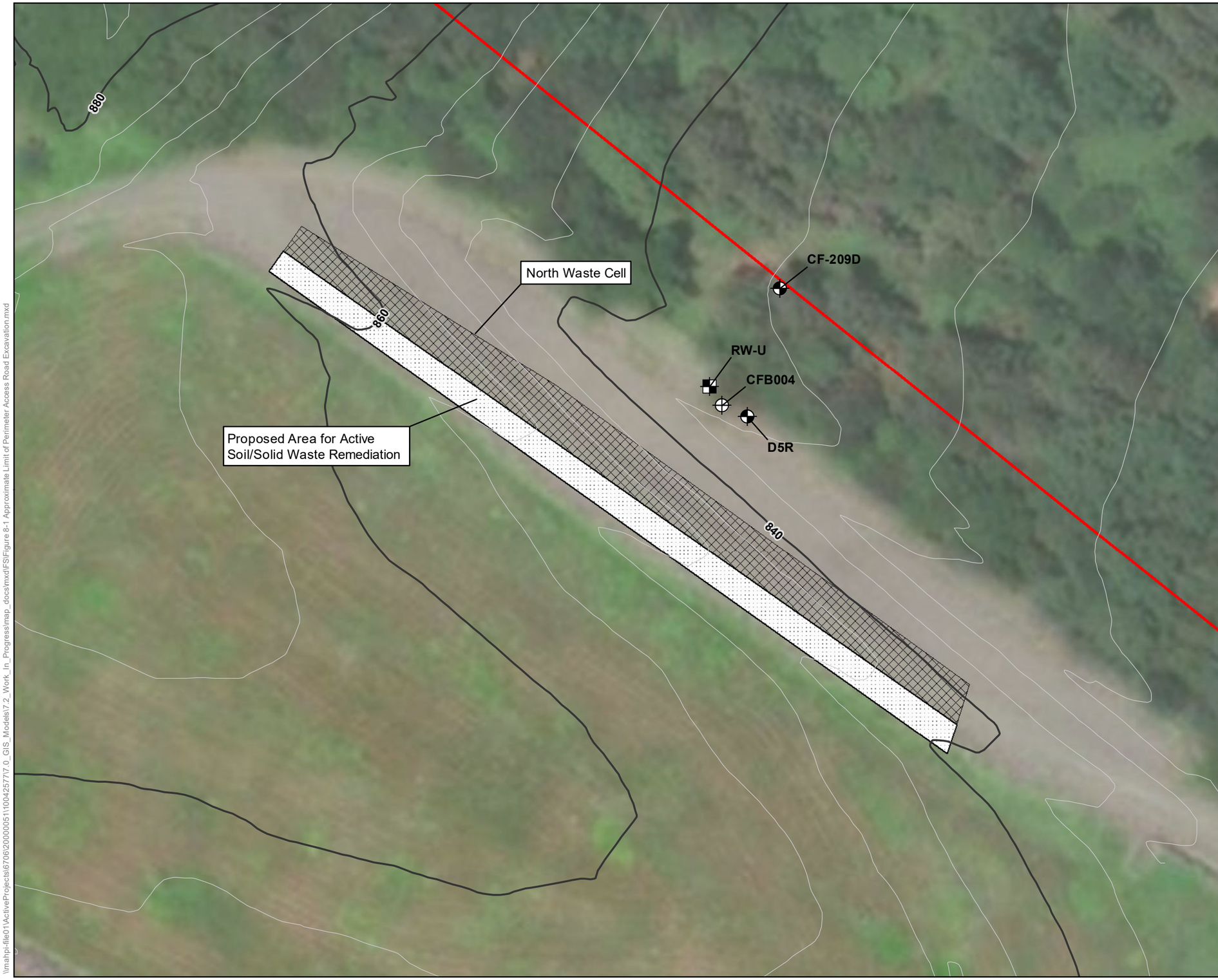
- OU1 - Landfill Property Boundary
- OU2 Investigation Area
- North Waste Cell
- Proposed Area for Soil/Solid Waste Remediation
- Monitor Well
- Soil Boring
- Recovery Well
- 5 ft Elevation Contour
- 20 ft Elevation Contour

0 25 50 Feet

Estimated Extent of North Waste Cell Soil Contamination

Figure 4-4
August, 2018

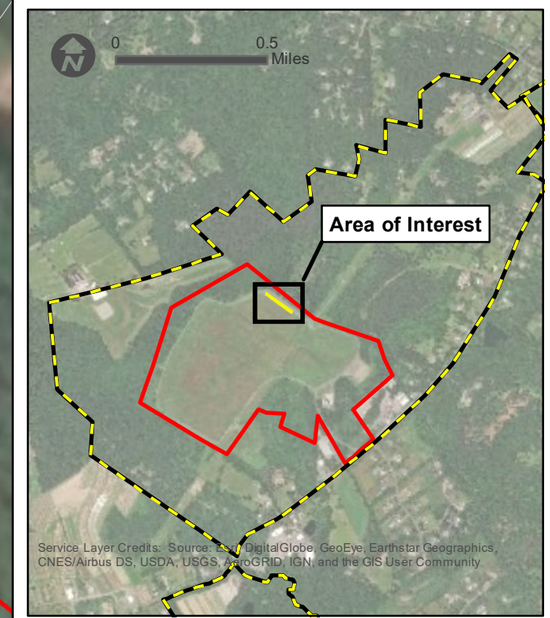
\\mahpi-file01\ActiveProjects\6706\2000000511\00425777\7.0_GIS_Models\7.2_Work_In_Progress\map_docs\mxd\FS\Figure 4-4 Estimated Extent of North Waste Cell Soil Contamination.mxd



Combe Fill South Landfill Superfund Site RI/FS

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet
Projection: Transverse Mercator
Datum: North American 1983
Units: Foot US



Legend

- OU1 - Landfill Property Boundary
- OU2 Investigation Area
- North Waste Cell
- Proposed Area for Soil/Solid Waste Remediation
- Monitor Well
- Soil Boring
- Recovery Well
- 5 ft Elevation Contour
- 20 ft Elevation Contour

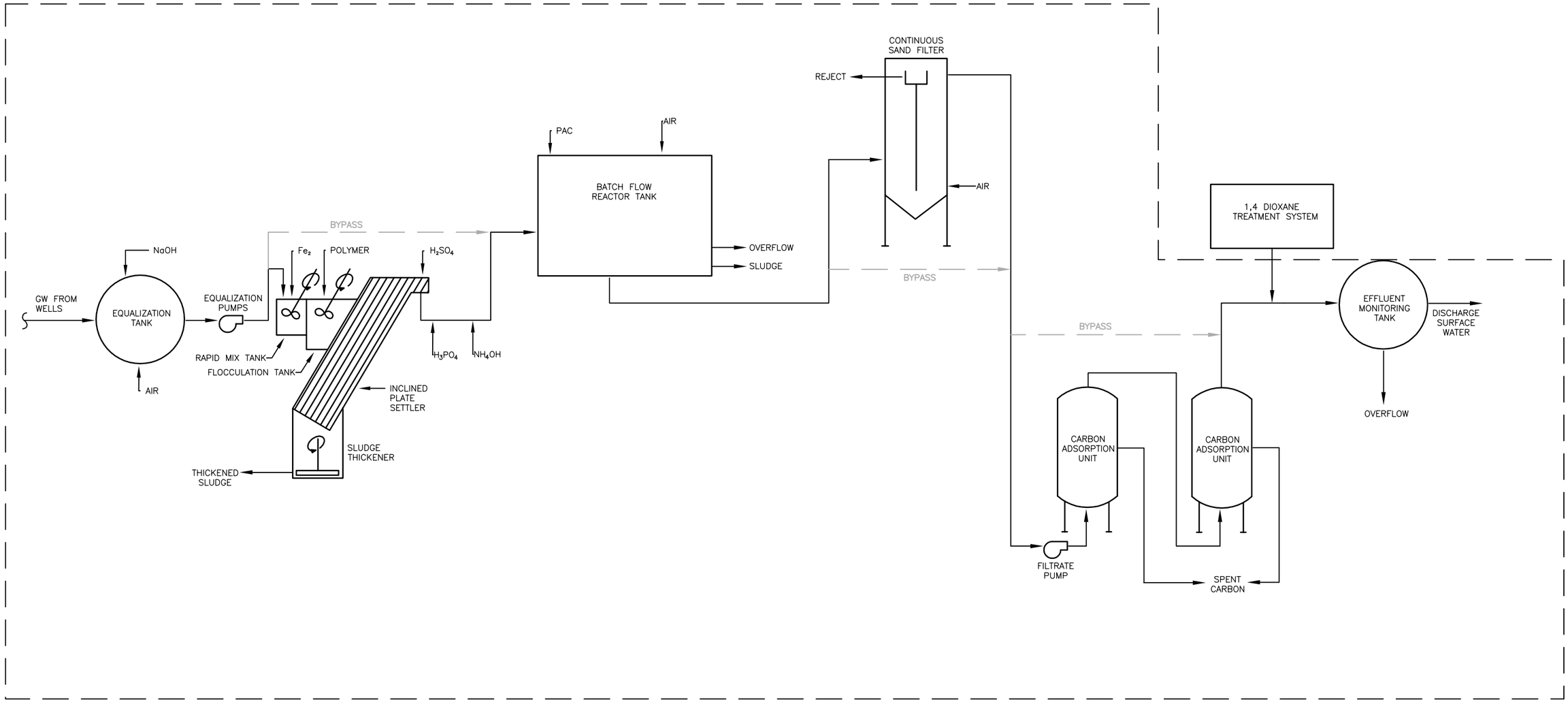
0 25 50 Feet

Approximate Limit of Perimeter Access Road Excavation

Figure 8-1
August, 2018

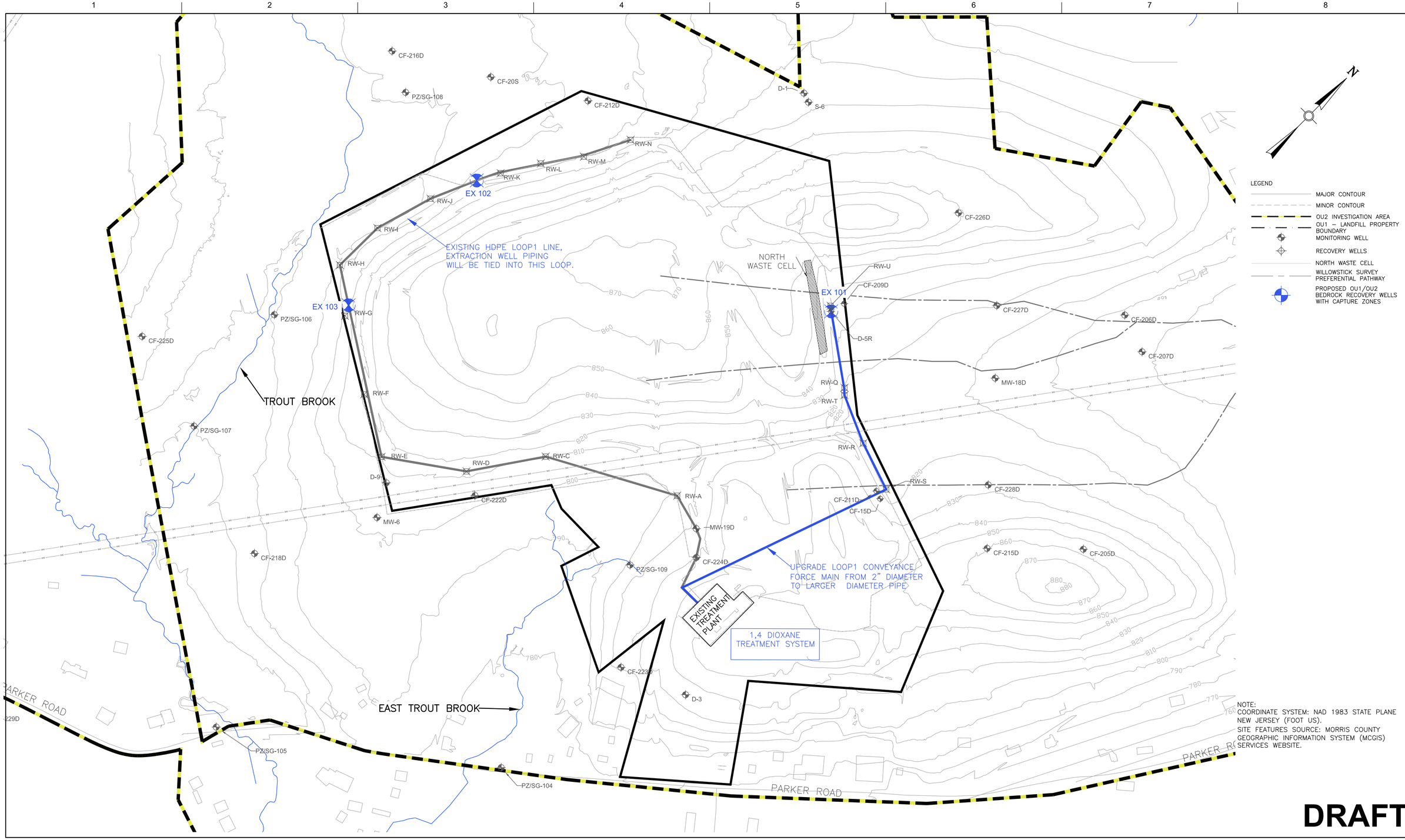
\\mahpi-file01\ActiveProjects\6706\20000051\100425777.0_GIS_Models\7.2_Work_In_Progress\map_docs\mxd\FS\Figure 8-1 Approximate Limit of Perimeter Access Road Excavation.mxd

EXISTING TREATMENT PLANT PROCESS FLOW DIAGRAM (PFD)



DRAFT

PROJECT TITLE	FEASIBILITY STUDY COMBE FILL SOUTH LANDFILL SUPERFUND SITE CHESTER & WASHINGTON TOWNSHIP MORRIS COUNTY, NEW JERSEY	PROJECT NUMBER	REFERENCE SHEET
		PROJECT MANAGER	SCALE
SHEET TITLE	GROUNDWATER EXTRACTION AND TREATMENT PROCESS FLOW DIAGRAM	DATE	FIGURE 8–3



NOTE:
COORDINATE SYSTEM: NAD 1983 STATE PLANE NEW JERSEY (FOOT US).
SITE FEATURES SOURCE: MORRIS COUNTY GEOGRAPHIC INFORMATION SYSTEM (MCGIS) SERVICES WEBSITE.

DRAFT

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	P. PARVIS
LEAD DESIGN PROF.	E. ZIMMERMAN
DESIGN ENGINEER	A. WATSON
PROJECT NUMBER	10042577

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

CONTRACT NO. EP-W-09-009
WORK ASSIGNMENT NO. 018-RICO-0256

FEASIBILITY STUDY

COMBE FILL SOUTH LANDFILL SUPERFUND SITE
CHESTER & WASHINGTON TOWNSHIP
MORRIS COUNTY, NEW JERSEY

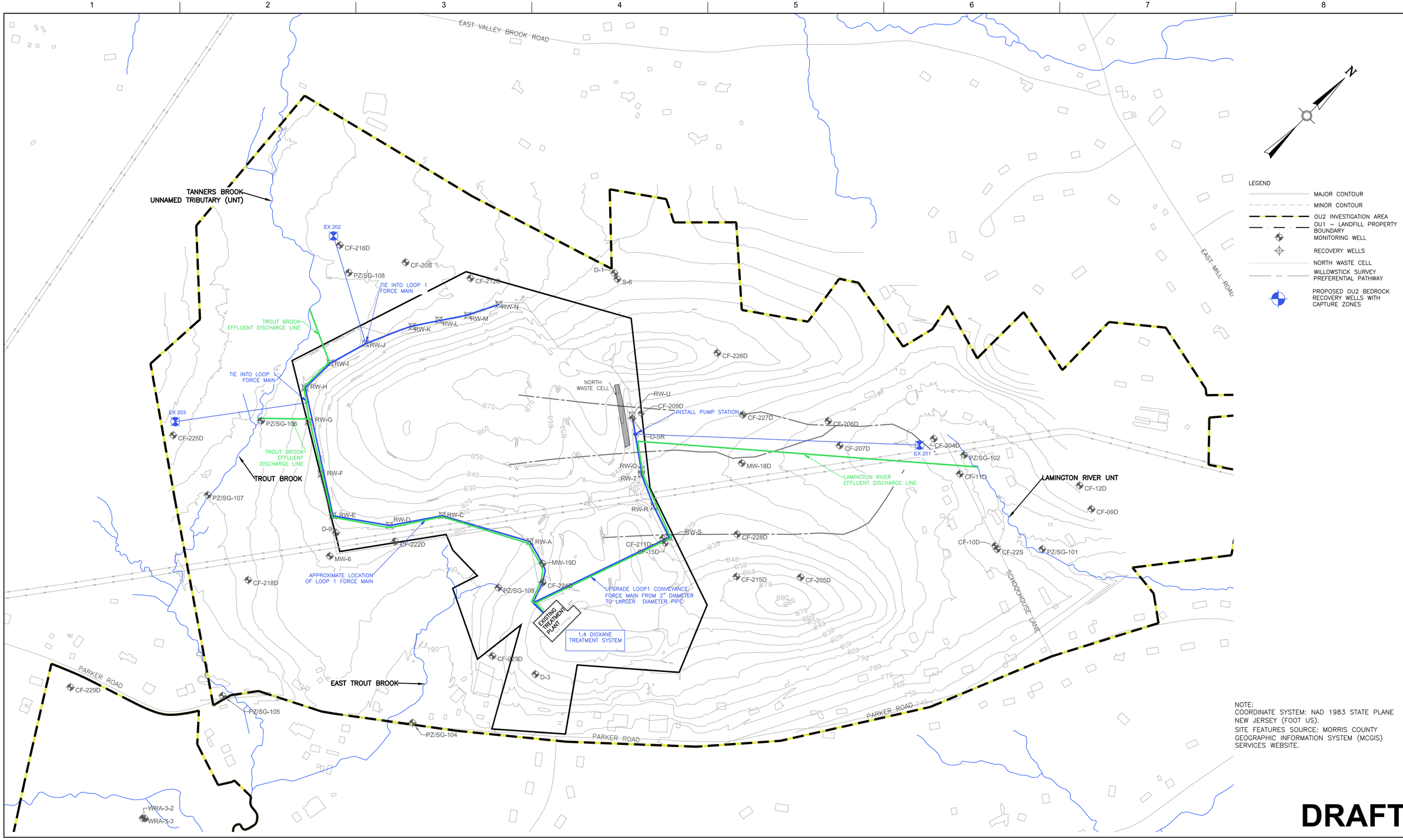
ALTERNATIVE OU1-G3 EXTRACTION AND TREATMENT

0 200 400

FILENAME

SCALE 1"=200'

SHEET 8–4



NOTE:
COORDINATE SYSTEM: NAD 1983 STATE PLANE NEW JERSEY (FOOT US).
SITE FEATURES SOURCE: MORRIS COUNTY GEOGRAPHIC INFORMATION SYSTEM (MCGIS) SERVICES WEBSITE.

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CONTRACT NO. EP-W-09-009
WORK ASSIGNMENT NO. 018-RICO-0256

FEASIBILITY STUDY

COMBE FILL SOUTH LANDFILL SUPERFUND SITE
CHESTER & WASHINGTON TOWNSHIP
MORRIS COUNTY, NEW JERSEY

ALTERNATIVE OU2-G3 EXTRACTION AND TREATMENT

0 300 600

FILENAME

SCALE 1"=300'

SHEET 8–5

APPENDIX A

Cost Estimate Backup-Summary

Summary of Total Cost of Remedial Alternatives - OU1 Groundwater

Site:	Combe Fill South (CFS)	**Base Year:**	2018
Location:	Morris County, NJ	**Date:**	August 9, 2018
Phase:	Feasibility Study (-30% - +50%)		

	Alternative OU1-G1	Alternative OU1-G2	Alternative OU1-G3
Description	**No Action**	**Upgrade OU1 GWET System, Source Area Removal with LTM/ ICs**	**Upgrade OU1 GWET System, Additional Groundwater Extraction, Source Area Removal with LTM/ ICs**
Estimated Active Project Duration (Years)	-	30	30
Estimated Long Term Monitoring (Years)	-	30	30
Capital Cost	$ -	$ 9,828,414	$ 10,457,289
Annual O&M Cost	$ -	$ 890,660	$ 920,360
Total O&M Cost	$ -	$ 11,052,300	$ 11,420,800
Periodic Cost	$ -	$ 55,503	$ 55,503
Total Present Value of Alternatives	**$ -**	**$ 20,936,217**	**$ 21,933,592**

Cost Estimate for Alternative OU1-G1

Alternative OU1-G1 - No Action

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description: **Alternative OU1-G1 consists of no action.**

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Capital Costs**					
1.1	No Capital Costs	0	LS	$ -	0	
	Sub-Total				0	
2	**Institutional Controls**					
2.1	No Institutional Controls	0	LS	$ -	0	
	Sub-Total				0	
	TOTAL CAPITAL COST				0	

ANNUAL O&M COST:

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
1	**Annual O&M Costs**					
1.1	No Annual O&M Costs	0	LS	$ -	0	
	Sub-Total				0	
2	**Maintenance**					
2.1	No Maintenance Costs	0	LS	$ -	0	
	Sub-Total				0	
	Sub-Total				0	
	Contingency	15%			0	
	Sub-Total				0	
	Project Management				0	
	Technical Support				0	

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Periodic Costs**						
1.1	No Periodic Costs		0	LS	$ -	0	
	Sub-Total					0	

PRESENT VALUE ANALYSIS: Discount Rate 7%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**		0	0	
2	**Total O&M Cost**		0	0	
3	**Periodic Costs**		0	0	
	TOTAL PRESENT VALUE OF ALTERNATIVE			0	

Cost Estimate for Alternative OU1-G2

Alternative OU1-G2 - Upgrade OU1 GWET System, Source Area removal with LTM/ ICs

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description:

Alternative OU1-G2 consists of:
-Source area removal - North Waste Cell
-Upgrade existing OU1 treatment plant and "Loop 2" piping, and operate at higher capacity;
-Ex-situ treatment for 1,4-Dioxane;
-LTM for bedrock groundwater within OU1.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Site Survey and Utility Clearance**					
1.1	Survey	1	LS	$ 15,000	$ 15,000	
1.2	Utility Clearance	1	LS	$ 15,000	$ 15,000	
	Sub-Total				**$ 30,000**	
2	**Pre-Design Investigation**					
2.1	Investigation Work Plan	1	LS	$ 75,000	$ 75,000	Sampling Plan, QAPP, HASP
2.2	Mobilization/ Demobilization	1	LS	$ 15,000	$ 15,000	Mobilize all equipment and personnel
2.3	Permits	1	LS	$ 5,000	$ 5,000	
2.4	North Waste Cell Soil Investigation	1	LS	$ 25,000	$ 25,000	To define excavation limits at North Waste Cell
2.5	Soil Sampling	15	EA	$ 20	$ 300	
2.6	Water Level Measurements	8	LS	$ 1,500	$ 12,000	
2.7	Groundwater Sampling	20	EA	$ 600	$ 12,000	Assume 20 wells for baseline
2.8	Groundwater Laboratory Analysis	48	EA	$ 500	$ 24,000	VOCs, 1,4-dioxane, metals + 20% QC samples.
2.9	Hydrogeologic Assessment-Pumping Test	1	LS	$ 50,000	$ 50,000	
2.10	Extraction Well Redevelopment	1	LS	$ 100,000	$ 100,000	
2.11	Hydrogeologic Evaluation	1	LS	$ 75,000	$ 75,000	
2.12	Statistical Analysis and Groundwater Modeling	1	LS	$ 50,000	$ 50,000	
2.13	IDW Characterization and Disposal	1	LS	$ 50,000	$ 50,000	Sleeves, decon water, misc. used items, groundwater waste from extraction well redevelopment.
2.14	PDI Report	1	LS	$ 50,000	$ 50,000	
	Sub-Total				**$ 543,300**	
3	**Site Mobilization/Demobilization**					
3.1	Remedial Action Work plan/Permitting	1	LS	$ 100,000	$ 100,000	Permit equivalents, access agreements, RAWP, Construction HASP, Subcontractor procurement
3.2	Submittals/Implementation Plans	1	LS	$ 100,000	$ 100,000	Remedial Design reports
3.3	Post Construction Submittals	1	LS	$ 50,000	$ 50,000	Bi-weekly reports, monthly progress reports
3.4	Decontamination Station	1	LS	$ 5,000	$ 5,000	
	Sub-Total				**$ 255,000**	
4	**Health and Safety**					
4.1	PPE and Field Supplies	1	LS	$ 5,000	$ 5,000	
	Sub-Total				**$ 5,000**	
5	**Site Preparation**					
5.1	Safety Fence	1,040	LF	$ 0.50	$ 520	
5.2	Stabilized construction entrance to work area	1	LS	$ 3,000	$ 3,000	
5.3	Place and Maintain E&S Controls	1	LS	$ 5,000	$ 5,000	
5.4	Soil and Waste Staging Areas	1	LS	$ 8,000	$ 8,000	
	Sub-Total				**$ 16,520**	

Cost Estimate for Alternative OU1-G2

Alternative OU1-G2 - Upgrade OU1 GWET System, Source Area removal with LTM/ ICs

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description:

Alternative OU1-G2 consists of:
-Source area removal - North Waste Cell
-Upgrade existing OU1 treatment plant and "Loop 2" piping, and operate at higher capacity;
-Ex-situ treatment for 1,4-Dioxane;
-LTM for bedrock groundwater within OU1.

Item No.		Description	Quantity	Unit	Unit Cost	Total	Notes
6		**Excavation, Off-site Disposal and Restoration**					Source area removal
	6.1	Mob of Construction Equipment	1	LS	$ 120,812	$ 120,812	Assume 10% of costs for mobilization
	6.2	Water Supply / Pressure washer	5,000	Gallons	$ 0.50	$ 2,500	Decontamination
	6.3	Soil Excavation	4,595	CY	$ 25	$ 114,885	Excavate impacted soil from North Waste Cell. Includes 20% contingency on excavation quantities.
	6.4	Transportation & Disposal (Non-haz soil)	6,433	Ton	$ 95	$ 611,135	Disposal as non-hazardous material. Includes Waste Classification sampling. No reuse of soil assumed. Non-hazardous classification is based off of the 2011 NJDEP Closeout Report.
	6.5	Lab Packs / Drum overpacking	100	EA	$ 500	$ 50,000	
	6.6	Backfill	4,600	CY	$ 28	$ 128,800	Importing certified clean fill, includes placement, hauling, compaction
	6.7	Compaction / Grading	5,000	SF	$ 3.50	$ 17,500	12" lifts, mechanical compaction, grading
	6.8	Backfill Source Sampling	3	EA	$ 750	$ 2,250	PCBs/Pesticides, VOCs, SVOCs, metals analysis, every 1,000 cy
	6.9	Post Excavation Sampling	57	EA	$ 1,150	$ 65,550	End point sampling per NJ; includes labor and analytical
	6.10	Waste Characterization Sampling	10	EA	$ 1,150	$ 11,500	includes labor and analytical
	6.11	Decon Water Storage, Characterization (for on-site treatment)	1	LS	$ 2,000	$ 2,000	
	6.12	Post-excavation Surveying	1	LS	$ 2,000	$ 2,000	
	6.13	Landfill Cap Repair	1	LS	$ 200,000	$ 200,000	Cost based on 2011 NJDEP Closeout Report.
	6.14	Surface Restoration	500	SY	$ 5	$ 2,500	
	6.15	Demobilization	1	LS	$ 54,477.90	$ 54,478	Assume 4.5% of costs for demobilization
		Sub-Total				**$ 1,385,910**	
7		**Treatment Plant Upgrades**					
	7.1	Demolition and Replacement of Existing Equipment	1	LS	$ 500,000	$ 500,000	Includes the demolition and replacement of treatment equipment as necessary to accommodate additional volume. Also includes a new structure to accommodate the additional treatment equipment.
	7.2	1,4 Dioxane Treatment System	1	LS	$ 3,000,000	$ 3,000,000	1,4-Dioxane Treatment
		Sub-Total				**$ 3,500,000**	
8		**Conveyance Piping**					Upgrade Loop 2
	8.1	Mobilization	1	LS	$ 25,000	$ 25,000	
	8.2	Soil Erosion and Sediment Control	2,200	LF	$ 3	$ 6,600	
	8.3	Trenching	15,000	CY	$ 50	$ 750,000	
	8.4	Pipe (HDPE double walled)	2,000	LF	$ 30	$ 60,000	
	8.5	Utility Marking	1	LS	$ 5,000.00	$ 5,000	
	8.6	Bedding	481	CY	$ 20	$ 9,620	
	8.7	Backfill and Compaction	3,000	SF	$ 5	$ 15,000	
	8.8	Cleanout Vaults	7	EA	$ 6,500	$ 43,333	
		Sub-Total				**$ 914,553**	

Cost Estimate for Alternative OU1-G2

Alternative OU1-G2 - Upgrade OU1 GWET System, Source Area removal with LTM/ ICs

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description:

Alternative OU1-G2 consists of:
-Source area removal - North Waste Cell
-Upgrade existing OU1 treatment plant and "Loop 2" piping, and operate at higher capacity;
-Ex-situ treatment for 1,4-Dioxane;
-LTM for bedrock groundwater within OU1.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
9	**Reporting and Institutional Controls**					
9.1	Remedial Action Report	1	LS	$ 50,000	$ 50,000	As-built, construction completion report
9.2	Institutional Controls & Site Management Plan	1	LS	$ 20,000	$ 20,000	
	Sub-Total				**$ 70,000**	
Sub-Total					**$ 6,720,283**	Sub-Total All Construction Costs.
	Contingency	25%			$ 1,680,071	15% scope + 10% bid
Sub-Total					**$ 8,400,354**	
Project Management		5%			$ 420,018	See Exhibit 5-8 of EPA/ USACE FS Cost
Remedial Design		6%			$ 504,021	Estimate Guidance Document for PM, RD, and
Construction Management		6%			$ 504,021	CM estimates.
TOTAL CAPITAL COST					**$ 9,828,414**	

ANNUAL O&M COSTS

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Operations Costs - Year 1 to 30**	1 to 30					Every year through year 30.
1.1	Utilities (Gas and Electric)		12	Month	$ 12,750.00	$ 153,000	System operates for 30 years. Costs based on actual O&M data. Escalated for 1,4-D treatment
1.2	Operator Labor		2,080	Hr.	$ 120	$ 249,600	FT Operator Cost Average. Assume N-4 oversight of N-2 and Tech support.
1.3	Chemical Usage		12	Month	$ 4,500	$ 54,000	Process chemicals for pH buffering, metals precipitation, coagulation and flocculation, and biological processes. Costs based on actual O&M data.
1.4	Treatment Plant Compliance Sampling		12	Month	$ 3,000	$ 36,000	Monthly analytical sampling. Costs based on actual O&M data.
1.5	Routine Site Maintenance		12	Month	$ 1,500	$ 18,000	Monthly maintenance items for the facility and treatment plant equipment.
1.6	1,4-dioxane Treatment O&M		12	Month	$ 4,500	$ 54,000	Assumes adsorption treatment technology. Cost includes maintenance costs for equipment and GAC disposal costs for the condensate.
1.7	Reporting		12	Month	$ 5,000	$ 60,000	Monthly reporting
	Sub-Total					**$ 624,600**	
2	**LTM - Year 1 to 30**	1 to 30					Every year through year 30.
2.1	Maintain Engineering Controls		1	LS	$ 12,000	$ 12,000	
2.2	Groundwater Sampling		40	EA	$ 600	$ 24,000	20 wells semiannually; includes labor
2.3	Groundwater Sample Laboratory Analysis		96	EA	$ 1,000	$ 96,000	Total VOCs analysis + 20% QC samples.
2.4	Data Reduction, Evaluation and Reporting		1	EA	$ 20,000	$ 20,000	
2.5	Annual Report		1	EA	$ 24,000	$ 24,000	Includes periodic report
	Sub-Total					**$ 176,000**	
	Contingency		10%			$ 80,060	
Sub-Total						**$ 880,660**	
Project Management						$ 5,000	
Technical Support						$ 5,000	
ANNUAL O&M COSTS (Year 1 to 30)						**$ 890,660**	

Cost Estimate for Alternative OU1-G2

Alternative OU1-G2 - Upgrade OU1 GWET System, Source Area removal with LTM/ ICs

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description:

Alternative OU1-G2 consists of:
-Source area removal - North Waste Cell
-Upgrade existing OU1 treatment plant and "Loop 2" piping, and operate at higher capacity;
-Ex-situ treatment for 1,4-Dioxane;
-LTM for bedrock groundwater within OU1.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Decommission System and Site Close Out**	30					At the end of Year 30
1.1	Decommission System		1	LS	$ 100,000	$ 100,000	
1.2	Monitoring Well Abandonment		150	EA	$ 1,500	$ 225,000	Drilling subcontractor, abandonment of all monitoring wells and extraction wells.
1.3	Final Closure Report		1	LS	$ 50,000	$ 50,000	
	Sub-Total					**$ 375,000**	
	Contingency		10%			$ 37,500	
	Sub-Total					**$ 412,500**	
	Project Management					$ 5,000	
	Technical Support					$ 5,000	
	PERIODIC COSTS (Year 30)					**$ 422,500**	

PRESENT VALUE ANALYSIS: Discount Rate 7%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**		$ 9,828,414	**$ 9,828,414**	
2	**Total O&M Cost**	1 to 30	$ 890,660	**$ 11,052,300**	
3	**Periodic Costs**	30	$ 422,500	**$ 55,503**	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 20,936,217**	

Cost Estimate for Alternative OU1-G3

Alternative OU1-G3 - Upgrade OU1 GWET System, Additional groundwater Extraction, Source Area Removal with LTM/ ICs

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description:

Alternative OU1-G3 consists of:
-Source area removal - North Waste Cell
-Addition of new extraction wells downgradient;
-Upgrade existing OU1 treatment plant and "Loop 2" piping, and operate at higher capacity;
-Ex-situ treatment for 1,4-Dioxane.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Site Survey and Utility Clearance**					
1.1	Survey	1	LS	$ 15,000	$ 15,000	
1.2	Utility Clearance	1	LS	$ 15,000	$ 15,000	
	Sub-Total				**$ 30,000**	
2	**Pre-Design Investigation**					
2.1	Investigation Work Plan	1	LS	$ 75,000	$ 75,000	Sampling Plan, QAPP, HASP
2.2	Mobilization/ Demobilization	1	LS	$ 15,000	$ 15,000	Mobilize all equipment and personnel
2.3	Permits	1	LS	$ 5,000	$ 5,000	
2.4	North Waste Cell Soil Investigation	1	LS	$ 25,000	$ 25,000	To define excavation limits at North Waste Cell
2.5	Soil Sampling	15	EA	$ 20	$ 300	
2.6	Groundwater Sampling	20	EA	$ 600	$ 12,000	Assume 20 wells for baseline
2.7	Groundwater Laboratory Analysis	48	EA	$ 500	$ 24,000	VOCs, 1,4-dioxane, metals
2.8	Water Level Measurements	1	LS	$ 1,500	$ 1,500	
2.9	Hydrogeologic Assessment-Pumping Test	1	LS	$ 50,000	$ 50,000	
2.10	Extraction Well Redevelopment	1	LS	$ 100,000	$ 100,000	
2.11	Hydrogeologic Evaluation	1	LS	$ 300,000	$ 300,000	
2.12	IDW Characterization and Disposal	1	LS	$ 50,000	$ 50,000	Sleeves, decon water, misc. used items, groundwater waste from extraction well redevelopment.
2.13	PDI Report	1	LS	$ 50,000	$ 50,000	
	Sub-Total				**$ 707,800**	
3	**Site Mobilization/Demobilization**					
3.1	Remedial Action Work plan/Permitting	1	LS	$ 100,000	$ 100,000	Permit equivalents, access agreements, RAWP, Construction HASP, Subcontractor procurement
3.2	Submittals/Implementation Plans	1	LS	$ 100,000	$ 100,000	Remedial Design reports
3.3	Post Construction Submittals	1	LS	$ 50,000	$ 50,000	Bi-weekly reports, monthly progress reports
3.4	Decontamination Station	1	LS	$ 5,000	$ 5,000	
	Sub-Total				**$ 255,000**	
4	**Health and Safety**					
4.1	PPE and Field Supplies	1	LS	$ 5,000	$ 5,000	
	Sub-Total				**$ 5,000**	
5	**Site Preparation**					
5.1	Safety Fence	1,040	LF	$ 0.50	$ 520	
5.2	Stabilized construction entrance to work area	1	LS	$ 3,000	$ 3,000	
5.3	Place and Maintain E&S Controls	1	LS	$ 5,000	$ 5,000	
5.4	Soil and Waste Staging Areas	1	LS	$ 8,000	$ 8,000	
5.5	Bedrock Recovery Well Location Clearing	3	EA	$ 5,000	$ 15,000	
	Sub-Total				**$ 31,520**	

Cost Estimate for Alternative OU1-G3

Alternative OU1-G3 - Upgrade OU1 GWET System, Additional groundwater Extraction, Source Area Removal with LTM/ ICs

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description:

Alternative OU1-G3 consists of:
-Source area removal - North Waste Cell
-Addition of new extraction wells downgradient;
-Upgrade existing OU1 treatment plant and "Loop 2" piping, and operate at higher capacity;
-Ex-situ treatment for 1,4-Dioxane.

Item No.		Description	Quantity	Unit	Unit Cost	Total	Notes
6		**Excavation, Off-site Disposal and Restoration**					Source area removal
	6.1	Mob of Construction Equipment	1	LS	$ 120,812	$ 120,812	
	6.2	Water Supply / Pressure washer	5,000	Gallons	$ 1	$ 2,500	Decontamination
	6.3	Soil Excavation	4,595	CY	$ 25	$ 114,885	Excavate impacted soil from North Waste Cell. Includes 20% contingency on excavation quantities.
	6.4	Transportation & Disposal (Non-haz soil)	6,433	Ton	$ 95	$ 611,135	Disposal as non-hazardous material. Includes Waste Classification sampling. No reuse of soil assumed.
	6.5	Backfill	4,600	CY	$ 28	$ 128,800	Importing certified clean fill, includes placement, hauling, compaction
	6.6	Compaction / Grading	5,000	SF	$ 4	$ 17,500	12" lifts, mechanical compaction, grading
	6.7	Backfill Source Sampling	3	EA	$ 750	$ 2,250	PCBs/Pesticides, VOCs, SVOCs, metals analysis, every 1,000 cy
	6.8	Post Excavation Sampling	57	EA	$ 1,150	$ 65,550	End point sampling per NJ; includes labor and analytical
	6.9	Waste Characterization Sampling	10	EA	$ 1,150	$ 11,500	includes labor and analytical
	6.10	Decon Water Storage, Characterization (for on-site treatment)	1	LS	$ 2,000	$ 2,000	
	6.11	Post-excavation Surveying	1	LS	$ 2,000	$ 2,000	
	6.12	Landfill Cap Repair	1	LS	$ 200,000	$ 200,000	Cost based on 2011 NJDEP Closeout Report.
	6.13	Surface Restoration	500	SY	$ 5	$ 2,500	
	6.14	Demobilization	1	LS	$ 54,478	$ 54,478	
		Sub-Total				**$ 1,335,910**	
7		**Treatment Plant Upgrades**					
	7.1	Demolition and Replacement of Existing Equipment	1	LS	$ 500,000	$ 500,000	Includes the demolition and replacement of treatment equipment as necessary to accommodate additional volume. Also includes a new structure to accommodate the additional treatment equipment.
	7.2	1,4 Dioxane Treatment System	1	LS	$ 3,000,000	$ 3,000,000	1,4-Dioxane Treatment
		Sub-Total				**$ 3,500,000**	

Cost Estimate for Alternative OU1-G3

Alternative OU1-G3 - Upgrade OU1 GWET System, Additional groundwater Extraction, Source Area Removal with LTM/ ICs

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description:

Alternative OU1-G3 consists of:
-Source area removal - North Waste Cell
-Addition of new extraction wells downgradient;
-Upgrade existing OU1 treatment plant and "Loop 2" piping, and operate at higher capacity;
-Ex-situ treatment for 1,4-Dioxane.

Item No.		Description	Quantity	Unit	Unit Cost	Total	Notes
8		**New Extraction Well Drilling**					
	8.1	Mobilization/ Demobilization	1	LS	$ 50,000	$ 50,000	
	8.2	Per Diem (Per working crew day)	30	Crew-day	$ 750	$ 22,500	Estimate 10 days per well
	8.3	Standby	8	HR	$ 450	$ 3,600	
	8.4	Grouting Open Boreholes	300	LF	$ 15	$ 4,500	
	8.5	Bedrock Drilling	1,050	LF	$ 73	$ 76,650	Assume 350 ft. bgs wells
	8.6	Borehole Geophysics	3	EA	$ 4,500	$ 13,500	Estimate $4,500 per well, including reporting.
	8.7	Packer Testing	24	HR	$ 550	$ 13,200	Estimate $550 per hour and 8 hours per borehole.
	8.8	Steel Casing	300	LF	$ 49	$ 14,700	Assume casing goes to 100 ft. bgs for each well
	8.9	Extraction Well Vault	3	EA	$ 5,000	$ 15,000	
	8.10	Connect to Conveyance Force Mains	3	EA	$ 5,000	$ 15,000	
	8.11	Borehole/ Well Development	30	HR	$ 375	$ 11,250	
	8.12	Dual Packer Testing	24	HR	$ 525	$ 12,600	
	8.13	Site Access, Set-up, Breakdown and Restoration	1	LS	$ 20,000	$ 20,000	
	8.14	IDW Drums	100	EA	$ 100	$ 10,000	
	8.15	Manage IDW	30	HR	$ 350	$ 10,500	
	8.16	Decontamination	30	HR	$ 250	$ 7,500	
		Sub-Total				**$ 300,500**	
9		**Conveyance Piping**					Upgrade Loop 2
	9.1	Mobilization	1	LS	$ 25,000	$ 25,000	
	9.2	Soil Erosion and Sediment Control	2,200	LF	$ 3	$ 6,600	
	9.3	Trenching	15,000	CY	$ 50	$ 750,000	
	9.4	Pipe (HDPE double walled)	2,000	LF	$ 30	$ 60,000	
	9.5	Utility Marking Tape	1	LF	$ 5,000.00	$ 5,000	
	9.6	Bedding	481	CY	$ 20	$ 9,620	
	9.7	Backfill and Compaction	3,000	SF	$ 5	$ 15,000	
	9.8	Vaults and Junctions	7	EA	$ 6,500	$ 43,333	
		Sub-Total				**$ 914,553**	
10		**Reporting and Institutional Controls**					
	10.1	Remedial Action Report	1	LS	$ 50,000	$ 50,000	As-built, construction completion report
	10.2	Institutional Controls & Site Management Plan	1	LS	$ 20,000	$ 20,000	
		Sub-Total				**$ 70,000**	
		Sub-Total				**$ 7,150,283**	Sub-Total All Construction Costs.
		Contingency	25%			$ 1,787,571	15% scope + 10% bid
		Sub-Total				**$ 8,937,854**	
		Project Management	5%			$ 446,893	See Exhibit 5-8 of EPA/ USACE FS Cost Estimate
		Remedial Design	6%			$ 536,271	Guidance Document for PM, RD, and CM
		Construction Management	6%			$ 536,271	estimates.
		TOTAL CAPITAL COST				**$ 10,457,289**	

Cost Estimate for Alternative OU1-G3

Alternative OU1-G3 - Upgrade OU1 GWET System, Additional groundwater Extraction, Source Area Removal with LTM/ ICs

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description:

Alternative OU1-G3 consists of:
-Source area removal - North Waste Cell
-Addition of new extraction wells downgradient;
-Upgrade existing OU1 treatment plant and "Loop 2" piping, and operate at higher capacity;
-Ex-situ treatment for 1,4-Dioxane.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes

ANNUAL O&M COSTS

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Operations Costs - Year 1 to 30**	1 to 30					System operates for 30 years. Costs based on actual O&M data. Escalated for 1,4-D treatment.
1.1	Utilities (Gas and Electric)		12	Month	$ 15,000.00	$ 180,000	Additional electrical costs for new bedrock extraction wells.
1.2	Operator Labor		2,080	Hr.	$ 120.00	$ 249,600	FT Operator Cost Average. Assume N-4 oversight of N-2 and Tech support.
1.3	Chemical Usage		12	Month	$ 4,500.00	$ 54,000	Process chemicals for pH buffering, metals precipitation, coagulation and flocculation, and biological processes. Costs based on actual O&M data.
1.4	Treatment Plant Compliance Sampling		12	Month	$ 3,000.00	$ 36,000	Monthly analytical sampling. Costs based on actual O&M data.
1.5	Routine Site Maintenance		12	Month	$ 1,500.00	$ 18,000	Monthly maintenance items for the facility and treatment plant equipment.
1.6	1,4-dioxane Treatment O&M		12	Month	$ 4,500	$ 54,000	Assumes adsorption treatment technology. Cost includes maintenance costs for equipment and GAC disposal costs for the condensate.
1.7	Reporting		12	Month	$ 5,000.00	$ 60,000	Monthly reporting
	Sub-Total					**$ 651,600**	

Cost Estimate for Alternative OU1-G3

Alternative OU1-G3 - Upgrade OU1 GWET System, Additional groundwater Extraction, Source Area Removal with LTM/ ICs

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description:

Alternative OU1-G3 consists of:
-Source area removal - North Waste Cell
-Addition of new extraction wells downgradient;
-Upgrade existing OU1 treatment plant and "Loop 2" piping, and operate at higher capacity;
-Ex-situ treatment for 1,4-Dioxane.

Item No.	Description		Quantity	Unit	Unit Cost	Total	Notes
2	**LTM - Year 1 to 30**	1 to 30					Every year through year 30.
2.1	Maintain Institutional Controls		1	LS	$ 12,000	$ 12,000	
2.2	Groundwater Sampling		40	EA	$ 600	$ 24,000	40 wells annually; includes labor
2.3	Groundwater Sample Laboratory Analysis		96	EA	$ 1,000	$ 96,000	Total VOCs analysis + 20% QC samples.
2.4	Data Reduction, Evaluation and Reporting		1	EA	$ 20,000	$ 20,000	
2.5	Annual Report		1	EA	$ 24,000	$ 24,000	Includes periodic report
	Sub-Total					**$ 176,000**	
	Contingency		10%			$ 82,760	
	Sub-Total					**$ 910,360**	
	Project Management					$ 5,000	
	Technical Support					$ 5,000	
	ANNUAL O&M COSTS (Year 1 to 30)					**$ 920,360**	

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Decommission System and Site Close Out**	30					At the end of Year 30
1.1	Decommission System		1	LS	$ 100,000	$ 100,000	
1.2	Monitoring Well Abandonment		150	EA	$ 1,500	$ 225,000	Drilling subcontractor, abandonment of all monitoring wells and old and new extraction wells
1.3	Final Closure Report		1	LS	$ 50,000	$ 50,000	
	Sub-Total					**$ 375,000**	
	Contingency		10%			$ 37,500	
	Sub-Total					**$ 412,500**	
	Project Management					$ 5,000	
	Technical Support					$ 5,000	
	PERIODIC COSTS (Year 30)					**$ 422,500**	

PRESENT VALUE ANALYSIS: Discount Rate 7%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**		$ 10,457,289	**$ 10,457,289**	
2	**Total O&M Cost**	1 to 30	$ 920,360	**$11,420,800**	
3	**Periodic Costs**	30	$ 422,500	**$55,503**	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 21,933,592**	

Summary of Total Cost of Remedial Alternatives - OU2 Groundwater

Site:	Combe Fill South (CFS)	**Base Year:**	2018
Location:	Morris County, NJ	**Date:**	August 9, 2018
Phase:	Feasibility Study (-30% - +50%)		

	Alternative OU2-G1	Alternative OU2-G2	Alternative OU2-G3
Description	**No Action**	**LTM/ ICs**	**Extraction and Treatment of OU2 Groundwater/ LTMs/ ICs**
Estimated Active Project Duration (Years)	-	10	10
Estimated Long Term Monitoring (Years)	-	10	10
Capital Cost	$ -	$ -	$ 9,056,339
Annual O&M Cost	$ -	$ 111,200	$ 246,060
Total O&M Cost	$ -	$ 781,100	$ 1,728,300
Periodic Cost	$ -	$ -	$ -
Total Present Value of Alternatives	**$ -**	**$ 781,100**	**$ 10,784,639**

Cost Estimate for Alternative OU2-G1

Alternative OU2-G1
No Action

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description: Alternative OU2-G1 consists of no action.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Capital Costs**					
1.1	No Capital Costs	0	LS	$ -	0	
	Sub-Total				0	
2	**Institutional Controls**					
2.1	No Institutional Controls	0	LS	$ -	0	
	Sub-Total				0	
	TOTAL CAPITAL COST				0	

ANNUAL O&M COST:

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
1	**Annual O&M Costs**					
1.1	No Annual O&M Costs	0	LS	$ -	0	
	Sub-Total				0	
2	**Maintenance**					
2.1	No Maintenance Costs	0	LS	$ -	0	
	Sub-Total				0	
	Sub-Total				0	
	Contingency	15%			0	
	Sub-Total				0	
	Project Management				0	
	Technical Support				0	

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Periodic Costs**						
1.1	No Periodic Costs		0	LS	$ -	0	
	Sub-Total					0	

PRESENT VALUE ANALYSIS: Discount Rate 7% 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**		0	0	
2	**Annual O&M Cost**		0	0	
3	**Periodic Costs**		0	0	
	TOTAL PRESENT VALUE OF ALTERNATIVE			0	

Cost Estimate for Alternative OU2-G2- 5 Years

Alternative OU2-G2 - LTM/ ICs

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description: **Alternative OU2-G2 consists of:**
-Active remedy at OU1
-LTM/ ICs at OU2 for 10 years

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						There are no capital costs associated with this alternative.
1	**Site Survey and Utility Clearance**					
1.1	Survey	0	LS	$ 15,000	$ -	
1.2	Utility Clearance	0	LS	$ 15,000	$ -	
	Sub-Total				**$ -**	
2	**Pre-Design Investigation**					
2.1	Investigation Work Plan	0	LS	$ 75,000	$ -	
2.2	Groundwater Sampling	0	EA	$ 600	$ -	
2.3	Laboratory Analysis	0	EA	$ 500	$ -	
2.4	Water Level Measurements	0	EA	$ 1,500	$ -	
2.5	Data Reduction	0	EA	$ 5,000	$ -	
2.6	Statistical Analysis and Groundwater Model	0	LS	$ 50,000	$ -	
2.7	PDI Report	0	LS	$ 50,000	$ -	
		0			**$ -**	
3	**Site Mobilization/Demobilization**					
3.1	Remedial Action Work plan	0	LS	$ 100,000	$ -	
3.2	Submittals/Implementation Plans	0	LS	$ 100,000	$ -	
	Sub-Total				**$ -**	
4	**Health and Safety**					
4.1	PPE and Field Supplies	0	LS	$ 5,000	$ -	
	Sub-Total				**$ -**	
5	**Reporting and Institutional Controls**					
5.1	Remedial Action Report	0	LS	$ 50,000	$ -	
5.2	Institutional Controls & Site Management Plan	0	LS	$ 20,000	$ -	
	Sub-Total				**$ -**	
	Sub-Total				**$ -**	
	Contingency	25%			$ -	
	Sub-Total				**$ -**	
	Project Management	6%			$ -	
	Remedial Design	12%			$ -	
	Construction Management	8%			$ -	
	TOTAL CAPITAL COST				**$ -**	

Cost Estimate for Alternative OU2-G2- 5 Years

Alternative OU2-G2 - LTM/ ICs

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description: **Alternative OU2-G2 consists of:**
-Active remedy at OU1
-LTM/ ICs at OU2 for 10 years

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes

ANNUAL O&M COSTS

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**LTM - Year 1 to 10**	1 to 10					
1.1	Maintain Institutional Controls		1	LS	$ 12,000	$ 12,000	
1.2	Groundwater Sampling		12	EA	$ 600	$ 7,200	Assume 6 MW/ FLUTe well locations semiannually; includes labor.
1.3	Groundwater Sample Laboratory Analysis		29	EA	$ 1,000	$ 28,800	VOCs, 1,4-dioxane, metals (12 samples + 20% QC).
1.4	Data Reduction, Evaluation and Reporting		1	EA	$ 20,000	$ 20,000	
1.5	Annual Reports		1	EA	$ 24,000	$ 24,000	Includes periodic report
	Sub-Total					**$ 92,000**	
	Contingency		10%			$ 9,200	
Sub-Total						**$ 101,200**	
Project Management						$ 5,000	
Technical Support						$ 5,000	
ANNUAL O&M COSTS (Year 1 to 10)						**$ 111,200**	

PERIODIC COSTS:

No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Decommission System and Site Close Out**	10					Covered under OU1
1.1	Monitoring Well Abandonment		0	EA	$ 1,500	$ -	
1.2	Final Closure Report		0	LS	$ 50,000	$ -	
	Sub-Total					**$ -**	
	Contingency		10%			$ -	
Sub-Total						**$ -**	
Project Management						$ -	
Technical Support						$ -	
PERIODIC COSTS (Year 10)						**$ -**	

PRESENT VALUE ANALYSIS: Discount Rate 7%

No.	Cost Type	Year	Total Cost	Value	Notes
1	**Capital Cost**		$ -	**$ -**	
2	**Annual O&M Cost**	1 to 10	$111,200	**$781,100**	
3	**Periodic Costs**	10	$ -	**$0**	These costs are captured in the OU1 remedy.
TOTAL PRESENT VALUE OF ALTERNATIVE				**$ 781,100**	

Cost Estimate for Alternative OU2-G3

Alternative OU2-G3 - Extraction and Treatment of OU2 Groundwater/ LTMs/ ICs

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description:

Alternative OU2-G3 consists of:
-Installation of three new extraction wells at OU2;
-Connect to upgraded OU1 treatment plant; and
-Ex-situ treatment for 1,4-Dioxane.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Site Survey and Utility Clearance**					
1.1	Survey	1	LS	$ 15,000	$ 15,000	
1.2	Utility Clearance	1	LS	$ 15,000	$ 15,000	
	Sub-Total				**$ 30,000**	
2	**Pre-Design Investigation**					
2.1	Investigation Work Plan	1	LS	$ 75,000	$ 75,000	Sampling Plan, QAPP, HASP
2.2	Mobilization/ Demobilization	1	LS	$ 15,000	$ 15,000	Mobilize all equipment and personnel
2.3	Groundwater Sampling	20	EA	$ 600	$ 12,000	Assume 20 wells for baseline
2.4	Groundwater Laboratory Analysis	1	EA	$ 500	$ 500	VOCs, 1,4-dioxane, metals + 20% QC samples.
2.5	Water Level Measurements	1	LS	$ 1,500	$ 1,500	
2.6	Hydrogeologic Assessment-Pumping Test	5	EA	$ 15,000	$ 75,000	
2.7	Hydraulic/ Hydrogeologic/ Geophysical Evaluation	1	LS	$ 300,000	$ 300,000	Evaluation to characterize the south west portion of the Site and to evaluate the hydraulic impacts from the proposed extraction wells.
2.8	IDW Characterization and Disposal	1	LS	$ 50,000	$ 50,000	Sleeves, decon water, misc. used items, groundwater waste from sampling
2.9	PDI Report	1	LS	$ 50,000	$ 50,000	
					$ 579,000	
3	**Site Mobilization/Demobilization**					
3.1	Remedial Action Work plan/Permitting	1	LS	$ 100,000	$ 100,000	Permit equivalents, access agreements, RAWP, Construction HASP, Subcontractor procurement
3.2	Submittals/Implementation Plans	1	LS	$ 100,000	$ 100,000	Remedial Design reports
3.3	Post Construction Submittals	1	LS	$ 50,000	$ 50,000	Bi-weekly reports, monthly progress reports
3.4	Decontamination Station	1	LS	$ 5,000	$ 5,000	
	Sub-Total				**$ 255,000**	
4	**Health and Safety**					
4.1	PPE and Field Supplies	1	LS	$ 5,000	$ 5,000	
	Sub-Total				**$ 5,000**	
5	**Site Preparation**					
5.1	Temporary Security Fence	1,000	LF	$ 30	$ 30,000	
	Sub-Total				**$ 30,000**	
6	**Treatment Plant Upgrades**					
6.1	Upgrades to the existing OU1 GWET System	1	LS	$ 100,000	$ 100,000	Upgrade the existing OU1 GWET System to accept water from OU2 recovery wells. This cost assumes that the treatment plant will have already been upgraded by a new OU1 remedy proposed in the FS.
	Sub-Total				**$ 100,000**	

Cost Estimate for Alternative OU2-G3

Alternative OU2-G3 - Extraction and Treatment of OU2 Groundwater/ LTMs/ ICs

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description:

Alternative OU2-G3 consists of:
-Installation of three new extraction wells at OU2;
-Connect to upgraded OU1 treatment plant; and
-Ex-situ treatment for 1,4-Dioxane.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
7	**New Extraction Well Drilling**					Assumes three new extraction wells to 350 feet bgs.
7.1	Mobilization/ Demobilization	1	LS	$ 50,000	$ 50,000	
7.2	Per Diem (Per working crew day)	30	Crew-day	$ 750	$ 22,500	Estimate 10 days per well
7.3	Standby	8	HR	$ 450	$ 3,600	
7.4	Site Preparation	3	EA	$ 5,000	$ 15,000	Clearing drilling locations
7.5	Permits	1	LS	$ 5,000	$ 5,000	
7.6	Borehole Geophysics	3	EA	$ 4,500	$ 13,500	Estimate $4500 per well, including reporting
7.7	Packer Testing	24	EA	$ 550	$ 13,200	Estimate $550 per hour for 8 hrs. per borehole
7.8	Grouting Open Boreholes	300	LF	$ 15	$ 4,500	
7.9	Bedrock Drilling	1,050	LF	$ 73	$ 76,650	Assume each well is 350 ft. bgs
7.10	Steel Casing	300	LF	$ 49	$ 14,700	Assume casing goes to 100 ft. bgs for each well
7.11	Extraction Well Vault	3	EA	$ 5,000	$ 15,000	
7.12	Borehole/ Well Development	30	HR	$ 375	$ 11,250	
7.13	Dual Packer Testing	24	HR	$ 525	$ 12,600	
7.14	Site Access, Set-up, Breakdown and Restoration	1	LS	$ 20,000	$ 20,000	
7.15	IDW Drums	100	EA	$ 100	$ 10,000	
7.16	Manage IDW	30	HR	$ 350	$ 10,500	
7.17	Decon	30	HR	$ 250	$ 7,500	
	Sub-Total				**$ 305,500**	
8	**Extraction Well Pumps**					
8.1	Extraction Well Pump	3	EA	$ 25,000	$ 75,000	
8.2	Electrical Wiring	3	EA	$ 8,500	$ 25,500	
8.3	PLC Upgrade	1	LS	$ 25,000	$ 25,000	
					$ 125,500	
9	**Conveyance Piping**					Connect to OU1 treatment plant
9.1	Mobilization	1	LS	$ 25,000	$ 25,000	
9.2	Soil Erosion and Sediment Control	10,495	LF	$ 3	$ 31,485	
9.3	Trenching	78,713	CY	$ 50	$ 3,935,625	
9.4	Pipe (HDPE double walled)	5,145	LF	$ 30	$ 154,350	Recovery wells tie into existing conveyance lines
9.5	Pipe (HDPE)	5,350	LF	$ 15	$ 80,250	Treatment plant to stream discharge locations
9.6	Utility Marking	1	LS	$ 5,000.00	$ 5,000	
9.7	Bedding	2,524	CY	$ 20	$ 50,481	
9.8	Backfill and Compaction	15,743	SF	$ 5	$ 78,713	
9.9	Vaults and Junctions	35	EA	$ 6,500	$ 227,392	
	Sub-Total				**$ 4,588,295**	
10	**Reporting and Institutional Controls**					
10.1	Remedial Action Report	1	LS	$ 50,000	$ 50,000	As-built, construction completion report
10.2	Institutional Controls & Site Management Plan	1	LS	$ 20,000	$ 20,000	
	Sub-Total				**$ 70,000**	
	Sub-Total				**$ 6,088,295**	Sub-Total All Construction Costs.
	Contingency	25%			$ 1,522,074	15% scope + 10% bid
	Sub-Total				**$ 7,610,369**	
	Project Management	5%			$ 380,518	See Exhibit 5-8 of EPA/ USACE FS Cost
	Remedial Design	8%			$ 608,830	Estimate Guidance Document for PM, RD, and
	Construction Management	6%			$ 456,622	CM estimates.
	TOTAL CAPITAL COST				**$ 9,056,339**	

Cost Estimate for Alternative OU2-G3

Alternative OU2-G3 - Extraction and Treatment of OU2 Groundwater/ LTMs/ ICs

COST ESTIMATE SUMMARY

Site: Combe Fill South (CFS)
Location: Morris County, NJ
Phase: Feasibility Study (-30% - +50%)
Base Year: 2018
Date: August 9, 2018

Description:

Alternative OU2-G3 consists of:
-Installation of three new extraction wells at OU2;
-Connect to upgraded OU1 treatment plant; and
-Ex-situ treatment for 1,4-Dioxane.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes

ANNUAL O&M COSTS

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Operations Costs - Year 1 to 10**	1 to 10					Every year through year 10.
1.1	Electrical Usage		490,000	KW-Hr	$ 0.24	$ 117,600	OU2 Extraction Well electric. Assume 3, 25 hp well pumps.
1.2	Extraction Well Maintenance Costs		1	LS	$ 5,000	$ 5,000	Annual maintenance costs associated with OU2 extraction wells.
	Sub-Total					**$ 122,600**	
2	**LTM - Year 1 to 10**	1 to 10					
2.1	Maintain Institutional Controls		1	LS	$ 12,000	$ 12,000	
2.2	Groundwater Sampling		12	EA	$ 600	$ 7,200	
2.3	Groundwater Sample Laboratory Analysis		29	EA	$ 1,000	$ 28,800	
2.4	Data Reduction, Evaluation and Reporting		1	EA	$ 20,000	$ 20,000	
2.5	Annual Report		1	EA	$ 24,000	$ 24,000	
	Sub-Total					**$ 92,000**	
	Contingency		10%			$ 21,460	
	Sub-Total					**$ 236,060**	
	Project Management					$ 5,000	
	Technical Support					$ 5,000	
	ANNUAL O&M COSTS (Year 1 to 10)					**$ 246,060**	

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Decommission System and Site Close Out**	10					Covered under OU1
1.1	Monitoring Well Abandonment		0	EA	$ 1,500	$ -	
1.2	Final Closure Report		0	LS	$ 50,000	$ -	
	Sub-Total					**$ -**	
	Contingency		10%			$ -	
	Sub-Total					**$ -**	
	Project Management					$ -	
	Technical Support					$ -	
	PERIODIC COSTS (Year 10)					**$ -**	

PRESENT VALUE ANALYSIS: Rate of Return: 7%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**		$ 9,056,339	**$ 9,056,339**	
2	**Annual O&M Cost**	1 to 10	$ 246,060	**$1,728,300**	
3	**Periodic Costs**	10	$ -	**$0**	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 10,784,639**	

APPENDIX B

CF-209D Hydrogeologic Assessment Technical Memorandum

Technical Memorandum

To: Pamela Baxter, RPM/EPA R2

From: Patricia Parvis, PM/HDR

Date: June 9, 2017

Subject: 018-RICO-0256 Combe Fill South OU-2 RI/FS
CF-209D Hydrogeologic Assessment

Executive Summary

Henningson Durham and Richardson Architecture and Engineering, P.C. in association with HDR Engineering, Inc. (HDR), was retained by the Environmental Protection Agency (EPA) to perform the Operable Unit 2 (OU-2) Remedial Investigation/Feasibility Study (RI/ FS) at Combe Fill South Landfill (the Site). A hydrogeologic assessment of the deep bedrock aquifer (hereafter referred to as deep aquifer) in the area surrounding the former north waste cell was outlined in the Amended October 2016 Work Plan under Work Assignment No. 018-RICO-0256 of Contract No. EP-W-09-009.

This technical memorandum (TM) provides a summary of the field activities and results from the monitoring well CF-209D hydrogeologic assessment that took place at the Site from January to April, 2017. The objectives of the hydrogeologic assessment were to gain a better understanding of the chemical and hydraulic properties of the deep aquifer in the area surrounding the former north waste cell; a source area containing the highest concentrations of 1,4-dioxane in groundwater emanating from the Site. These objectives were achieved by collecting groundwater samples before, during, and after pumping well CF-209D, and monitoring the water level responses in the pumping well and an on- and off-site network of monitoring and recovery wells.

The results of the hydrogeologic assessment suggest the existence of preferential flow paths oriented in a southwest to northeast direction, supporting the conclusions of the 2013 Willowstick® electromagnetic survey. Groundwater drawdown in the deep aquifer wells monitored during the pumping test showed an area of influence extending up to 3,000 feet northeast and southwest (parallel to the overhead, high voltage electrical transmission lines) and at least 500 feet east-southeast and west-northwest (perpendicular to the transmission lines). The analytical groundwater data reported 1,4-dioxane concentrations ranging from 29 to 350 µg/L, which exceeds the interim New Jersey Groundwater Quality Criteria (GWQC) of 0.4 µg/L. These results will better inform the hydraulic capture component of the remedial alternatives presented in the FS Report.

In addition to this TM, HDR submitted biweekly reports nos. 74 to 79 outlining the field activities covered during those reporting periods, and three trip reports summarizing the sampling activities that were conducted under the CLP Case Numbers 46712 and 46775.

CF-209D Hydrogeologic Assessment

The hydrogeologic assessment was conducted in a series of steps that included the following:

- Collecting one final round of groundwater samples from all 4 Water FLUTe™ ports at CF-209D prior to well modification for the pumping test;
- Modifying CF-209D from a 700 foot deep multi-port FLUTe™ well to a 356 foot deep open rock well (borehole) for the aquifer pumping test; and upon completion of the pumping test, to a traditional 2” PVC monitoring well screened from 150 to 160 feet below ground surface (bgs);
- Long term water level monitoring with pressure transducers installed at select monitoring wells and recovery wells (Figure 1), to record background, pumping, and recovery conditions;

- A month long aquifer pumping test at CF-209D which included a step drawdown test and a constant rate test of approximately 70 gallons per minute (gpm); and
- Low-flow groundwater sampling from modified well CF-209D two weeks after completion and development as a 2" PVC monitoring well.

HDR retained B&B Drilling, Inc. (B&B), a New Jersey licensed driller, to support the hydrogeologic assessment by performing the modifications to CF-209D and providing support for the aquifer testing by temporarily installing test pumps and installing approximately 1500 feet of discharge conveyance. The conveyance consisted of 3-inch diameter heat welded HDPE piping from the CF-209D pumping well to a force main cleanout on the opposite side of the landfill tied into an 8-inch diameter force main that is a component of the on-site groundwater treatment facility (GWTF).

CF-209D FLUTE™ Sampling

Prior to modifying the previously existing Water FLUTe™ multi-port sampling system known as well CF-209D, a final round of groundwater sampling was conducted on January 12, 2017 from all 4 of the sampling ports. The groundwater data served as a baseline and was used, in part, to determine the final traditional well screen depth once the pumping test was complete. The complete analytical results are presented in Appendix A of this TM. Table 1 presents the 1,4-dioxane results from each Water FLUTe™ sample port.

Table 1: 1,4-dioxane results, January 12, 2017

Sample Port (screen interval, feet bgs)	1,4-dioxane results, µg/L
1 (150 – 160)	350
2 (227 – 237)	130
3 (295 – 305)	130
4 (335 – 345)	40

The January 2017 results from the 4 ports were among some of the highest 1,4-dioxane concentrations reported during the OU-2 RI. Port 1 had the highest 1,4-dioxane concentration at 350 µg/L, which is almost three orders of magnitude above the interim GWQC of 0.4 µg/L.

Monitoring Well CF-209D Modification

The Water FLUTe™ multi-port sampling system was removed from CF-209D on January 23 and 24, 2017. This involved pumping approximately 650 gallons of potable water from inside the liner and inverting the liner and network of tubing to remove the system from the borehole. The open borehole was then back-grouted from its drilled depth of 700 feet to a new temporary depth of 356 feet bgs from January 25 through 27, 2017. The borehole was back-grouted in accordance with NJAC 7.9D-2.9 using a Portland neat cement-water mixture installed via the pressure method through a tremie pipe.

CF-209D Aquifer Pumping Testing

HDR conducted a month long aquifer pumping test to gain a better understanding of the hydraulic properties within the bedrock fracture network and the area surrounding the former north waste cell. Testing was completed in four stages:

- Background monitoring;
- Short-term step drawdown test;
- Long-term constant rate test; and

- Recovery monitoring.

Background Monitoring

Pressure transducers[1] were installed in twelve monitoring and recovery wells between January 20 and January 27, 2017. The background monitoring concluded on January 31, 2017. The purpose of background monitoring was to monitor for water level trends that may affect the aquifer pumping tests. In-Situ™ pressure transducers were set to collect measurements at one minute intervals. The background water level data from these wells was reviewed to inform the pumping tests and determine if there were any short or long-term water level trends within the areas surrounding the former north waste cell. Hydrographs are presented in Appendix B. Table 2 lists the wells and their distance to pumping test well CF-209D. Electronic files of the data collected during the background monitoring, aquifer pumping tests, and recovery periods are located on a compact disk in Appendix C. GWTF recovery wells RW-R, RW-T, and RW-U were in operation during the background monitoring period. During background monitoring, monitoring well PZ-21R was directly influenced by recovery well RW-U pumping cycles; monitoring wells CF-11D and CF-226D showed slightly decreasing water level trends; monitoring well D6 water levels remained at a constant elevation; and monitoring wells CF-15D, CF-205D, CF-224D, MW-18D and MW-19 all showed increasing water level trends. There was trace precipitation with no measurable effects during background monitoring.

Step Drawdown Test

A step drawdown test was conducted on February 1, 2017 to determine the flow rate of the long-term constant rate test. A 20-horse power (hp) Goulds-brand submersible pump, installed at 295 feet bgs, was used to lift water through a 2-inch galvanized steel riser to the well head. Two 1-inch HDPE stilling tubes were also installed; one instrumented with a 100 psi In-Situ™ Level Troll pressure transducer and the other for measuring manual water levels. The driller constructed an approximately 20 foot long piping manifold at the well head, consisting of a pressure gauge, shut-off valve, electronic flow meter with totalizer, sample port, by-pass valve, flow control ball valve, and connection to the 3-inch diameter HDPE piping for conveyance to the GWTF's force main. The force main discharges directly to the GWTF. A 45 KW generator was used to power the pump during the step drawdown test.

Four 90-minute steps were conducted: 30 gpm, 50 gpm, 70 gpm, and 90 gpm. Test well CF-209D was instrumented with a 100 psi In-Situ™ Level Troll pressure transducer. Drawdown of the deep aquifer was monitored by taking manual and pressure transducer water level measurements from the test well and pressure transducer measurements from observation wells using 30 psi In-Situ™ Level Trolls. The manual water level measurements were obtained from CF-209D with a Solinst® electronic water level indicator. Hydrographs were generated by plotting water levels against time for the test well as well as the observation wells (Appendix B). A review of the CF-209D background monitoring data, step test and recovery monitoring hydrographs, as well as the pump curve for the 7.5 hp submersible pump for the long-term constant rate test, confirmed that a flow rate of 70 gpm would be sustainable for the long-term constant rate test. The GWTF's current operating capacity is approximately 70 gpm[2]. Step drawdown test influence was observed at monitoring wells PZ-21R, D6, CF-26D and MW-18D, and recovery well RW-U.

Long-Term Constant Rate Test

Following completion of the step-drawdown test, the 20-hp submersible pump was replaced by a hard wired 7.5-hp submersible pump suitable for the long-term constant rate test. The pump was installed at 250 feet bgs and pumped at 70 gpm for 25 days starting on February 2, 2017. Aquifer drawdown was monitored in test well CF-209D, and a network of 12 monitoring and recovery wells using In-Situ™ Level Troll pressure transducers as previously described.

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[1] 30 psi In-Situ™ Level Trolls

[2] The GWTF has a design capacity of 120 gpm; however, the current long-term operational capacity is approximately 70 gpm.

Climatological data for the test period were obtained from Somerset Airport approximately 10 miles from the Site. The average temperature and total precipitation during the long-term constant rate test were 37°F and 1.55 inches, respectively. The daily temperature and precipitation readings are presented in Appendix B.

The GWTF lost electric power during a storm event for a period of approximately six hours from February 12, 2017 into February 13, 2017. The pump shut off because of the power outage and pumping resumed at the pre-set 70 gpm immediately after power was restored.

The long-term constant rate test was completed on February 27, 2017. The pumping rate was maintained at an average of 70 gpm, and a total of 2,463,000 gallons of groundwater were removed. Short Term Water Use Report Forms BWA-003 and BWA-004 were submitted to NJDEP to satisfy the conditions of the Short Term Water Use Permit-by-Rule for diversion of more than 100,000 gallons of groundwater per day for less than 31 days. Recovery monitoring of water levels continued until March 2, 2017, at which time the pump was removed from CF-209D and a PVC monitoring well constructed within the open borehole.

Monitoring wells PZ-21R, D6 and CR-11D, and recovery well RW-U, were directly influenced by the long-term constant rate pumping of test well CF-209D. Monitoring well CF-226D was directly influenced by pumping CF-209D (step drawdown test and long term constant rate test); however, at approximately 22,000 minutes (15 days) into the long term constant rate test, groundwater levels began recovering for several days, unrelated to precipitation events. Groundwater levels at CF-226D then stabilized for the last few days of the constant rate test (with a short duration spike attributed to a precipitation event) and then began to recover again at the end of the constant rate pumping. Groundwater elevations at monitoring wells CF-205D and MW-18D remained fairly stable during the long term constant rate test. However, MW-18D showed an increasing water level trend during background monitoring and being influenced by the step drawdown test, and a sharp recovery trend at the end of the constant rate test. Monitoring wells CF-15D, CF-224D, MW-19D, and recovery wells RW-R and RW-T showed increasing water level trends during the constant rate test.

Recovery Monitoring

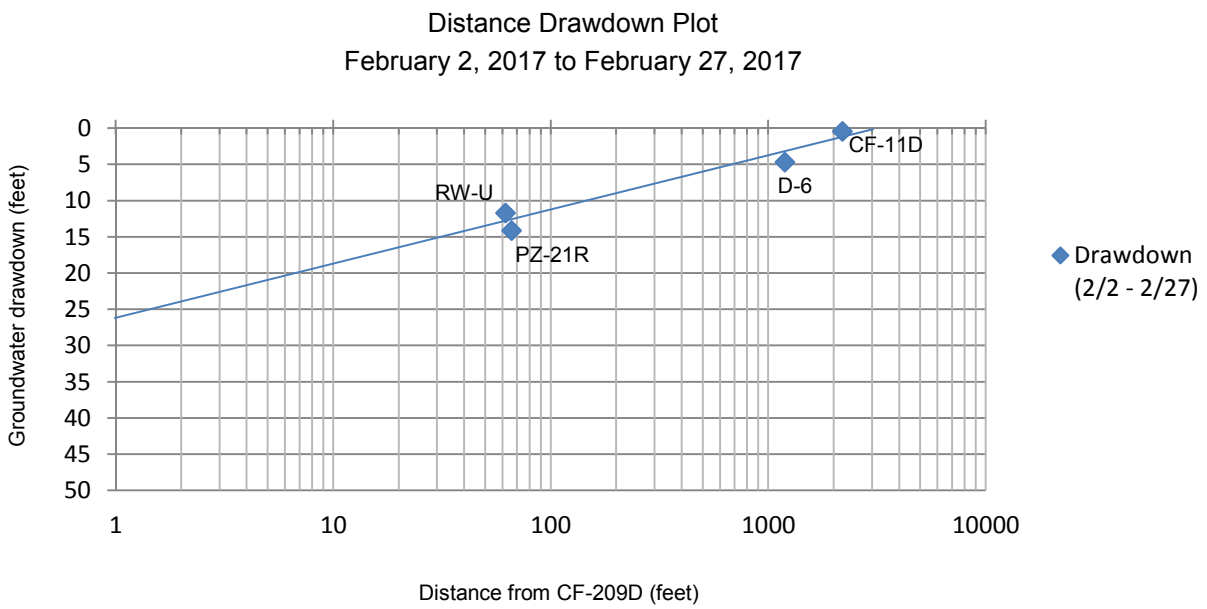
At the end of the long-term constant rate test, the pump was turned off and monitoring well water levels continued to be recorded electronically at a one minute intervals. The water level in test well CF-209D recovered to 90 percent of the pre-pumped level within the first 20 minutes of recovery monitoring. The recovery monitoring period for all wells was from February 27 to March 6, 2017. The recovery test data were used to confirm the drawdown data and any influence from other pumping or regional trends. Recovery well RW-R was returned to service for the GWTF approximately 80 minutes after the recovery monitoring started. Recovery wells RW-T and RW-U were returned to service approximately two days (45 hours) and three days (84 hours) respectively, after recovery monitoring began. Influences from recovery well pumping during the recovery monitoring period can be seen at several monitoring wells (Appendix B).

Aquifer Pumping Test Results

Manual water level measurements (Table 2) were used to generate groundwater contour maps for both the shallow aquifer wells (overburden and saprolite wells generally screened less than 100 feet bgs) and deep aquifer wells (wells where the screens are set in competent bedrock, generally screened greater than 100 feet). The groundwater level measurements used to generate the contour maps were measured on February 24, 2017 towards the end of the long-term constant rate pumping test. The contour maps are presented on Figures 2 and 3. Figure 4 illustrates the differences in groundwater elevations on Site from the beginning to the end of the long-term constant rate test (February 2 to 27, 2017).

Shallow aquifer monitoring wells were not affected by the long term pumping of CF-209D, and in some cases, exhibited increasing water level trends likely influenced by the pumping of recovery wells RW-R, RW-T, and RW-U for the GWTF prior to initiation of the aquifer pumping test, along with seasonal groundwater recharge. Deep aquifer monitoring wells located in a southwest to northeast orientation relative to the location of CF-209D and the former north waste cell, exhibited the greatest amount of drawdown from pumping CF-209D; strongly suggesting that there are preferential zones of higher hydraulic conductivity (i.e., fractures, bedding planes, contacts) oriented in this same direction. This concurs with previous findings of the orientation of preferential flow paths including the results of the 2013 Willowstick® electromagnetic survey which located three significant preferential flow paths from the former north waste cell to Schoolhouse Lane.

A semi-logarithmic plot of distance versus drawdown was generated from drawdown measurements calculated over the duration of the long-term constant rate pumping test (presented below). The plot depicts drawdown at monitoring wells D-6, PZ-21R, and CF-11D, and recovery well RW-U, verses distance from pumping well CF-209D. A best fit line extends through the data points to intersect both the X and Y-axes. Extension of the best fit line to zero on the X-axis shows the maximum influence of the long-term constant rate pumping test to be 3,000 feet from CF-209D. However, as shown on Figures 3 and 4, the influence is elongated predominantly in a southwest to northeast orientation.



CF-209D Well Completion and Development

After the long-term pumping test ended, B&B removed the test pump and completed borehole CF-209D as a 2-inch diameter PVC monitoring well. The monitoring well installation occurred during the period March 2 to March 8, 2017. The well was screened from 150 to 160 feet bgs with a three foot sump from 160 to 163 feet bgs. The annular space of the screen was filled with well gravel (Morie #1 sand) to three feet above the screen. Two feet of very fine sand (Morie #00) was installed above the well gravel to seal the filter pack. Grout (Portland cement-bentonite mixture) was installed above the #00 sand to 0.5 feet bgs. The monitoring well was completed as a stick-up and protected with a steel casing.

The monitoring well was developed on March 10, 2017 by a combination of surging and air lifting to remove fine grained sediments in the vicinity of the well screen. The monitoring well was developed for two hours and thirty minutes with approximately 475 gallons of groundwater removed from the well during development. Water quality parameters were analyzed using a Horiba U-52 multi-parameter meter. The

turbidity readings during well development ranged from a high of 29.9 Nephelometric Turbidity Units (NTUs) to a low of 13.3 NTUs. At the start of well development, the pH was observed at 12.19 and decreased to 8.95 at the end of the development. The elevated pH observed at the start of the development was likely a result of the Portland cement (pH 12-13) that was used to complete the monitoring well.

CF-209D Sampling (Post Construction)

On March 24, 2017, HDR collected a groundwater sample from CF-209D in accordance with the low-flow purging and sampling method using a QED Sample Pro® Teflon™ bladder pump. Water quality parameters were collected using a New Jersey laboratory-certified Horiba U-52 multi-parameter meter and the sample was sent to a CLP laboratory for analysis. 1,4-dioxane was reported at a concentration of 29 µg/L, which is lower than the Port 1[3] FLUTe sample results in January of 350 µg/L. Additional sampling and analysis would be required to determine if there is contaminant rebound at CF-209D, or if through the course of the pumping test activities, the bulk of the contaminant mass was extracted. The full analytical results are included in Appendix A.

CF-209D Hydrogeologic Assessment Conclusions

- In general, shallow aquifer monitoring wells were not affected by the long term pumping of CF-209D, and in some cases, had an increasing water level trend likely influenced by the pumping of recovery wells RW-R, RW-T, and RW-U for the GWTF prior to initiation of the aquifer pumping test, along with seasonal groundwater recharge.
- Existing operational GWTF recovery wells influence groundwater elevations in overburden and saprolite wells.
- Deep aquifer monitoring wells located in a southwest to northeast orientation relative to the location of CF-209D and the former north waste cell, exhibited the greatest drawdown from pumping CF-209D, strongly suggesting that there are preferential zones of higher hydraulic conductivity (i.e., fractures, bedding planes, contacts) oriented in this same direction. This concurs with previous findings of the orientation of preferential flow paths including the results of the 2013 Willowstick® electromagnetic survey, which located three significant preferential flow paths from the former north waste cell to Schoolhouse Lane.
- Groundwater drawdown in the deep aquifer wells during pumping of CF-209D exhibited an area of influence extending up to 3,000 feet northeast and southwest (parallel to the overhead high voltage electric transmission lines) and at least 500 feet east-southeast and west-northwest (perpendicular to the transmission lines). This is consistent with the results of the 2011 long-term pumping test of recovery well RW-T conducted between September 2010 and March 2011 by Handex Consulting and Remediation, LLC. (HCR) on behalf of NJDEP. The 2010 to 2011 pumping test resulted in a drawdown of up to 10 feet at distances of 630 feet to the northeast, and 750 feet to the southwest of RW-T. Perpendicular to this orientation, 10 feet of drawdown extended only 200 feet to both the northwest and southeast of RW-T.
- The highest January 2017 1,4-dioxane concentration of 350 µg/L from 150 to 160 feet bgs (former FLUTe™ Port 1) dropped by an order of magnitude to 29 µg/L at the same depth bgs after the extraction of 2,463,000 gallons of groundwater during the aquifer pumping test. It remains to be determined if the aquifer pumping test removed a considerable mass of 1,4-dioxane or if concentrations will continue to rebound after the last sampling event.

[3] FLUTe Port 1 was screened from 150 – 160 feet bgs, which is the same depth interval as the new CF-209D screened interval.

Attachments:

Tables

Table 2 – Monitoring Well Information (Screen Intervals, Manual Water Levels, Distance from CF-209D, Test Drawdown)

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Figure 1 – Hydrogeologic Assesment Site Plan

Figure 2 – 2/24/2017 Shallow Well Potentiometric Surface Map

Figure 3 – 2/24/2017 Deep Well Potentiometric Surface Map

Figure 4 – Difference in Groundwater Elevation

Appendices

Appendix A – Analytical Summary Data

Appendix B – Hydrographs

Appendix C – Electronic Data

References:

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HDR 2017a. Henningson, Durham and Richardson Architecture and Engineering, P.C. HDR Biweekly Reports 74 – 79. January – April, 2017

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HDR 2017d. Henningson, Durham and Richardson Architecture and Engineering, P.C. Complete Sampling Trip Report CLP Case No. 46775. March 27, 2017

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TABLE 2 - Monitoring Well Information

Well ID	Manual Watter Levels							Survey Data				Transducer Water Levels		
	Well Screen	1/19/2017	1/20/2017	1/25/2017	1/27/2017	2/6/2017	2/24/2017	Distance from CF-209D	Surface Elevation	TOC Elevation	GWE - 2/24/17	Start of Test DTW 2/2/17@13:50	End of Test DTW- 2/27/17@ 7:35	Drawdown
Overburden and Shallow Bedrock Wells - < 100 ft. bgs														
CF-222D-P1	92 - 96						86.12	1867.8	805.6	806.34	720			
MW-18D	76 - 143		26.4		26.72	26.16	26.63	756	807.5	809.62	783	25.576	25.682	-0.1
PZ-21R	45 - 95		52.83		50.75	55.69	62.51	65.6	837.19	837.19	775	52.806	65.544	-12.7
RW-U	39 - 89	52.2				52.94	57.74	61.9	835.49	835.49	778	48.362	60.002	-11.6
RW-T	65 - 115	68.8				34.71	33.81	396.3	818	819.25	785	34.763	32.548	2.2
MW-19D	80 - 107	32.38			31.55	32	30.16	1208.8	815.3	814.91	785	30.174	29.161	1.0
RW-R	11 - 51	47.8				26.18	24.73	652.3	817	817	792	30.684	24.294	6.4
MW-14	66 - 90						30.14	614	814	816.23	786			
MW-15	55 - 79						33.34	814.9	818	821	788			
MW-9	9 - 29						30.28	745.6	816	818.05	788			
MW-13	70 - 82						34.05	419.2	815	817.56	784			
MW-12	47 - 68						44.80	213.8	824	825.9	781			
MW-11	15 - 35						36.49	467.3	822	824.88	788			
MW-D5R	50 - 125	49.05						67.6						
D-1	89 - 147	38.57						962.3						
Deep Bedrock Wells - > 100 ft. bgs														
CF-226D	105 - 200		48.28		37.82	41.05	41.91	657.5	869.01	869.32	827	39.036	41.607	-2.6
CF-205D	150 - 160		83.35		82.03	81.27	80.81	1539	856.4	856.95	776	80.459	79.074	1.4
CF-224D	145 - 160	40.22	39.31			38.54	38.14	1318.6	818.9	819.51	781	38.588	38.011	0.6
CF-222D-P2	134 - 139						79.23	1867.8	805.6	806.34	727			
CF-222D-P3	165 - 170						79.27	1867.8	805.6	806.34	727			
CF-209D					39.13	132.9	136.29	0	834.6	834.78	698	52.475	136.545	-84.1
CF-11D	145 - 170		6.09		5.11	6.23	6.17	2193.2	772.61	772.23	766	5.758	6.163	-0.4
CF-15D	165 - 190	37.79			37.57	36.97	36.73	890.9	821	823.08	786	37.089	36.603	0.5
D-6	110 - 175			88.02	88.00	90.69	92.49	1194	870.09	872.32	780	87.997	92.695	-4.7

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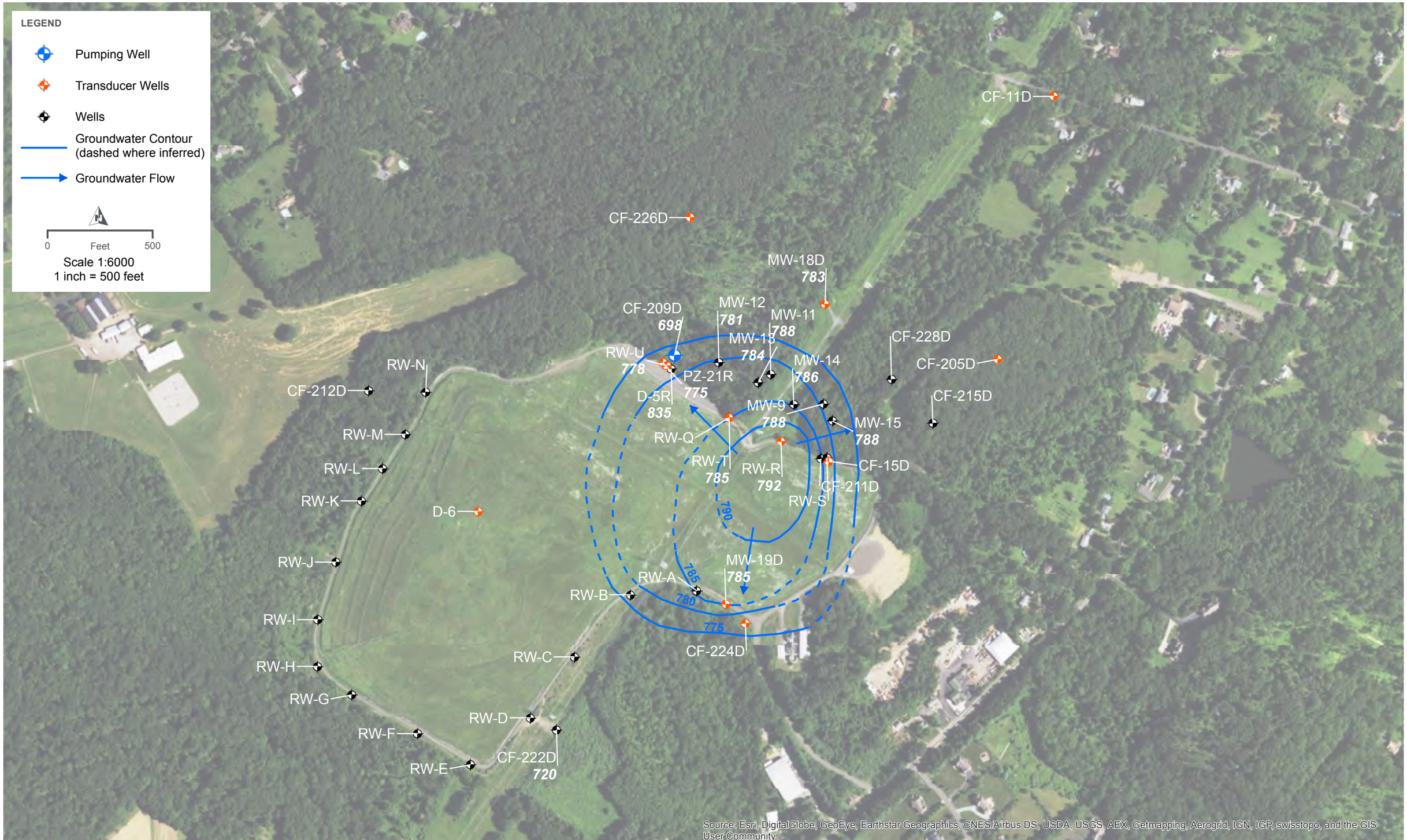
HYDROGEOLOGIC ASSESSMENT

COMBE FILL

FIGURE 1

PATH: G:\443005_USEPA REGION 2\0134975_EPAR2-018RICO0256-COMB FILL\GIS\MAP_DOCS\MXD\2017_HYDROGEOASSESSMENT\2017_HYDROGEOASSESSMENT_BASEMAP.MXD - USER: HROSADO - DATE: 4/11/2017



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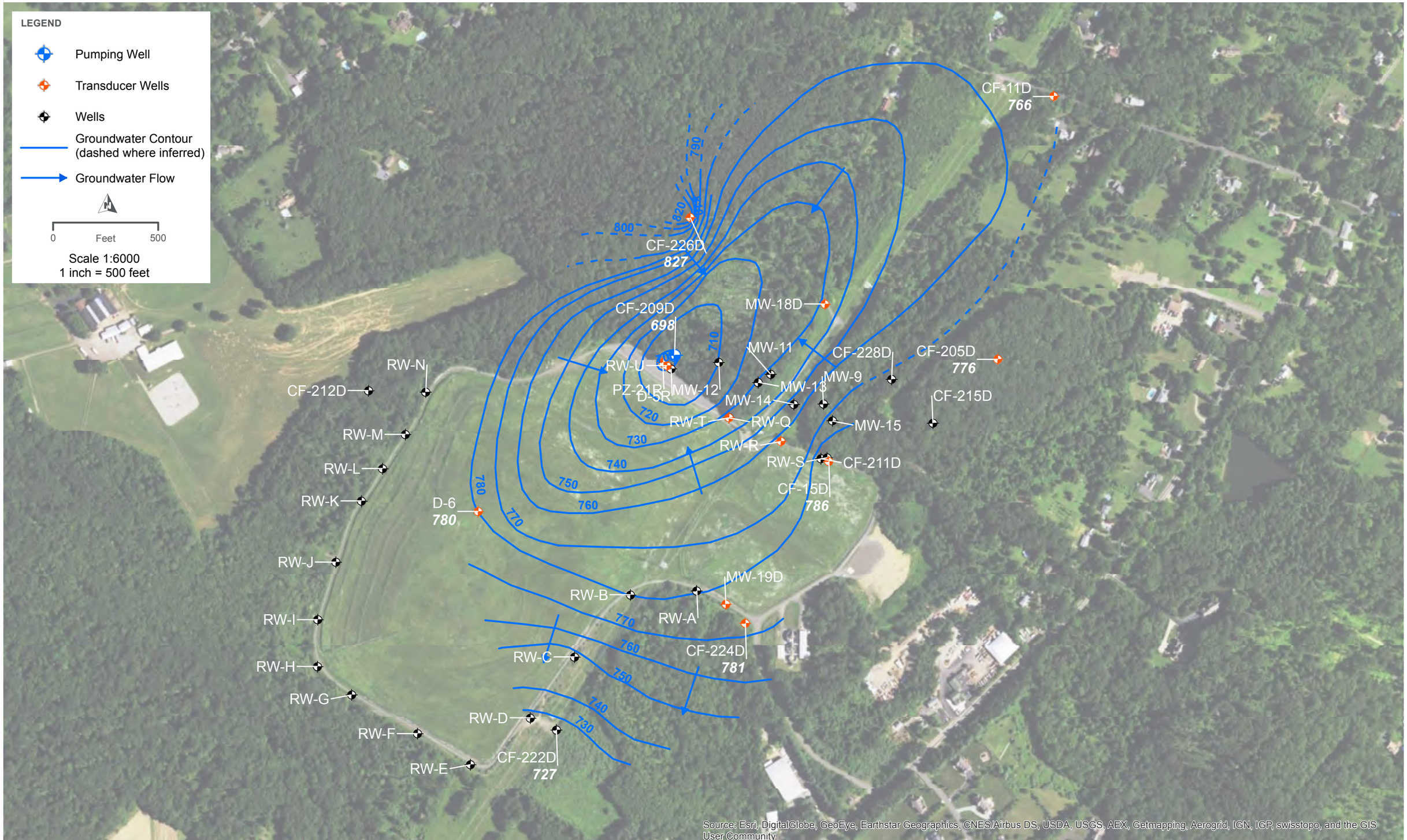
GROUNDWATER CONTOUR - 2/24/17

OVERBURDEN AND SHALLOW BEDROCK WELLS (WELL SCREEN ≤ 100')

FIGURE 2

COMBE FILL

PATH: G:\443005_USEPA REGION 2\0134975_EPAR2-018RICO0256-COMB FILL\GIS\MAP_DOCS\MXD\2017_HYDROGEOASSESSMENT\GROUNDWATERCONTOUR_SHALLOWWELLS_20170501.MXD - USER: HROSADO - DATE: 5/8/2017



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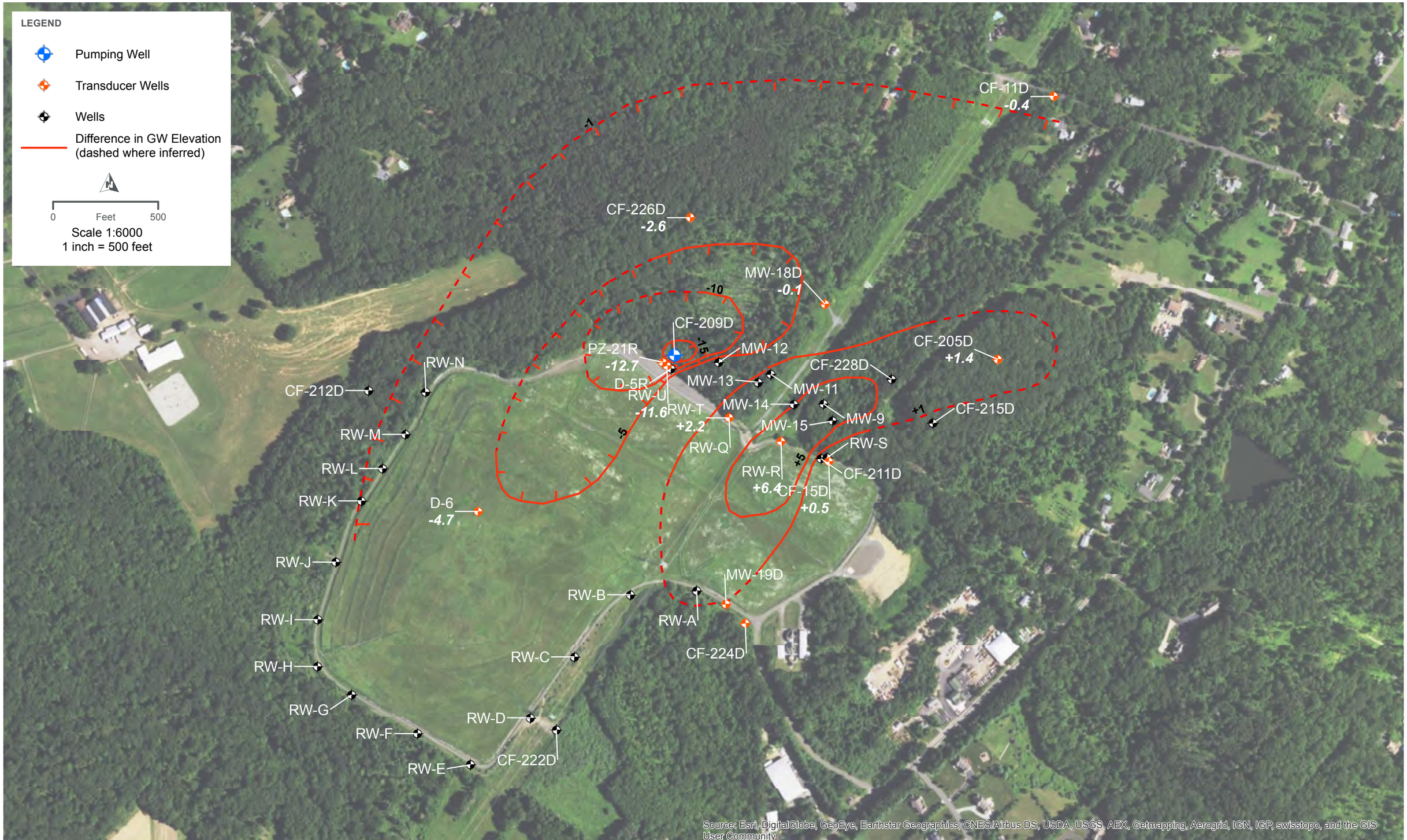
GROUNDWATER CONTOURS - 2/24/17

DEEP BEDROCK WELLS (WELL SCREEN > 100')

FIGURE 3

COMBE FILL

PATH: G:\443005_USEPA REGION 2\0134975_EPAR2-018RICO0256-COMB FILL\GIS\MAP_DOCS\MXD\2017_HYDROGEOASSESSMENT\GROUNDWATERCONTOUR_DEEPWELLS_20170501.MXD - USER: HROSADO - DATE: 5/8/2017



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DIFFERENCE IN GROUNDWATER ELEVATION

FEBRUARY 2, 2017 TO FEBRUARY 27, 2017

FIGURE 4

PATH: G:\443005_USEPA REGION 2\0134975_EPAR2-018RICO0256-COMB FILL\GIS\MAP_DOCS\MXD\2017_HYDROGEOASSESSMENT\DIFFERENCEINGROUNDWATERELEVATION-FEB2017_20170502.MXD - USER: HROSADO - DATE: 5/31/2017

COMBE FILL

						Sample ID:	CF209D-20170216	CF209D-20170227	CF-209D-20170324-BD710-N	CF209D-FD-20170216	CF209D-GW-R3-P1-0-20170112
						CLP Sample ID(s):	BD6Z7	BD705	BD710	BD6Z8	CF209D-GW-R3-P1-0
						Parent Sample ID:				CF209D-20170216	
						Sample Date:	2/16/2017	2/27/2017	3/24/2017	2/16/2017	1/12/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**					
Volatile Organic Compounds (VOCs)											
8260C	1,1,1-TRICHLOROETHANE	71-55-6	30		ug/l	TRG					0.5 U
E524.2	1,1,1-TRICHLOROETHANE	71-55-6	30		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	1,1,2,2-TETRACHLOROETHANE	79-34-5	1		ug/l	TRG					0.5 U
E524.2	1,1,2,2-TETRACHLOROETHANE	79-34-5	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	20000	*Interim GWQC	ug/l	TRG					0.5 U
E524.2	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	20000	*Interim GWQC	ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	1,1,2-TRICHLOROETHANE	79-00-5	3		ug/l	TRG					0.5 U
E524.2	1,1,2-TRICHLOROETHANE	79-00-5	3		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	1,1-DICHLOROETHANE	75-34-3	50		ug/l	TRG					0.5 U
E524.2	1,1-DICHLOROETHANE	75-34-3	50		ug/l	TRG	**0.49 J**	**0.51**	**0.59**	**0.49 J**	
8260C	1,1-DICHLOROETHENE	75-35-4	1		ug/l	TRG					0.5 U
E524.2	1,1-DICHLOROETHENE	75-35-4	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	1,2,3-TRICHLOROBENZENE	87-61-6	NS		ug/l	TRG					0.5 U
E524.2	1,2,3-TRICHLOROBENZENE	87-61-6	NS		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	1,2,4-TRICHLOROBENZENE	120-82-1	9		ug/l	TRG					0.5 U
8260C SIM	1,2,3-TRICHLOROPROPANE	96-18-4	0.03		ug/l	TRG					0.03 U
E524.2	1,2,4-TRICHLOROBENZENE	120-82-1	9		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C SIM	1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	0.02		ug/l	TRG					0.02 U
E524.2	1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	0.02		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C SIM	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	106-93-4	0.03		ug/l	TRG					0.02 U
E524.2	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	106-93-4	0.03		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	1,2-DICHLOROBENZENE	95-50-1	600		ug/l	TRG					0.5 U
E524.2	1,2-DICHLOROBENZENE	95-50-1	600		ug/l	TRG	**0.19 J**	**0.17 J**	**0.22 J**	**0.21 J**	
8260C	1,2-DICHLOROETHANE	107-06-2	2		ug/l	TRG					**0.31 J**
E524.2	1,2-DICHLOROETHANE	107-06-2	2		ug/l	TRG	**3**	**3**	**3.2**	**3**	
8260C	1,2-DICHLOROPROPANE	78-87-5	1		ug/l	TRG					0.5 U
E524.2	1,2-DICHLOROPROPANE	78-87-5	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	1,3-DICHLOROBENZENE	541-73-1	600		ug/l	TRG					0.5 U
E524.2	1,3-DICHLOROBENZENE	541-73-1	600		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	1,4-DICHLOROBENZENE	106-46-7	75		ug/l	TRG					**1.1**
8260C	1,4-DIOXANE (P-DIOXANE)	123-91-1	0.4	*Interim GWQC	ug/l	TRG					**350**
8260C SIM	1,4-DIOXANE (P-DIOXANE)	123-91-1	0.4	*Interim GWQC	ug/l	TRG					
8260C	1,4-DIOXANE, 2,5-DIMETHYL-	15176-21-3	NS		ug/l	TIC					**17 JN**
8270D	1,4-DICHLOROBENZENE	106-46-7	75		ug/l	TIC					**1 J**
E524.2	1,4-DICHLOROBENZENE	106-46-7	75		ug/l	TRG	**1.2**	**0.96**	**1.2**	**1.1**	
8260C	2-HEXANONE	591-78-6	300	*Interim GWQC	ug/l	TRG					2.5 U
E524.2	2-HEXANONE	591-78-6	300	*Interim GWQC	ug/l	TRG	5 U	5 U	5 U	5 U	
8260C	ACETONE	67-64-1	6000		ug/l	TRG					**170**
E524.2	ACETONE	67-64-1	6000		ug/l	TRG	5 U	5 U	5 U	5 U	
8260C	BENZENE	71-43-2	1		ug/l	TRG					**0.37 J**
E524.2	BENZENE	71-43-2	1		ug/l	TRG	**5.6**	**8.4**	**9.2**	**5.7**	
8260C	BROMOCHLOROMETHANE	74-97-5	NS		ug/l	TRG					0.5 U
E524.2	BROMOCHLOROMETHANE	74-97-5	NS		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
E524.2	BROMODICHLOROMETHANE	75-27-4	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	BROMOFORM	75-25-2	4		ug/l	TRG					0.5 U
E524.2	BROMOFORM	75-25-2	4		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	BROMOMETHANE	74-83-9	10		ug/l	TRG					0.5 U
E524.2	BROMOMETHANE	74-83-9	10		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	CARBON DISULFIDE	75-15-0	700		ug/l	TRG					0.5 U
E524.2	CARBON DISULFIDE	75-15-0	700		ug/l	TRG	0.5 U	0.5 U	**0.24 J**	0.5 U	
8260C	CARBON TETRACHLORIDE	56-23-5	1		ug/l	TRG					0.5 U
E524.2	CARBON TETRACHLORIDE	56-23-5	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	CHLOROBENZENE	108-90-7	50		ug/l	TRG					0.5 U
8260C	CHLORODIBROMOMETHANE	121-48-1	5	*Interim Generic GWQC	ug/l	TRG					0.5 U
E524.2	CHLOROBENZENE	108-90-7	50		ug/l	TRG	**1.3**	**1.1**	**1.1**	**1.2**	
8260C	CHLOROETHANE	75-00-3	5	*Interim GWQC	ug/l	TRG					0.5 U
E524.2	CHLOROETHANE	75-00-3	5	*Interim GWQC	ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	CHLOROFORM	67-66-3	70		ug/l	TRG					0.5 U
E524.2	CHLOROFORM	67-66-3	70		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	CHLOROMETHANE	74-87-3	NS		ug/l	TRG					0.5 U
E524.2	CHLOROMETHANE	74-87-3	NS		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	CIS-1,2-DICHLOROETHYLENE	156-59-2	70		ug/l	TRG					**0.34 J**
E524.2	CIS-1,2-DICHLOROETHYLENE	156-59-2	70		ug/l	TRG	**3.6**	**3.2**	**3.8**	**3.7**	
8260C	CIS-1,3-DICHLOROPROPENE	10061-01-5	1		ug/l	TRG					0.5 U
E524.2	CIS-1,3-DICHLOROPROPENE	10061-01-5	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	CYCLOHEXANE	110-82-7	NS		ug/l	TRG					0.5 U
E524.2	CYCLOHEXANE	110-82-7	NS		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	DIBROMOCHLOROMETHANE	124-48-1	1		ug/l	TRG					0.5 U
E524.2	DIBROMOCHLOROMETHANE	124-48-1	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	DICHLORODIFLUOROMETHANE	75-71-8	1000		ug/l	TRG					0.5 U
E524.2	DICHLORODIFLUOROMETHANE	75-71-8	1000		ug/l	TRG	**0.41 J**	**0.58**	**0.58 J+**	**0.43 J**	

						Sample ID:	CF209D-20170216	CF209D-20170227	CF-209D-20170324-BD710-N	CF209D-FD-20170216	CF209D-GW-R3-P1-0-20170112
						CLP Sample ID(s):	BD6Z7	BD705	BD710	BD6Z8	CF209D-GW-R3-P1-0
						Parent Sample ID:				CF209D-20170216	
						Sample Date:	2/16/2017	2/27/2017	3/24/2017	2/16/2017	1/12/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**					
E524.2	DICHLOROFLUOROMETHANE	75-43-4	NS		ug/l	TIC			**2.3 NJ**		
8260C	DIETHYL ETHER (ETHYL ETHER)	60-29-7	1000		ug/l	TRG					**100**
E524.2	DIETHYL ETHER (ETHYL ETHER)	60-29-7	1000		ug/l	TRG	**230**	**230**	**250**	**230**	
8260C	ETHYLBENZENE	100-41-4	700		ug/l	TRG					0.5 U
E524.2	ETHYLBENZENE	100-41-4	700		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	ISOPROPANOL	67-63-0	NS		ug/l	TIC					**130**
E524.2	ISOPROPYL ETHER	108-20-3	20000		ug/l	TIC	**1.2 NJ**				
8260C	ISOPROPYLBENZENE (CUMENE)	98-82-8	700		ug/l	TRG					0.5 U
E524.2	ISOPROPYLBENZENE (CUMENE)	98-82-8	700		ug/l	TRG	0.5 U	0.5 U	**0.15 J**	0.5 U	
8260C	M, P XYLENES	179601-23-1	1000		ug/l	TRG					0.5 U
E524.2	M, P XYLENES	179601-23-1	1000		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	METHYL ACETATE	79-20-9	7000		ug/l	TRG					**1.8 J**
E524.2	METHYL ACETATE	79-20-9	7000		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	METHYL ETHYL KETONE (2-BUTANONE)	78-93-3	300		ug/l	TRG					**3.7**
E524.2	METHYL ETHYL KETONE (2-BUTANONE)	78-93-3	300		ug/l	TRG	5 U	5 U	5 U	5 U	
8260C	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	108-10-1	NS		ug/l	TRG					2.5 U
E524.2	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	108-10-1	NS		ug/l	TRG	5 U	5 U	5 U	5 U	
8260C	METHYLCYCLOHEXANE	108-87-2	NS		ug/l	TRG					0.5 U
E524.2	METHYLCYCLOHEXANE	108-87-2	NS		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	METHYLENE CHLORIDE	75-09-2	3		ug/l	TRG					**0.27 J**
E524.2	METHYLENE CHLORIDE	75-09-2	3		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
E524.2	OCTAMETHYLCYCLOTETRASILOXANE	556-67-2	NS		ug/l	TIC					
8260C	O-XYLENE (1,2-DIMETHYLBENZENE)	95-47-6	1000		ug/l	TRG					0.5 U
E524.2	O-XYLENE (1,2-DIMETHYLBENZENE)	95-47-6	1000		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	STYRENE	100-42-5	100		ug/l	TRG					0.5 U
E524.2	STYRENE	100-42-5	100		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	TERT-BUTYL ALCOHOL	75-65-0	100		ug/l	TRG					5 U
E524.2	TERT-BUTYL ALCOHOL	75-65-0	100		ug/l	TRG					
8260C	TERT-BUTYL METHYL ETHER	1634-04-4	70		ug/l	TRG					0.5 U
E524.2	TERT-BUTYL METHYL ETHER	1634-04-4	70		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	TETRACHLOROETHYLENE(PCE)	127-18-4	1		ug/l	TRG					0.5 U
E524.2	TETRACHLOROETHYLENE(PCE)	127-18-4	1		ug/l	TRG	0.5 U	0.5 U	**0.32 J**	0.5 U	
8260C	TOLUENE	108-88-3	600		ug/l	TRG					**0.75**
E524.2	TOLUENE	108-88-3	600		ug/l	TRG	**0.28 J**	**0.15 J**	**2.8**	**0.28 J**	
8260C	TOTAL CONCENTRATION	TOT_CONC	NS		ug/l	TRG					**628.64**
8260C	TOTAL TICS	TOT_TICS	NS		ug/l	TIC					**152.2**
8260C	TRANS-1,2-DICHLOROETHENE	156-60-5	100		ug/l	TRG					0.5 U
E524.2	TRANS-1,2-DICHLOROETHENE	156-60-5	100		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	TRANS-1,3-DICHLOROPROPENE	10061-02-6	1		ug/l	TRG					0.5 U
E524.2	TRANS-1,3-DICHLOROPROPENE	10061-02-6	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	TRICHLOROETHYLENE (TCE)	79-01-6	1		ug/l	TRG					0.5 U
E524.2	TRICHLOROETHYLENE (TCE)	79-01-6	1		ug/l	TRG	**0.28 J**	**0.23 J**	**0.33 J**	**0.26 J**	
8260C	TRICHLOROFLUOROMETHANE	75-69-4	2000		ug/l	TRG					0.5 U
E524.2	TRICHLOROFLUOROMETHANE	75-69-4	2000		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C	UNKNOWN WITH HIGHEST CONC.	UNKNOWN1	NS		ug/l	TIC					**5.2 J**
E524.2	UNKNOWN ALKANE-01	UNK ALKANE-01	NS		ug/l	TIC	**2.4 J**	**2.1 J**		**2.3 J**	
E524.2	UNKNOWN-01 (1 5.001)	UNKNOWN-01	NS		ug/l	TIC	**0.92 J**	**0.62 J**	**0.77 J**	**0.61 J**	
E524.2	UNKNOWN-02 (1 5.001)	UNKNOWN-02	NS		ug/l	TIC	**0.8 J**	**1.2 J**	**1.4 J**	**1.1 J**	
E524.2	UNKNOWN-03 (1 5.001)	UNKNOWN-03	NS		ug/l	TIC					
8260C	VINYL CHLORIDE	75-01-4	1		ug/l	TRG					0.5 U
E524.2	VINYL CHLORIDE	75-01-4	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U	
8260C SIM	TOTAL CONCENTRATION	TOT_CONC	NS		ug/l	TRG					**0**
Semi-Volatile Organic Compounds (SVOCs)											
8270D	1,2,4,5-TETRACHLOROBENZENE	95-94-3	NS		ug/l	TRG					10 U
E625	1,2,4,5-TETRACHLOROBENZENE	95-94-3	NS		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	1,4-DIOXANE (P-DIOXANE)	123-91-1	0.4	*Interim GWQC	ug/l	TIC					**67**
E625	1,4-DIOXANE (P-DIOXANE)	123-91-1	0.4	*Interim GWQC	ug/l	TRG	**53 J-**	**66**	**29 D**	**57 D**	
E625 SIM	1,4-DIOXANE (P-DIOXANE)	123-91-1	0.4	*Interim GWQC	ug/l	TRG					
8270D	1,4-DIOXANE, 2,5-DIMETHYL-	15176-21-3	NS		ug/l	TIC					**70 JN**
8270D	2,2'-OXYBIS[1-CHLOROPROPANE]	52438-91-2	NS		ug/l	TRG					10 U
8270D	2,3,4,6-TETRACHLOROPHENOL	58-90-2	200		ug/l	TRG					10 U
E625	2,3,4,6-TETRACHLOROPHENOL	58-90-2	200		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	2,4,5-TRICHLOROPHENOL	95-95-4	700		ug/l	TRG					10 U
E625	2,4,5-TRICHLOROPHENOL	95-95-4	700		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	2,4,6-TRICHLOROPHENOL	88-06-2	20		ug/l	TRG					10 U
E625	2,4,6-TRICHLOROPHENOL	88-06-2	20		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	2,4-DICHLOROPHENOL	120-83-2	20		ug/l	TRG					10 U
E625	2,4-DICHLOROPHENOL	120-83-2	20		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	2,4-DIMETHYLPHENOL	105-67-9	100		ug/l	TRG					10 U
E625	2,4-DIMETHYLPHENOL	105-67-9	100		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	2,4-DINITROPHENOL	51-28-5	40		ug/l	TRG					20 U
E625	2,4-DINITROPHENOL	51-28-5	40		ug/l	TRG	10 U	10 U	10 U	10 U	

						Sample ID:	CF209D-20170216	CF209D-20170227	CF-209D-20170324-BD710-N	CF209D-FD-20170216	CF209D-GW-R3-P1-0-20170112
						CLP Sample ID(s):	BD6Z7	BD705	BD710	BD6Z8	CF209D-GW-R3-P1-0
						Parent Sample ID:				CF209D-20170216	
						Sample Date:	2/16/2017	2/27/2017	3/24/2017	2/16/2017	1/12/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**					
8270D	2,4-DINITROTOLUENE	121-14-2	NS		ug/l	TRG					2 U
E625	2,4-DINITROTOLUENE	121-14-2	NS		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	2,6-DINITROTOLUENE	606-20-2	NS		ug/l	TRG					2 U
E625	2,6-DINITROTOLUENE	606-20-2	NS		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	2-CHLORONAPHTHALENE	91-58-7	600		ug/l	TRG					10 U
E625	2-CHLORONAPHTHALENE	91-58-7	600		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	2-CHLOROPHENOL	95-57-8	40		ug/l	TRG					10 U
E625	2-CHLOROPHENOL	95-57-8	40		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	2-METHYLNAPHTHALENE	91-57-6	30	*Interim GWQC	ug/l	TRG					10 U
E625	2-METHYLNAPHTHALENE	91-57-6	30	*Interim GWQC	ug/l	TRG	0.1 U		0.1 U	0.1 U	
E625 SIM	2-METHYLNAPHTHALENE	91-57-6	30	*Interim GWQC	ug/l	TRG		0.1 U			
8270D	2-METHYLPHENOL (O-CRESOL)	95-48-7	50	*Interim GWQC	ug/l	TRG					10 U
E625	2-METHYLPHENOL (O-CRESOL)	95-48-7	50	*Interim GWQC	ug/l	TRG	10 U	10 U	10 U	10 U	
8270D	2-NITROANILINE	88-74-4	NS		ug/l	TRG					10 U
E625	2-NITROANILINE	88-74-4	NS		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	2-NITROPHENOL	88-75-5	NS		ug/l	TRG					10 U
E625	2-NITROPHENOL	88-75-5	NS		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	3,3'-DICHLOROBENZIDINE	91-94-1	30		ug/l	TRG					10 U
E625	3,3'-DICHLOROBENZIDINE	91-94-1	30		ug/l	TRG	10 U	10 U	10 U	10 U	
8270D	3-NITROANILINE	99-09-2	NS		ug/l	TRG					10 U
E625	3-NITROANILINE	99-09-2	NS		ug/l	TRG	10 U	10 U	10 U	10 U	
8270D	4,6-DINITRO-2-METHYLPHENOL	534-52-1	1	*Interim GWQC	ug/l	TRG					20 U
E625	4,6-DINITRO-2-METHYLPHENOL	534-52-1	1	*Interim GWQC	ug/l	TRG	10 U	10 U	10 U	10 U	
8270D	4-BROMOPHENYL PHENYL ETHER	101-55-3	NS		ug/l	TRG					10 U
E625	4-BROMOPHENYL PHENYL ETHER	101-55-3	NS		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	4-CHLORO-3-METHYLPHENOL	59-50-7	100	*Interim GWQC	ug/l	TRG					10 U
E625	4-CHLORO-3-METHYLPHENOL	59-50-7	100	*Interim GWQC	ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	4-CHLOROANILINE	106-47-8	30		ug/l	TRG					10 U
E625	4-CHLOROANILINE	106-47-8	30		ug/l	TRG	10 U	10 U	10 U	10 U	
8270D	4-CHLOROPHENYL PHENYL ETHER	7005-72-3	NS		ug/l	TRG					10 U
E625	4-CHLOROPHENYL PHENYL ETHER	7005-72-3	NS		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	4-METHYLPHENOL (P-CRESOL)	106-44-5	50		ug/l	TRG					10 U
E625	4-METHYLPHENOL (P-CRESOL)	106-44-5	50		ug/l	TRG	10 U	10 U	10 U	10 U	
8270D	4-NITROANILINE	100-01-6	NS		ug/l	TRG					10 U
E625	4-NITROANILINE	100-01-6	NS		ug/l	TRG	10 U	10 U	10 U	10 U	
8270D	4-NITROPHENOL	100-02-7	NS		ug/l	TRG					20 U
E625	4-NITROPHENOL	100-02-7	NS		ug/l	TRG	10 U	10 U	10 U	10 U	
E625	6-OCTADECENOIC ACID	1000336-66-8	NS		ug/l	TIC					
8270D	ACENAPHTHENE	83-32-9	400		ug/l	TRG					10 U
E625	ACENAPHTHENE	83-32-9	400		ug/l	TRG	0.1 U		0.1 U	0.1 U	
E625 SIM	ACENAPHTHENE	83-32-9	400		ug/l	TRG		0.1 U			
8270D	ACENAPHTHYLENE	208-96-8	100	*Interim GWQC	ug/l	TRG					10 U
E625	ACENAPHTHYLENE	208-96-8	100	*Interim GWQC	ug/l	TRG	0.1 U		0.1 U	0.1 U	
E625 SIM	ACENAPHTHYLENE	208-96-8	100	*Interim GWQC	ug/l	TRG		0.1 U			
8270D	ACETOPHENONE	98-86-2	700		ug/l	TRG					10 U
E625	ACETOPHENONE	98-86-2	700		ug/l	TRG	10 U	10 U	10 U	10 U	
8270D SIM	ANTHRACENE	120-12-7	2000		ug/l	TRG					0.05 U
E625	ANTHRACENE	120-12-7	2000		ug/l	TRG	0.1 U		0.1 U	0.1 U	
E625 SIM	ANTHRACENE	120-12-7	2000		ug/l	TRG		0.1 U			
8270D	ATRAZINE	1912-24-9	3		ug/l	TRG					2 U
E625	ATRAZINE	1912-24-9	3		ug/l	TRG	10 U	10 U	10 U	10 U	
8270D	BENZALDEHYDE	100-52-7	NS		ug/l	TRG					10 U
E625	BENZALDEHYDE	100-52-7	NS		ug/l	TRG	10 U	10 U	10 U	10 U	
8270D	BENZENESULFONAMIDE, N-BUTYL-	3622-84-2	NS		ug/l	TIC					**41 JN**
E625	BENZENESULFONAMIDE, N-BUTYL-	3622-84-2	NS		ug/l	TIC					
8270D SIM	BENZO(A)ANTHRACENE	56-55-3	0.1		ug/l	TRG					0.05 U
E625	BENZO(A)ANTHRACENE	56-55-3	0.1		ug/l	TRG	0.05 U		0.05 U	0.05 U	
E625 SIM	BENZO(A)ANTHRACENE	56-55-3	0.1		ug/l	TRG		0.05 U			
8270D SIM	BENZO(A)PYRENE	50-32-8	0.1		ug/l	TRG					0.05 U
E625	BENZO(A)PYRENE	50-32-8	0.1		ug/l	TRG	0.05 U		0.05 U	0.05 U	
E625 SIM	BENZO(A)PYRENE	50-32-8	0.1		ug/l	TRG		0.05 U			
8270D SIM	BENZO(B)FLUORANTHENE	205-99-2	0.2		ug/l	TRG					0.05 U
E625	BENZO(B)FLUORANTHENE	205-99-2	0.2		ug/l	TRG	0.05 U		0.05 U	0.05 U	
E625 SIM	BENZO(B)FLUORANTHENE	205-99-2	0.2		ug/l	TRG		0.05 U			
8270D	BENZO(G,H,I)PERYLENE	191-24-2	100	*Interim GWQC	ug/l	TRG					10 U
E625	BENZO(G,H,I)PERYLENE	191-24-2	100	*Interim GWQC	ug/l	TRG	0.1 U		0.1 U	0.1 U	
E625 SIM	BENZO(G,H,I)PERYLENE	191-24-2	100	*Interim GWQC	ug/l	TRG		0.1 U			
8270D SIM	BENZO(K)FLUORANTHENE	207-08-9	0.5		ug/l	TRG					0.05 U
E625	BENZO(K)FLUORANTHENE	207-08-9	0.5		ug/l	TRG	0.05 U		0.05 U	0.05 U	
E625 SIM	BENZO(K)FLUORANTHENE	207-08-9	0.5		ug/l	TRG		0.05 U			
E625	BENZOIC ACID	65-85-0	30000		ug/l	TIC		**2.1 NJ**	**2.9 NJ**		
8270D	BENZYL BUTYL PHTHALATE	85-68-7	100		ug/l	TRG					10 U
E625	BENZYL BUTYL PHTHALATE	85-68-7	100		ug/l	TRG	5 U	5 U	5 U	5 U	

						Sample ID:	CF209D-20170216	CF209D-20170227	CF-209D-20170324-BD710-N	CF209D-FD-20170216	CF209D-GW-R3-P1-0-20170112
						CLP Sample ID(s):	BD6Z7	BD705	BD710	BD6Z8	CF209D-GW-R3-P1-0
						Parent Sample ID:				CF209D-20170216	
						Sample Date:	2/16/2017	2/27/2017	3/24/2017	2/16/2017	1/12/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**					
8270D	BIPHENYL (DIPHENYL)	92-52-4	400		ug/l	TRG					10 U
E625	BIPHENYL (DIPHENYL)	92-52-4	400		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	BIS(2-CHLOROETHOXY) METHANE	111-91-1	NS		ug/l	TRG					10 U
E625	BIS(2-CHLOROETHOXY) METHANE	111-91-1	NS		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D SIM	BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	111-44-4	7		ug/l	TRG					0.02 U
E625	BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	111-44-4	7		ug/l	TRG	10 U	10 U	10 U	10 U	
E625	BIS(2-CHLOROISOPROPYL) ETHER	108-60-1	300		ug/l	TRG	10 U	10 U	10 UJ	10 U	
8270D	BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	3		ug/l	TRG					2 U
E625	BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	3		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	BISPHENOL A	80-05-7	NS		ug/l	TIC					**11**
8270D	BUTYL HEXADECANOATE	111-06-8	NS		ug/l	TIC					**14 JN**
8270D	BUTYL STEARATE	123-95-5	NS		ug/l	TIC					**7.1 JN**
8270D	CAPROLACTAM	105-60-2	5000	*Interim GWQC	ug/l	TRG					10 U
E625	CAPROLACTAM	105-60-2	5000	*Interim GWQC	ug/l	TRG	10 U	10 U	10 U	10 U	
8270D	CARBAZOLE	86-74-8	NS		ug/l	TRG					10 U
E625	CARBAZOLE	86-74-8	NS		ug/l	TRG	10 U	10 U	10 U	10 U	
8270D	CHRYSENE	218-01-9	5		ug/l	TRG					2 U
E625	CHRYSENE	218-01-9	5		ug/l	TRG	0.1 U		0.1 U	0.1 U	
E625 SIM	CHRYSENE	218-01-9	5		ug/l	TRG		0.1 U			
E625	CIS-13-OCTADECENOIC ACID	13126-39-1	NS		ug/l	TIC					
8270D SIM	DIBENZ(A,H)ANTHRACENE	53-70-3	0.3		ug/l	TRG					0.05 U
E625	DIBENZ(A,H)ANTHRACENE	53-70-3	0.3		ug/l	TRG	0.05 U		0.05 U	0.05 U	
E625 SIM	DIBENZ(A,H)ANTHRACENE	53-70-3	0.3		ug/l	TRG		0.05 U			
8270D	DIBENZOFURAN	132-64-9	NS		ug/l	TRG					10 U
E625	DIBENZOFURAN	132-64-9	NS		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	DIETHYL PHTHALATE	84-66-2	6000		ug/l	TRG					10 U
E625	DIETHYL PHTHALATE	84-66-2	6000		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	DIMETHYL PHTHALATE	131-11-3	100	*Interim GWQC	ug/l	TRG					10 U
E625	DIMETHYL PHTHALATE	131-11-3	100	*Interim GWQC	ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	DI-N-BUTYL PHTHALATE	84-74-2	700		ug/l	TRG					10 U
E625	DI-N-BUTYL PHTHALATE	84-74-2	700		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	DI-N-OCTYLPHTHALATE	117-84-0	100		ug/l	TRG					10 U
E625	DI-N-OCTYLPHTHALATE	117-84-0	100		ug/l	TRG	10 U	10 U	10 U	10 U	
8270D SIM	FLUORANTHENE	206-44-0	300		ug/l	TRG					0.05 U
E625	FLUORANTHENE	206-44-0	300		ug/l	TRG	0.05 U		0.05 U	0.05 U	
E625 SIM	FLUORANTHENE	206-44-0	300		ug/l	TRG		0.05 U			
8270D	FLUORENE	86-73-7	300		ug/l	TRG					10 U
E625	FLUORENE	86-73-7	300		ug/l	TRG	0.1 U		0.1 U	0.1 U	
E625 SIM	FLUORENE	86-73-7	300		ug/l	TRG		0.1 U			
8270D SIM	HEXACHLOROBENZENE	118-74-1	0.02		ug/l	TRG					0.02 U
E625	HEXACHLOROBENZENE	118-74-1	0.02		ug/l	TRG	0.1 U		0.1 U	0.1 U	
E625 SIM	HEXACHLOROBENZENE	118-74-1	0.02		ug/l	TRG		0.1 U			
8270D	HEXACHLOROBUTADIENE	87-68-3	1		ug/l	TRG					1 U
E625	HEXACHLOROBUTADIENE	87-68-3	1		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	HEXACHLOROCYCLOPENTADIENE	77-47-4	40		ug/l	TRG					10 U
E625	HEXACHLOROCYCLOPENTADIENE	77-47-4	40		ug/l	TRG	10 U	10 U	10 U	10 U	
8270D	HEXACHLOROETHANE	67-72-1	7		ug/l	TRG					1 U
E625	HEXACHLOROETHANE	67-72-1	7		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	HEXADECANOIC ACID, 1,1-DIMETHYLETHYL	31158-91-5	NS		ug/l	TIC					
8270D SIM	INDENO(1,2,3-C,D)PYRENE	193-39-5	0.2		ug/l	TRG					0.05 U
E625	INDENO(1,2,3-C,D)PYRENE	193-39-5	0.2		ug/l	TRG	0.05 U		0.05 U	0.05 U	
E625 SIM	INDENO(1,2,3-C,D)PYRENE	193-39-5	0.2		ug/l	TRG		0.05 U			
8270D	ISOPHORONE	78-59-1	40		ug/l	TRG					10 U
E625	ISOPHORONE	78-59-1	40		ug/l	TRG	5 U	5 U	5 U	5 U	
SM2320B	LIME (AS CALCIUM CARBONATE)	471-34-1	NS		mg/l	TRG					**230**

						Sample ID:	CF209D-20170216	CF209D-20170227	CF-209D-20170324-BD710-N	CF209D-FD-20170216	CF209D-GW-R3-P1-0-20170112
						CLP Sample ID(s):	BD6Z7	BD705	BD710	BD6Z8	CF209D-GW-R3-P1-0
						Parent Sample ID:				CF209D-20170216	
						Sample Date:	2/16/2017	2/27/2017	3/24/2017	2/16/2017	1/12/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**					
8270D	N,N-DIMETHYL FORMAMIDE	68-12-2	NS		ug/l	TIC					
8270D	NAPHTHALENE	91-20-3	300		ug/l	TRG					10 U
E625	NAPHTHALENE	91-20-3	300		ug/l	TRG	0.1 U		0.1 U	0.1 U	
E625 SIM	NAPHTHALENE	91-20-3	300		ug/l	TRG		0.1 U			
8270D	NITROBENZENE	98-95-3	6		ug/l	TRG					1 U
E625	NITROBENZENE	98-95-3	6		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	N-NITROSODI-N-PROPYLAMINE	621-64-7	10		ug/l	TRG					1 U
E625	N-NITROSODI-N-PROPYLAMINE	621-64-7	10		ug/l	TRG	5 U	5 U	5 U	5 U	
8270D	N-NITROSODIPHENYLAMINE	86-30-6	10		ug/l	TRG					10 U
E625	N-NITROSODIPHENYLAMINE	86-30-6	10		ug/l	TRG	5 U	5 U	5 U	5 U	
E625	OCTADEC-9-ENOIC ACID	1000190-13-7	NS		ug/l	TIC				**15 NJ**	
8270D	OCTADECANOIC ACID, 2-METHYLPROPYL EST	646-13-9	NS		ug/l	TIC					
E625	OLEIC ACID	112-80-1	NS		ug/l	TIC				**10 NJD**	
8270D SIM	PENTACHLOROPHENOL	87-86-5	0.3		ug/l	TRG					0.2 U
E625	PENTACHLOROPHENOL	87-86-5	0.3		ug/l	TRG	**0.13 J**		0.1 UJ	0.1 UJ	
E625 SIM	PENTACHLOROPHENOL	87-86-5	0.3		ug/l	TRG		0.1 UJ			
8270D SIM	PHENANTHRENE	85-01-8	100	*Interim GWQC	ug/l	TRG					0.05 U
E625	PHENANTHRENE	85-01-8	100	*Interim GWQC	ug/l	TRG	0.05 U		0.05 U	0.05 U	
E625 SIM	PHENANTHRENE	85-01-8	100	*Interim GWQC	ug/l	TRG		0.05 U			
E625	PHENOBARBITAL	50-06-6	NS		ug/l	TIC	**5 NJ**	**5 NJ**	**2.6 NJ**	**5.9 NJ**	
8270D	PHENOL	108-95-2	2000		ug/l	TRG					10 U
E625	PHENOL	108-95-2	2000		ug/l	TRG	10 U	10 U	10 U	10 U	
8270D SIM	PYRENE	129-00-0	200		ug/l	TRG					0.05 U
E625	PYRENE	129-00-0	200		ug/l	TRG	0.05 U		0.05 U	0.05 U	
E625 SIM	PYRENE	129-00-0	200		ug/l	TRG		0.05 U			
SM2540C	RESIDUE, NON-FILTERABLE	010-17-3	NS		mg/l	TRG					**350**
SM2540D	RESIDUE, NON-FILTERABLE	010-17-3	NS		mg/l	TRG					10 U
8270D	TETRADECANOIC ACID	544-63-8	NS		ug/l	TIC					**15 JN**
8270D	TOTAL CONCENTRATION	TOT_CONC	NS		ug/l	TRG					**0**
8270D SIM	TOTAL CONCENTRATION	TOT_CONC	NS		ug/l	TRG					**0**
SM5310C	TOTAL ORGANIC CARBON	TOC	NS		mg/l	TRG					**5.6**
8270D	TOTAL TICS	TOT_TICS	NS		ug/l	TIC					**438.2**
8270D	UNKNOWN WITH 10TH HIGHEST CONC.	UNKNOWN10	NS		ug/l	TIC					**9.1 J**
8270D	UNKNOWN WITH 2ND HIGHEST CONC.	UNKNOWN2	NS		ug/l	TIC					**7.5 J**
8270D	UNKNOWN WITH 3RD HIGHEST CONC.	UNKNOWN3	NS		ug/l	TIC					**6.4 J**
8270D	UNKNOWN WITH 4TH HIGHEST CONC.	UNKNOWN4	NS		ug/l	TIC					**13 J**
8270D	UNKNOWN WITH 5TH HIGHEST CONC.	UNKNOWN5	NS		ug/l	TIC					**12 J**
8270D	UNKNOWN WITH 6TH HIGHEST CONC.	UNKNOWN6	NS		ug/l	TIC					**8 J**
8270D	UNKNOWN WITH 7TH HIGHEST CONC.	UNKNOWN7	NS		ug/l	TIC					**12 J**
8270D	UNKNOWN WITH 8TH HIGHEST CONC.	UNKNOWN8	NS		ug/l	TIC					**6.4 J**
8270D	UNKNOWN WITH 9TH HIGHEST CONC.	UNKNOWN9	NS		ug/l	TIC					**65 J**
E625	UNKNOWN-01 (1 5.001)	UNKNOWN-01	NS		ug/l	TIC	**5.1 J**	**2.6 J**	**3.7 J**	**2.3 J**	
E625	UNKNOWN-02 (1 5.001)	UNKNOWN-02	NS		ug/l	TIC	**4.3 J**	**2.8 J**	**2.9 J**	**6 J**	
E625	UNKNOWN-03 (1 5.001)	UNKNOWN-03	NS		ug/l	TIC	**3.1 J**	**4.7 J**	**4.4 J**	**5.6 J**	
E625	UNKNOWN-04 (1 5.001)	UNKNOWN-04	NS		ug/l	TIC	**4.4 J**	**3.5 J**	**2.6 J**	**3.3 J**	
E625	UNKNOWN-05 (6 18.250)	UNKNOWN-05	NS		ug/l	TIC		**3.6 J**	**2 J**	**6.9 J**	
E625	UNKNOWN-06 (5 16.134)	UNKNOWN-06	NS		ug/l	TIC		**3.6 J**	**2.7 J**		
E625	UNKNOWN-07 (5 16.134)	UNKNOWN-07	NS		ug/l	TIC					
E625	UNKNOWN-08 (6 18.255)	UNKNOWN-08	NS		ug/l	TIC					
8270D	UNKNOWN-11	UNKNOWN11	NS		ug/l	TIC					**8.7 J**
8270D	UNKNOWN-12	UNKNOWN12	NS		ug/l	TIC					**21 J**
8270D	UNKNOWN-13	UNKNOWN13	NS		ug/l	TIC					
8270D	UNKNOWN-14	UNKNOWN14	NS		ug/l	TIC					
8270D	UNKNOWN-15	UNKNOWN15	NS		ug/l	TIC					
8270D	UNKNOWN-16	UNKNOWN16	NS		ug/l	TIC					
8270D	UNKNOWN-17	UNKNOWN17	NS		ug/l	TIC					
8270D	UNKNOWN-18	UNKNOWN18	NS		ug/l	TIC					
8270D	UNKNOWN-19	UNKNOWN19	NS		ug/l	TIC					
8270D	UNKNOWN-20	UNKNOWN20	NS		ug/l	TIC					
8270D	UNKNOWN-21	UNKNOWN21	NS		ug/l	TIC					
8270D	UNKNOWN-22	UNKNOWN22	NS		ug/l	TIC					
8270D	UNKNOWN-23	UNKNOWN23	NS		ug/l	TIC					
8270D	UNKNOWN-24	UNKNOWN24	NS		ug/l	TIC					
8270D	UNKNOWN-25	UNKNOWN25	NS		ug/l	TIC					
8270D	UNKNOWN-26	UNKNOWN26	NS		ug/l	TIC					
8270D	UNKNOWN-27	UNKNOWN27	NS		ug/l	TIC					
8270D	UNKNOWN-28	UNKNOWN28	NS		ug/l	TIC					
8270D	UNKNOWN-29	UNKNOWN29	NS		ug/l	TIC					
8270D	UNKNOWN-30	UNKNOWN30	NS		ug/l	TIC					
8270D	UNKNOWN-31	UNKNOWN31	NS		ug/l	TIC					

						Sample ID:	CF209D-20170216	CF209D-20170227	CF-209D-20170324-BD710-N	CF209D-FD-20170216	CF209D-GW-R3-P1-0-20170112
						CLP Sample ID(s):	BD6Z7	BD705	BD710	BD6Z8	CF209D-GW-R3-P1-0
						Parent Sample ID:				CF209D-20170216	
						Sample Date:	2/16/2017	2/27/2017	3/24/2017	2/16/2017	1/12/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**					
Pesticides											
8081B	ALDRIN	309-00-2	0.04		ug/l	TRG					0.02 U
CPEST	ALDRIN	309-00-2	0.04		ug/l	TRG	0.0025 UJ	0.0076 U	0.091 UJ	0.0025 U	
8081B	ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	319-84-6	0.02		ug/l	TRG					0.02 U
CPEST	ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	319-84-6	0.02		ug/l	TRG	**0.00013 J**	**0.00041 J**	0.091 U	**0.0002 J**	
8081B	ALPHA ENDOSULFAN	959-98-8	40		ug/l	TRG					0.02 U
CPEST	ALPHA ENDOSULFAN	959-98-8	40		ug/l	TRG	0.0025 U	0.0076 U	0.0045 U	0.05 U	
8081B	ALPHA-CHLORDANE	5103-71-9	0.5		ug/l	TRG					0.02 U
CPEST	ALPHA-CHLORDANE	5103-71-9	0.5		ug/l	TRG	0.05 U	0.15 U	0.091 U	0.05 U	
8081B	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	319-85-7	0.04		ug/l	TRG					0.02 U
CPEST	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	319-85-7	0.04		ug/l	TRG	0.05 U	0.0076 U	0.091 U	0.05 U	
8081B	BETA ENDOSULFAN	33213-65-9	40		ug/l	TRG					0.02 U
CPEST	BETA ENDOSULFAN	33213-65-9	40		ug/l	TRG	0.1 U	0.3 U	0.18 U	0.1 U	
8081B	CHLORDENE; GAMMA-	56641-38-4	NS		ug/l	TRG					0.02 U
CPEST	BETA-CHLORDANE	5103-74-2	0.5		ug/l	TRG	0.05 U	0.15 U	0.091 U	0.05 U	
8081B	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	319-86-8	NS		ug/l	TRG					0.02 U
CPEST	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	319-86-8	NS		ug/l	TRG	0.0025 U	0.0076 U	0.0045 U	0.0025 U	
8081B	DIELDRIN	60-57-1	0.03		ug/l	TRG					0.02 U
CPEST	DIELDRIN	60-57-1	0.03		ug/l	TRG	0.005 UJ	0.015 U	0.0091 UJ	0.005 U	
8081B	ENDOSULFAN SULFATE	1031-07-8	40		ug/l	TRG					0.02 U
CPEST	ENDOSULFAN SULFATE	1031-07-8	40		ug/l	TRG		0.015 U	0.0091 U		
8081B	ENDRIN	72-20-8	2		ug/l	TRG					0.02 U
CPEST	ENDRIN	72-20-8	2		ug/l	TRG	0.005 UJ	0.3 U	0.0091 UJ	0.005 U	
8081B	ENDRIN ALDEHYDE	7421-93-4	NS		ug/l	TRG					0.02 U
CPEST	ENDRIN ALDEHYDE	7421-93-4	NS		ug/l	TRG	**0.00028 J**	**0.0016 J**	0.0091 U	0.1 U	
8081B	ENDRIN KETONE	53494-70-5	NS		ug/l	TRG					0.02 U
CPEST	ENDRIN KETONE	53494-70-5	NS		ug/l	TRG	0.005 U	0.015 U	0.0091 U	0.005 U	
8081B	GAMMA BHC (LINDANE)	58-89-9	0.03		ug/l	TRG					0.02 U
8081B	GAMMA-CHLORDANE	12789-03-6	0.5		ug/l	TRG					0.5 U
CPEST	GAMMA BHC (LINDANE)	58-89-9	0.03		ug/l	TRG	0.0025 UJ	**0.00099 J**	0.091 UJ	0.0025 U	
8081B	HEPTACHLOR	76-44-8	0.05		ug/l	TRG					0.02 U
CPEST	HEPTACHLOR	76-44-8	0.05		ug/l	TRG	**0.00033 J**	0.0076 U		0.0025 U	
8081B	HEPTACHLOR EPOXIDE	1024-57-3	0.2		ug/l	TRG					0.02 U
CPEST	HEPTACHLOR EPOXIDE	1024-57-3	0.2		ug/l	TRG	0.0025 U	0.15 U	0.0045 U	0.0025 U	
8081B	METHOXYCHLOR	72-43-5	40		ug/l	TRG					0.02 U
CPEST	METHOXYCHLOR	72-43-5	40		ug/l	TRG	0.05 U	0.15 U	0.091 U	0.05 U	
8081B	P,P'-DDD	72-54-8	0.1		ug/l	TRG					0.02 U
CPEST	P,P'-DDD	72-54-8	0.1		ug/l	TRG	**0.00014 J**	0.015 U	0.18 U	**0.00014 J**	
8081B	P,P'-DDE	72-55-9	0.1		ug/l	TRG					0.02 U
CPEST	P,P'-DDE	72-55-9	0.1		ug/l	TRG	0.005 U	0.015 U	0.0091 U	0.005 U	
8081B	P,P'-DDT	50-29-3	0.1		ug/l	TRG					0.02 U
CPEST	P,P'-DDT	50-29-3	0.1		ug/l	TRG	0.1 U	0.015 U	0.18 U	0.005 U	
8081B	TOXAPHENE	8001-35-2	2		ug/l	TRG					0.5 U
CPEST	TOXAPHENE	8001-35-2	2		ug/l	TRG	0.05 U	0.15 U	0.091 U	0.05 U	
Polychlorinated Biphenyls (PCBs)											
8082A	CHLOROBIPHENYL	37324-23-5	0.5		ug/l	TRG					0.4 U
E608	CHLOROBIPHENYL	37324-23-5	0.5		ug/l	TRG	0.03 U	0.03 U	0.03 U	0.03 U	
8082A	PCB-1016 (AROCLOR 1016)	12674-11-2	0.5		ug/l	TRG					0.4 U
E608	PCB-1016 (AROCLOR 1016)	12674-11-2	0.5		ug/l	TRG	0.03 U	0.03 U	0.03 U	0.03 U	
8082A	PCB-1221 (AROCLOR 1221)	11104-28-2	0.5		ug/l	TRG					0.4 U
E608	PCB-1221 (AROCLOR 1221)	11104-28-2	0.5		ug/l	TRG	0.03 U	0.03 U	0.03 U	0.03 U	
8082A	PCB-1232 (AROCLOR 1232)	11141-16-5	0.5		ug/l	TRG					0.4 U
E608	PCB-1232 (AROCLOR 1232)	11141-16-5	0.5		ug/l	TRG	0.03 U	0.03 U	0.03 U	0.03 U	
8082A	PCB-1242 (AROCLOR 1242)	53469-21-9	0.5		ug/l	TRG					0.4 U
E608	PCB-1242 (AROCLOR 1242)	53469-21-9	0.5		ug/l	TRG	0.03 U	0.03 U	0.03 U	0.03 U	
8082A	PCB-1248 (AROCLOR 1248)	12672-29-6	0.5		ug/l	TRG					0.4 U
E608	PCB-1248 (AROCLOR 1248)	12672-29-6	0.5		ug/l	TRG	0.03 U	0.03 U	0.03 U	0.03 U	
8082A	PCB-1254 (AROCLOR 1254)	11097-69-1	0.5		ug/l	TRG					0.4 U
E608	PCB-1254 (AROCLOR 1254)	11097-69-1	0.5		ug/l	TRG	0.03 U	0.03 U	0.03 U	0.03 U	
8082A	PCB-1260 (AROCLOR 1260)	11096-82-5	0.5		ug/l	TRG					0.4 U
E608	PCB-1260 (AROCLOR 1260)	11096-82-5	0.5		ug/l	TRG	0.03 U	0.03 U	0.03 U	0.03 U	
8082A	PCB-1268 (AROCLOR 1268)	11100-14-4	0.5		ug/l	TRG					0.4 U
E608	PCB-1268 (AROCLOR 1268)	11100-14-4	0.5		ug/l	TRG	0.03 U	0.03 U	0.03 U	0.03 U	
8082A	POLYCHLORINATED BIPHENYL (PCB)	1336-36-3	0.5		ug/l	TRG					0.4 U

						Sample ID:	CF209D-20170216	CF209D-20170227	CF-209D-20170324-BD710-N	CF209D-FD-20170216	CF209D-GW-R3-P1-0-20170112
						CLP Sample ID(s):	BD6Z7	BD705	BD710	BD6Z8	CF209D-GW-R3-P1-0
						Parent Sample ID:				CF209D-20170216	
						Sample Date:	2/16/2017	2/27/2017	3/24/2017	2/16/2017	1/12/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**					
Inorganics											
E200.8	ALUMINUM	7429-90-5	200		ug/l	TRG					10 U
E200.7	ANTIMONY	7440-36-0	6		ug/l	TRG					60 U
E200.7	ARSENIC	7440-38-2	3		ug/l	TRG					10 U
E200.8	BARIUM	7440-39-3	6000		ug/l	TRG					**19.5**
E200.7	BERYLLIUM	7440-41-7	1		ug/l	TRG					**0.27 J**
E200.7	CADMIUM	7440-43-9	4		ug/l	TRG					5 U
E200.7	CALCIUM	7440-70-2	NS		ug/l	TRG					**38000**
E300.0	CHLORIDE (AS CL)	16887-00-6	250		mg/l	TRG					**8.1**
E200.8	CHROMIUM, TOTAL	7440-47-3	70		ug/l	TRG					1 U
E200.7	COBALT	7440-48-4	100	*Interim GWQC	ug/l	TRG					50 U
E200.8	COPPER	7440-50-8	1300		ug/l	TRG					**0.21 J**
E335.4	CYANIDE	57-12-5	100		ug/l	TRG					**10 L**
E200.7	HARDNESS (AS CACO3)	HARD	250		mg/l	CAL					**214**
E200.7	IRON	7439-89-6	300		ug/l	TRG					**20100**
E200.7	LEAD	7439-92-1	5		ug/l	TRG					10 U
E200.7	MAGNESIUM	7439-95-4	NS		ug/l	TRG					**28900**
E200.7	MANGANESE	7439-96-5	50		ug/l	TRG					**662**
E245.2	MERCURY	7439-97-6	2		ug/l	TRG					0.2 U
E200.7	NICKEL	7440-02-0	100		ug/l	TRG					40 U
E200.7	POTASSIUM	7440-09-7	NS		ug/l	TRG					5000 U
E200.7	SELENIUM	7782-49-2	40		ug/l	TRG					35 U
E200.7	SILVER	7440-22-4	40		ug/l	TRG					10 U
E200.7	SODIUM	7440-23-5	50000		ug/l	TRG					**18600**
E200.7	THALLIUM	7440-28-0	2		ug/l	TRG					25 U
E200.8	VANADIUM	7440-62-2	NS		ug/l	TRG					2 U
E200.8	ZINC	7440-66-6	2000		ug/l	TRG					**1.8 J**

						Sample ID: CLP Sample ID(s): Parent Sample ID: Sample Date:	CF209D-GW-R3-P2-0-20170112 CF209D-GW-R3-P2-0 1/12/2017	CF209D-GW-R3-P2-1-20170112 CF209D-GW-R3-P2-1 CF209D-GW-R3-P2-0-20170112 1/12/2017	CF209D-GW-R3-P3-0-20170112 CF209D-GW-R3-P3-0 1/12/2017	CF209D-GW-R3-P4-0-20170112 CF209D-GW-R3-P4-0 1/12/2017	CF-209D-PT-R1-20170203-0 BD6Z2 2/3/2017	CFS-PILOTTEST-COL1-20170208-0 BD6Z5 2/8/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**						
Volatile Organic Compounds (VOCs)												
8260C	1,1,1-TRICHLOROETHANE	71-55-6	30		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	1,1,1-TRICHLOROETHANE	71-55-6	30		ug/l	TRG					0.5 U	
8260C	1,1,2,2-TETRACHLOROETHANE	79-34-5	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	1,1,2,2-TETRACHLOROETHANE	79-34-5	1		ug/l	TRG					0.5 U	
8260C	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	20000	*Interim GWQC	ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	20000	*Interim GWQC	ug/l	TRG					0.5 U	
8260C	1,1,2-TRICHLOROETHANE	79-00-5	3		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	1,1,2-TRICHLOROETHANE	79-00-5	3		ug/l	TRG					0.5 U	
8260C	1,1-DICHLOROETHANE	75-34-3	50		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	1,1-DICHLOROETHANE	75-34-3	50		ug/l	TRG					**0.28 J**	
8260C	1,1-DICHLOROETHENE	75-35-4	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	1,1-DICHLOROETHENE	75-35-4	1		ug/l	TRG					0.5 U	
8260C	1,2,3-TRICHLOROBENZENE	87-61-6	NS		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	1,2,3-TRICHLOROBENZENE	87-61-6	NS		ug/l	TRG					0.5 U	
8260C	1,2,4-TRICHLOROBENZENE	120-82-1	9		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
8260C SIM	1,2,3-TRICHLOROPROPANE	96-18-4	0.03		ug/l	TRG	0.03 U	0.03 U	0.03 U	0.03 U		
E524.2	1,2,4-TRICHLOROBENZENE	120-82-1	9		ug/l	TRG					0.5 U	
8260C SIM	1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	0.02		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
E524.2	1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	0.02		ug/l	TRG					0.5 U	
8260C SIM	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	106-93-4	0.03		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
E524.2	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	106-93-4	0.03		ug/l	TRG					0.5 U	
8260C	1,2-DICHLOROBENZENE	95-50-1	600		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	1,2-DICHLOROBENZENE	95-50-1	600		ug/l	TRG					**0.22 J**	
8260C	1,2-DICHLOROETHANE	107-06-2	2		ug/l	TRG	**0.32 J**	**0.33 J**	**0.5**	**0.42 J**		
E524.2	1,2-DICHLOROETHANE	107-06-2	2		ug/l	TRG					**1.7**	
8260C	1,2-DICHLOROPROPANE	78-87-5	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	1,2-DICHLOROPROPANE	78-87-5	1		ug/l	TRG					0.5 U	
8260C	1,3-DICHLOROBENZENE	541-73-1	600		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	1,3-DICHLOROBENZENE	541-73-1	600		ug/l	TRG					0.5 U	
8260C	1,4-DICHLOROBENZENE	106-46-7	75		ug/l	TRG	**1.2**	**1.3**	0.5 U	0.5 U		
8260C	1,4-DIOXANE (P-DIOXANE)	123-91-1	0.4	*Interim GWQC	ug/l	TRG	**130**	**120**	**130**			
8260C SIM	1,4-DIOXANE (P-DIOXANE)	123-91-1	0.4	*Interim GWQC	ug/l	TRG				**40**		
8260C	1,4-DIOXANE, 2,5-DIMETHYL-	15176-21-3	NS		ug/l	TIC						
8270D	1,4-DICHLOROBENZENE	106-46-7	75		ug/l	TIC						
E524.2	1,4-DICHLOROBENZENE	106-46-7	75		ug/l	TRG					**1.3**	
8260C	2-HEXANONE	591-78-6	300	*Interim GWQC	ug/l	TRG	2.5 U	2.5 U	2.5 U	2.5 U		
E524.2	2-HEXANONE	591-78-6	300	*Interim GWQC	ug/l	TRG					5 U	
8260C	ACETONE	67-64-1	6000		ug/l	TRG	**6.9**	**3**	**4.8**	2.5 U		
E524.2	ACETONE	67-64-1	6000		ug/l	TRG					5 U	
8260C	BENZENE	71-43-2	1		ug/l	TRG	**0.43 J**	**0.47 J**	**0.59**	**0.35 J**		
E524.2	BENZENE	71-43-2	1		ug/l	TRG					**1.6**	
8260C	BROMOCHLOROMETHANE	74-97-5	NS		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	BROMOCHLOROMETHANE	74-97-5	NS		ug/l	TRG					0.5 U	
E524.2	BROMODICHLOROMETHANE	75-27-4	1		ug/l	TRG					0.5 U	
8260C	BROMOFORM	75-25-2	4		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	BROMOFORM	75-25-2	4		ug/l	TRG					0.5 U	
8260C	BROMOMETHANE	74-83-9	10		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	BROMOMETHANE	74-83-9	10		ug/l	TRG					0.5 U	
8260C	CARBON DISULFIDE	75-15-0	700		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	CARBON DISULFIDE	75-15-0	700		ug/l	TRG					0.5 U	
8260C	CARBON TETRACHLORIDE	56-23-5	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	CARBON TETRACHLORIDE	56-23-5	1		ug/l	TRG					0.5 U	
8260C	CHLOROBENZENE	108-90-7	50		ug/l	TRG	**0.76**	**0.76**	**0.42 J**	0.5 U		
8260C	CHLORODIBROMOMETHANE	121-48-1	5	*Interim Generic GWQC	ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	CHLOROBENZENE	108-90-7	50		ug/l	TRG					**0.94**	
8260C	CHLOROETHANE	75-00-3	5	*Interim GWQC	ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	CHLOROETHANE	75-00-3	5	*Interim GWQC	ug/l	TRG					0.5 U	
8260C	CHLOROFORM	67-66-3	70		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	CHLOROFORM	67-66-3	70		ug/l	TRG					0.5 U	
8260C	CHLOROMETHANE	74-87-3	NS		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	CHLOROMETHANE	74-87-3	NS		ug/l	TRG					0.5 U	
8260C	CIS-1,2-DICHLOROETHYLENE	156-59-2	70		ug/l	TRG	**0.54**	**0.49 J**	**0.67**	**0.63**		
E524.2	CIS-1,2-DICHLOROETHYLENE	156-59-2	70		ug/l	TRG					**2.2**	
8260C	CIS-1,3-DICHLOROPROPENE	10061-01-5	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	CIS-1,3-DICHLOROPROPENE	10061-01-5	1		ug/l	TRG					0.5 U	
8260C	CYCLOHEXANE	110-82-7	NS		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	CYCLOHEXANE	110-82-7	NS		ug/l	TRG					0.5 U	
8260C	DIBROMOCHLOROMETHANE	124-48-1	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	DIBROMOCHLOROMETHANE	124-48-1	1		ug/l	TRG					0.5 U	
8260C	DICHLORODIFLUOROMETHANE	75-71-8	1000		ug/l	TRG	0.5 U	0.5 U	0.5 U	**0.97**		
E524.2	DICHLORODIFLUOROMETHANE	75-71-8	1000		ug/l	TRG					**0.39 J+**	

						Sample ID: CLP Sample ID(s): Parent Sample ID: Sample Date:	CF209D-GW-R3-P2-0-20170112 CF209D-GW-R3-P2-0 1/12/2017	CF209D-GW-R3-P2-1-20170112 CF209D-GW-R3-P2-1 CF209D-GW-R3-P2-0-20170112 1/12/2017	CF209D-GW-R3-P3-0-20170112 CF209D-GW-R3-P3-0 1/12/2017	CF209D-GW-R3-P4-0-20170112 CF209D-GW-R3-P4-0 1/12/2017	CF-209D-PT-R1-20170203-0 BD6Z2 2/3/2017	CFS-PILOTTEST-COL1-20170208-0 BD6Z5 2/8/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**						
E524.2	DICHLOROFLUOROMETHANE	75-43-4	NS		ug/l	TIC						
8260C	DIETHYL ETHER (ETHYL ETHER)	60-29-7	1000		ug/l	TRG	**82**	**81**	**88**	**34**		
E524.2	DIETHYL ETHER (ETHYL ETHER)	60-29-7	1000		ug/l	TRG					**150**	
8260C	ETHYLBENZENE	100-41-4	700		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	ETHYLBENZENE	100-41-4	700		ug/l	TRG					0.5 U	
8260C	ISOPROPANOL	67-63-0	NS		ug/l	TIC						
E524.2	ISOPROPYL ETHER	108-20-3	20000		ug/l	TIC						
8260C	ISOPROPYLBENZENE (CUMENE)	98-82-8	700		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	ISOPROPYLBENZENE (CUMENE)	98-82-8	700		ug/l	TRG					0.5 U	
8260C	M, P XYLENES	179601-23-1	1000		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	M, P XYLENES	179601-23-1	1000		ug/l	TRG					0.5 U	
8260C	METHYL ACETATE	79-20-9	7000		ug/l	TRG	2.5 U	2.5 U	2.5 U	2.5 U		
E524.2	METHYL ACETATE	79-20-9	7000		ug/l	TRG					0.5 U	
8260C	METHYL ETHYL KETONE (2-BUTANONE)	78-93-3	300		ug/l	TRG	2.5 U	2.5 U	2.5 U	2.5 U		
E524.2	METHYL ETHYL KETONE (2-BUTANONE)	78-93-3	300		ug/l	TRG					5 U	
8260C	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	108-10-1	NS		ug/l	TRG	2.5 U	2.5 U	2.5 U	2.5 U		
E524.2	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	108-10-1	NS		ug/l	TRG					5 U	
8260C	METHYLCYCLOHEXANE	108-87-2	NS		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	METHYLCYCLOHEXANE	108-87-2	NS		ug/l	TRG					0.5 U	
8260C	METHYLENE CHLORIDE	75-09-2	3		ug/l	TRG	**0.3 J**	**0.27 J**	**0.3 J**	**0.26 J**		
E524.2	METHYLENE CHLORIDE	75-09-2	3		ug/l	TRG					0.5 U	
E524.2	OCTAMETHYLCYCLOTETRASILOXANE	556-67-2	NS		ug/l	TIC					**2.8 NJ**	
8260C	O-XYLENE (1,2-DIMETHYLBENZENE)	95-47-6	1000		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	O-XYLENE (1,2-DIMETHYLBENZENE)	95-47-6	1000		ug/l	TRG					0.5 U	
8260C	STYRENE	100-42-5	100		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	STYRENE	100-42-5	100		ug/l	TRG					0.5 U	
8260C	TERT-BUTYL ALCOHOL	75-65-0	100		ug/l	TRG	5 U	5 U	5 U	5 U		
E524.2	TERT-BUTYL ALCOHOL	75-65-0	100		ug/l	TRG						
8260C	TERT-BUTYL METHYL ETHER	1634-04-4	70		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	TERT-BUTYL METHYL ETHER	1634-04-4	70		ug/l	TRG					0.5 U	
8260C	TETRACHLOROETHYLENE(PCE)	127-18-4	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	TETRACHLOROETHYLENE(PCE)	127-18-4	1		ug/l	TRG					0.5 U	
8260C	TOLUENE	108-88-3	600		ug/l	TRG	**0.46 J**	**0.27 J**	**0.42 J**	**0.48 J**		
E524.2	TOLUENE	108-88-3	600		ug/l	TRG					**2.4**	
8260C	TOTAL CONCENTRATION	TOT_CONC	NS		ug/l	TRG	**222.91**	**208.12**	**226.03**	**37.34**		
8260C	TOTAL TICS	TOT_TICS	NS		ug/l	TIC	**0**	**0**	**0**	**0**		
8260C	TRANS-1,2-DICHLOROETHENE	156-60-5	100		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	TRANS-1,2-DICHLOROETHENE	156-60-5	100		ug/l	TRG					0.5 U	
8260C	TRANS-1,3-DICHLOROPROPENE	10061-02-6	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	TRANS-1,3-DICHLOROPROPENE	10061-02-6	1		ug/l	TRG					0.5 U	
8260C	TRICHLOROETHYLENE (TCE)	79-01-6	1		ug/l	TRG	0.5 U	**0.23 J**	**0.33 J**	**0.23 J**		
E524.2	TRICHLOROETHYLENE (TCE)	79-01-6	1		ug/l	TRG					**0.38 J**	
8260C	TRICHLOROFLUOROMETHANE	75-69-4	2000		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	TRICHLOROFLUOROMETHANE	75-69-4	2000		ug/l	TRG					0.5 U	
8260C	UNKNOWN WITH HIGHEST CONC.	UNKNOWN1	NS		ug/l	TIC						
E524.2	UNKNOWN ALKANE-01	UNK ALKANE-01	NS		ug/l	TIC						
E524.2	UNKNOWN-01 (1 5.001)	UNKNOWN-01	NS		ug/l	TIC					**1.1 J**	
E524.2	UNKNOWN-02 (1 5.001)	UNKNOWN-02	NS		ug/l	TIC					**0.88 J**	
E524.2	UNKNOWN-03 (1 5.001)	UNKNOWN-03	NS		ug/l	TIC					**0.67 J**	
8260C	VINYL CHLORIDE	75-01-4	1		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
E524.2	VINYL CHLORIDE	75-01-4	1		ug/l	TRG					0.5 U	
8260C SIM	TOTAL CONCENTRATION	TOT_CONC	NS		ug/l	TRG	**0**	**0**	**0**	**40**		
Semi-Volatile Organic Compounds (SVOCs)												
8270D	1,2,4,5-TETRACHLOROBENZENE	95-94-3	NS		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	1,2,4,5-TETRACHLOROBENZENE	95-94-3	NS		ug/l	TRG					5 U	5 U
8270D	1,4-DIOXANE (P-DIOXANE)	123-91-1	0.4	*Interim GWQC	ug/l	TIC		**11 JN**				
E625	1,4-DIOXANE (P-DIOXANE)	123-91-1	0.4	*Interim GWQC	ug/l	TRG					**54**	**19**
E625 SIM	1,4-DIOXANE (P-DIOXANE)	123-91-1	0.4	*Interim GWQC	ug/l	TRG						
8270D	1,4-DIOXANE, 2,5-DIMETHYL-	15176-21-3	NS		ug/l	TIC						
8270D	2,2'-OXYBIS[1-CHLOROPROPANE]	52438-91-2	NS		ug/l	TRG	10 U	10 U	10 U	10 U		
8270D	2,3,4,6-TETRACHLOROPHENOL	58-90-2	200		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	2,3,4,6-TETRACHLOROPHENOL	58-90-2	200		ug/l	TRG					5 U	5 U
8270D	2,4,5-TRICHLOROPHENOL	95-95-4	700		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	2,4,5-TRICHLOROPHENOL	95-95-4	700		ug/l	TRG					5 U	5 U
8270D	2,4,6-TRICHLOROPHENOL	88-06-2	20		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	2,4,6-TRICHLOROPHENOL	88-06-2	20		ug/l	TRG					5 U	5 U
8270D	2,4-DICHLOROPHENOL	120-83-2	20		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	2,4-DICHLOROPHENOL	120-83-2	20		ug/l	TRG					5 U	5 U
8270D	2,4-DIMETHYLPHENOL	105-67-9	100		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	2,4-DIMETHYLPHENOL	105-67-9	100		ug/l	TRG					5 U	5 U
8270D	2,4-DINITROPHENOL	51-28-5	40		ug/l	TRG	20 U	20 U	20 U	20 U		
E625	2,4-DINITROPHENOL	51-28-5	40		ug/l	TRG					10 U	10 U

						Sample ID: CLP Sample ID(s): Parent Sample ID: Sample Date:	CF209D-GW-R3-P2-0-20170112 CF209D-GW-R3-P2-0 1/12/2017	CF209D-GW-R3-P2-1-20170112 CF209D-GW-R3-P2-1 CF209D-GW-R3-P2-0-20170112 1/12/2017	CF209D-GW-R3-P3-0-20170112 CF209D-GW-R3-P3-0 1/12/2017	CF209D-GW-R3-P4-0-20170112 CF209D-GW-R3-P4-0 1/12/2017	CF-209D-PT-R1-20170203-0 BD6Z2 2/3/2017	CFS-PILOTTEST-COL1-20170208-0 BD6Z5 2/8/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**						
8270D	2,4-DINITROTOLUENE	121-14-2	NS		ug/l	TRG	2 U	2 U	2 U	2 U		
E625	2,4-DINITROTOLUENE	121-14-2	NS		ug/l	TRG					5 U	5 U
8270D	2,6-DINITROTOLUENE	606-20-2	NS		ug/l	TRG	2 U	2 U	2 U	2 U		
E625	2,6-DINITROTOLUENE	606-20-2	NS		ug/l	TRG					5 U	5 U
8270D	2-CHLORONAPHTHALENE	91-58-7	600		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	2-CHLORONAPHTHALENE	91-58-7	600		ug/l	TRG					5 U	5 U
8270D	2-CHLOROPHENOL	95-57-8	40		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	2-CHLOROPHENOL	95-57-8	40		ug/l	TRG					5 U	5 U
8270D	2-METHYLNAPHTHALENE	91-57-6	30	*Interim GWQC	ug/l	TRG	10 U	10 U	10 U	10 U		
E625	2-METHYLNAPHTHALENE	91-57-6	30	*Interim GWQC	ug/l	TRG						
E625 SIM	2-METHYLNAPHTHALENE	91-57-6	30	*Interim GWQC	ug/l	TRG					0.1 U	0.1 U
8270D	2-METHYLPHENOL (O-CRESOL)	95-48-7	50	*Interim GWQC	ug/l	TRG	10 U	10 U	10 U	10 U		
E625	2-METHYLPHENOL (O-CRESOL)	95-48-7	50	*Interim GWQC	ug/l	TRG					10 U	10 U
8270D	2-NITROANILINE	88-74-4	NS		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	2-NITROANILINE	88-74-4	NS		ug/l	TRG					5 U	5 U
8270D	2-NITROPHENOL	88-75-5	NS		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	2-NITROPHENOL	88-75-5	NS		ug/l	TRG					5 U	5 U
8270D	3,3'-DICHLOROBENZIDINE	91-94-1	30		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	3,3'-DICHLOROBENZIDINE	91-94-1	30		ug/l	TRG					10 U	10 U
8270D	3-NITROANILINE	99-09-2	NS		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	3-NITROANILINE	99-09-2	NS		ug/l	TRG					10 U	10 U
8270D	4,6-DINITRO-2-METHYLPHENOL	534-52-1	1	*Interim GWQC	ug/l	TRG	20 U	20 U	20 U	20 U		
E625	4,6-DINITRO-2-METHYLPHENOL	534-52-1	1	*Interim GWQC	ug/l	TRG					10 U	10 U
8270D	4-BROMOPHENYL PHENYL ETHER	101-55-3	NS		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	4-BROMOPHENYL PHENYL ETHER	101-55-3	NS		ug/l	TRG					5 U	5 U
8270D	4-CHLORO-3-METHYLPHENOL	59-50-7	100	*Interim GWQC	ug/l	TRG	10 U	10 U	10 U	10 U		
E625	4-CHLORO-3-METHYLPHENOL	59-50-7	100	*Interim GWQC	ug/l	TRG					5 U	5 U
8270D	4-CHLOROANILINE	106-47-8	30		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	4-CHLOROANILINE	106-47-8	30		ug/l	TRG					10 U	10 U
8270D	4-CHLOROPHENYL PHENYL ETHER	7005-72-3	NS		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	4-CHLOROPHENYL PHENYL ETHER	7005-72-3	NS		ug/l	TRG					5 U	5 U
8270D	4-METHYLPHENOL (P-CRESOL)	106-44-5	50		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	4-METHYLPHENOL (P-CRESOL)	106-44-5	50		ug/l	TRG					10 U	10 U
8270D	4-NITROANILINE	100-01-6	NS		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	4-NITROANILINE	100-01-6	NS		ug/l	TRG					10 U	10 U
8270D	4-NITROPHENOL	100-02-7	NS		ug/l	TRG	20 U	20 U	20 U	20 U		
E625	4-NITROPHENOL	100-02-7	NS		ug/l	TRG					10 U	10 U
E625	6-OCTADECENOIC ACID	1000336-66-8	NS		ug/l	TIC					**2 NJ**	
8270D	ACENAPHTHENE	83-32-9	400		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	ACENAPHTHENE	83-32-9	400		ug/l	TRG						
E625 SIM	ACENAPHTHENE	83-32-9	400		ug/l	TRG					0.1 U	0.1 U
8270D	ACENAPHTHYLENE	208-96-8	100	*Interim GWQC	ug/l	TRG	10 U	10 U	10 U	10 U		
E625	ACENAPHTHYLENE	208-96-8	100	*Interim GWQC	ug/l	TRG						
E625 SIM	ACENAPHTHYLENE	208-96-8	100	*Interim GWQC	ug/l	TRG					0.1 U	0.1 U
8270D	ACETOPHENONE	98-86-2	700		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	ACETOPHENONE	98-86-2	700		ug/l	TRG					10 U	10 U
8270D SIM	ANTHRACENE	120-12-7	2000		ug/l	TRG	**0.16**	0.05 U	0.05 U	0.05 U		
E625	ANTHRACENE	120-12-7	2000		ug/l	TRG						
E625 SIM	ANTHRACENE	120-12-7	2000		ug/l	TRG					0.1 U	0.1 U
8270D	ATRAZINE	1912-24-9	3		ug/l	TRG	2 U	2 U	2 U	2 U		
E625	ATRAZINE	1912-24-9	3		ug/l	TRG					10 U	10 U
8270D	BENZALDEHYDE	100-52-7	NS		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	BENZALDEHYDE	100-52-7	NS		ug/l	TRG					10 U	10 U
8270D	BENZENESULFONAMIDE, N-BUTYL-	3622-84-2	NS		ug/l	TIC	**170 JN**	**150 JN**		**460 JN**		
E625	BENZENESULFONAMIDE, N-BUTYL-	3622-84-2	NS		ug/l	TIC					**6.8 NJ**	
8270D SIM	BENZO(A)ANTHRACENE	56-55-3	0.1		ug/l	TRG	**0.17**	0.05 U	0.05 U	0.05 U		
E625	BENZO(A)ANTHRACENE	56-55-3	0.1		ug/l	TRG						
E625 SIM	BENZO(A)ANTHRACENE	56-55-3	0.1		ug/l	TRG					0.05 U	0.05 U
8270D SIM	BENZO(A)PYRENE	50-32-8	0.1		ug/l	TRG	**0.15**	0.05 U	0.05 U	0.05 U		
E625	BENZO(A)PYRENE	50-32-8	0.1		ug/l	TRG						
E625 SIM	BENZO(A)PYRENE	50-32-8	0.1		ug/l	TRG					0.05 U	0.05 U
8270D SIM	BENZO(B)FLUORANTHENE	205-99-2	0.2		ug/l	TRG	**0.18**	0.05 U	0.05 U	0.05 U		
E625	BENZO(B)FLUORANTHENE	205-99-2	0.2		ug/l	TRG						
E625 SIM	BENZO(B)FLUORANTHENE	205-99-2	0.2		ug/l	TRG					0.05 U	0.05 U
8270D	BENZO(G,H,I)PERYLENE	191-24-2	100	*Interim GWQC	ug/l	TRG	10 U	10 U	10 U	10 U		
E625	BENZO(G,H,I)PERYLENE	191-24-2	100	*Interim GWQC	ug/l	TRG						
E625 SIM	BENZO(G,H,I)PERYLENE	191-24-2	100	*Interim GWQC	ug/l	TRG					0.1 U	0.1 U
8270D SIM	BENZO(K)FLUORANTHENE	207-08-9	0.5		ug/l	TRG	**0.14**	0.05 U	0.05 U	0.05 U		
E625	BENZO(K)FLUORANTHENE	207-08-9	0.5		ug/l	TRG						
E625 SIM	BENZO(K)FLUORANTHENE	207-08-9	0.5		ug/l	TRG					0.05 U	0.05 U
E625	BENZOIC ACID	65-85-0	30000		ug/l	TIC						
8270D	BENZYL BUTYL PHTHALATE	85-68-7	100		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	BENZYL BUTYL PHTHALATE	85-68-7	100		ug/l	TRG					5 U	5 U

						Sample ID: CLP Sample ID(s): Parent Sample ID: Sample Date:	CF209D-GW-R3-P2-0-20170112 CF209D-GW-R3-P2-0 1/12/2017	CF209D-GW-R3-P2-1-20170112 CF209D-GW-R3-P2-1 CF209D-GW-R3-P2-0-20170112 1/12/2017	CF209D-GW-R3-P3-0-20170112 CF209D-GW-R3-P3-0 1/12/2017	CF209D-GW-R3-P4-0-20170112 CF209D-GW-R3-P4-0 1/12/2017	CF-209D-PT-R1-20170203-0 BD6Z2 2/3/2017	CFS-PILOTTEST-COL1-20170208-0 BD6Z5 2/8/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**						
8270D	BIPHENYL (DIPHENYL)	92-52-4	400		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	BIPHENYL (DIPHENYL)	92-52-4	400		ug/l	TRG					5 U	5 U
8270D	BIS(2-CHLOROETHOXY) METHANE	111-91-1	NS		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	BIS(2-CHLOROETHOXY) METHANE	111-91-1	NS		ug/l	TRG					5 U	5 U
8270D SIM	BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	111-44-4	7		ug/l	TRG	**0.11**	0.02 U	0.02 U	0.02 U		
E625	BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	111-44-4	7		ug/l	TRG					10 U	10 U
E625	BIS(2-CHLOROISOPROPYL) ETHER	108-60-1	300		ug/l	TRG					10 U	10 U
8270D	BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	3		ug/l	TRG	2 U	2 U	2 U	2 U		
E625	BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	3		ug/l	TRG					5 U	5 U
8270D	BISPHENOL A	80-05-7	NS		ug/l	TIC						
8270D	BUTYL HEXADECANOATE	111-06-8	NS		ug/l	TIC		**6.4 JN**		**18 JN**		
8270D	BUTYL STEARATE	123-95-5	NS		ug/l	TIC				**13 JN**		
8270D	CAPROLACTAM	105-60-2	5000	*Interim GWQC	ug/l	TRG	10 U	10 U	10 U	10 U		
E625	CAPROLACTAM	105-60-2	5000	*Interim GWQC	ug/l	TRG					10 U	10 U
8270D	CARBAZOLE	86-74-8	NS		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	CARBAZOLE	86-74-8	NS		ug/l	TRG					10 U	10 U
8270D	CHRYSENE	218-01-9	5		ug/l	TRG	2 U	2 U	2 U	2 U		
E625	CHRYSENE	218-01-9	5		ug/l	TRG						
E625 SIM	CHRYSENE	218-01-9	5		ug/l	TRG					0.1 U	0.1 U
E625	CIS-13-OCTADECENOIC ACID	13126-39-1	NS		ug/l	TIC						
8270D SIM	DIBENZ(A,H)ANTHRACENE	53-70-3	0.3		ug/l	TRG	**0.15**	0.05 U	0.05 U	0.05 U		
E625	DIBENZ(A,H)ANTHRACENE	53-70-3	0.3		ug/l	TRG						
E625 SIM	DIBENZ(A,H)ANTHRACENE	53-70-3	0.3		ug/l	TRG					0.05 U	0.05 U
8270D	DIBENZOFURAN	132-64-9	NS		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	DIBENZOFURAN	132-64-9	NS		ug/l	TRG					5 U	5 U
8270D	DIETHYL PHTHALATE	84-66-2	6000		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	DIETHYL PHTHALATE	84-66-2	6000		ug/l	TRG					5 U	5 U
8270D	DIMETHYL PHTHALATE	131-11-3	100	*Interim GWQC	ug/l	TRG	10 U	10 U	10 U	10 U		
E625	DIMETHYL PHTHALATE	131-11-3	100	*Interim GWQC	ug/l	TRG					5 U	5 U
8270D	DI-N-BUTYL PHTHALATE	84-74-2	700		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	DI-N-BUTYL PHTHALATE	84-74-2	700		ug/l	TRG					5 U	5 U
8270D	DI-N-OCTYLPHTHALATE	117-84-0	100		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	DI-N-OCTYLPHTHALATE	117-84-0	100		ug/l	TRG					10 U	10 U
8270D SIM	FLUORANTHENE	206-44-0	300		ug/l	TRG	**0.18**	0.05 U	0.05 U	0.05 U		
E625	FLUORANTHENE	206-44-0	300		ug/l	TRG						
E625 SIM	FLUORANTHENE	206-44-0	300		ug/l	TRG					0.05 U	0.05 U
8270D	FLUORENE	86-73-7	300		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	FLUORENE	86-73-7	300		ug/l	TRG						
E625 SIM	FLUORENE	86-73-7	300		ug/l	TRG					0.1 U	0.1 U
8270D SIM	HEXACHLOROBENZENE	118-74-1	0.02		ug/l	TRG	**0.15**	0.02 U	0.02 U	0.02 U		
E625	HEXACHLOROBENZENE	118-74-1	0.02		ug/l	TRG						
E625 SIM	HEXACHLOROBENZENE	118-74-1	0.02		ug/l	TRG					0.1 U	0.1 U
8270D	HEXACHLOROBUTADIENE	87-68-3	1		ug/l	TRG	1 U	1 U	1 U	1 U		
E625	HEXACHLOROBUTADIENE	87-68-3	1		ug/l	TRG					5 U	5 U
8270D	HEXACHLOROCYCLOPENTADIENE	77-47-4	40		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	HEXACHLOROCYCLOPENTADIENE	77-47-4	40		ug/l	TRG					10 U	10 U
8270D	HEXACHLOROETHANE	67-72-1	7		ug/l	TRG	1 U	1 U	1 U	1 U		
E625	HEXACHLOROETHANE	67-72-1	7		ug/l	TRG					5 U	5 U
8270D	HEXADECANOIC ACID, 1,1-DIMETHYLETHYL	31158-91-5	NS		ug/l	TIC			**17 JN**			
8270D SIM	INDENO(1,2,3-C,D)PYRENE	193-39-5	0.2		ug/l	TRG	**0.2**	0.05 U	0.05 U	0.05 U		
E625	INDENO(1,2,3-C,D)PYRENE	193-39-5	0.2		ug/l	TRG						
E625 SIM	INDENO(1,2,3-C,D)PYRENE	193-39-5	0.2		ug/l	TRG					0.05 U	0.05 U
8270D	ISOPHORONE	78-59-1	40		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	ISOPHORONE	78-59-1	40		ug/l	TRG					5 U	5 U
SM2320B	LIME (AS CALCIUM CARBONATE)	471-34-1	NS		mg/l	TRG	**230**	**220**	**240**	**120**		

						Sample ID:	CF209D-GW-R3-P2-0-20170112	CF209D-GW-R3-P2-1-20170112	CF209D-GW-R3-P3-0-20170112	CF209D-GW-R3-P4-0-20170112	CF-209D-PT-R1-20170203-0	CFS-PILOTTEST-COL1-20170208-0
						CLP Sample ID(s):	CF209D-GW-R3-P2-0	CF209D-GW-R3-P2-1	CF209D-GW-R3-P3-0	CF209D-GW-R3-P4-0	BD6Z2	BD6Z5
						Parent Sample ID:		CF209D-GW-R3-P2-0-20170112				
						Sample Date:	1/12/2017	1/12/2017	1/12/2017	1/12/2017	2/3/2017	2/8/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**						
8270D	N,N-DIMETHYL FORMAMIDE	68-12-2	NS		ug/l	TIC			**7.8 JN**			
8270D	NAPHTHALENE	91-20-3	300		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	NAPHTHALENE	91-20-3	300		ug/l	TRG						
E625 SIM	NAPHTHALENE	91-20-3	300		ug/l	TRG					0.1 U	0.1 U
8270D	NITROBENZENE	98-95-3	6		ug/l	TRG	1 U	1 U	1 U	1 U		
E625	NITROBENZENE	98-95-3	6		ug/l	TRG					5 U	5 U
8270D	N-NITROSODI-N-PROPYLAMINE	621-64-7	10		ug/l	TRG	1 U	1 U	1 U	1 U		
E625	N-NITROSODI-N-PROPYLAMINE	621-64-7	10		ug/l	TRG					5 U	5 U
8270D	N-NITROSODIPHENYLAMINE	86-30-6	10		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	N-NITROSODIPHENYLAMINE	86-30-6	10		ug/l	TRG					5 U	5 U
E625	OCTADEC-9-ENOIC ACID	1000190-13-7	NS		ug/l	TIC						**2.3 NJ**
8270D	OCTADECANOIC ACID, 2-METHYLPROPYL EST	646-13-9	NS		ug/l	TIC			**11 JN**			
E625	OLEIC ACID	112-80-1	NS		ug/l	TIC						
8270D SIM	PENTACHLOROPHENOL	87-86-5	0.3		ug/l	TRG	0.2 U	0.2 U	0.2 U	0.2 U		
E625	PENTACHLOROPHENOL	87-86-5	0.3		ug/l	TRG						
E625 SIM	PENTACHLOROPHENOL	87-86-5	0.3		ug/l	TRG					**0.055 J**	10 U
8270D SIM	PHENANTHRENE	85-01-8	100	*Interim GWQC	ug/l	TRG	**0.17**	0.05 U	0.05 U	0.05 U		
E625	PHENANTHRENE	85-01-8	100	*Interim GWQC	ug/l	TRG						
E625 SIM	PHENANTHRENE	85-01-8	100	*Interim GWQC	ug/l	TRG					0.05 U	0.05 U
E625	PHENOBARBITAL	50-06-6	NS		ug/l	TIC					**7.2 NJ**	
8270D	PHENOL	108-95-2	2000		ug/l	TRG	10 U	10 U	10 U	10 U		
E625	PHENOL	108-95-2	2000		ug/l	TRG					10 U	10 U
8270D SIM	PYRENE	129-00-0	200		ug/l	TRG	**0.17**	0.05 U	0.05 U	0.05 U		
E625	PYRENE	129-00-0	200		ug/l	TRG						
E625 SIM	PYRENE	129-00-0	200		ug/l	TRG					0.05 U	0.05 U
SM2540C	RESIDUE, NON-FILTERABLE	010-17-3	NS		mg/l	TRG	**350**	**340**	**360**	**210**		
SM2540D	RESIDUE, NON-FILTERABLE	010-17-3	NS		mg/l	TRG	10 U	10 U	10 U	10 U		
8270D	TETRADECANOIC ACID	544-63-8	NS		ug/l	TIC						
8270D	TOTAL CONCENTRATION	TOT_CONC	NS		ug/l	TRG	**0**	**0**	**0**	**0**		
8270D SIM	TOTAL CONCENTRATION	TOT_CONC	NS		ug/l	TRG	**1.93**	**0**	**0**	**0**		
SM5310C	TOTAL ORGANIC CARBON	TOC	NS		mg/l	TRG	**4.3**	**3.7**	**6**	**6**		
8270D	TOTAL TICS	TOT_TICS	NS		ug/l	TIC	**254.9**	**226.9**	**579.1**	**604.9**		
8270D	UNKNOWN WITH 10TH HIGHEST CONC.	UNKNOWN10	NS		ug/l	TIC						
8270D	UNKNOWN WITH 2ND HIGHEST CONC.	UNKNOWN2	NS		ug/l	TIC						
8270D	UNKNOWN WITH 3RD HIGHEST CONC.	UNKNOWN3	NS		ug/l	TIC						
8270D	UNKNOWN WITH 4TH HIGHEST CONC.	UNKNOWN4	NS		ug/l	TIC						
8270D	UNKNOWN WITH 5TH HIGHEST CONC.	UNKNOWN5	NS		ug/l	TIC						
8270D	UNKNOWN WITH 6TH HIGHEST CONC.	UNKNOWN6	NS		ug/l	TIC						
8270D	UNKNOWN WITH 7TH HIGHEST CONC.	UNKNOWN7	NS		ug/l	TIC						
8270D	UNKNOWN WITH 8TH HIGHEST CONC.	UNKNOWN8	NS		ug/l	TIC						
8270D	UNKNOWN WITH 9TH HIGHEST CONC.	UNKNOWN9	NS		ug/l	TIC						
E625	UNKNOWN-01 (1 5.001)	UNKNOWN-01	NS		ug/l	TIC					**3 J**	**2.5 J**
E625	UNKNOWN-02 (1 5.001)	UNKNOWN-02	NS		ug/l	TIC					**4.7 J**	**2.5 J**
E625	UNKNOWN-03 (1 5.001)	UNKNOWN-03	NS		ug/l	TIC					**6.8 J**	**3.2 J**
E625	UNKNOWN-04 (1 5.001)	UNKNOWN-04	NS		ug/l	TIC					**2.6 J**	**2.1 J**
E625	UNKNOWN-05 (6 18.250)	UNKNOWN-05	NS		ug/l	TIC					**2.1 J**	
E625	UNKNOWN-06 (5 16.134)	UNKNOWN-06	NS		ug/l	TIC					**6.3 J**	
E625	UNKNOWN-07 (5 16.134)	UNKNOWN-07	NS		ug/l	TIC					**10 J**	
E625	UNKNOWN-08 (6 18.255)	UNKNOWN-08	NS		ug/l	TIC					**2.4 J**	
8270D	UNKNOWN-11	UNKNOWN11	NS		ug/l	TIC						
8270D	UNKNOWN-12	UNKNOWN12	NS		ug/l	TIC						
8270D	UNKNOWN-13	UNKNOWN13	NS		ug/l	TIC	**16 J**					
8270D	UNKNOWN-14	UNKNOWN14	NS		ug/l	TIC	**46 J**					
8270D	UNKNOWN-15	UNKNOWN15	NS		ug/l	TIC	**6.9 J**					
8270D	UNKNOWN-16	UNKNOWN16	NS		ug/l	TIC	**16 J**					
8270D	UNKNOWN-17	UNKNOWN17	NS		ug/l	TIC		**41 J**				
8270D	UNKNOWN-18	UNKNOWN18	NS		ug/l	TIC		**6.5 J**				
8270D	UNKNOWN-19	UNKNOWN19	NS		ug/l	TIC		**12 J**				
8270D	UNKNOWN-20	UNKNOWN20	NS		ug/l	TIC			**12 J**			
8270D	UNKNOWN-21	UNKNOWN21	NS		ug/l	TIC			**8.4 J**			
8270D	UNKNOWN-22	UNKNOWN22	NS		ug/l	TIC			**26 J**			
8270D	UNKNOWN-23	UNKNOWN23	NS		ug/l	TIC			**34 J**			
8270D	UNKNOWN-24	UNKNOWN24	NS		ug/l	TIC			**9.9 J**			
8270D	UNKNOWN-25	UNKNOWN25	NS		ug/l	TIC			**83 J**			
8270D	UNKNOWN-26	UNKNOWN26	NS		ug/l	TIC			**180 J**			
8270D	UNKNOWN-27	UNKNOWN27	NS		ug/l	TIC			**190 J**			
8270D	UNKNOWN-28	UNKNOWN28	NS		ug/l	TIC				**8.9 J**		
8270D	UNKNOWN-29	UNKNOWN29	NS		ug/l	TIC				**23 J**		
8270D	UNKNOWN-30	UNKNOWN30	NS		ug/l	TIC				**44 J**		
8270D	UNKNOWN-31	UNKNOWN31	NS		ug/l	TIC				**38 J**		

						Sample ID:	CF209D-GW-R3-P2-0-20170112	CF209D-GW-R3-P2-1-20170112	CF209D-GW-R3-P3-0-20170112	CF209D-GW-R3-P4-0-20170112	CF-209D-PT-R1-20170203-0	CFS-PILOTTEST-COL1-20170208-0
						CLP Sample ID(s):	CF209D-GW-R3-P2-0	CF209D-GW-R3-P2-1	CF209D-GW-R3-P3-0	CF209D-GW-R3-P4-0	BD6Z2	BD6Z5
						Parent Sample ID:		CF209D-GW-R3-P2-0-20170112				
						Sample Date:	1/12/2017	1/12/2017	1/12/2017	1/12/2017	2/3/2017	2/8/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria[(1)(2*)]**	**Note**	**Unit**	**Result Type**						
Pesticides												
8081B	ALDRIN	309-00-2	0.04		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	ALDRIN	309-00-2	0.04		ug/l	TRG					0.0025 UJ	
8081B	ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	319-84-6	0.02		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	319-84-6	0.02		ug/l	TRG					0.0025 UJ	
8081B	ALPHA ENDOSULFAN	959-98-8	40		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	ALPHA ENDOSULFAN	959-98-8	40		ug/l	TRG					0.0025 UJ	
8081B	ALPHA-CHLORDANE	5103-71-9	0.5		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	ALPHA-CHLORDANE	5103-71-9	0.5		ug/l	TRG					0.05 UJ	
8081B	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	319-85-7	0.04		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	319-85-7	0.04		ug/l	TRG					0.0025 UJ	
8081B	BETA ENDOSULFAN	33213-65-9	40		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	BETA ENDOSULFAN	33213-65-9	40		ug/l	TRG					0.1 UJ	
8081B	CHLORDENE; GAMMA-	56641-38-4	NS		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	BETA-CHLORDANE	5103-74-2	0.5		ug/l	TRG					0.05 UJ	
8081B	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	319-86-8	NS		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	319-86-8	NS		ug/l	TRG					0.0025 UJ	
8081B	DIELDRIN	60-57-1	0.03		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	DIELDRIN	60-57-1	0.03		ug/l	TRG					0.005 UJ	
8081B	ENDOSULFAN SULFATE	1031-07-8	40		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	ENDOSULFAN SULFATE	1031-07-8	40		ug/l	TRG					0.005 UJ	
8081B	ENDRIN	72-20-8	2		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	ENDRIN	72-20-8	2		ug/l	TRG					0.005 UJ	
8081B	ENDRIN ALDEHYDE	7421-93-4	NS		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	ENDRIN ALDEHYDE	7421-93-4	NS		ug/l	TRG					0.005 UJ	
8081B	ENDRIN KETONE	53494-70-5	NS		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	ENDRIN KETONE	53494-70-5	NS		ug/l	TRG					0.005 UJ	
8081B	GAMMA BHC (LINDANE)	58-89-9	0.03		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
8081B	GAMMA-CHLORDANE	12789-03-6	0.5		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
CPEST	GAMMA BHC (LINDANE)	58-89-9	0.03		ug/l	TRG					0.0025 UJ	
8081B	HEPTACHLOR	76-44-8	0.05		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	HEPTACHLOR	76-44-8	0.05		ug/l	TRG					0.0025 UJ	
8081B	HEPTACHLOR EPOXIDE	1024-57-3	0.2		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	HEPTACHLOR EPOXIDE	1024-57-3	0.2		ug/l	TRG					0.0025 UJ	
8081B	METHOXYCHLOR	72-43-5	40		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	METHOXYCHLOR	72-43-5	40		ug/l	TRG					0.5 UJ	
8081B	P,P'-DDD	72-54-8	0.1		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	P,P'-DDD	72-54-8	0.1		ug/l	TRG					0.005 UJ	
8081B	P,P'-DDE	72-55-9	0.1		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	P,P'-DDE	72-55-9	0.1		ug/l	TRG					0.005 UJ	
8081B	P,P'-DDT	50-29-3	0.1		ug/l	TRG	0.02 U	0.02 U	0.02 U	0.02 U		
CPEST	P,P'-DDT	50-29-3	0.1		ug/l	TRG					0.1 UJ	
8081B	TOXAPHENE	8001-35-2	2		ug/l	TRG	0.5 U	0.5 U	0.5 U	0.5 U		
CPEST	TOXAPHENE	8001-35-2	2		ug/l	TRG					0.05 UJ	
Polychlorinated Biphenyls (PCBs)												
8082A	CHLOROBIPHENYL	37324-23-5	0.5		ug/l	TRG	0.4 U	0.4 U	0.4 U	0.4 U		
E608	CHLOROBIPHENYL	37324-23-5	0.5		ug/l	TRG					0.03 U	
8082A	PCB-1016 (AROCLOR 1016)	12674-11-2	0.5		ug/l	TRG	0.4 U	0.4 U	0.4 U	0.4 U		
E608	PCB-1016 (AROCLOR 1016)	12674-11-2	0.5		ug/l	TRG					0.03 U	
8082A	PCB-1221 (AROCLOR 1221)	11104-28-2	0.5		ug/l	TRG	0.4 U	0.4 U	0.4 U	0.4 U		
E608	PCB-1221 (AROCLOR 1221)	11104-28-2	0.5		ug/l	TRG					0.03 U	
8082A	PCB-1232 (AROCLOR 1232)	11141-16-5	0.5		ug/l	TRG	0.4 U	0.4 U	0.4 U	0.4 U		
E608	PCB-1232 (AROCLOR 1232)	11141-16-5	0.5		ug/l	TRG					0.03 U	
8082A	PCB-1242 (AROCLOR 1242)	53469-21-9	0.5		ug/l	TRG	0.4 U	0.4 U	0.4 U	0.4 U		
E608	PCB-1242 (AROCLOR 1242)	53469-21-9	0.5		ug/l	TRG					0.03 U	
8082A	PCB-1248 (AROCLOR 1248)	12672-29-6	0.5		ug/l	TRG	0.4 U	0.4 U	0.4 U	0.4 U		
E608	PCB-1248 (AROCLOR 1248)	12672-29-6	0.5		ug/l	TRG					0.03 U	
8082A	PCB-1254 (AROCLOR 1254)	11097-69-1	0.5		ug/l	TRG	0.4 U	0.4 U	0.4 U	0.4 U		
E608	PCB-1254 (AROCLOR 1254)	11097-69-1	0.5		ug/l	TRG					0.03 U	
8082A	PCB-1260 (AROCLOR 1260)	11096-82-5	0.5		ug/l	TRG	0.4 U	0.4 U	0.4 U	0.4 U		
E608	PCB-1260 (AROCLOR 1260)	11096-82-5	0.5		ug/l	TRG					0.03 U	
8082A	PCB-1268 (AROCLOR 1268)	11100-14-4	0.5		ug/l	TRG	0.4 U	0.4 U	0.4 U	0.4 U		
E608	PCB-1268 (AROCLOR 1268)	11100-14-4	0.5		ug/l	TRG					0.03 U	
8082A	POLYCHLORINATED BIPHENYL (PCB)	1336-36-3	0.5		ug/l	TRG	0.4 U	0.4 U	0.4 U	0.4 U		

						Sample ID: CLP Sample ID(s): Parent Sample ID: Sample Date:	CF209D-GW-R3-P2-0-20170112 CF209D-GW-R3-P2-0 1/12/2017	CF209D-GW-R3-P2-1-20170112 CF209D-GW-R3-P2-1 CF209D-GW-R3-P2-0-20170112 1/12/2017	CF209D-GW-R3-P3-0-20170112 CF209D-GW-R3-P3-0 1/12/2017	CF209D-GW-R3-P4-0-20170112 CF209D-GW-R3-P4-0 1/12/2017	CF-209D-PT-R1-20170203-0 BD6Z2 2/3/2017	CFS-PILOTTEST-COL1-20170208-0 BD6Z5 2/8/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**						
Inorganics												
E200.8	ALUMINUM	7429-90-5	200		ug/l	TRG	10 U	10 U	10 U	10 U		
E200.7	ANTIMONY	7440-36-0	6		ug/l	TRG	60 U	60 U	60 U	60 U		
E200.7	ARSENIC	7440-38-2	3		ug/l	TRG	10 U	10 U	10 U	10 U		
E200.8	BARIUM	7440-39-3	6000		ug/l	TRG	**21.6**	**20.3**	**137**	**20.4**		
E200.7	BERYLLIUM	7440-41-7	1		ug/l	TRG	**0.24 J**	**0.22 J**	**0.099 J**	5 U		
E200.7	CADMIUM	7440-43-9	4		ug/l	TRG	5 U	5 U	5 U	5 U		
E200.7	CALCIUM	7440-70-2	NS		ug/l	TRG	**46300**	**44800**	**64400**	**38900**		
E300.0	CHLORIDE (AS CL)	16887-00-6	250		mg/l	TRG	**7.5**	**7**	**9.2**	**3.9**		
E200.8	CHROMIUM, TOTAL	7440-47-3	70		ug/l	TRG	1 U	1 U	1 U	1 U		
E200.7	COBALT	7440-48-4	100	*Interim GWQC	ug/l	TRG	50 U	50 U	50 U	50 U		
E200.8	COPPER	7440-50-8	1300		ug/l	TRG	**0.97 J**	**0.15 J**	**0.37 J**	**0.14 J**		
E335.4	CYANIDE	57-12-5	100		ug/l	TRG	10 U	10 U	10 U	10 U		
E200.7	HARDNESS (AS CACO3)	HARD	250		mg/l	CAL	**229**	**229**	**262**	**139**		
E200.7	IRON	7439-89-6	300		ug/l	TRG	**18200**	**19500**	**14300**	**1650**		
E200.7	LEAD	7439-92-1	5		ug/l	TRG	10 U	10 U	10 U	10 U		
E200.7	MAGNESIUM	7439-95-4	NS		ug/l	TRG	**27600**	**28500**	**24600**	**10200**		
E200.7	MANGANESE	7439-96-5	50		ug/l	TRG	**559**	**585**	**530**	**310**		
E245.2	MERCURY	7439-97-6	2		ug/l	TRG	0.2 U	0.2 U	0.2 U	0.2 U		
E200.7	NICKEL	7440-02-0	100		ug/l	TRG	40 U	40 U	40 U	40 U		
E200.7	POTASSIUM	7440-09-7	NS		ug/l	TRG	5000 U	5000 U	5000 U	5000 U		
E200.7	SELENIUM	7782-49-2	40		ug/l	TRG	35 U	35 U	**1.9 J**	35 U		
E200.7	SILVER	7440-22-4	40		ug/l	TRG	10 U	10 U	10 U	10 U		
E200.7	SODIUM	7440-23-5	50000		ug/l	TRG	**17000**	**17500**	**16700**	**9770**		
E200.7	THALLIUM	7440-28-0	2		ug/l	TRG	25 U	25 U	25 U	25 U		
E200.8	VANADIUM	7440-62-2	NS		ug/l	TRG	2 U	2 U	2 U	2 U		
E200.8	ZINC	7440-66-6	2000		ug/l	TRG	**1 J**	**1.2 J**	**1.5 J**	**2.1**		

						Sample ID: CLP Sample ID(s): Parent Sample ID: Sample Date:	CFS-PILOTTEST-COL3-20170220 BD701 2/20/2017	CFS-PILOTTEST-COL3-20170227 BD709 2/27/2017	CFS-PILOTTEST-COL3-FD-20170220 BD702 CFS-PILOTTEST-COL3-20170220 2/20/2017	CFS-PILOTTEST-INF-20170206-0 BD6Z4 2/6/2017	CFS-PILOTTEST-INF-20170220 BD700 2/20/2017	CFS-PILOTTEST-INF-20170227 BD708 2/27/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**						
Volatile Organic Compounds (VOCs)												
8260C	1,1,1-TRICHLOROETHANE	71-55-6	30		ug/l	TRG						
E524.2	1,1,1-TRICHLOROETHANE	71-55-6	30		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	1,1,2,2-TETRACHLOROETHANE	79-34-5	1		ug/l	TRG						
E524.2	1,1,2,2-TETRACHLOROETHANE	79-34-5	1		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	20000	*Interim GWQC	ug/l	TRG						
E524.2	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	20000	*Interim GWQC	ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	1,1,2-TRICHLOROETHANE	79-00-5	3		ug/l	TRG						
E524.2	1,1,2-TRICHLOROETHANE	79-00-5	3		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	1,1-DICHLOROETHANE	75-34-3	50		ug/l	TRG						
E524.2	1,1-DICHLOROETHANE	75-34-3	50		ug/l	TRG	0.5 U	0.5 U	0.5 U		**0.5**	0.5 U
8260C	1,1-DICHLOROETHENE	75-35-4	1		ug/l	TRG						
E524.2	1,1-DICHLOROETHENE	75-35-4	1		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	1,2,3-TRICHLOROBENZENE	87-61-6	NS		ug/l	TRG						
E524.2	1,2,3-TRICHLOROBENZENE	87-61-6	NS		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	1,2,4-TRICHLOROBENZENE	120-82-1	9		ug/l	TRG						
8260C SIM	1,2,3-TRICHLOROPROPANE	96-18-4	0.03		ug/l	TRG						
E524.2	1,2,4-TRICHLOROBENZENE	120-82-1	9		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C SIM	1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	0.02		ug/l	TRG						
E524.2	1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	0.02		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C SIM	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	106-93-4	0.03		ug/l	TRG						
E524.2	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	106-93-4	0.03		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	1,2-DICHLOROBENZENE	95-50-1	600		ug/l	TRG						
E524.2	1,2-DICHLOROBENZENE	95-50-1	600		ug/l	TRG	0.5 U	0.5 U	0.5 U		**0.22 J**	0.5 U
8260C	1,2-DICHLOROETHANE	107-06-2	2		ug/l	TRG						
E524.2	1,2-DICHLOROETHANE	107-06-2	2		ug/l	TRG	0.5 U	0.5 U	0.5 U		**3.8**	**0.6**
8260C	1,2-DICHLOROPROPANE	78-87-5	1		ug/l	TRG						
E524.2	1,2-DICHLOROPROPANE	78-87-5	1		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	1,3-DICHLOROBENZENE	541-73-1	600		ug/l	TRG						
E524.2	1,3-DICHLOROBENZENE	541-73-1	600		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	1,4-DICHLOROBENZENE	106-46-7	75		ug/l	TRG						
8260C	1,4-DIOXANE (P-DIOXANE)	123-91-1	0.4	*Interim GWQC	ug/l	TRG						
8260C SIM	1,4-DIOXANE (P-DIOXANE)	123-91-1	0.4	*Interim GWQC	ug/l	TRG						
8260C	1,4-DIOXANE, 2,5-DIMETHYL-	15176-21-3	NS		ug/l	TIC						
8270D	1,4-DICHLOROBENZENE	106-46-7	75		ug/l	TIC						
E524.2	1,4-DICHLOROBENZENE	106-46-7	75		ug/l	TRG	0.5 U	0.5 U	0.5 U		**1.2**	0.5 U
8260C	2-HEXANONE	591-78-6	300	*Interim GWQC	ug/l	TRG						
E524.2	2-HEXANONE	591-78-6	300	*Interim GWQC	ug/l	TRG	5 U	5 U	5 U		5 U	5 U
8260C	ACETONE	67-64-1	6000		ug/l	TRG						
E524.2	ACETONE	67-64-1	6000		ug/l	TRG	5 U	**2.6 J**	5 U		5 U	5 U
8260C	BENZENE	71-43-2	1		ug/l	TRG						
E524.2	BENZENE	71-43-2	1		ug/l	TRG	0.5 U	0.5 U	0.5 U		**6.1**	**0.17 J**
8260C	BROMOCHLOROMETHANE	74-97-5	NS		ug/l	TRG						
E524.2	BROMOCHLOROMETHANE	74-97-5	NS		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
E524.2	BROMODICHLOROMETHANE	75-27-4	1		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	BROMOFORM	75-25-2	4		ug/l	TRG						
E524.2	BROMOFORM	75-25-2	4		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	BROMOMETHANE	74-83-9	10		ug/l	TRG						
E524.2	BROMOMETHANE	74-83-9	10		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	CARBON DISULFIDE	75-15-0	700		ug/l	TRG						
E524.2	CARBON DISULFIDE	75-15-0	700		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	CARBON TETRACHLORIDE	56-23-5	1		ug/l	TRG						
E524.2	CARBON TETRACHLORIDE	56-23-5	1		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	CHLOROBENZENE	108-90-7	50		ug/l	TRG						
8260C	CHLORODIBROMOMETHANE	121-48-1	5	*Interim Generic GWQC	ug/l	TRG						
E524.2	CHLOROBENZENE	108-90-7	50		ug/l	TRG	0.5 U	0.5 U	0.5 U		**1.2**	0.5 U
8260C	CHLOROETHANE	75-00-3	5	*Interim GWQC	ug/l	TRG						
E524.2	CHLOROETHANE	75-00-3	5	*Interim GWQC	ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	CHLOROFORM	67-66-3	70		ug/l	TRG						
E524.2	CHLOROFORM	67-66-3	70		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	CHLOROMETHANE	74-87-3	NS		ug/l	TRG						
E524.2	CHLOROMETHANE	74-87-3	NS		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	CIS-1,2-DICHLOROETHYLENE	156-59-2	70		ug/l	TRG						
E524.2	CIS-1,2-DICHLOROETHYLENE	156-59-2	70		ug/l	TRG	0.5 U	0.5 U	0.5 U		**3.3**	**0.13 J**
8260C	CIS-1,3-DICHLOROPROPENE	10061-01-5	1		ug/l	TRG						
E524.2	CIS-1,3-DICHLOROPROPENE	10061-01-5	1		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	CYCLOHEXANE	110-82-7	NS		ug/l	TRG						
E524.2	CYCLOHEXANE	110-82-7	NS		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	DIBROMOCHLOROMETHANE	124-48-1	1		ug/l	TRG						
E524.2	DIBROMOCHLOROMETHANE	124-48-1	1		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	DICHLORODIFLUOROMETHANE	75-71-8	1000		ug/l	TRG						
E524.2	DICHLORODIFLUOROMETHANE	75-71-8	1000		ug/l	TRG	0.5 U	0.5 U	0.5 U		**0.36 J**	0.5 U

						Sample ID: CLP Sample ID(s): Parent Sample ID: Sample Date:	CFS-PILOTTEST-COL3-20170220 BD701 2/20/2017	CFS-PILOTTEST-COL3-20170227 BD709 2/27/2017	CFS-PILOTTEST-COL3-FD-20170220 BD702 CFS-PILOTTEST-COL3-20170220 2/20/2017	CFS-PILOTTEST-INF-20170206-0 BD6Z4 2/6/2017	CFS-PILOTTEST-INF-20170220 BD700 2/20/2017	CFS-PILOTTEST-INF-20170227 BD708 2/27/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**						
E524.2	DICHLOROFLUOROMETHANE	75-43-4	NS		ug/l	TIC						
8260C	DIETHYL ETHER (ETHYL ETHER)	60-29-7	1000		ug/l	TRG						
E524.2	DIETHYL ETHER (ETHYL ETHER)	60-29-7	1000		ug/l	TRG	50 U	50 U	50 U		**240**	50 U
8260C	ETHYLBENZENE	100-41-4	700		ug/l	TRG						
E524.2	ETHYLBENZENE	100-41-4	700		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	ISOPROPANOL	67-63-0	NS		ug/l	TIC						
E524.2	ISOPROPYL ETHER	108-20-3	20000		ug/l	TIC						
8260C	ISOPROPYLBENZENE (CUMENE)	98-82-8	700		ug/l	TRG						
E524.2	ISOPROPYLBENZENE (CUMENE)	98-82-8	700		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	M, P XYLENES	179601-23-1	1000		ug/l	TRG						
E524.2	M, P XYLENES	179601-23-1	1000		ug/l	TRG	0.5 U	0.5 U	0.5 U		**0.34 J**	**0.13 J**
8260C	METHYL ACETATE	79-20-9	7000		ug/l	TRG						
E524.2	METHYL ACETATE	79-20-9	7000		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	METHYL ETHYL KETONE (2-BUTANONE)	78-93-3	300		ug/l	TRG						
E524.2	METHYL ETHYL KETONE (2-BUTANONE)	78-93-3	300		ug/l	TRG	5 U	5 U	5 U		5 U	5 U
8260C	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	108-10-1	NS		ug/l	TRG						
E524.2	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	108-10-1	NS		ug/l	TRG	5 U	5 U	5 U		5 U	5 U
8260C	METHYLCYCLOHEXANE	108-87-2	NS		ug/l	TRG						
E524.2	METHYLCYCLOHEXANE	108-87-2	NS		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	METHYLENE CHLORIDE	75-09-2	3		ug/l	TRG						
E524.2	METHYLENE CHLORIDE	75-09-2	3		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
E524.2	OCTAMETHYLCYCLOTETRASILOXANE	556-67-2	NS		ug/l	TIC						
8260C	O-XYLENE (1,2-DIMETHYLBENZENE)	95-47-6	1000		ug/l	TRG						
E524.2	O-XYLENE (1,2-DIMETHYLBENZENE)	95-47-6	1000		ug/l	TRG	0.5 U	0.5 U	0.5 U		**0.14 J**	0.5 U
8260C	STYRENE	100-42-5	100		ug/l	TRG						
E524.2	STYRENE	100-42-5	100		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	TERT-BUTYL ALCOHOL	75-65-0	100		ug/l	TRG						
E524.2	TERT-BUTYL ALCOHOL	75-65-0	100		ug/l	TRG		**140 J+**				
8260C	TERT-BUTYL METHYL ETHER	1634-04-4	70		ug/l	TRG						
E524.2	TERT-BUTYL METHYL ETHER	1634-04-4	70		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	TETRACHLOROETHYLENE(PCE)	127-18-4	1		ug/l	TRG						
E524.2	TETRACHLOROETHYLENE(PCE)	127-18-4	1		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	TOLUENE	108-88-3	600		ug/l	TRG						
E524.2	TOLUENE	108-88-3	600		ug/l	TRG	0.5 U	0.5 U	0.5 U		**0.32 J**	0.5 U
8260C	TOTAL CONCENTRATION	TOT_CONC	NS		ug/l	TRG						
8260C	TOTAL TICS	TOT_TICS	NS		ug/l	TIC						
8260C	TRANS-1,2-DICHLOROETHENE	156-60-5	100		ug/l	TRG						
E524.2	TRANS-1,2-DICHLOROETHENE	156-60-5	100		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	TRANS-1,3-DICHLOROPROPENE	10061-02-6	1		ug/l	TRG						
E524.2	TRANS-1,3-DICHLOROPROPENE	10061-02-6	1		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	TRICHLOROETHYLENE (TCE)	79-01-6	1		ug/l	TRG						
E524.2	TRICHLOROETHYLENE (TCE)	79-01-6	1		ug/l	TRG	0.5 U	0.5 U	0.5 U		**0.31 J**	0.5 U
8260C	TRICHLOROFLUOROMETHANE	75-69-4	2000		ug/l	TRG						
E524.2	TRICHLOROFLUOROMETHANE	75-69-4	2000		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C	UNKNOWN WITH HIGHEST CONC.	UNKNOWN1	NS		ug/l	TIC						
E524.2	UNKNOWN ALKANE-01	UNK ALKANE-01	NS		ug/l	TIC					**1.1 J**	
E524.2	UNKNOWN-01 (1 5.001)	UNKNOWN-01	NS		ug/l	TIC					**0.53 J**	
E524.2	UNKNOWN-02 (1 5.001)	UNKNOWN-02	NS		ug/l	TIC					**1.2 J**	
E524.2	UNKNOWN-03 (1 5.001)	UNKNOWN-03	NS		ug/l	TIC						
8260C	VINYL CHLORIDE	75-01-4	1		ug/l	TRG						
E524.2	VINYL CHLORIDE	75-01-4	1		ug/l	TRG	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U
8260C SIM	TOTAL CONCENTRATION	TOT_CONC	NS		ug/l	TRG						
Semi-Volatile Organic Compounds (SVOCs)												
8270D	1,2,4,5-TETRACHLOROBENZENE	95-94-3	NS		ug/l	TRG						
E625	1,2,4,5-TETRACHLOROBENZENE	95-94-3	NS		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	1,4-DIOXANE (P-DIOXANE)	123-91-1	0.4	*Interim GWQC	ug/l	TIC						
E625	1,4-DIOXANE (P-DIOXANE)	123-91-1	0.4	*Interim GWQC	ug/l	TRG	**0.28 B**		0.11 U	**50**	**51 J-**	**61**
E625 SIM	1,4-DIOXANE (P-DIOXANE)	123-91-1	0.4	*Interim GWQC	ug/l	TRG		0.1 U				
8270D	1,4-DIOXANE, 2,5-DIMETHYL-	15176-21-3	NS		ug/l	TIC						
8270D	2,2'-OXYBIS[1-CHLOROPROPANE]	52438-91-2	NS		ug/l	TRG						
8270D	2,3,4,6-TETRACHLOROPHENOL	58-90-2	200		ug/l	TRG						
E625	2,3,4,6-TETRACHLOROPHENOL	58-90-2	200		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	2,4,5-TRICHLOROPHENOL	95-95-4	700		ug/l	TRG						
E625	2,4,5-TRICHLOROPHENOL	95-95-4	700		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	2,4,6-TRICHLOROPHENOL	88-06-2	20		ug/l	TRG						
E625	2,4,6-TRICHLOROPHENOL	88-06-2	20		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	2,4-DICHLOROPHENOL	120-83-2	20		ug/l	TRG						
E625	2,4-DICHLOROPHENOL	120-83-2	20		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	2,4-DIMETHYLPHENOL	105-67-9	100		ug/l	TRG						
E625	2,4-DIMETHYLPHENOL	105-67-9	100		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	2,4-DINITROPHENOL	51-28-5	40		ug/l	TRG						
E625	2,4-DINITROPHENOL	51-28-5	40		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U

						Sample ID: CLP Sample ID(s): Parent Sample ID: Sample Date:	CFS-PILOTTEST-COL3-20170220 BD701 2/20/2017	CFS-PILOTTEST-COL3-20170227 BD709 2/27/2017	CFS-PILOTTEST-COL3-FD-20170220 BD702 CFS-PILOTTEST-COL3-20170220 2/20/2017	CFS-PILOTTEST-INF-20170206-0 BD6Z4 2/6/2017	CFS-PILOTTEST-INF-20170220 BD700 2/20/2017	CFS-PILOTTEST-INF-20170227 BD708 2/27/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**						
8270D	2,4-DINITROTOLUENE	121-14-2	NS		ug/l	TRG						
E625	2,4-DINITROTOLUENE	121-14-2	NS		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	2,6-DINITROTOLUENE	606-20-2	NS		ug/l	TRG						
E625	2,6-DINITROTOLUENE	606-20-2	NS		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	2-CHLORONAPHTHALENE	91-58-7	600		ug/l	TRG						
E625	2-CHLORONAPHTHALENE	91-58-7	600		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	2-CHLOROPHENOL	95-57-8	40		ug/l	TRG						
E625	2-CHLOROPHENOL	95-57-8	40		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	2-METHYLNAPHTHALENE	91-57-6	30	*Interim GWQC	ug/l	TRG						
E625	2-METHYLNAPHTHALENE	91-57-6	30	*Interim GWQC	ug/l	TRG	0.1 U		0.11 U		0.1 U	
E625 SIM	2-METHYLNAPHTHALENE	91-57-6	30	*Interim GWQC	ug/l	TRG		0.1 U		0.1 U		0.1 U
8270D	2-METHYLPHENOL (O-CRESOL)	95-48-7	50	*Interim GWQC	ug/l	TRG						
E625	2-METHYLPHENOL (O-CRESOL)	95-48-7	50	*Interim GWQC	ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D	2-NITROANILINE	88-74-4	NS		ug/l	TRG						
E625	2-NITROANILINE	88-74-4	NS		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	2-NITROPHENOL	88-75-5	NS		ug/l	TRG						
E625	2-NITROPHENOL	88-75-5	NS		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	3,3'-DICHLOROBENZIDINE	91-94-1	30		ug/l	TRG						
E625	3,3'-DICHLOROBENZIDINE	91-94-1	30		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D	3-NITROANILINE	99-09-2	NS		ug/l	TRG						
E625	3-NITROANILINE	99-09-2	NS		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D	4,6-DINITRO-2-METHYLPHENOL	534-52-1	1	*Interim GWQC	ug/l	TRG						
E625	4,6-DINITRO-2-METHYLPHENOL	534-52-1	1	*Interim GWQC	ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D	4-BROMOPHENYL PHENYL ETHER	101-55-3	NS		ug/l	TRG						
E625	4-BROMOPHENYL PHENYL ETHER	101-55-3	NS		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	4-CHLORO-3-METHYLPHENOL	59-50-7	100	*Interim GWQC	ug/l	TRG						
E625	4-CHLORO-3-METHYLPHENOL	59-50-7	100	*Interim GWQC	ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	4-CHLOROANILINE	106-47-8	30		ug/l	TRG						
E625	4-CHLOROANILINE	106-47-8	30		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D	4-CHLOROPHENYL PHENYL ETHER	7005-72-3	NS		ug/l	TRG						
E625	4-CHLOROPHENYL PHENYL ETHER	7005-72-3	NS		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	4-METHYLPHENOL (P-CRESOL)	106-44-5	50		ug/l	TRG						
E625	4-METHYLPHENOL (P-CRESOL)	106-44-5	50		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D	4-NITROANILINE	100-01-6	NS		ug/l	TRG						
E625	4-NITROANILINE	100-01-6	NS		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D	4-NITROPHENOL	100-02-7	NS		ug/l	TRG						
E625	4-NITROPHENOL	100-02-7	NS		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
E625	6-OCTADECENOIC ACID	1000336-66-8	NS		ug/l	TIC						
8270D	ACENAPHTHENE	83-32-9	400		ug/l	TRG						
E625	ACENAPHTHENE	83-32-9	400		ug/l	TRG	0.1 U		0.11 U		0.1 U	
E625 SIM	ACENAPHTHENE	83-32-9	400		ug/l	TRG		0.1 U		0.1 U		0.1 U
8270D	ACENAPHTHYLENE	208-96-8	100	*Interim GWQC	ug/l	TRG						
E625	ACENAPHTHYLENE	208-96-8	100	*Interim GWQC	ug/l	TRG	0.1 U		0.11 U		0.1 U	
E625 SIM	ACENAPHTHYLENE	208-96-8	100	*Interim GWQC	ug/l	TRG		0.1 U		0.1 U		0.1 U
8270D	ACETOPHENONE	98-86-2	700		ug/l	TRG						
E625	ACETOPHENONE	98-86-2	700		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D SIM	ANTHRACENE	120-12-7	2000		ug/l	TRG						
E625	ANTHRACENE	120-12-7	2000		ug/l	TRG	0.1 U		0.11 U		0.1 U	
E625 SIM	ANTHRACENE	120-12-7	2000		ug/l	TRG		0.1 U		0.1 U		0.1 U
8270D	ATRAZINE	1912-24-9	3		ug/l	TRG						
E625	ATRAZINE	1912-24-9	3		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D	BENZALDEHYDE	100-52-7	NS		ug/l	TRG						
E625	BENZALDEHYDE	100-52-7	NS		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D	BENZENESULFONAMIDE, N-BUTYL-	3622-84-2	NS		ug/l	TIC						
E625	BENZENESULFONAMIDE, N-BUTYL-	3622-84-2	NS		ug/l	TIC						
8270D SIM	BENZO(A)ANTHRACENE	56-55-3	0.1		ug/l	TRG						
E625	BENZO(A)ANTHRACENE	56-55-3	0.1		ug/l	TRG	0.052 U		0.054 U		0.052 U	
E625 SIM	BENZO(A)ANTHRACENE	56-55-3	0.1		ug/l	TRG		0.05 U		0.05 U		0.05 U
8270D SIM	BENZO(A)PYRENE	50-32-8	0.1		ug/l	TRG						
E625	BENZO(A)PYRENE	50-32-8	0.1		ug/l	TRG	0.052 U		0.054 U		0.052 U	
E625 SIM	BENZO(A)PYRENE	50-32-8	0.1		ug/l	TRG		0.05 U		0.05 U		0.05 U
8270D SIM	BENZO(B)FLUORANTHENE	205-99-2	0.2		ug/l	TRG						
E625	BENZO(B)FLUORANTHENE	205-99-2	0.2		ug/l	TRG	0.052 U		0.054 U		0.052 U	
E625 SIM	BENZO(B)FLUORANTHENE	205-99-2	0.2		ug/l	TRG		0.05 U		0.05 U		0.05 U
8270D	BENZO(G,H,I)PERYLENE	191-24-2	100	*Interim GWQC	ug/l	TRG						
E625	BENZO(G,H,I)PERYLENE	191-24-2	100	*Interim GWQC	ug/l	TRG	0.1 U		0.11 U		0.1 U	
E625 SIM	BENZO(G,H,I)PERYLENE	191-24-2	100	*Interim GWQC	ug/l	TRG		0.1 U		0.1 U		0.1 U
8270D SIM	BENZO(K)FLUORANTHENE	207-08-9	0.5		ug/l	TRG						
E625	BENZO(K)FLUORANTHENE	207-08-9	0.5		ug/l	TRG	0.052 U		0.054 U		0.052 U	
E625 SIM	BENZO(K)FLUORANTHENE	207-08-9	0.5		ug/l	TRG		0.05 U		0.05 U		0.05 U
E625	BENZOIC ACID	65-85-0	30000		ug/l	TIC						**4.6 NJ**
8270D	BENZYL BUTYL PHTHALATE	85-68-7	100		ug/l	TRG						
E625	BENZYL BUTYL PHTHALATE	85-68-7	100		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U

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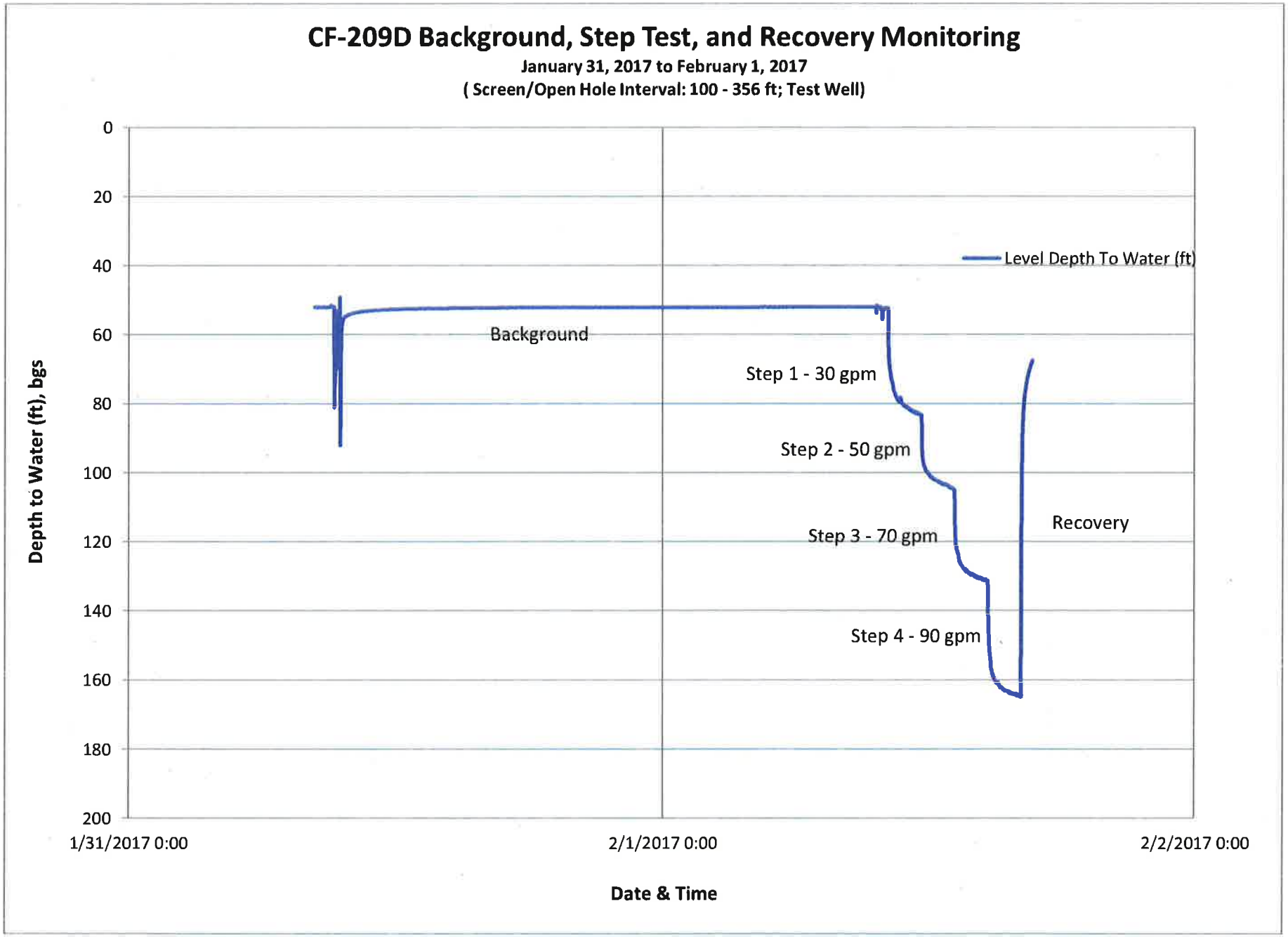
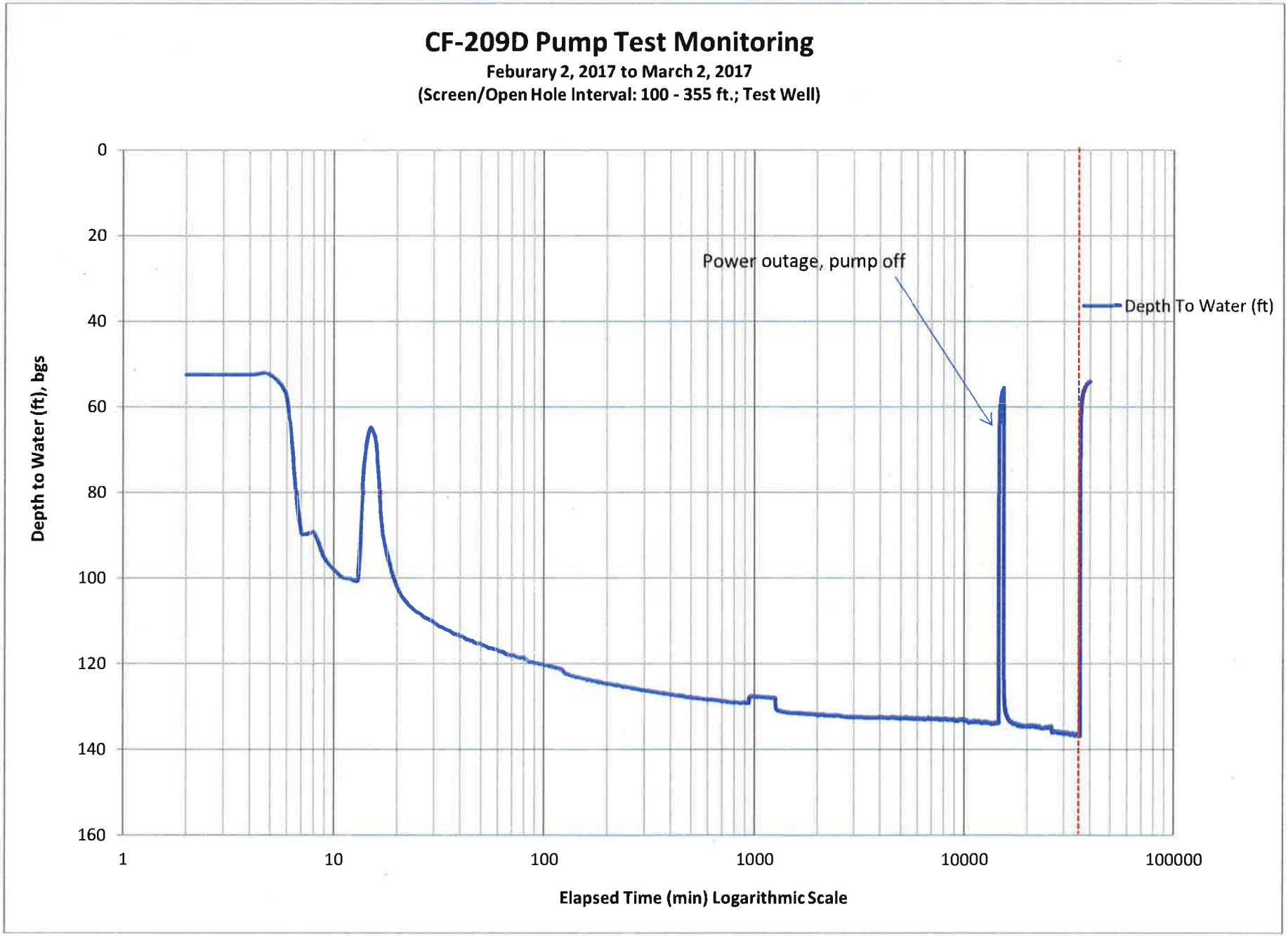
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**						
8270D	BIPHENYL (DIPHENYL)	92-52-4	400		ug/l	TRG						
E625	BIPHENYL (DIPHENYL)	92-52-4	400		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	BIS(2-CHLOROETHOXY) METHANE	111-91-1	NS		ug/l	TRG						
E625	BIS(2-CHLOROETHOXY) METHANE	111-91-1	NS		ug/l	TRG	5.1 U	5 U	5.3 U	**1.7 J**	5.3 U	5 U
8270D SIM	BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	111-44-4	7		ug/l	TRG						
E625	BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	111-44-4	7		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
E625	BIS(2-CHLOROISOPROPYL) ETHER	108-60-1	300		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D	BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	3		ug/l	TRG						
E625	BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	3		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	BISPHENOL A	80-05-7	NS		ug/l	TIC						
8270D	BUTYL HEXADECANOATE	111-06-8	NS		ug/l	TIC						
8270D	BUTYL STEARATE	123-95-5	NS		ug/l	TIC						
8270D	CAPROLACTAM	105-60-2	5000	*Interim GWQC	ug/l	TRG						
E625	CAPROLACTAM	105-60-2	5000	*Interim GWQC	ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D	CARBAZOLE	86-74-8	NS		ug/l	TRG						
E625	CARBAZOLE	86-74-8	NS		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D	CHRYSENE	218-01-9	5		ug/l	TRG						
E625	CHRYSENE	218-01-9	5		ug/l	TRG	0.1 U		0.11 U		0.1 U	
E625 SIM	CHRYSENE	218-01-9	5		ug/l	TRG		0.1 U		0.1 U		0.1 U
E625	CIS-13-OCTADECENOIC ACID	13126-39-1	NS		ug/l	TIC					**3.2 NJ**	
8270D SIM	DIBENZ(A,H)ANTHRACENE	53-70-3	0.3		ug/l	TRG						
E625	DIBENZ(A,H)ANTHRACENE	53-70-3	0.3		ug/l	TRG	0.052 U		0.054 U		0.052 U	
E625 SIM	DIBENZ(A,H)ANTHRACENE	53-70-3	0.3		ug/l	TRG		0.05 U		0.05 U		0.05 U
8270D	DIBENZOFURAN	132-64-9	NS		ug/l	TRG						
E625	DIBENZOFURAN	132-64-9	NS		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	DIETHYL PHTHALATE	84-66-2	6000		ug/l	TRG						
E625	DIETHYL PHTHALATE	84-66-2	6000		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	DIMETHYL PHTHALATE	131-11-3	100	*Interim GWQC	ug/l	TRG						
E625	DIMETHYL PHTHALATE	131-11-3	100	*Interim GWQC	ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	DI-N-BUTYL PHTHALATE	84-74-2	700		ug/l	TRG						
E625	DI-N-BUTYL PHTHALATE	84-74-2	700		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	DI-N-OCTYLPHTHALATE	117-84-0	100		ug/l	TRG						
E625	DI-N-OCTYLPHTHALATE	117-84-0	100		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D SIM	FLUORANTHENE	206-44-0	300		ug/l	TRG						
E625	FLUORANTHENE	206-44-0	300		ug/l	TRG	0.052 U		0.054 U		0.052 U	
E625 SIM	FLUORANTHENE	206-44-0	300		ug/l	TRG		0.05 U		0.05 U		0.05 U
8270D	FLUORENE	86-73-7	300		ug/l	TRG						
E625	FLUORENE	86-73-7	300		ug/l	TRG	0.1 U		0.11 U		0.1 U	
E625 SIM	FLUORENE	86-73-7	300		ug/l	TRG		0.1 U		0.1 U		0.1 U
8270D SIM	HEXACHLOROBENZENE	118-74-1	0.02		ug/l	TRG						
E625	HEXACHLOROBENZENE	118-74-1	0.02		ug/l	TRG	0.1 U		0.11 U		0.1 U	
E625 SIM	HEXACHLOROBENZENE	118-74-1	0.02		ug/l	TRG		0.1 U		0.1 U		0.1 U
8270D	HEXACHLOROBUTADIENE	87-68-3	1		ug/l	TRG						
E625	HEXACHLOROBUTADIENE	87-68-3	1		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	HEXACHLOROCYCLOPENTADIENE	77-47-4	40		ug/l	TRG						
E625	HEXACHLOROCYCLOPENTADIENE	77-47-4	40		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D	HEXACHLOROETHANE	67-72-1	7		ug/l	TRG						
E625	HEXACHLOROETHANE	67-72-1	7		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	HEXADECANOIC ACID, 1,1-DIMETHYLETHYL	31158-91-5	NS		ug/l	TIC						
8270D SIM	INDENO(1,2,3-C,D)PYRENE	193-39-5	0.2		ug/l	TRG						
E625	INDENO(1,2,3-C,D)PYRENE	193-39-5	0.2		ug/l	TRG	0.052 U		0.054 U		0.052 U	
E625 SIM	INDENO(1,2,3-C,D)PYRENE	193-39-5	0.2		ug/l	TRG		0.05 U		0.05 U		0.05 U
8270D	ISOPHORONE	78-59-1	40		ug/l	TRG						
E625	ISOPHORONE	78-59-1	40		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
SM2320B	LIME (AS CALCIUM CARBONATE)	471-34-1	NS		mg/l	TRG						

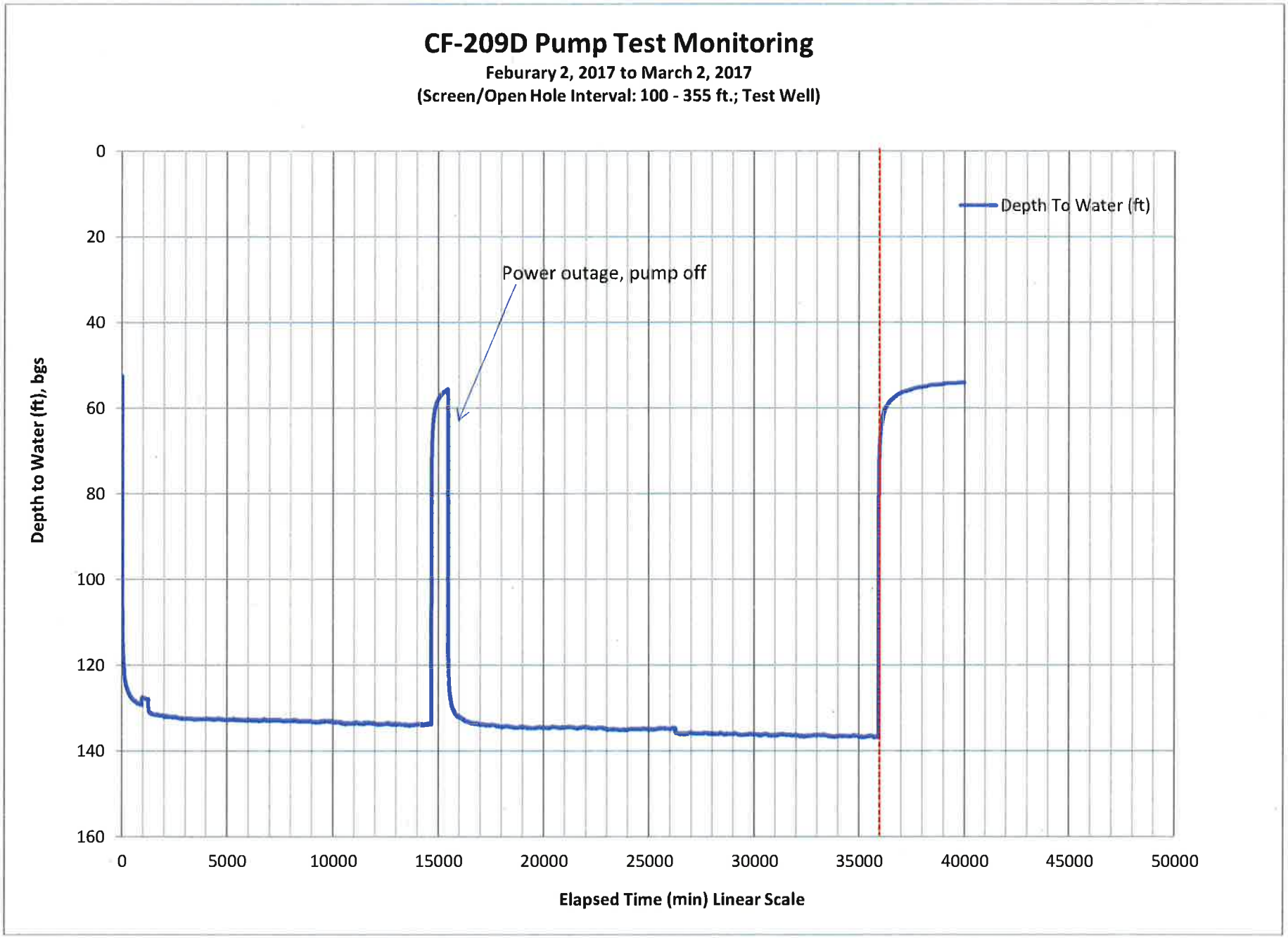
						Sample ID: CLP Sample ID(s): Parent Sample ID: Sample Date:	CFS-PILOTTEST-COL3-20170220 BD701 2/20/2017	CFS-PILOTTEST-COL3-20170227 BD709 2/27/2017	CFS-PILOTTEST-COL3-FD-20170220 BD702 CFS-PILOTTEST-COL3-20170220 2/20/2017	CFS-PILOTTEST-INF-20170206-0 BD6Z4 2/6/2017	CFS-PILOTTEST-INF-20170220 BD700 2/20/2017	CFS-PILOTTEST-INF-20170227 BD708 2/27/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**						
8270D	N,N-DIMETHYL FORMAMIDE	68-12-2	NS		ug/l	TIC						
8270D	NAPHTHALENE	91-20-3	300		ug/l	TRG						
E625	NAPHTHALENE	91-20-3	300		ug/l	TRG	0.1 U		0.11 U		0.1 U	
E625 SIM	NAPHTHALENE	91-20-3	300		ug/l	TRG		0.1 U		**0.022 J**		0.1 U
8270D	NITROBENZENE	98-95-3	6		ug/l	TRG						
E625	NITROBENZENE	98-95-3	6		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	N-NITROSODI-N-PROPYLAMINE	621-64-7	10		ug/l	TRG						
E625	N-NITROSODI-N-PROPYLAMINE	621-64-7	10		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
8270D	N-NITROSODIPHENYLAMINE	86-30-6	10		ug/l	TRG						
E625	N-NITROSODIPHENYLAMINE	86-30-6	10		ug/l	TRG	5.1 U	5 U	5.3 U	5 U	5.3 U	5 U
E625	OCTADEC-9-ENOIC ACID	1000190-13-7	NS		ug/l	TIC						
8270D	OCTADECANOIC ACID, 2-METHYLPROPYL EST	646-13-9	NS		ug/l	TIC						
E625	OLEIC ACID	112-80-1	NS		ug/l	TIC						
8270D SIM	PENTACHLOROPHENOL	87-86-5	0.3		ug/l	TRG						
E625	PENTACHLOROPHENOL	87-86-5	0.3		ug/l	TRG	0.1 UJ		0.11 UJ		0.1 UJ	
E625 SIM	PENTACHLOROPHENOL	87-86-5	0.3		ug/l	TRG		0.1 UJ		10 UJ		0.1 UJ
8270D SIM	PHENANTHRENE	85-01-8	100	*Interim GWQC	ug/l	TRG						
E625	PHENANTHRENE	85-01-8	100	*Interim GWQC	ug/l	TRG	0.052 U		0.054 U		0.052 U	
E625 SIM	PHENANTHRENE	85-01-8	100	*Interim GWQC	ug/l	TRG		0.05 U		0.05 U		0.05 U
E625	PHENOBARBITAL	50-06-6	NS		ug/l	TIC				**3.3 NJ**	**4.9 NJ**	
8270D	PHENOL	108-95-2	2000		ug/l	TRG						
E625	PHENOL	108-95-2	2000		ug/l	TRG	10 U	10 U	11 U	10 U	11 U	10 U
8270D SIM	PYRENE	129-00-0	200		ug/l	TRG						
E625	PYRENE	129-00-0	200		ug/l	TRG	0.052 U		0.054 U		0.052 U	
E625 SIM	PYRENE	129-00-0	200		ug/l	TRG		0.05 U		0.05 U		0.05 U
SM2540C	RESIDUE, NON-FILTERABLE	010-17-3	NS		mg/l	TRG						
SM2540D	RESIDUE, NON-FILTERABLE	010-17-3	NS		mg/l	TRG						
8270D	TETRADECANOIC ACID	544-63-8	NS		ug/l	TIC						
8270D	TOTAL CONCENTRATION	TOT_CONC	NS		ug/l	TRG						
8270D SIM	TOTAL CONCENTRATION	TOT_CONC	NS		ug/l	TRG						
SM5310C	TOTAL ORGANIC CARBON	TOC	NS		mg/l	TRG						
8270D	TOTAL TICS	TOT_TICS	NS		ug/l	TIC						
8270D	UNKNOWN WITH 10TH HIGHEST CONC.	UNKNOWN10	NS		ug/l	TIC						
8270D	UNKNOWN WITH 2ND HIGHEST CONC.	UNKNOWN2	NS		ug/l	TIC						
8270D	UNKNOWN WITH 3RD HIGHEST CONC.	UNKNOWN3	NS		ug/l	TIC						
8270D	UNKNOWN WITH 4TH HIGHEST CONC.	UNKNOWN4	NS		ug/l	TIC						
8270D	UNKNOWN WITH 5TH HIGHEST CONC.	UNKNOWN5	NS		ug/l	TIC						
8270D	UNKNOWN WITH 6TH HIGHEST CONC.	UNKNOWN6	NS		ug/l	TIC						
8270D	UNKNOWN WITH 7TH HIGHEST CONC.	UNKNOWN7	NS		ug/l	TIC						
8270D	UNKNOWN WITH 8TH HIGHEST CONC.	UNKNOWN8	NS		ug/l	TIC						
8270D	UNKNOWN WITH 9TH HIGHEST CONC.	UNKNOWN9	NS		ug/l	TIC						
E625	UNKNOWN-01 (1 5.001)	UNKNOWN-01	NS		ug/l	TIC				**4.5 J**	**4.2 J**	
E625	UNKNOWN-02 (1 5.001)	UNKNOWN-02	NS		ug/l	TIC				**5 J**	**4.1 J**	
E625	UNKNOWN-03 (1 5.001)	UNKNOWN-03	NS		ug/l	TIC				**4.2 J**	**3 J**	
E625	UNKNOWN-04 (1 5.001)	UNKNOWN-04	NS		ug/l	TIC				**5.6 J**	**3.6 J**	
E625	UNKNOWN-05 (6 18.250)	UNKNOWN-05	NS		ug/l	TIC						
E625	UNKNOWN-06 (5 16.134)	UNKNOWN-06	NS		ug/l	TIC						
E625	UNKNOWN-07 (5 16.134)	UNKNOWN-07	NS		ug/l	TIC						
E625	UNKNOWN-08 (6 18.255)	UNKNOWN-08	NS		ug/l	TIC						
8270D	UNKNOWN-11	UNKNOWN11	NS		ug/l	TIC						
8270D	UNKNOWN-12	UNKNOWN12	NS		ug/l	TIC						
8270D	UNKNOWN-13	UNKNOWN13	NS		ug/l	TIC						
8270D	UNKNOWN-14	UNKNOWN14	NS		ug/l	TIC						
8270D	UNKNOWN-15	UNKNOWN15	NS		ug/l	TIC						
8270D	UNKNOWN-16	UNKNOWN16	NS		ug/l	TIC						
8270D	UNKNOWN-17	UNKNOWN17	NS		ug/l	TIC						
8270D	UNKNOWN-18	UNKNOWN18	NS		ug/l	TIC						
8270D	UNKNOWN-19	UNKNOWN19	NS		ug/l	TIC						
8270D	UNKNOWN-20	UNKNOWN20	NS		ug/l	TIC						
8270D	UNKNOWN-21	UNKNOWN21	NS		ug/l	TIC						
8270D	UNKNOWN-22	UNKNOWN22	NS		ug/l	TIC						
8270D	UNKNOWN-23	UNKNOWN23	NS		ug/l	TIC						
8270D	UNKNOWN-24	UNKNOWN24	NS		ug/l	TIC						
8270D	UNKNOWN-25	UNKNOWN25	NS		ug/l	TIC						
8270D	UNKNOWN-26	UNKNOWN26	NS		ug/l	TIC						
8270D	UNKNOWN-27	UNKNOWN27	NS		ug/l	TIC						
8270D	UNKNOWN-28	UNKNOWN28	NS		ug/l	TIC						
8270D	UNKNOWN-29	UNKNOWN29	NS		ug/l	TIC						
8270D	UNKNOWN-30	UNKNOWN30	NS		ug/l	TIC						
8270D	UNKNOWN-31	UNKNOWN31	NS		ug/l	TIC						

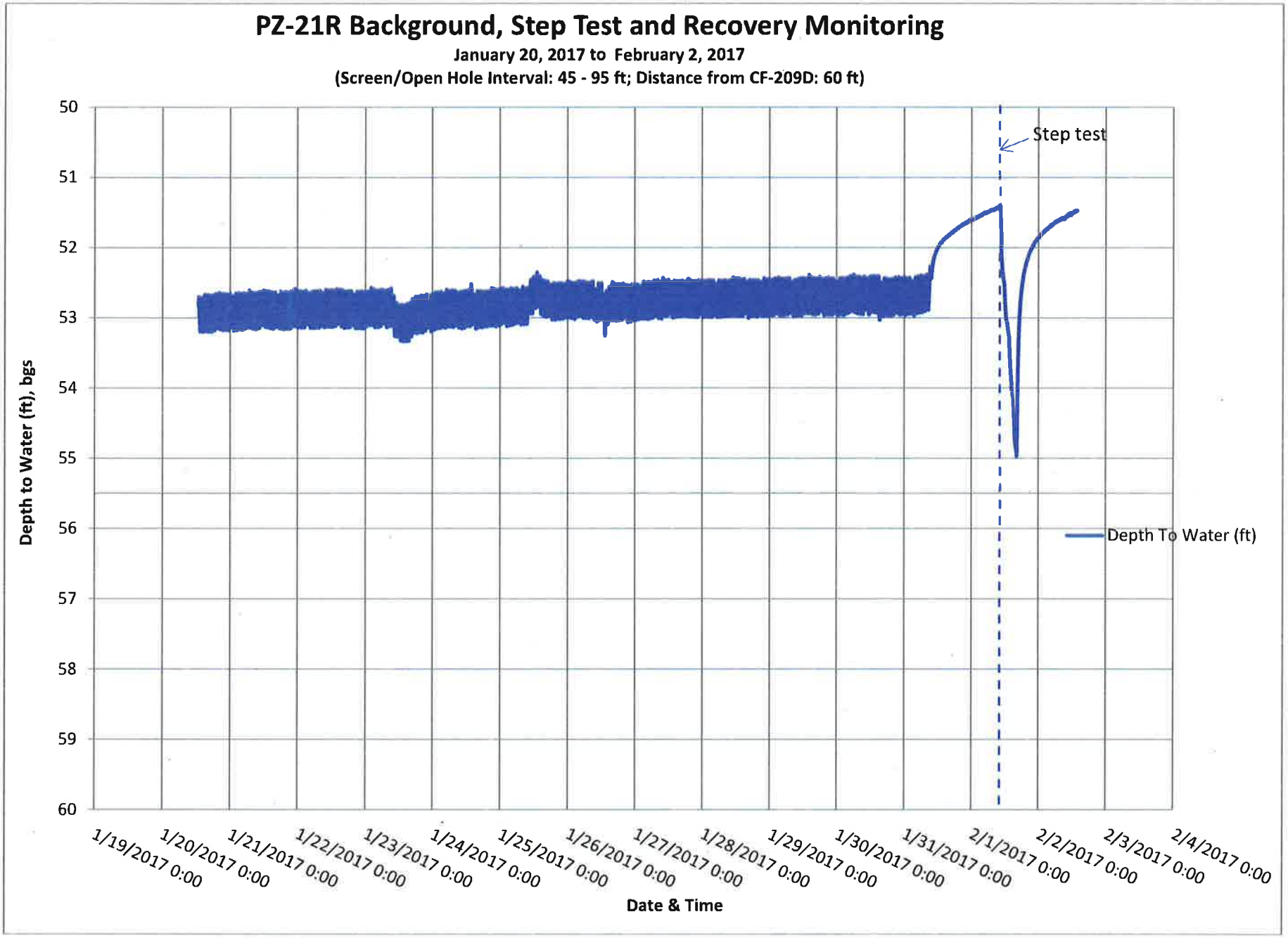
						Sample ID: CLP Sample ID(s): Parent Sample ID: Sample Date:	CFS-PILOTTEST-COL3-20170220 BD701 2/20/2017	CFS-PILOTTEST-COL3-20170227 BD709 2/27/2017	CFS-PILOTTEST-COL3-FD-20170220 BD702 CFS-PILOTTEST-COL3-20170220 2/20/2017	CFS-PILOTTEST-INF-20170206-0 BD6Z4 2/6/2017	CFS-PILOTTEST-INF-20170220 BD700 2/20/2017	CFS-PILOTTEST-INF-20170227 BD708 2/27/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**						
Pesticides												
8081B	ALDRIN	309-00-2	0.04		ug/l	TRG						
CPEST	ALDRIN	309-00-2	0.04		ug/l	TRG						
8081B	ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	319-84-6	0.02		ug/l	TRG						
CPEST	ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	319-84-6	0.02		ug/l	TRG						
8081B	ALPHA ENDOSULFAN	959-98-8	40		ug/l	TRG						
CPEST	ALPHA ENDOSULFAN	959-98-8	40		ug/l	TRG						
8081B	ALPHA-CHLORDANE	5103-71-9	0.5		ug/l	TRG						
CPEST	ALPHA-CHLORDANE	5103-71-9	0.5		ug/l	TRG						
8081B	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	319-85-7	0.04		ug/l	TRG						
CPEST	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	319-85-7	0.04		ug/l	TRG						
8081B	BETA ENDOSULFAN	33213-65-9	40		ug/l	TRG						
CPEST	BETA ENDOSULFAN	33213-65-9	40		ug/l	TRG						
8081B	CHLORDENE; GAMMA-	56641-38-4	NS		ug/l	TRG						
CPEST	BETA-CHLORDANE	5103-74-2	0.5		ug/l	TRG						
8081B	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	319-86-8	NS		ug/l	TRG						
CPEST	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	319-86-8	NS		ug/l	TRG						
8081B	DIELDRIN	60-57-1	0.03		ug/l	TRG						
CPEST	DIELDRIN	60-57-1	0.03		ug/l	TRG						
8081B	ENDOSULFAN SULFATE	1031-07-8	40		ug/l	TRG						
CPEST	ENDOSULFAN SULFATE	1031-07-8	40		ug/l	TRG						
8081B	ENDRIN	72-20-8	2		ug/l	TRG						
CPEST	ENDRIN	72-20-8	2		ug/l	TRG						
8081B	ENDRIN ALDEHYDE	7421-93-4	NS		ug/l	TRG						
CPEST	ENDRIN ALDEHYDE	7421-93-4	NS		ug/l	TRG						
8081B	ENDRIN KETONE	53494-70-5	NS		ug/l	TRG						
CPEST	ENDRIN KETONE	53494-70-5	NS		ug/l	TRG						
8081B	GAMMA BHC (LINDANE)	58-89-9	0.03		ug/l	TRG						
8081B	GAMMA-CHLORDANE	12789-03-6	0.5		ug/l	TRG						
CPEST	GAMMA BHC (LINDANE)	58-89-9	0.03		ug/l	TRG						
8081B	HEPTACHLOR	76-44-8	0.05		ug/l	TRG						
CPEST	HEPTACHLOR	76-44-8	0.05		ug/l	TRG						
8081B	HEPTACHLOR EPOXIDE	1024-57-3	0.2		ug/l	TRG						
CPEST	HEPTACHLOR EPOXIDE	1024-57-3	0.2		ug/l	TRG						
8081B	METHOXYCHLOR	72-43-5	40		ug/l	TRG						
CPEST	METHOXYCHLOR	72-43-5	40		ug/l	TRG						
8081B	P,P'-DDD	72-54-8	0.1		ug/l	TRG						
CPEST	P,P'-DDD	72-54-8	0.1		ug/l	TRG						
8081B	P,P'-DDE	72-55-9	0.1		ug/l	TRG						
CPEST	P,P'-DDE	72-55-9	0.1		ug/l	TRG						
8081B	P,P'-DDT	50-29-3	0.1		ug/l	TRG						
CPEST	P,P'-DDT	50-29-3	0.1		ug/l	TRG						
8081B	TOXAPHENE	8001-35-2	2		ug/l	TRG						
CPEST	TOXAPHENE	8001-35-2	2		ug/l	TRG						
Polychlorinated Biphenyls (PCBs)												
8082A	CHLOROBIPHENYL	37324-23-5	0.5		ug/l	TRG						
E608	CHLOROBIPHENYL	37324-23-5	0.5		ug/l	TRG						
8082A	PCB-1016 (AROCLOR 1016)	12674-11-2	0.5		ug/l	TRG						
E608	PCB-1016 (AROCLOR 1016)	12674-11-2	0.5		ug/l	TRG						
8082A	PCB-1221 (AROCLOR 1221)	11104-28-2	0.5		ug/l	TRG						
E608	PCB-1221 (AROCLOR 1221)	11104-28-2	0.5		ug/l	TRG						
8082A	PCB-1232 (AROCLOR 1232)	11141-16-5	0.5		ug/l	TRG						
E608	PCB-1232 (AROCLOR 1232)	11141-16-5	0.5		ug/l	TRG						
8082A	PCB-1242 (AROCLOR 1242)	53469-21-9	0.5		ug/l	TRG						
E608	PCB-1242 (AROCLOR 1242)	53469-21-9	0.5		ug/l	TRG						
8082A	PCB-1248 (AROCLOR 1248)	12672-29-6	0.5		ug/l	TRG						
E608	PCB-1248 (AROCLOR 1248)	12672-29-6	0.5		ug/l	TRG						
8082A	PCB-1254 (AROCLOR 1254)	11097-69-1	0.5		ug/l	TRG						
E608	PCB-1254 (AROCLOR 1254)	11097-69-1	0.5		ug/l	TRG						
8082A	PCB-1260 (AROCLOR 1260)	11096-82-5	0.5		ug/l	TRG						
E608	PCB-1260 (AROCLOR 1260)	11096-82-5	0.5		ug/l	TRG						
8082A	PCB-1268 (AROCLOR 1268)	11100-14-4	0.5		ug/l	TRG						
E608	PCB-1268 (AROCLOR 1268)	11100-14-4	0.5		ug/l	TRG						
8082A	POLYCHLORINATED BIPHENYL (PCB)	1336-36-3	0.5		ug/l	TRG						

						Sample ID: CLP Sample ID(s): Parent Sample ID: Sample Date:	CFS-PILOTTEST-COL3-20170220 BD701 2/20/2017	CFS-PILOTTEST-COL3-20170227 BD709 2/27/2017	CFS-PILOTTEST-COL3-FD-20170220 BD702 CFS-PILOTTEST-COL3-20170220 2/20/2017	CFS-PILOTTEST-INF-20170206-0 BD6Z4 2/6/2017	CFS-PILOTTEST-INF-20170220 BD700 2/20/2017	CFS-PILOTTEST-INF-20170227 BD708 2/27/2017
Method	**Analyte**	**CAS RN**	**NJDEP GWQS & Interim GWQ Criteria(1)(2*)**	**Note**	**Unit**	**Result Type**						
Inorganics												
E200.8	ALUMINUM	7429-90-5	200		ug/l	TRG						
E200.7	ANTIMONY	7440-36-0	6		ug/l	TRG						
E200.7	ARSENIC	7440-38-2	3		ug/l	TRG						
E200.8	BARIUM	7440-39-3	6000		ug/l	TRG						
E200.7	BERYLLIUM	7440-41-7	1		ug/l	TRG						
E200.7	CADMIUM	7440-43-9	4		ug/l	TRG						
E200.7	CALCIUM	7440-70-2	NS		ug/l	TRG						
E300.0	CHLORIDE (AS CL)	16887-00-6	250		mg/l	TRG						
E200.8	CHROMIUM, TOTAL	7440-47-3	70		ug/l	TRG						
E200.7	COBALT	7440-48-4	100	*Interim GWQC	ug/l	TRG						
E200.8	COPPER	7440-50-8	1300		ug/l	TRG						
E335.4	CYANIDE	57-12-5	100		ug/l	TRG						
E200.7	HARDNESS (AS CACO3)	HARD	250		mg/l	CAL						
E200.7	IRON	7439-89-6	300		ug/l	TRG						
E200.7	LEAD	7439-92-1	5		ug/l	TRG						
E200.7	MAGNESIUM	7439-95-4	NS		ug/l	TRG						
E200.7	MANGANESE	7439-96-5	50		ug/l	TRG						
E245.2	MERCURY	7439-97-6	2		ug/l	TRG						
E200.7	NICKEL	7440-02-0	100		ug/l	TRG						
E200.7	POTASSIUM	7440-09-7	NS		ug/l	TRG						
E200.7	SELENIUM	7782-49-2	40		ug/l	TRG						
E200.7	SILVER	7440-22-4	40		ug/l	TRG						
E200.7	SODIUM	7440-23-5	50000		ug/l	TRG						
E200.7	THALLIUM	7440-28-0	2		ug/l	TRG						
E200.8	VANADIUM	7440-62-2	NS		ug/l	TRG						
E200.8	ZINC	7440-66-6	2000		ug/l	TRG						


CF-209D Background, Step Test, and Recovery Monitoring
January 31, 2017 to February 1, 2017
(Screen/Open Hole Interval: 100 - 356 ft; Test Well)
Depth to Water (ft), bgs
0
20
40
60
80
100
120
140
160
180
200
1/31/2017 0:00
2/1/2017 0:00
2/2/2017 0:00
Date & Time
Level Depth To Water (ft)
Background
Step 1 - 30 gpm
Step 2 - 50 gpm
Step 3 - 70 gpm
Step 4 - 90 gpm
Recovery


CF-209D Pump Test Monitoring
Feburary 2, 2017 to March 2, 2017
(Screen/Open Hole Interval: 100 - 355 ft.; Test Well)
Power outage, pump off
Depth To Water (ft)
Depth to Water (ft), bgs
0
20
40
60
80
100
120
140
160
1
10
100
1000
10000
100000
Elapsed Time (min) Logarithmic Scale


CF-209D Pump Test Monitoring
Feburary 2, 2017 to March 2, 2017
(Screen/Open Hole Interval: 100 - 355 ft.; Test Well)
Depth to Water (ft), bgs
0
20
40
60
80
100
120
140
160
Power outage, pump off
Depth To Water (ft)
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
Elapsed Time (min) Linear Scale


PZ-21R Background, Step Test and Recovery Monitoring
January 20, 2017 to February 2, 2017
(Screen/Open Hole Interval: 45 - 95 ft; Distance from CF-209D: 60 ft)
Step test
Depth To Water (ft)
Depth to Water (ft), bgs
50
51
52
53
54
55
56
57
58
59
60
1/19/2017 0:00
1/20/2017 0:00
1/21/2017 0:00
1/22/2017 0:00
1/23/2017 0:00
1/24/2017 0:00
1/25/2017 0:00
1/26/2017 0:00
1/27/2017 0:00
1/28/2017 0:00
1/29/2017 0:00
1/30/2017 0:00
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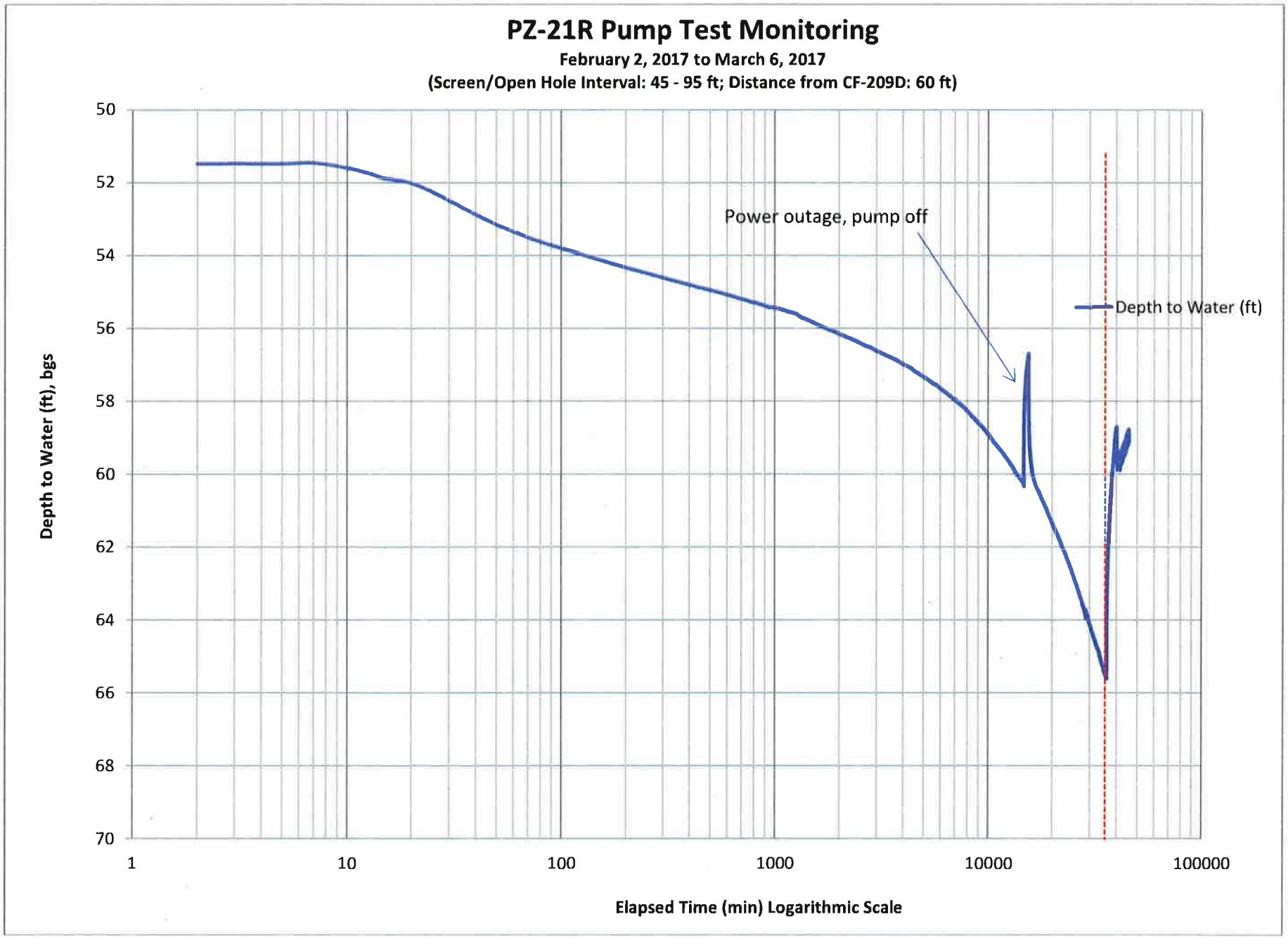
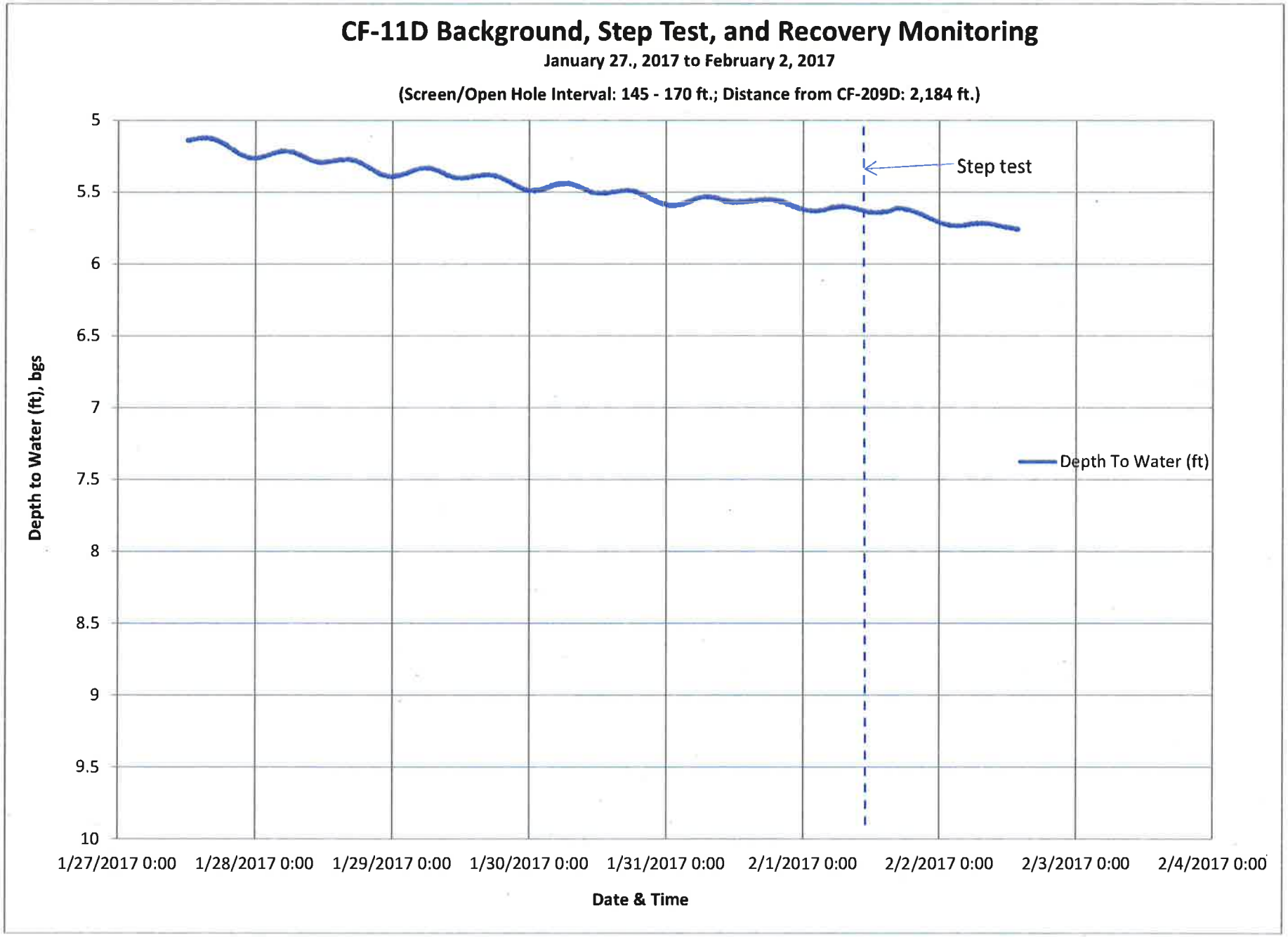
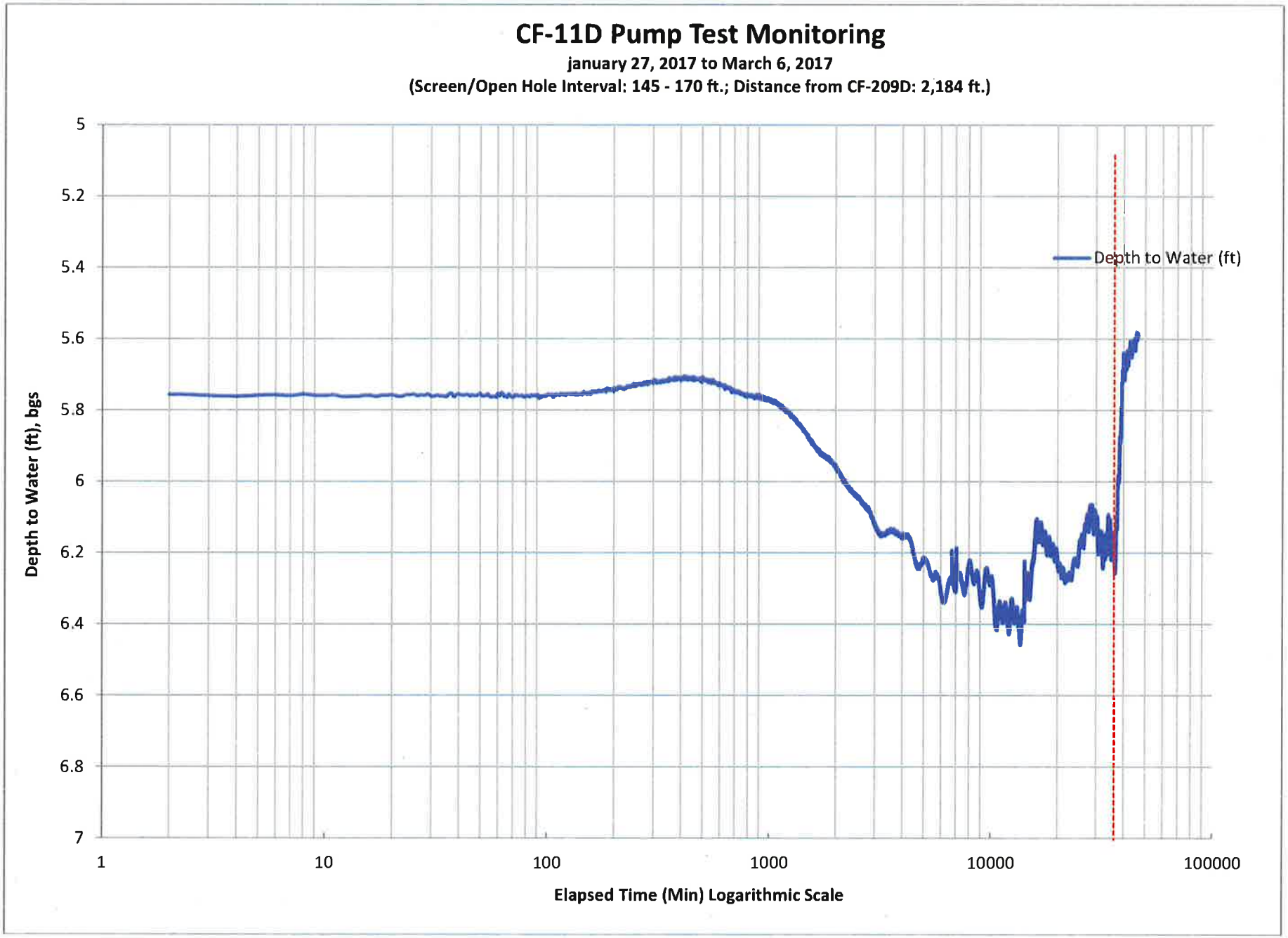
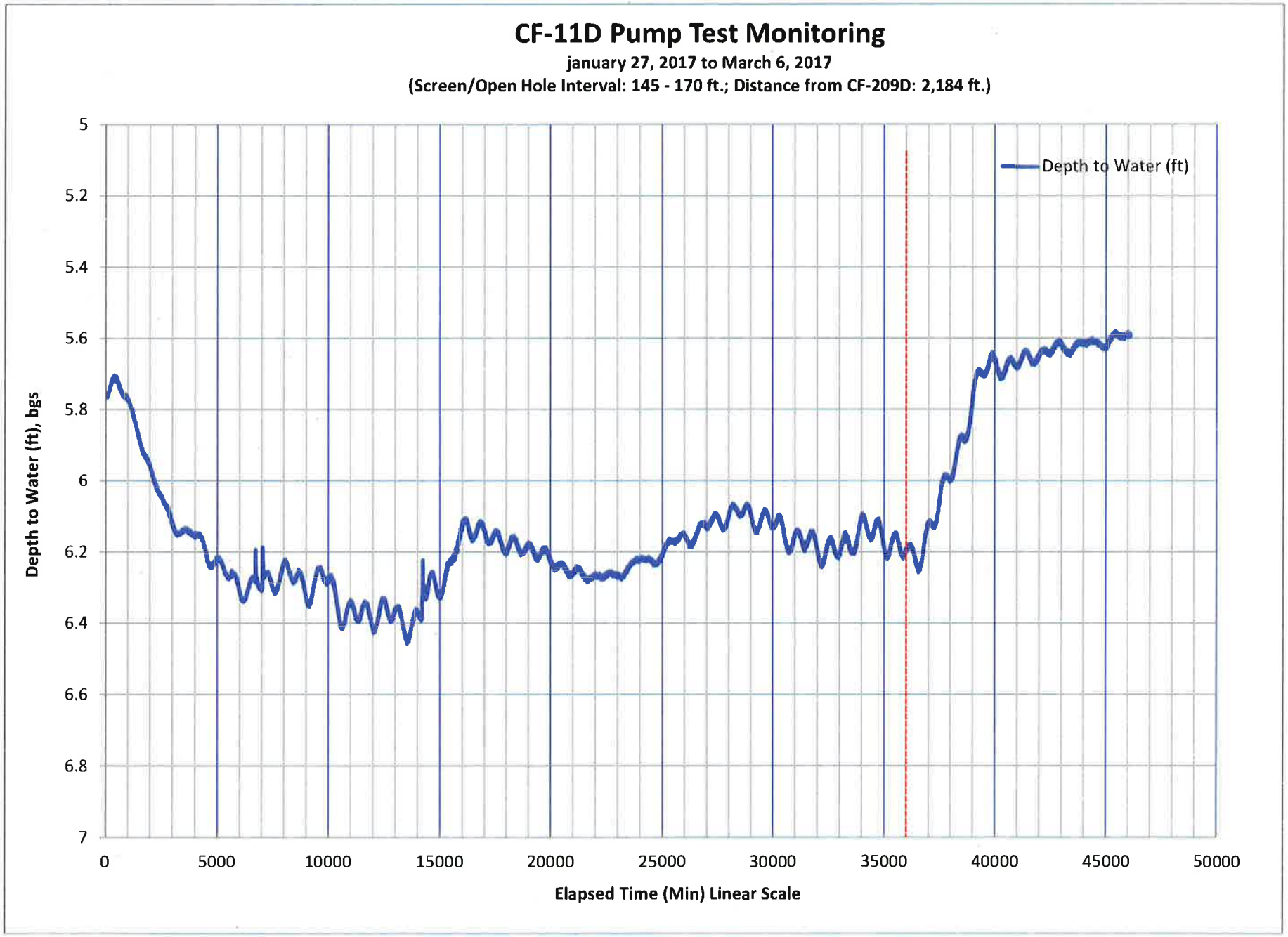
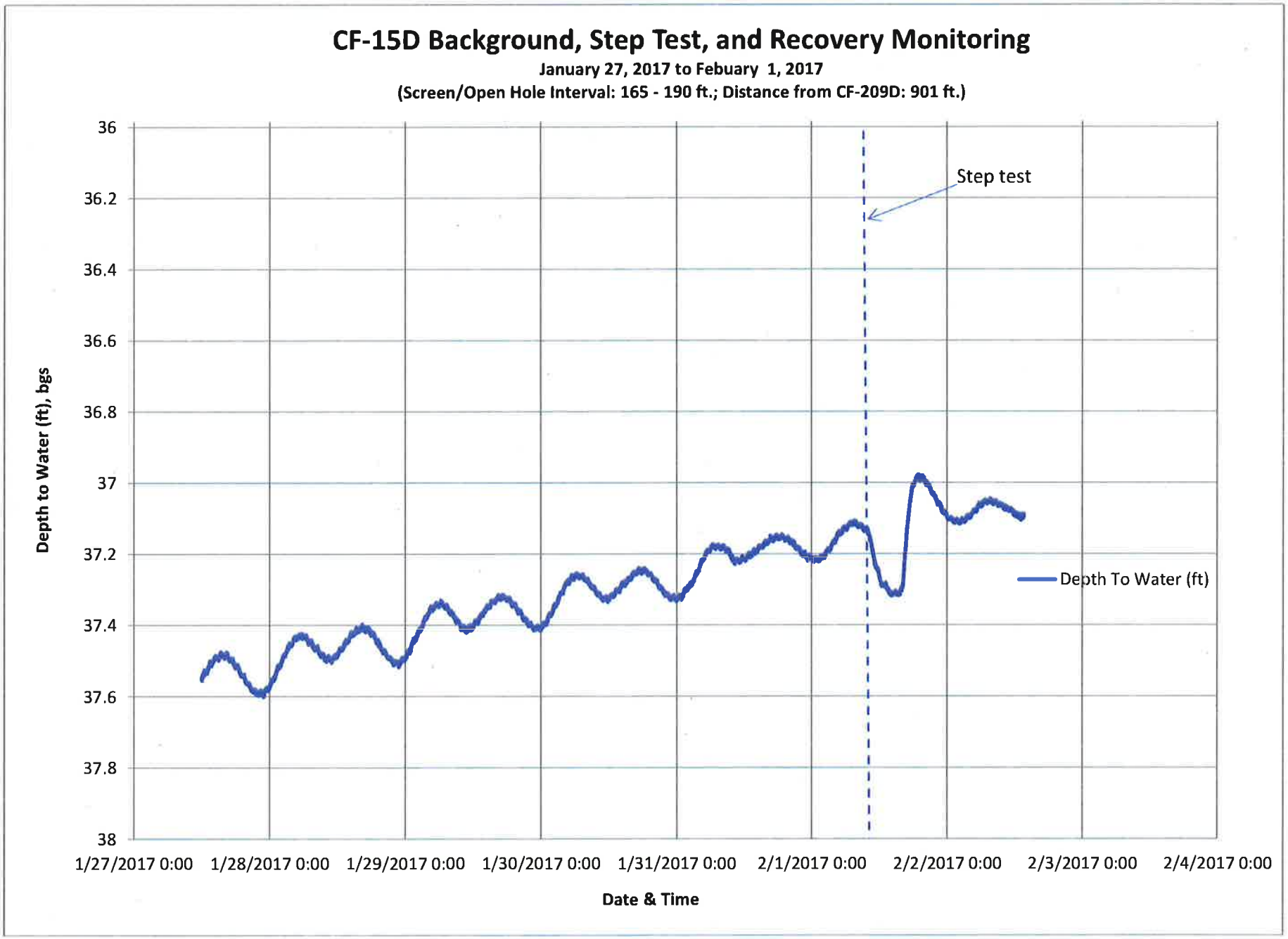
2/1/2017 0:00
2/2/2017 0:00
2/3/2017 0:00
2/4/2017 0:00
Date & Time

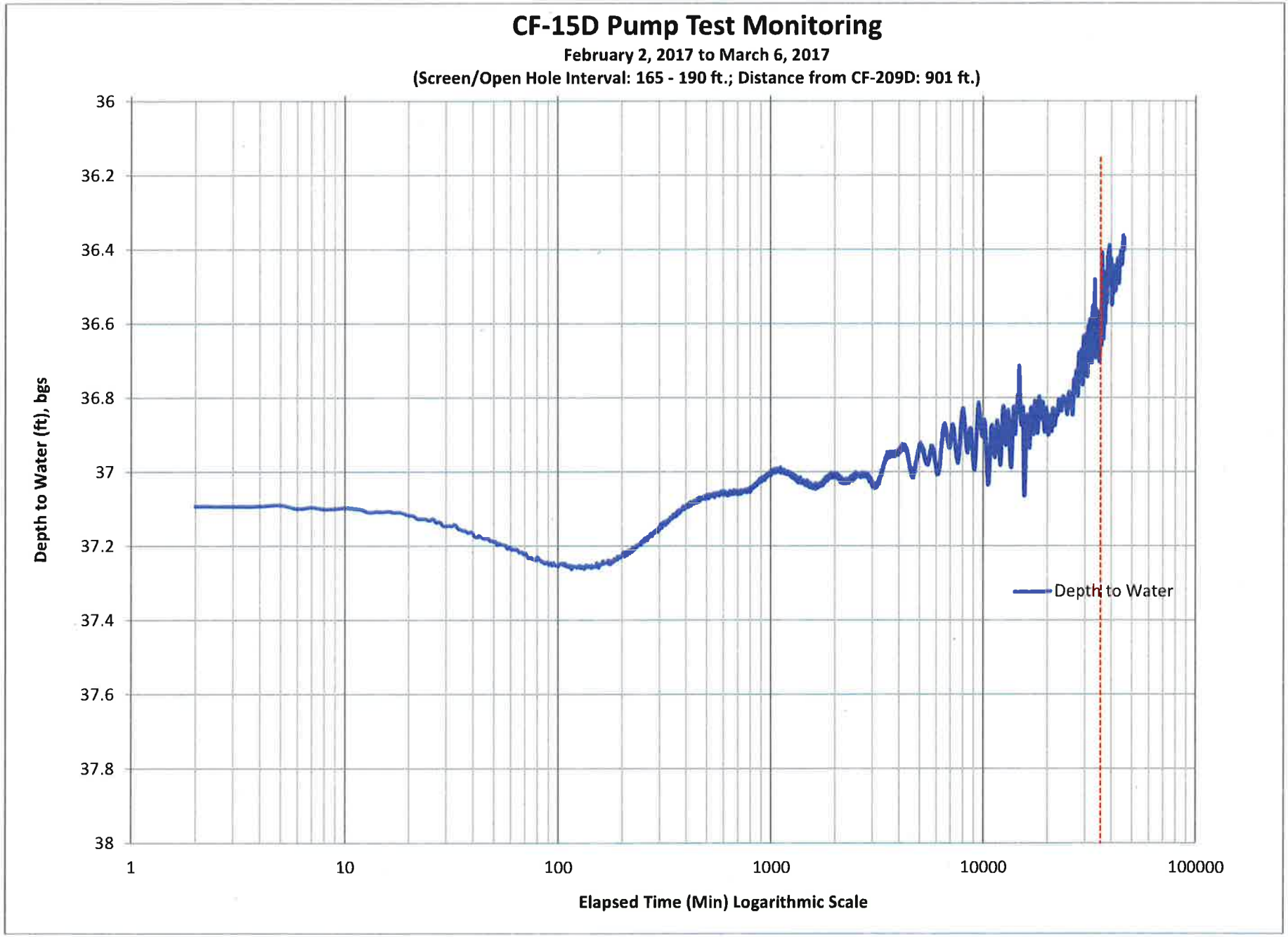

PZ-21R Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 45 - 95 ft; Distance from CF-209D: 60 ft)
Power outage, pump off
Depth to Water (ft)
Depth to Water (ft), bgs
50
52
54
56
58
60
62
64
66
68
70
1
10
100
1000
10000
100000
Elapsed Time (min) Logarithmic Scale

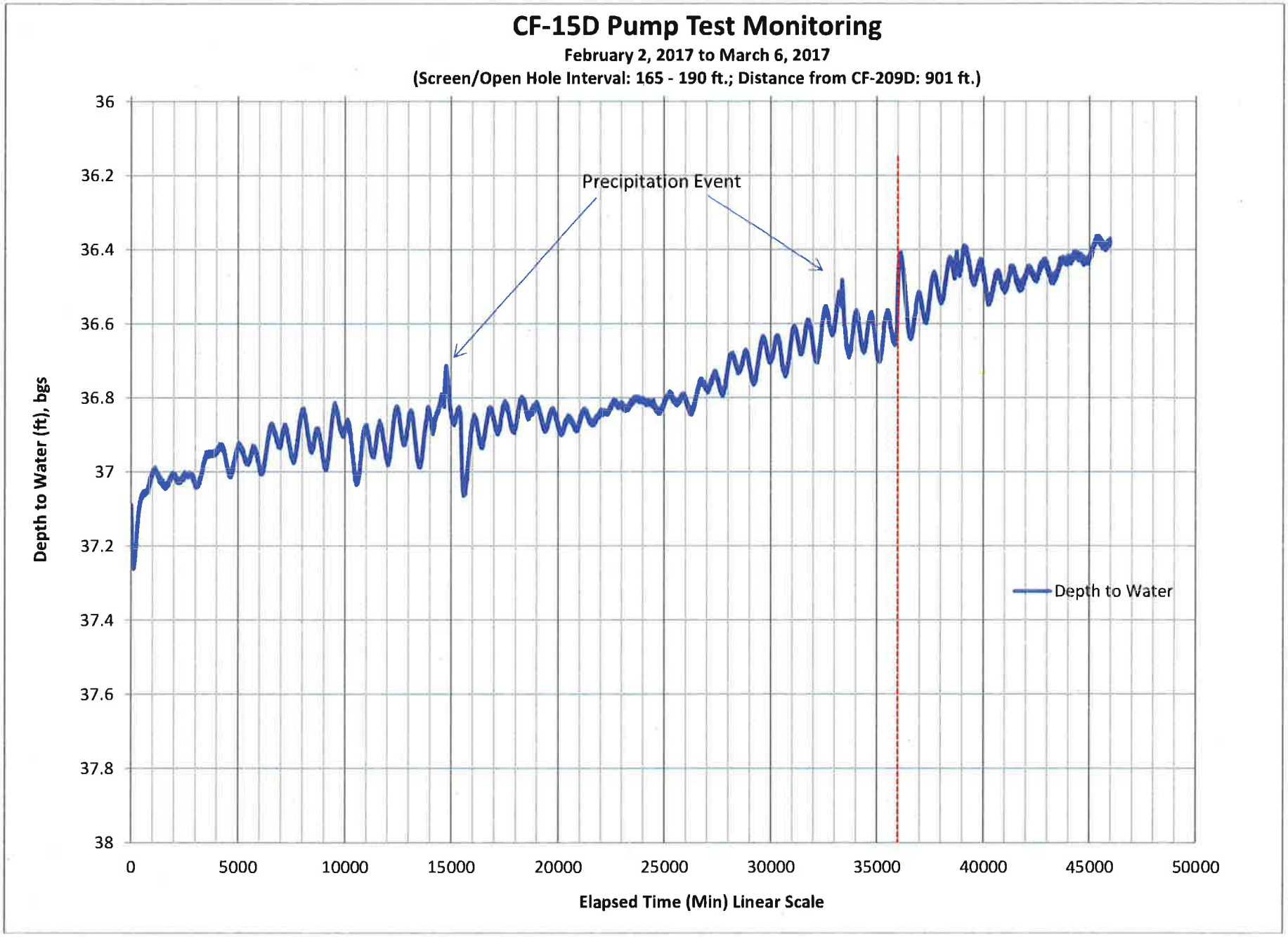

CF-11D Background, Step Test, and Recovery Monitoring
January 27., 2017 to February 2, 2017
(Screen/Open Hole Interval: 145 - 170 ft.; Distance from CF-209D: 2,184 ft.)
Step test
Depth To Water (ft)
Depth to Water (ft), bgs
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
1/27/2017 0:00
1/28/2017 0:00
1/29/2017 0:00
1/30/2017 0:00
1/31/2017 0:00
2/1/2017 0:00
2/2/2017 0:00
2/3/2017 0:00
2/4/2017 0:00
Date & Time

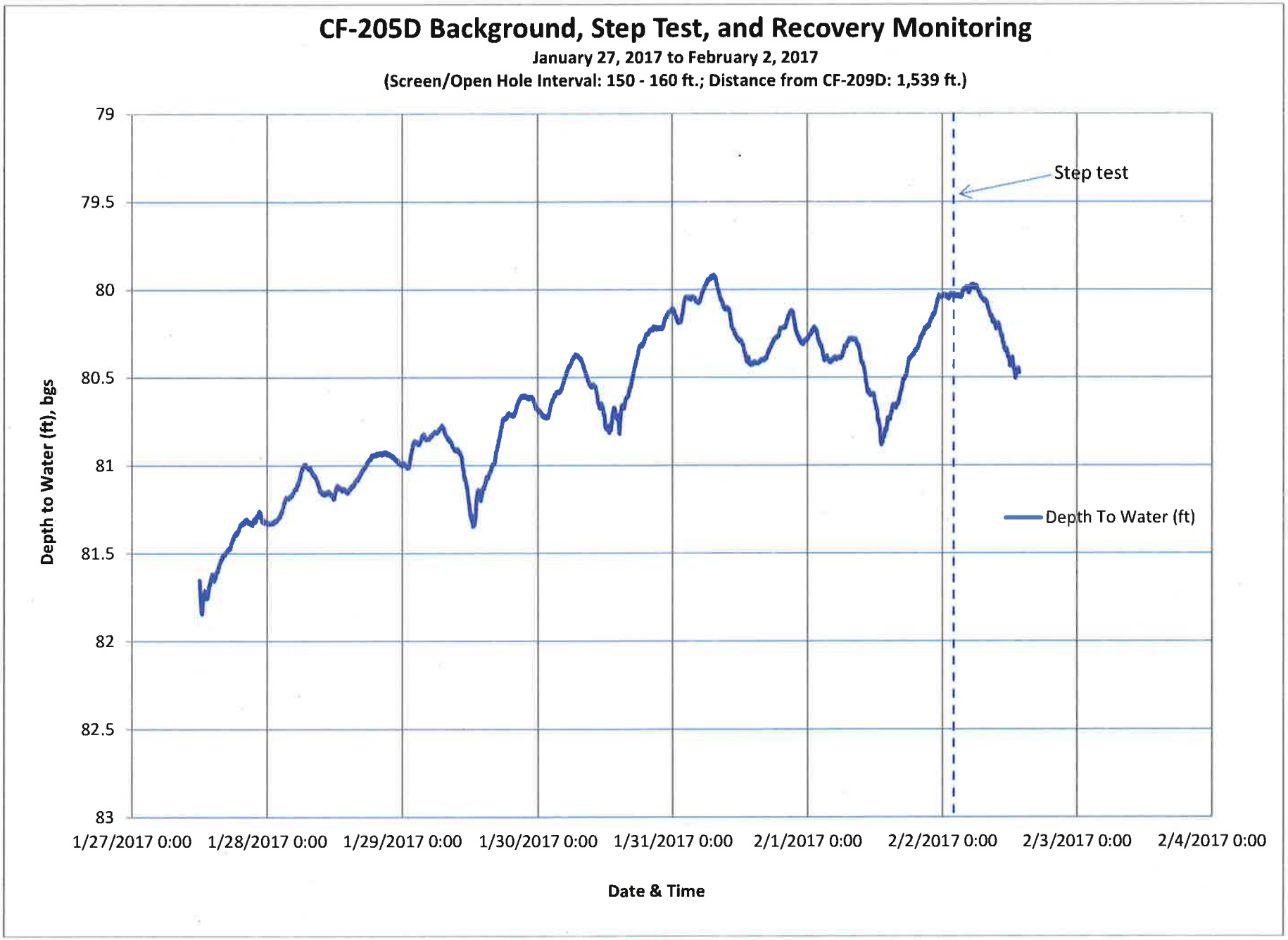

CF-11D Pump Test Monitoring
january 27, 2017 to March 6, 2017
(Screen/Open Hole Interval: 145 - 170 ft.; Distance from CF-209D: 2,184 ft.)
Depth to Water (ft), bgs
5
5.2
5.4
5.6
5.8
6
6.2
6.4
6.6
6.8
7
1
10
100
1000
10000
100000
Elapsed Time (Min) Logarithmic Scale
Depth to Water (ft)

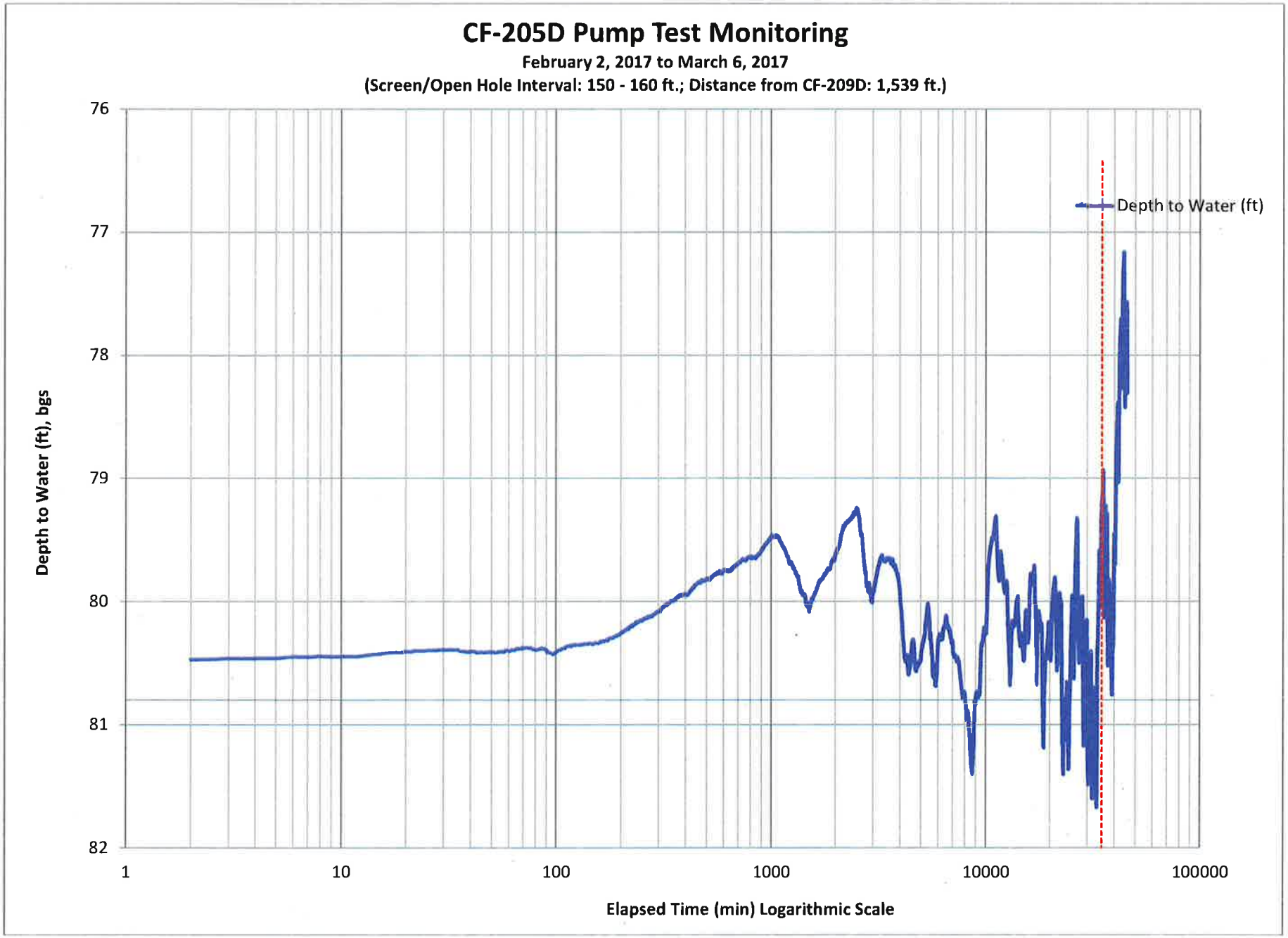

CF-11D Pump Test Monitoring
january 27, 2017 to March 6, 2017
(Screen/Open Hole Interval: 145 - 170 ft.; Distance from CF-209D: 2,184 ft.)
Depth to Water (ft)
Depth to Water (ft), bgs
5
5.2
5.4
5.6
5.8
6
6.2
6.4
6.6
6.8
7
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
Elapsed Time (Min) Linear Scale

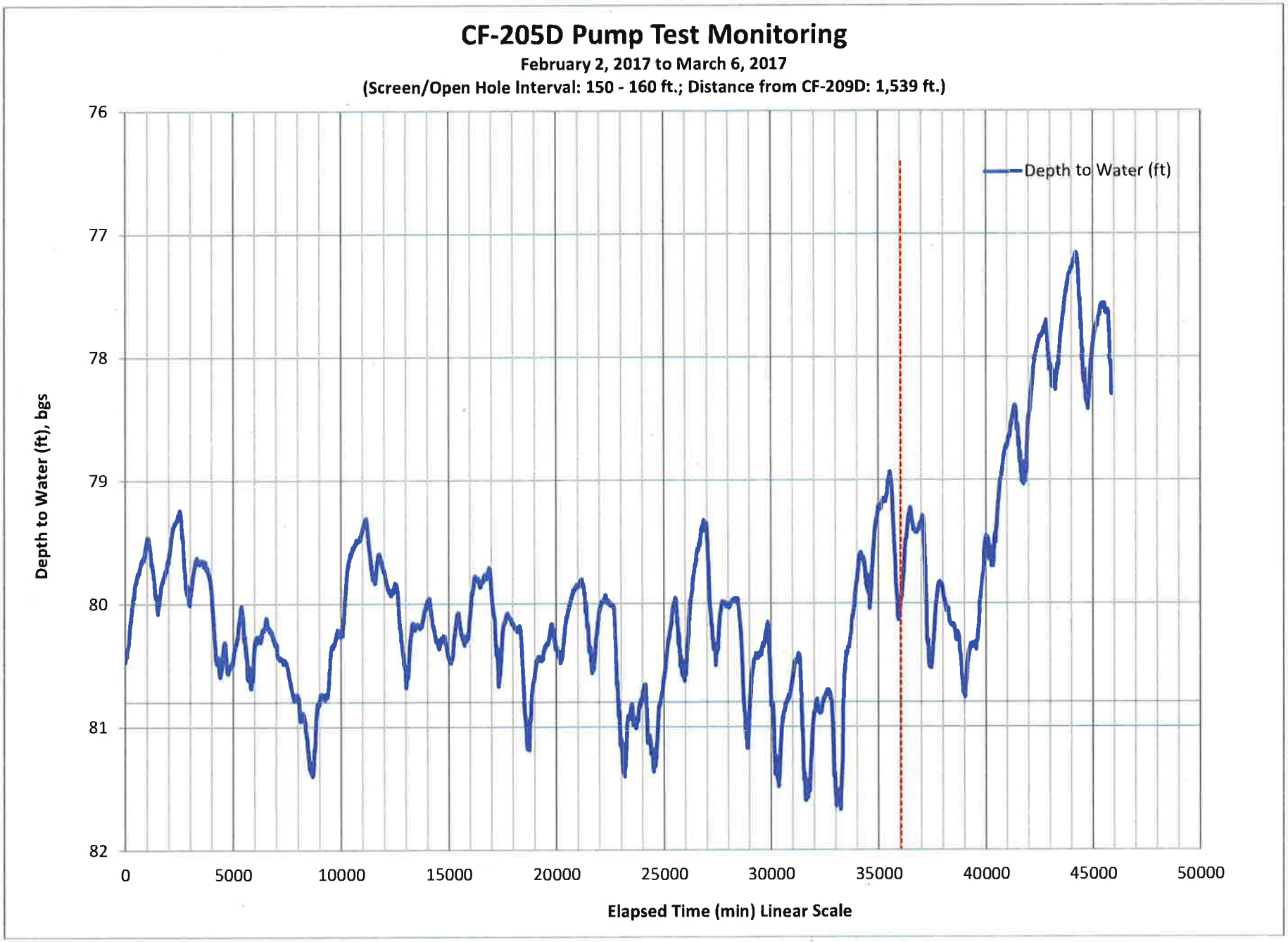

CF-15D Background, Step Test, and Recovery Monitoring
January 27, 2017 to Febuary 1, 2017
(Screen/Open Hole Interval: 165 - 190 ft.; Distance from CF-209D: 901 ft.)
Step test
Depth To Water (ft)
Depth to Water (ft), bgs
36
36.2
36.4
36.6
36.8
37
37.2
37.4
37.6
37.8
38
1/27/2017 0:00
1/28/2017 0:00
1/29/2017 0:00
1/30/2017 0:00
1/31/2017 0:00
2/1/2017 0:00
2/2/2017 0:00
2/3/2017 0:00
2/4/2017 0:00
Date & Time

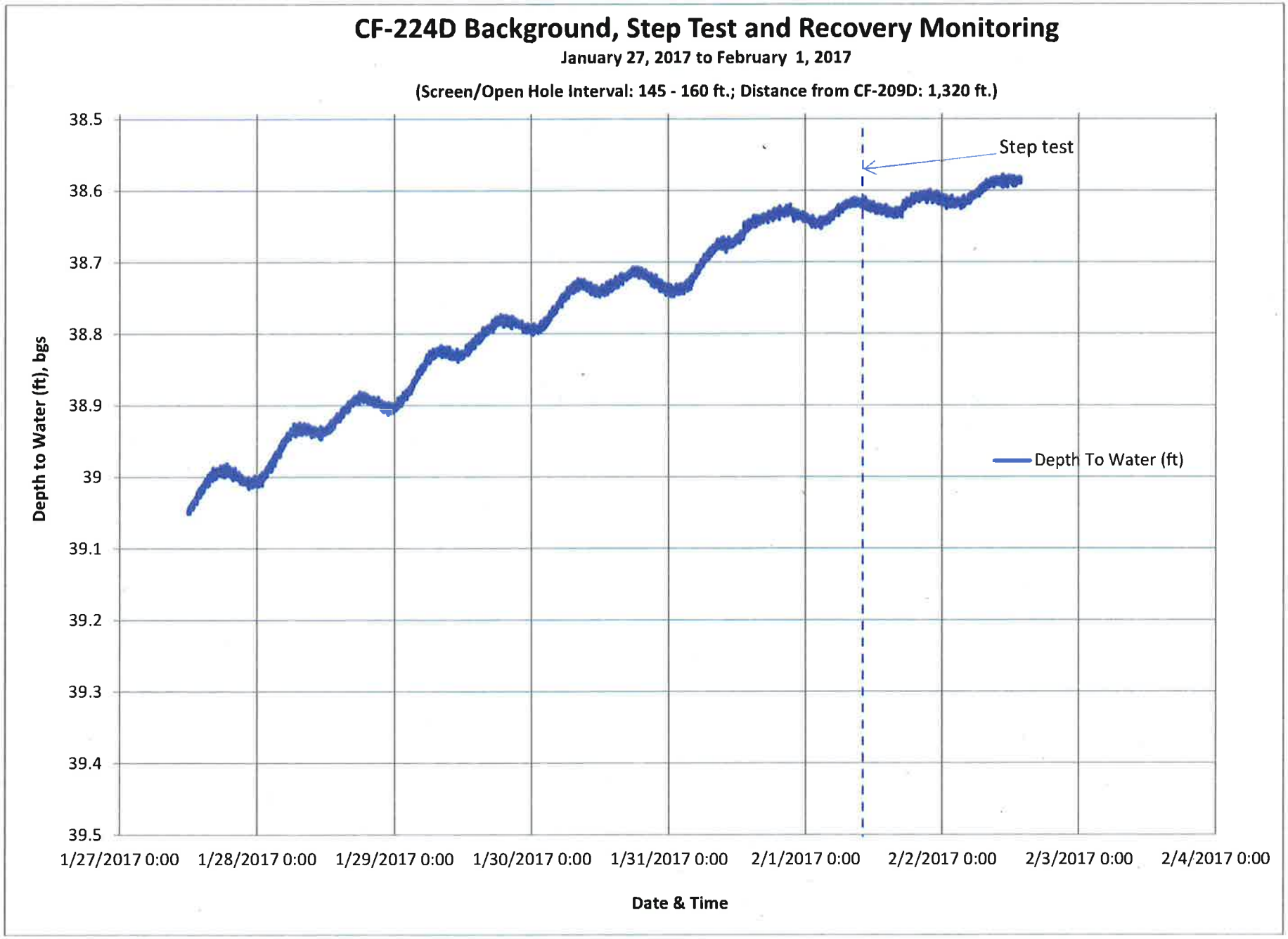

CF-15D Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 165 - 190 ft.; Distance from CF-209D: 901 ft.)
Depth to Water (ft), bgs
36
36.2
36.4
36.6
36.8
37
37.2
37.4
37.6
37.8
38
1
10
100
1000
10000
100000
Elapsed Time (Min) Logarithmic Scale
Depth to Water

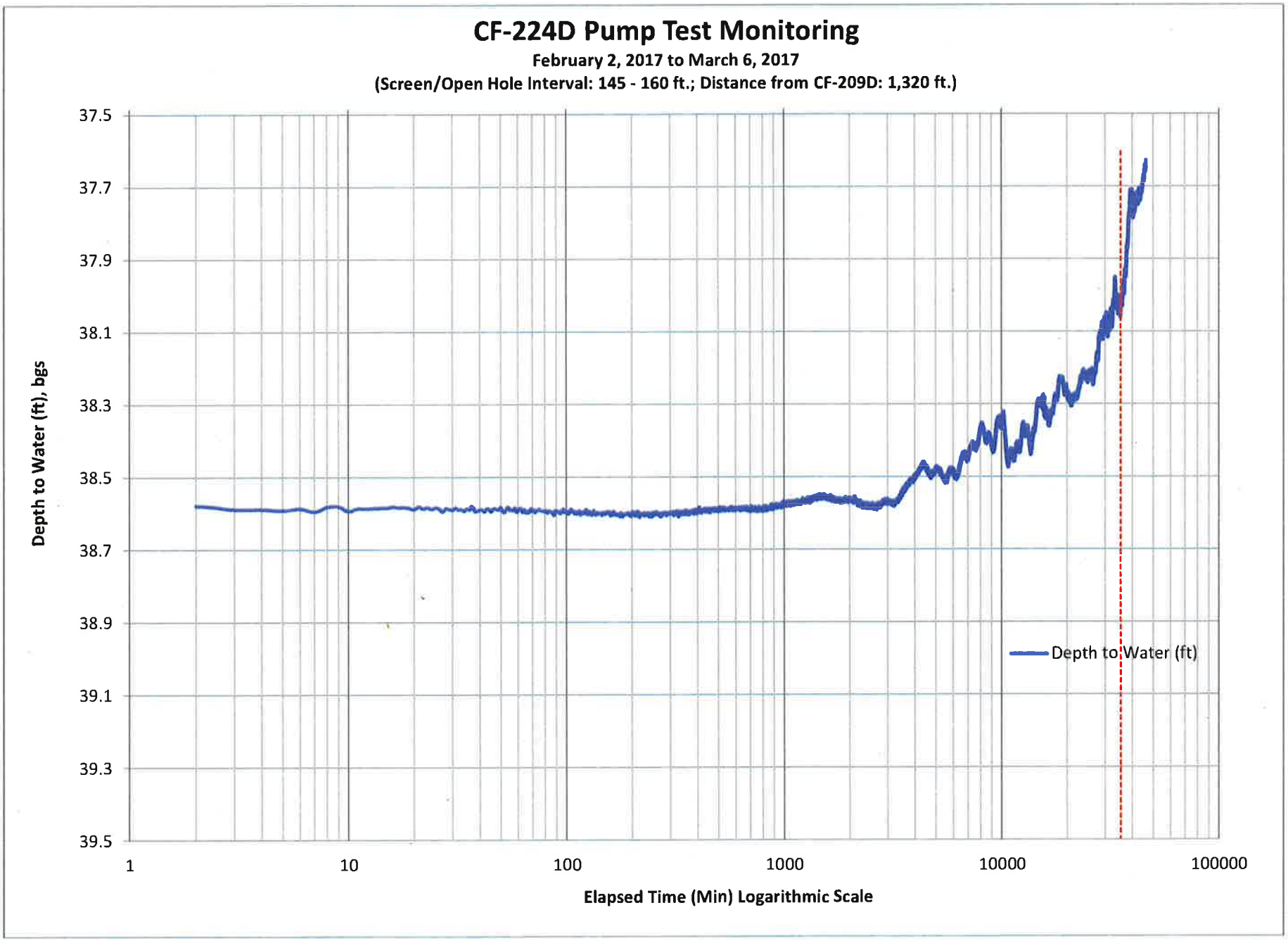

CF-15D Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 165 - 190 ft.; Distance from CF-209D: 901 ft.)
Precipitation Event
Depth to Water
Depth to Water (ft), bgs
36
36.2
36.4
36.6
36.8
37
37.2
37.4
37.6
37.8
38
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
Elapsed Time (Min) Linear Scale

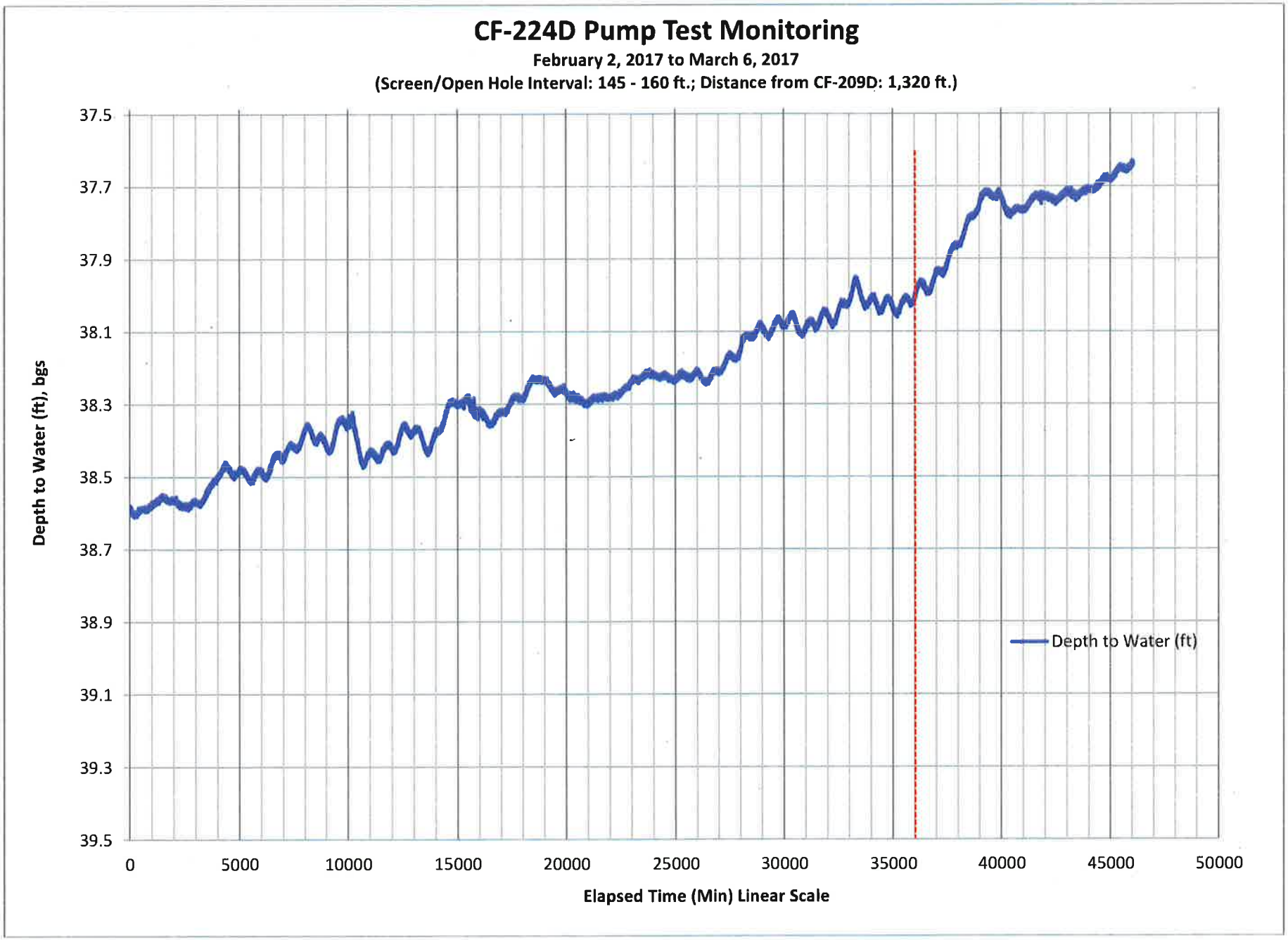

CF-205D Background, Step Test, and Recovery Monitoring
January 27, 2017 to February 2, 2017
(Screen/Open Hole Interval: 150 - 160 ft.; Distance from CF-209D: 1,539 ft.)
Step test
Depth To Water (ft)
Depth to Water (ft), bgs
79
79.5
80
80.5
81
81.5
82
82.5
83
1/27/2017 0:00
1/28/2017 0:00
1/29/2017 0:00
1/30/2017 0:00
1/31/2017 0:00
2/1/2017 0:00
2/2/2017 0:00
2/3/2017 0:00
2/4/2017 0:00
Date & Time

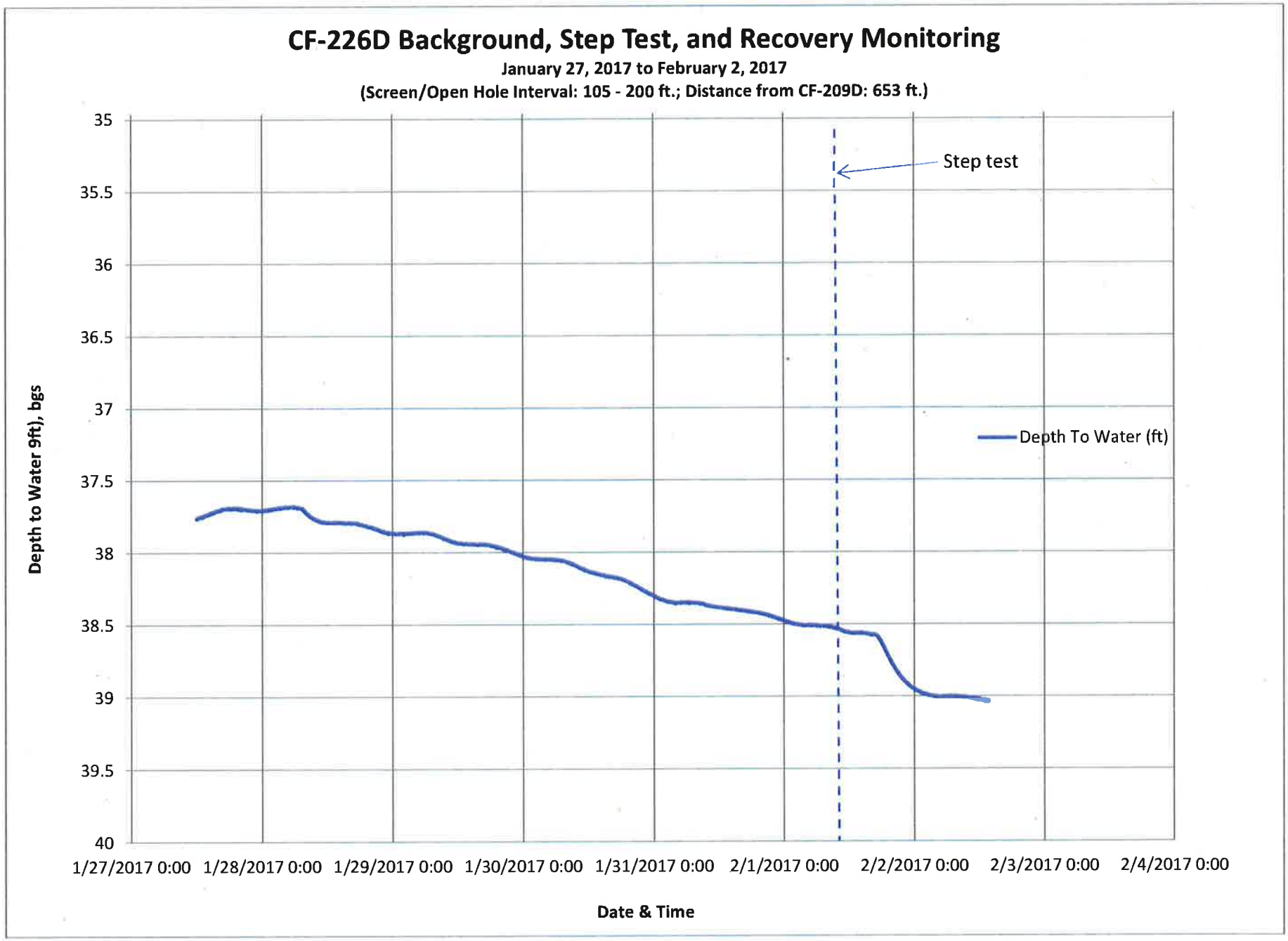

CF-205D Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 150 - 160 ft.; Distance from CF-209D: 1,539 ft.)
Depth to Water (ft)
Depth to Water (ft), bgs
76
77
78
79
80
81
82
1
10
100
1000
10000
100000
Elapsed Time (min) Logarithmic Scale

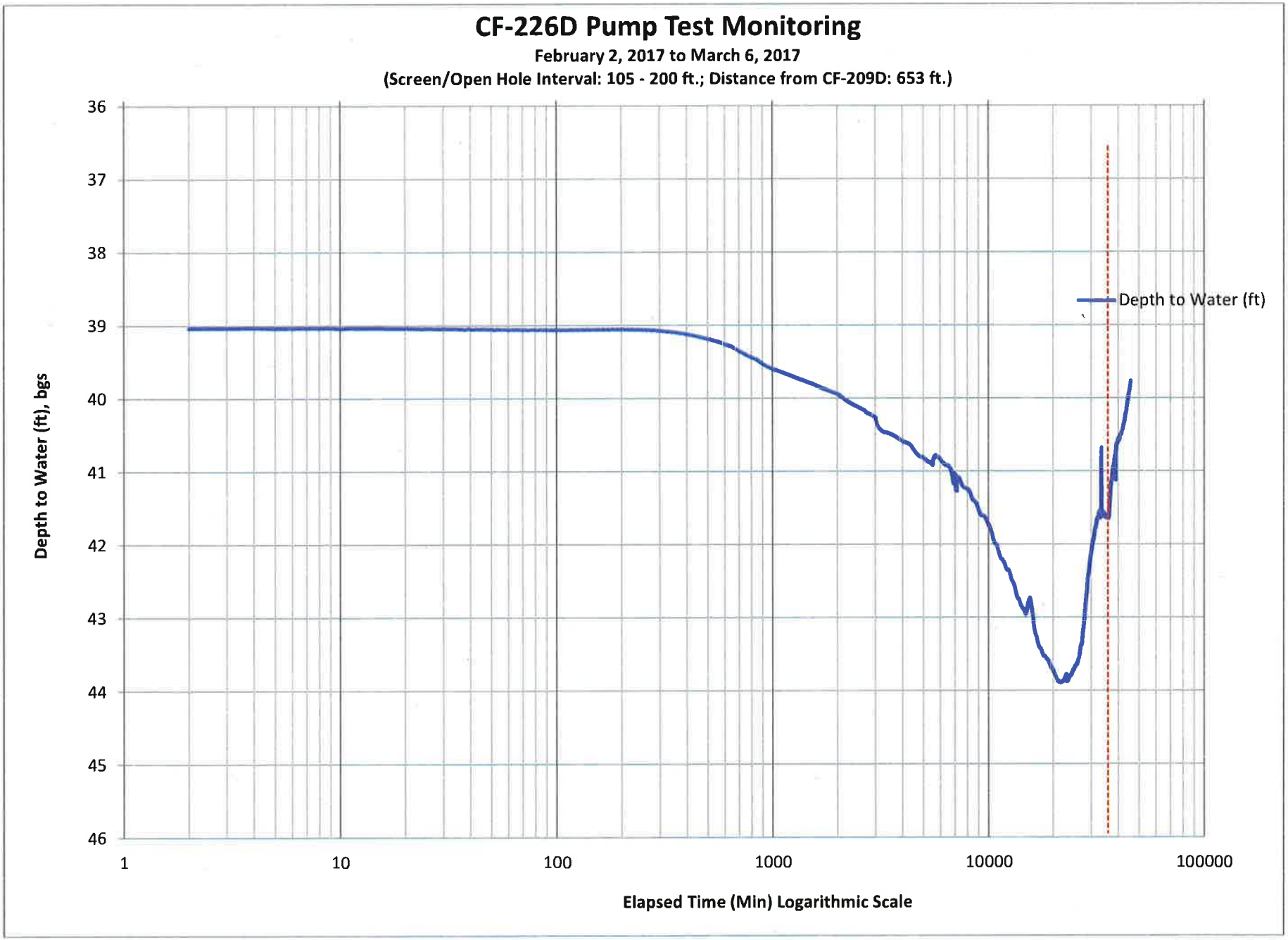

CF-205D Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 150 - 160 ft.; Distance from CF-209D: 1,539 ft.)
Depth to Water (ft)
Depth to Water (ft), bgs
76
77
78
79
80
81
82
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
Elapsed Time (min) Linear Scale

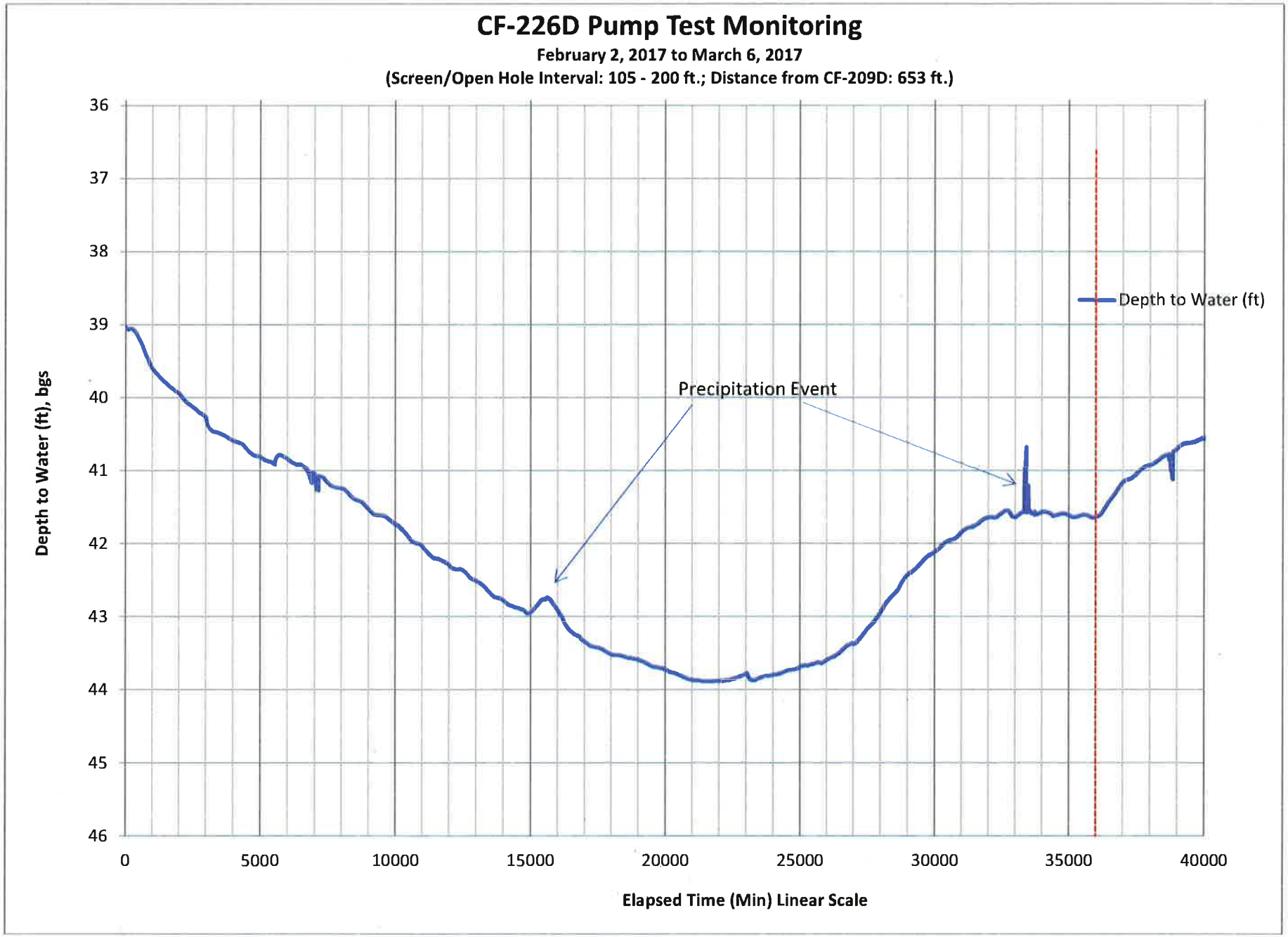

CF-224D Background, Step Test and Recovery Monitoring
January 27, 2017 to February 1, 2017
(Screen/Open Hole Interval: 145 - 160 ft.; Distance from CF-209D: 1,320 ft.)
Step test
Depth To Water (ft)
Depth to Water (ft), bgs
38.5
38.6
38.7
38.8
38.9
39
39.1
39.2
39.3
39.4
39.5
1/27/2017 0:00
1/28/2017 0:00
1/29/2017 0:00
1/30/2017 0:00
1/31/2017 0:00
2/1/2017 0:00
2/2/2017 0:00
2/3/2017 0:00
2/4/2017 0:00
Date & Time

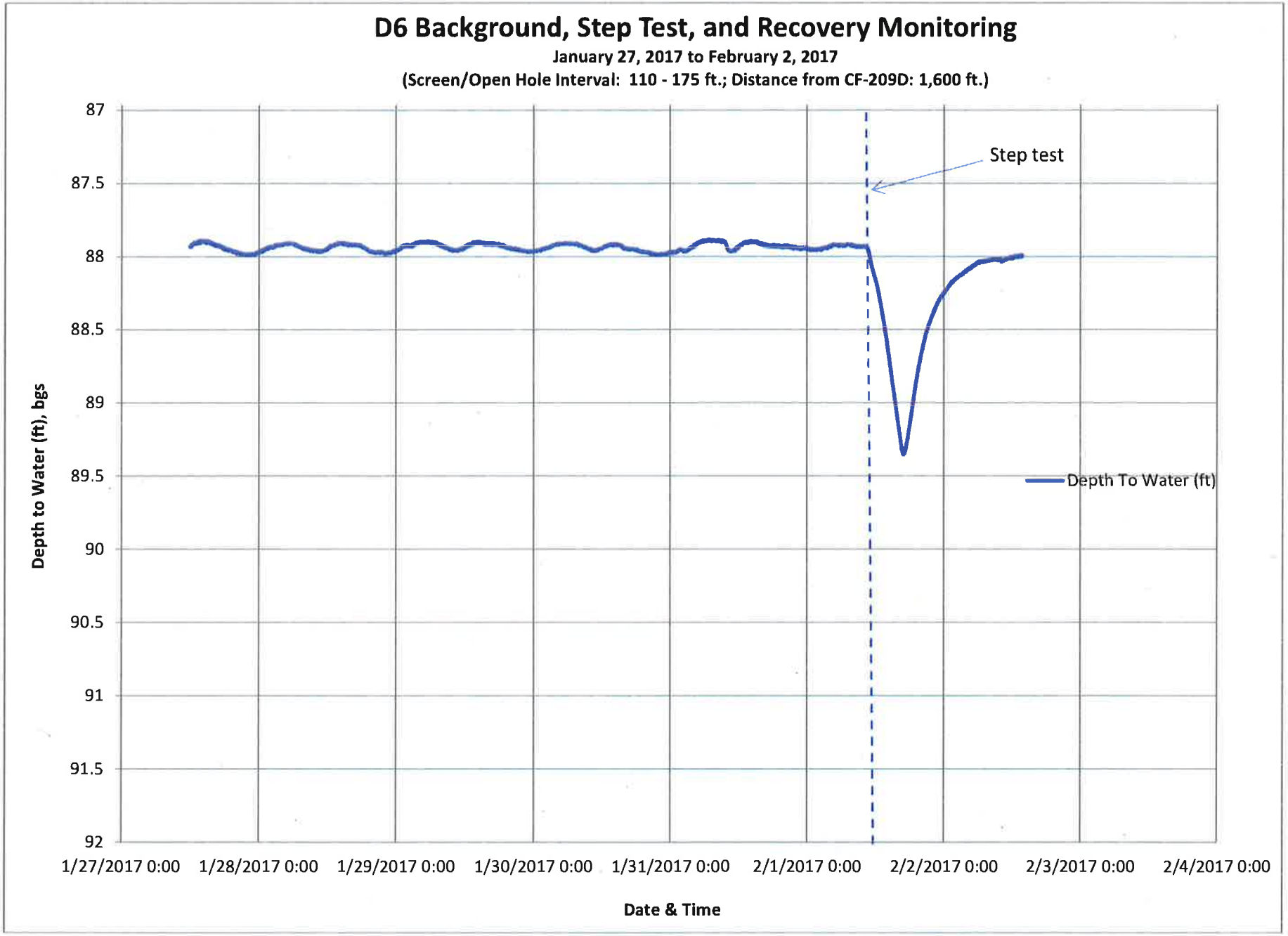

CF-224D Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 145 - 160 ft.; Distance from CF-209D: 1,320 ft.)
Depth to Water (ft), bgs
37.5
37.7
37.9
38.1
38.3
38.5
38.7
38.9
39.1
39.3
39.5
1
10
100
1000
10000
100000
Elapsed Time (Min) Logarithmic Scale
Depth to Water (ft)

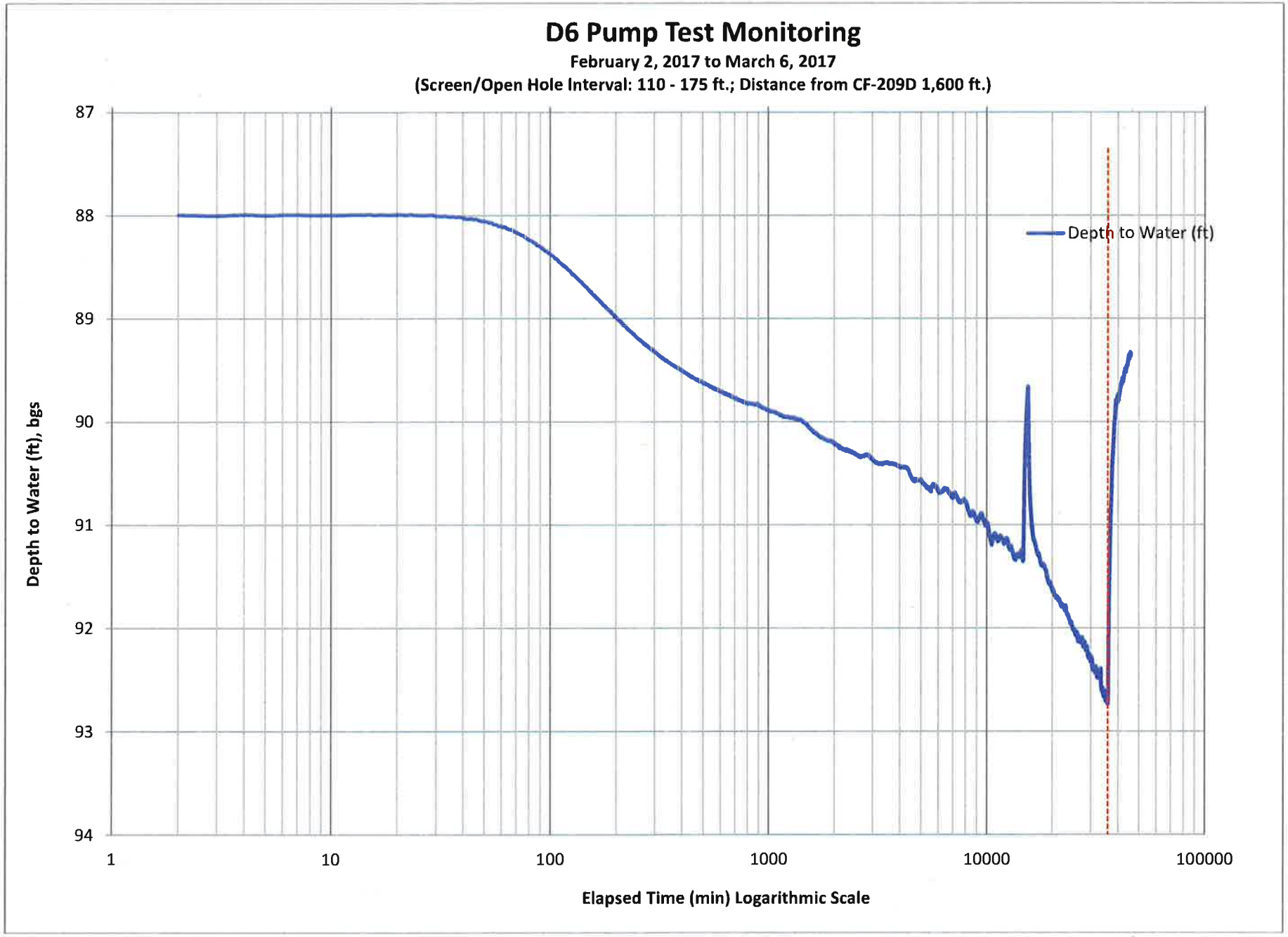

CF-224D Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 145 - 160 ft.; Distance from CF-209D: 1,320 ft.)
Depth to Water (ft), bgs
37.5
37.7
37.9
38.1
38.3
38.5
38.7
38.9
39.1
39.3
39.5
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
Elapsed Time (Min) Linear Scale
Depth to Water (ft)

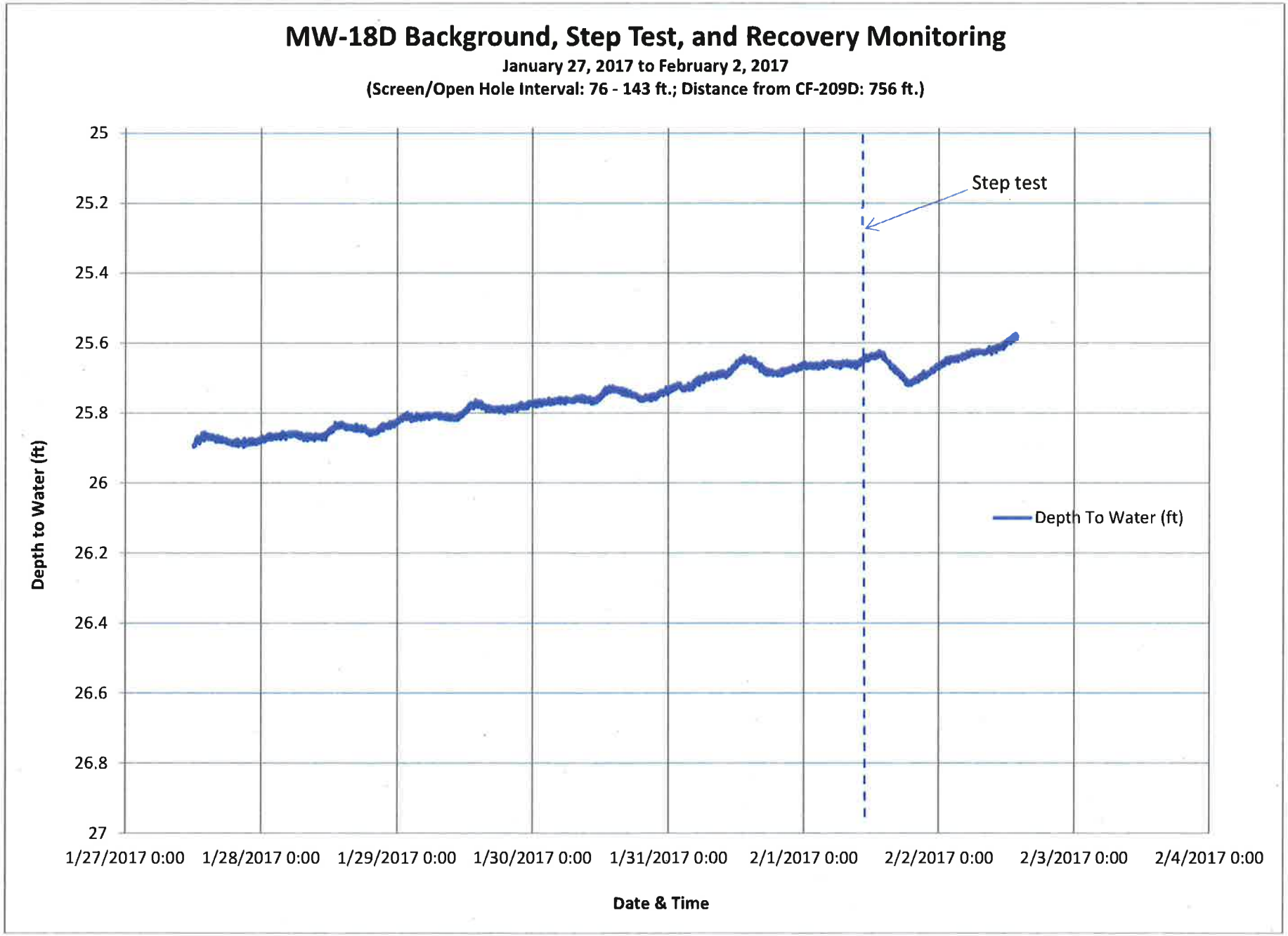

CF-226D Background, Step Test, and Recovery Monitoring
January 27, 2017 to February 2, 2017
(Screen/Open Hole Interval: 105 - 200 ft.; Distance from CF-209D: 653 ft.)
Step test
Depth To Water (ft)
Depth to Water 9ft), bgs
35
35.5
36
36.5
37
37.5
38
38.5
39
39.5
40
1/27/2017 0:00
1/28/2017 0:00
1/29/2017 0:00
1/30/2017 0:00
1/31/2017 0:00
2/1/2017 0:00
2/2/2017 0:00
2/3/2017 0:00
2/4/2017 0:00
Date & Time

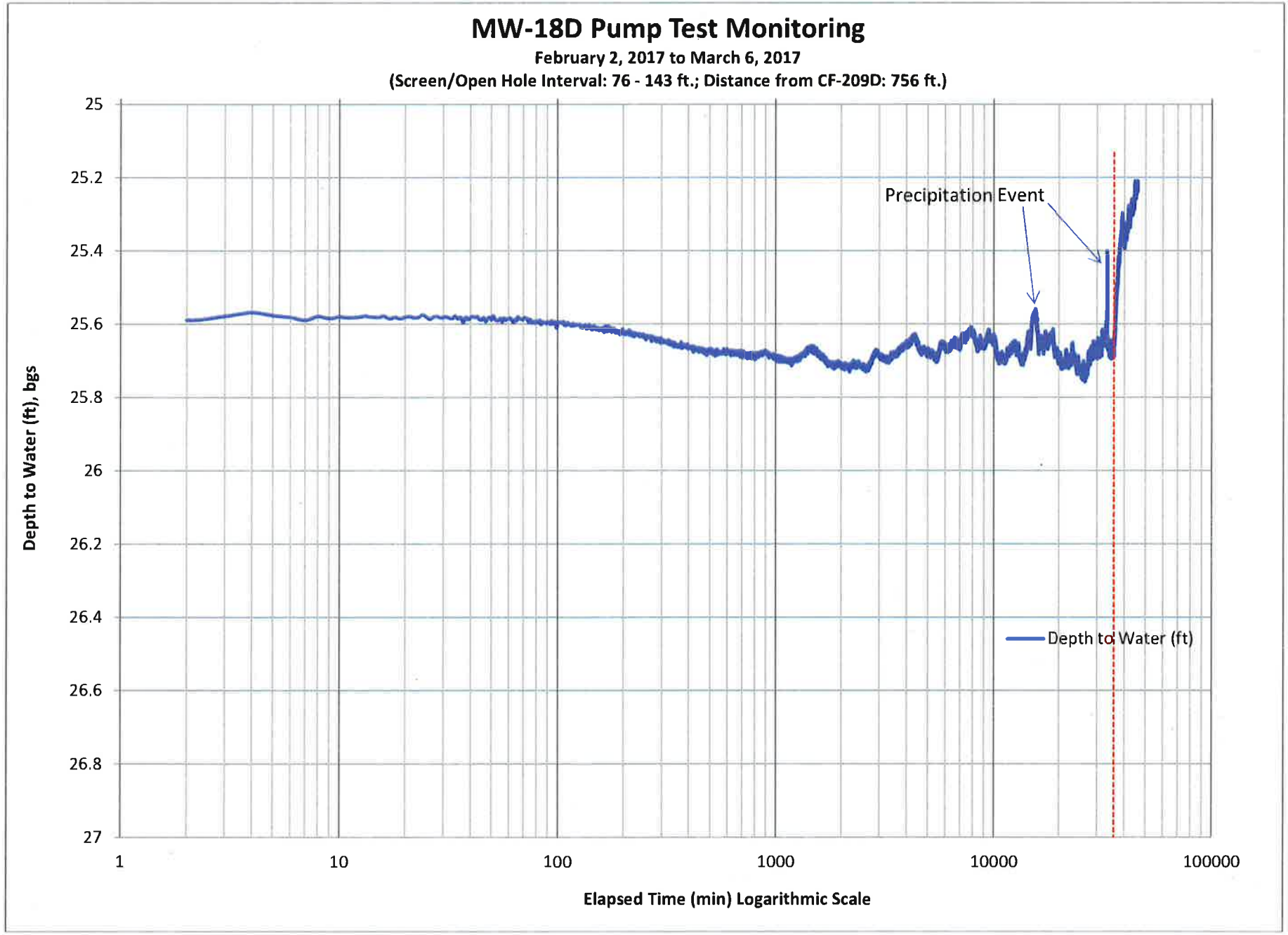

CF-226D Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 105 - 200 ft.; Distance from CF-209D: 653 ft.)
Depth to Water (ft), bgs
36
37
38
39
40
41
42
43
44
45
46
1
10
100
1000
10000
100000
Elapsed Time (Min) Logarithmic Scale
Depth to Water (ft)

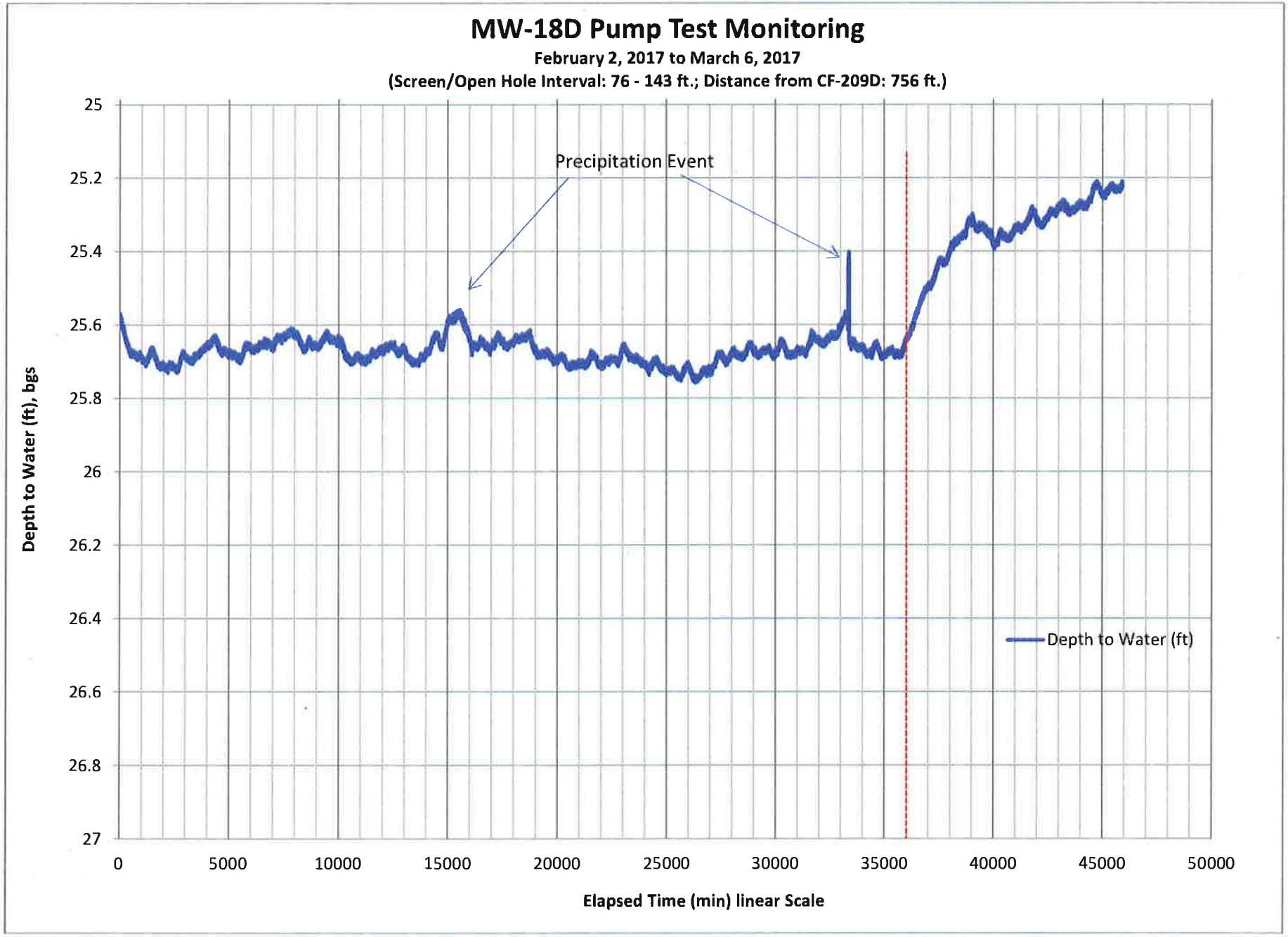

CF-226D Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 105 - 200 ft.; Distance from CF-209D: 653 ft.)
Depth to Water (ft), bgs
36
37
38
39
40
41
42
43
44
45
46
0
5000
10000
15000
20000
25000
30000
35000
40000
Elapsed Time (Min) Linear Scale
Precipitation Event
Depth to Water (ft)

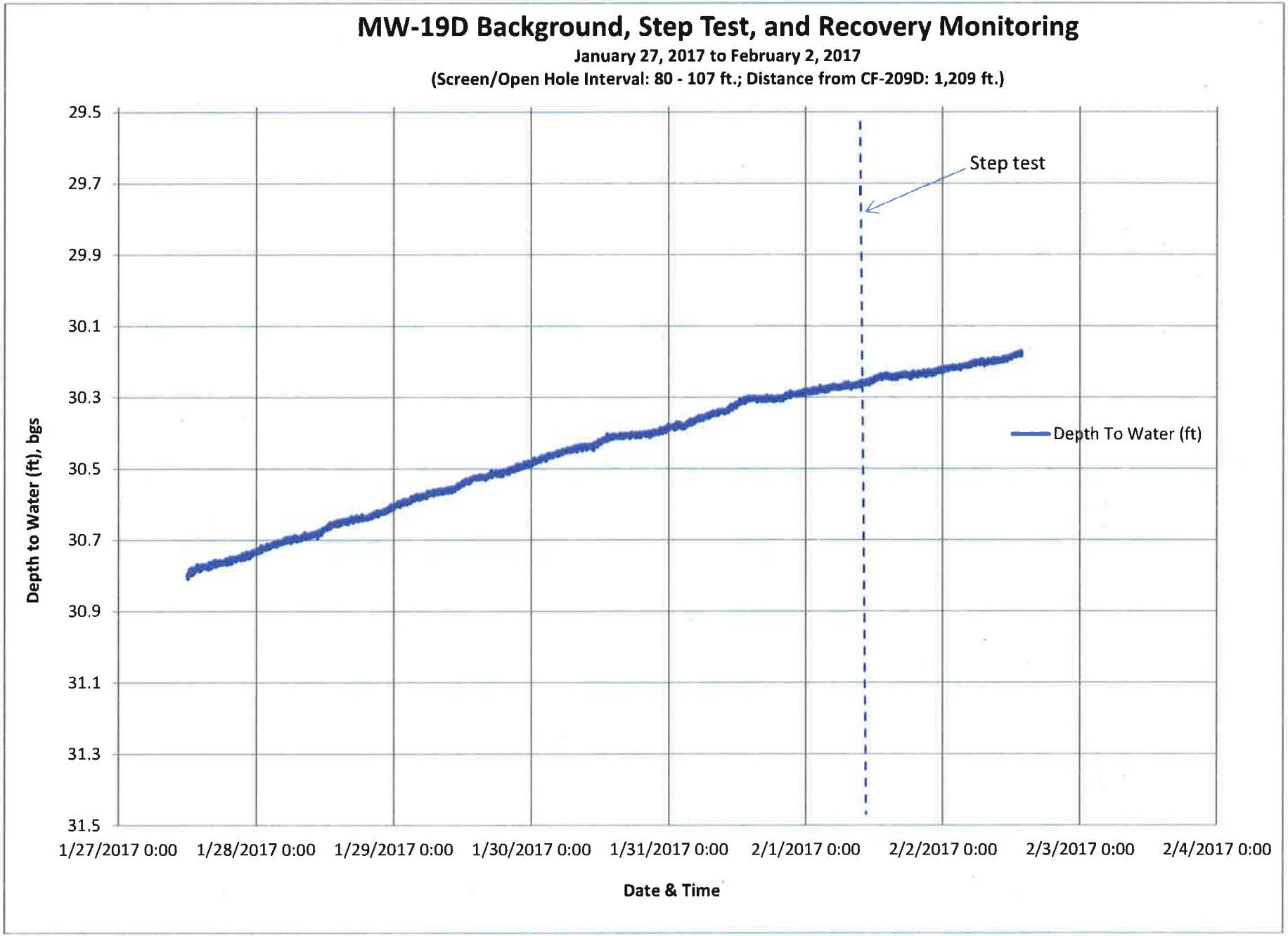

D6 Background, Step Test, and Recovery Monitoring
January 27, 2017 to February 2, 2017
(Screen/Open Hole Interval: 110 - 175 ft.; Distance from CF-209D: 1,600 ft.)
Step test
Depth To Water (ft)
Depth to Water (ft), bgs
87
87.5
88
88.5
89
89.5
90
90.5
91
91.5
92
1/27/2017 0:00
1/28/2017 0:00
1/29/2017 0:00
1/30/2017 0:00
1/31/2017 0:00
2/1/2017 0:00
2/2/2017 0:00
2/3/2017 0:00
2/4/2017 0:00
Date & Time

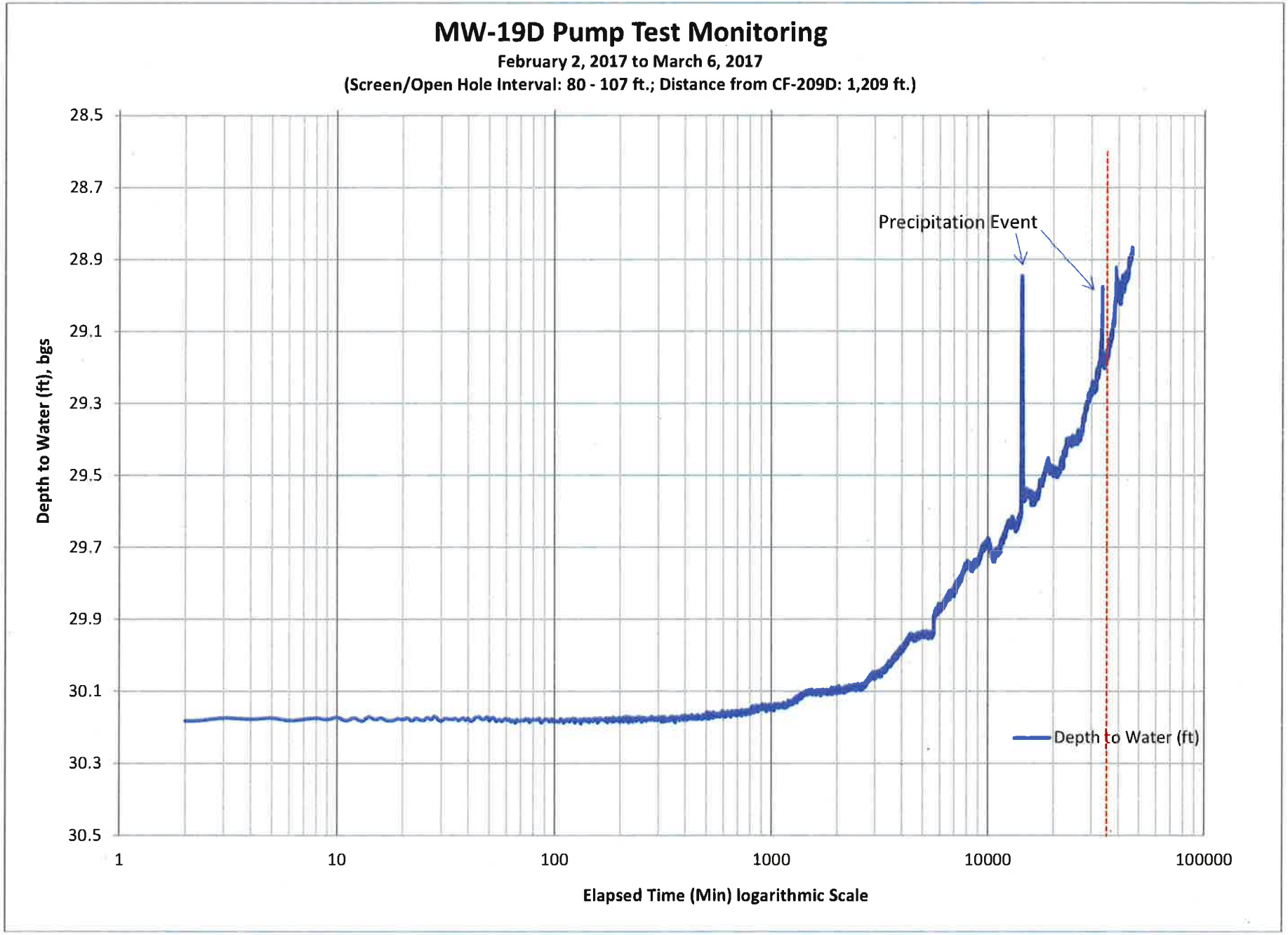

D6 Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 110 - 175 ft.; Distance from CF-209D 1,600 ft.)
Depth to Water (ft), bgs
87
88
89
90
91
92
93
94
1
10
100
1000
10000
100000
Elapsed Time (min) Logarithmic Scale
Depth to Water (ft)

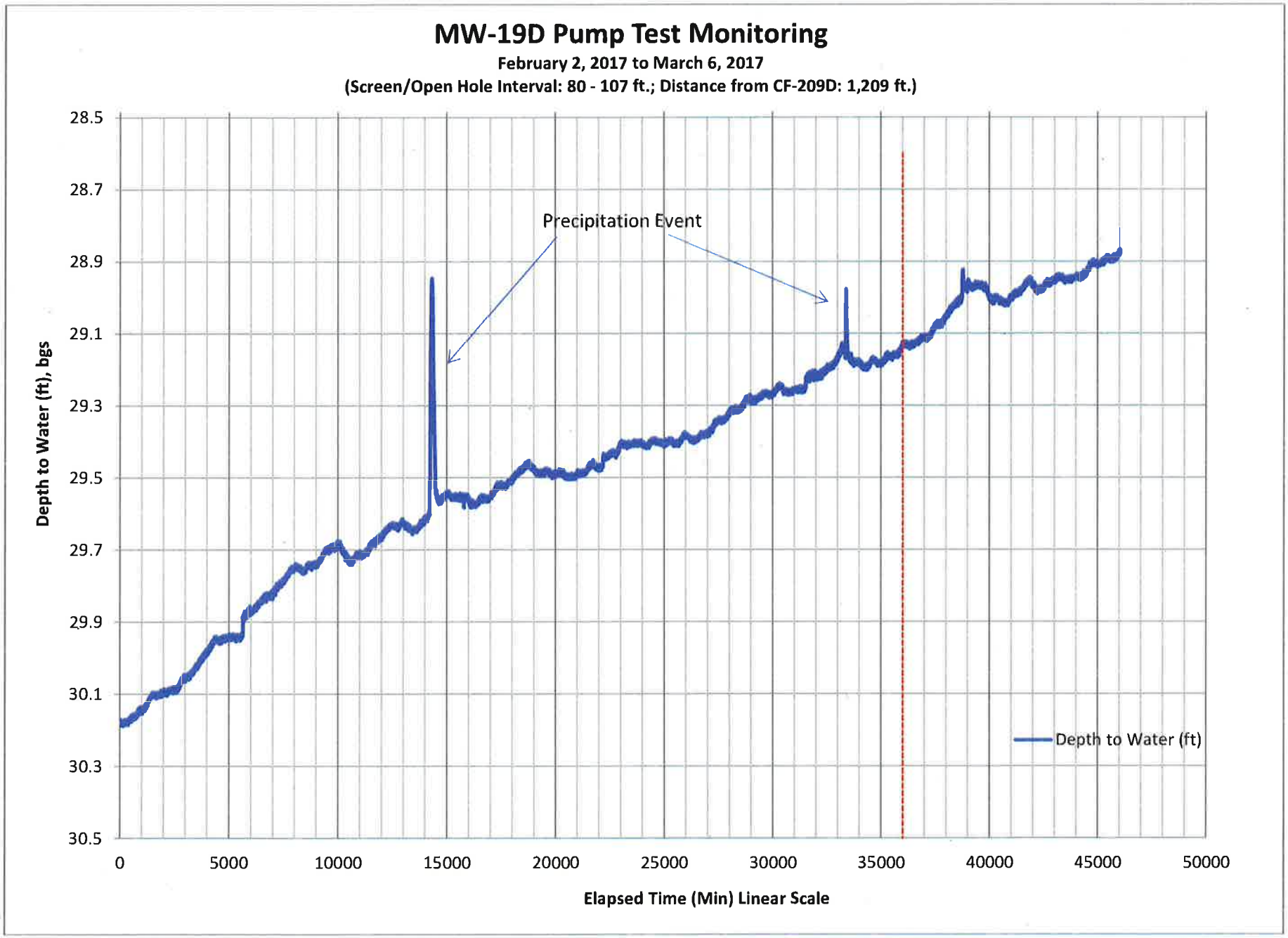

MW-18D Background, Step Test, and Recovery Monitoring
January 27, 2017 to February 2, 2017
(Screen/Open Hole Interval: 76 - 143 ft.; Distance from CF-209D: 756 ft.)
Step test
Depth To Water (ft)
Depth to Water (ft)
25
25.2
25.4
25.6
25.8
26
26.2
26.4
26.6
26.8
27
1/27/2017 0:00
1/28/2017 0:00
1/29/2017 0:00
1/30/2017 0:00
1/31/2017 0:00
2/1/2017 0:00
2/2/2017 0:00
2/3/2017 0:00
2/4/2017 0:00
Date & Time

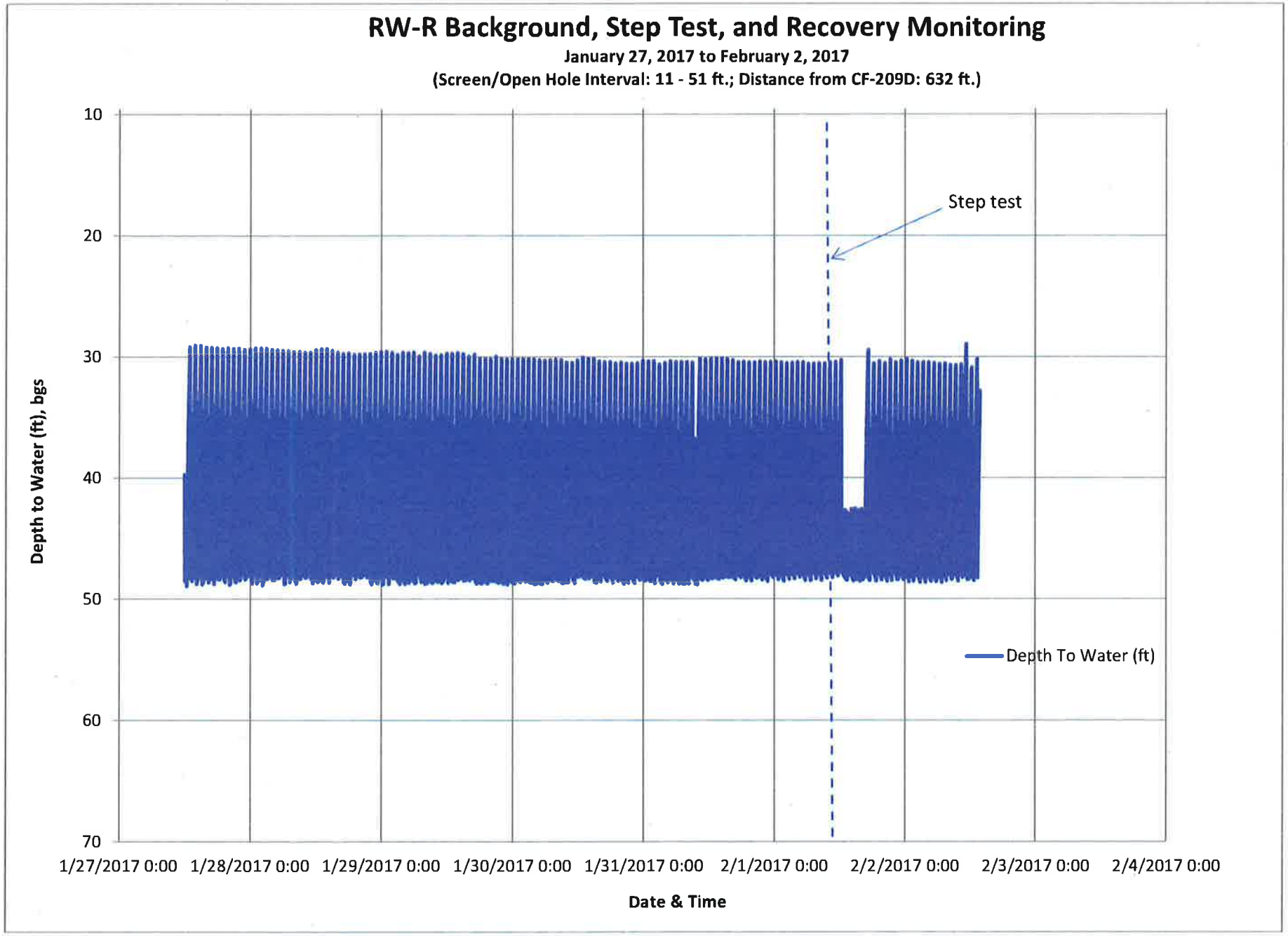

MW-18D Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 76 - 143 ft.; Distance from CF-209D: 756 ft.)
Depth to Water (ft), bgs
25
25.2
25.4
25.6
25.8
26
26.2
26.4
26.6
26.8
27
1
10
100
1000
10000
100000
Elapsed Time (min) Logarithmic Scale
Precipitation Event
Depth to Water (ft)

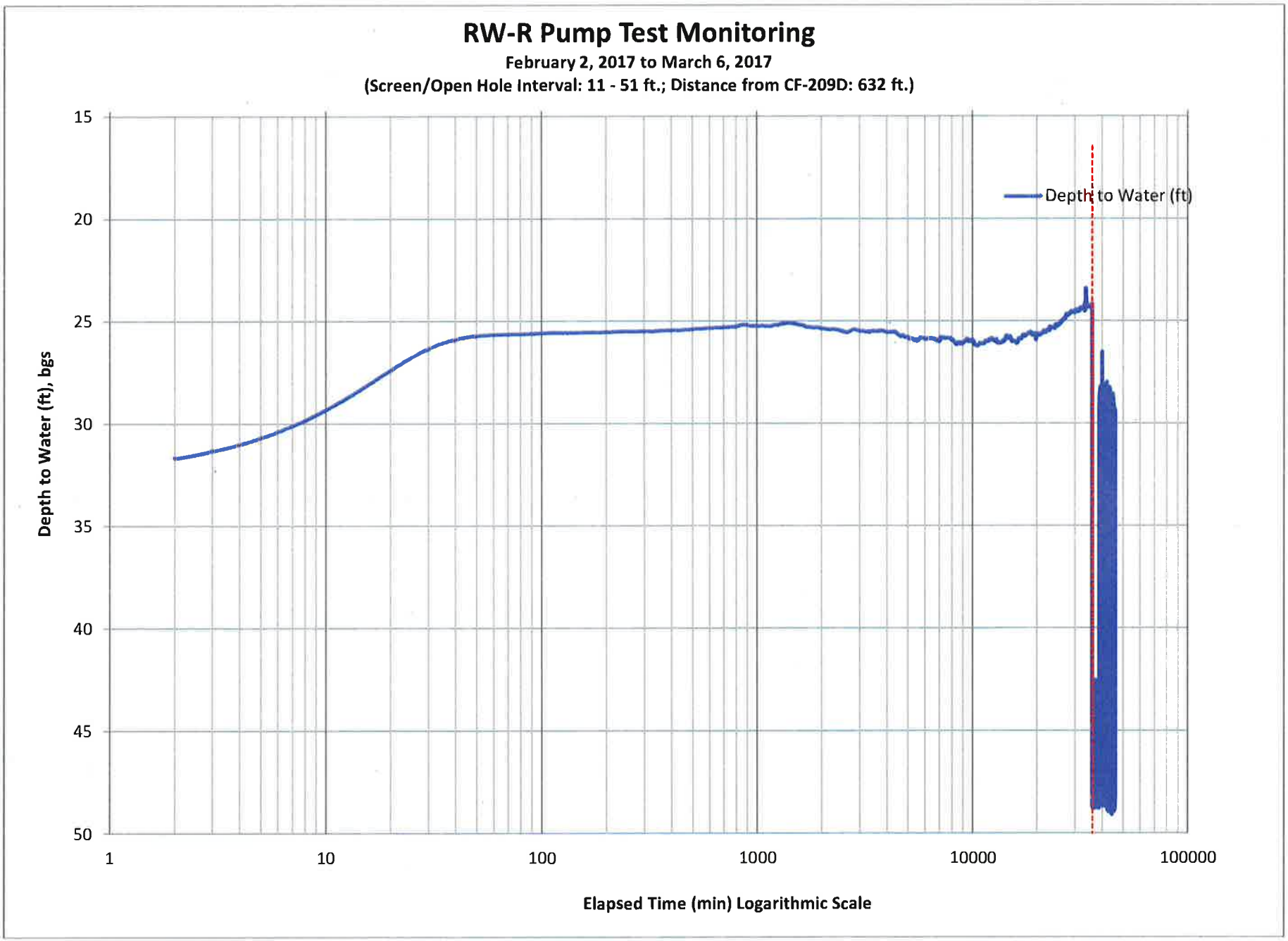

MW-18D Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 76 - 143 ft.; Distance from CF-209D: 756 ft.)
Precipitation Event
Depth to Water (ft)
Depth to Water (ft), bgs
25
25.2
25.4
25.6
25.8
26
26.2
26.4
26.6
26.8
27
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
Elapsed Time (min) linear Scale

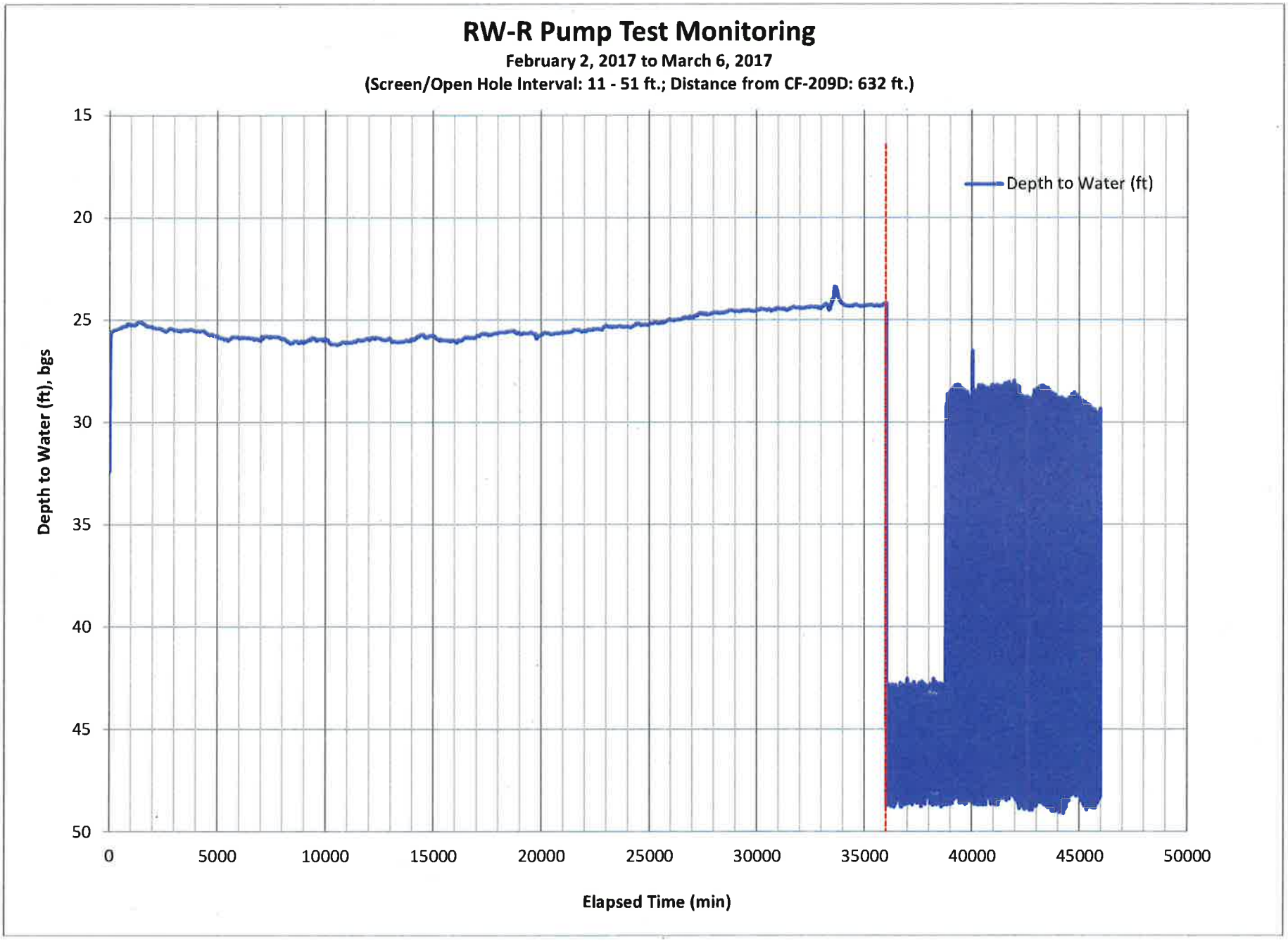

MW-19D Background, Step Test, and Recovery Monitoring
January 27, 2017 to February 2, 2017
(Screen/Open Hole Interval: 80 - 107 ft.; Distance from CF-209D: 1,209 ft.)
Step test
Depth To Water (ft)
Depth to Water (ft), bgs
29.5
29.7
29.9
30.1
30.3
30.5
30.7
30.9
31.1
31.3
31.5
1/27/2017 0:00
1/28/2017 0:00
1/29/2017 0:00
1/30/2017 0:00
1/31/2017 0:00
2/1/2017 0:00
2/2/2017 0:00
2/3/2017 0:00
2/4/2017 0:00
Date & Time

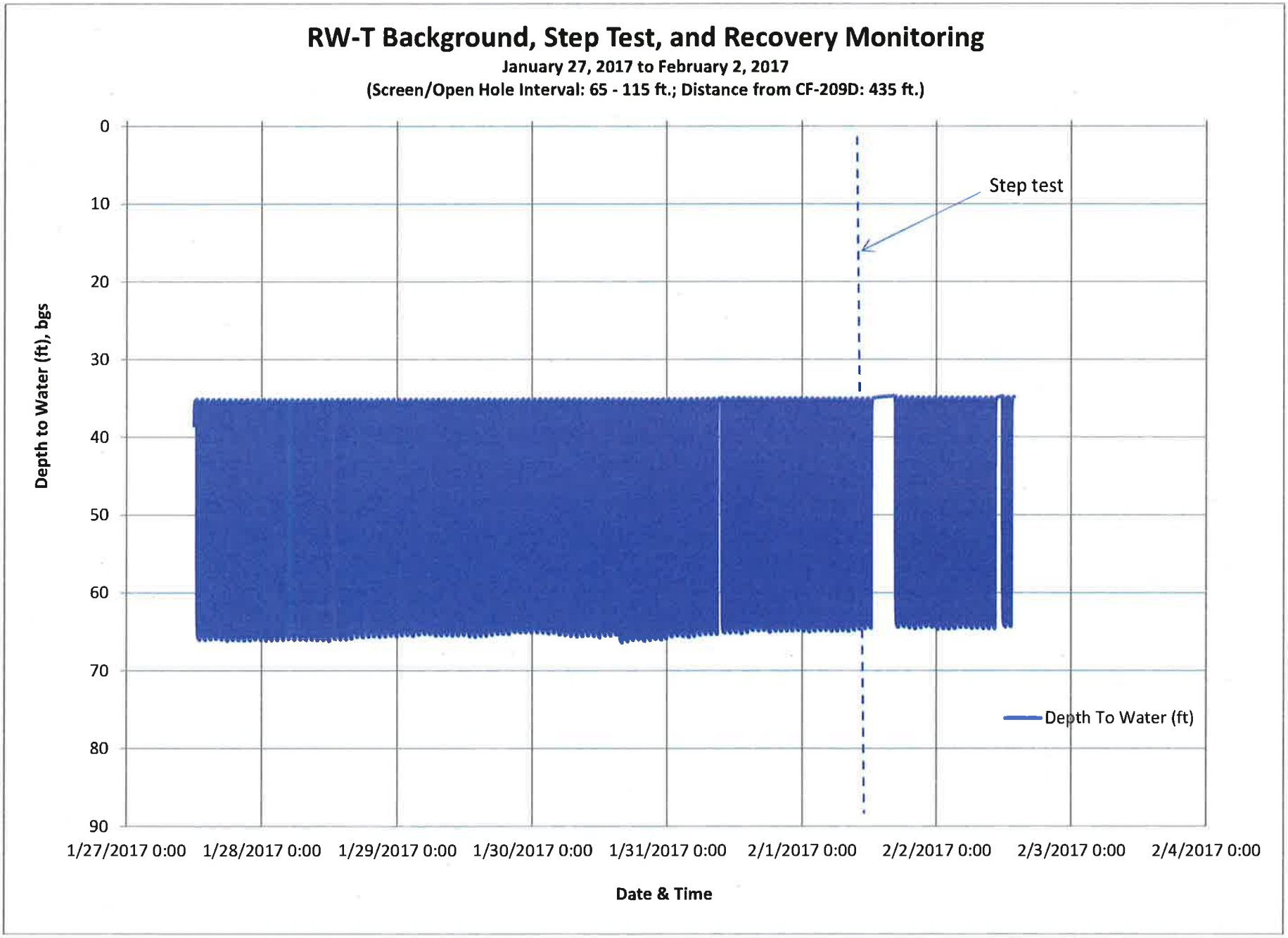

MW-19D Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 80 - 107 ft.; Distance from CF-209D: 1,209 ft.)
Depth to Water (ft), bgs
28.5
28.7
28.9
29.1
29.3
29.5
29.7
29.9
30.1
30.3
30.5
1
10
100
1000
10000
100000
Elapsed Time (Min) logarithmic Scale
Precipitation Event
Depth to Water (ft)

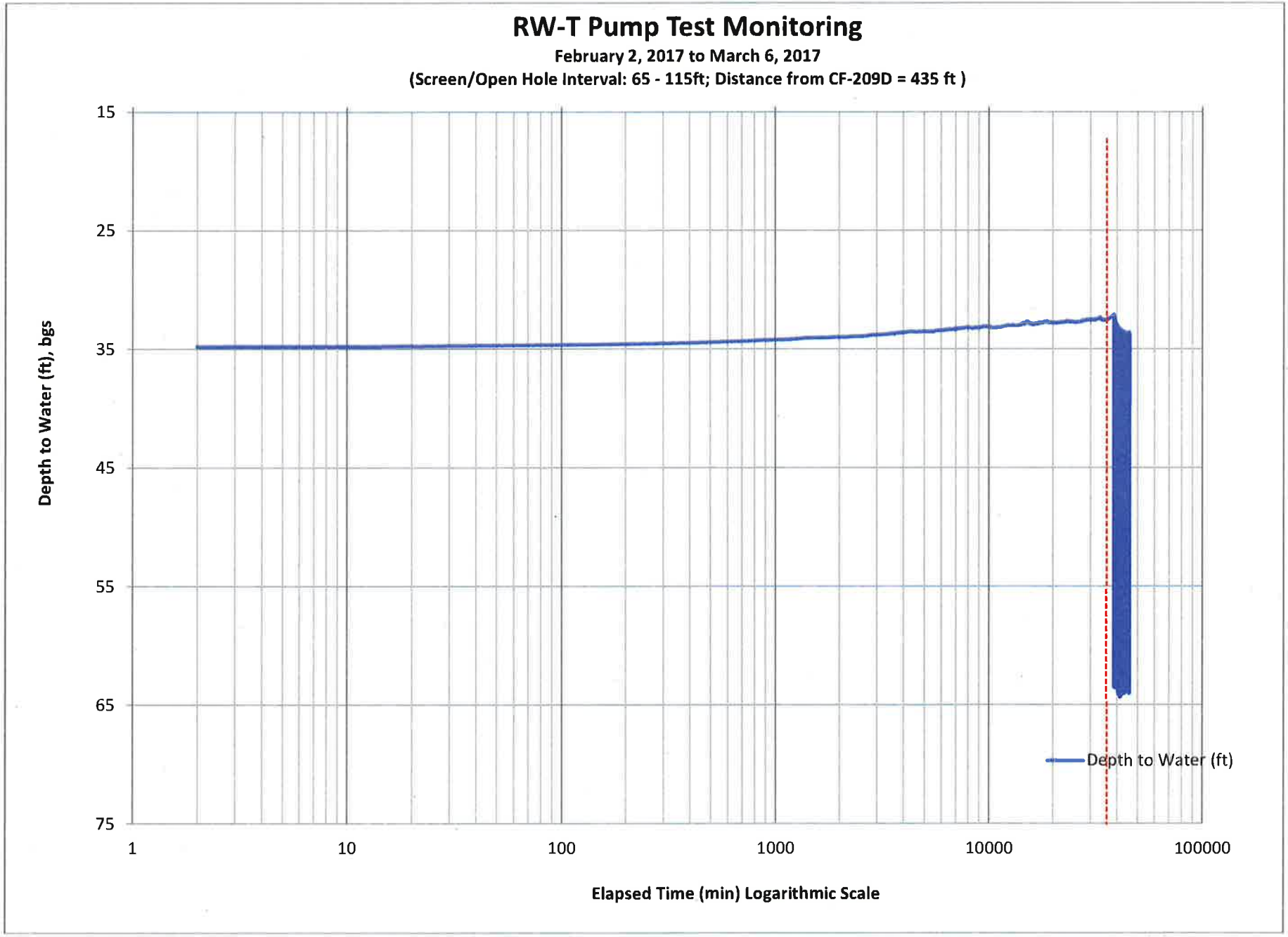

MW-19D Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 80 - 107 ft.; Distance from CF-209D: 1,209 ft.)
Precipitation Event
Depth to Water (ft)
Depth to Water (ft), bgs
28.5
28.7
28.9
29.1
29.3
29.5
29.7
29.9
30.1
30.3
30.5
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
Elapsed Time (Min) Linear Scale

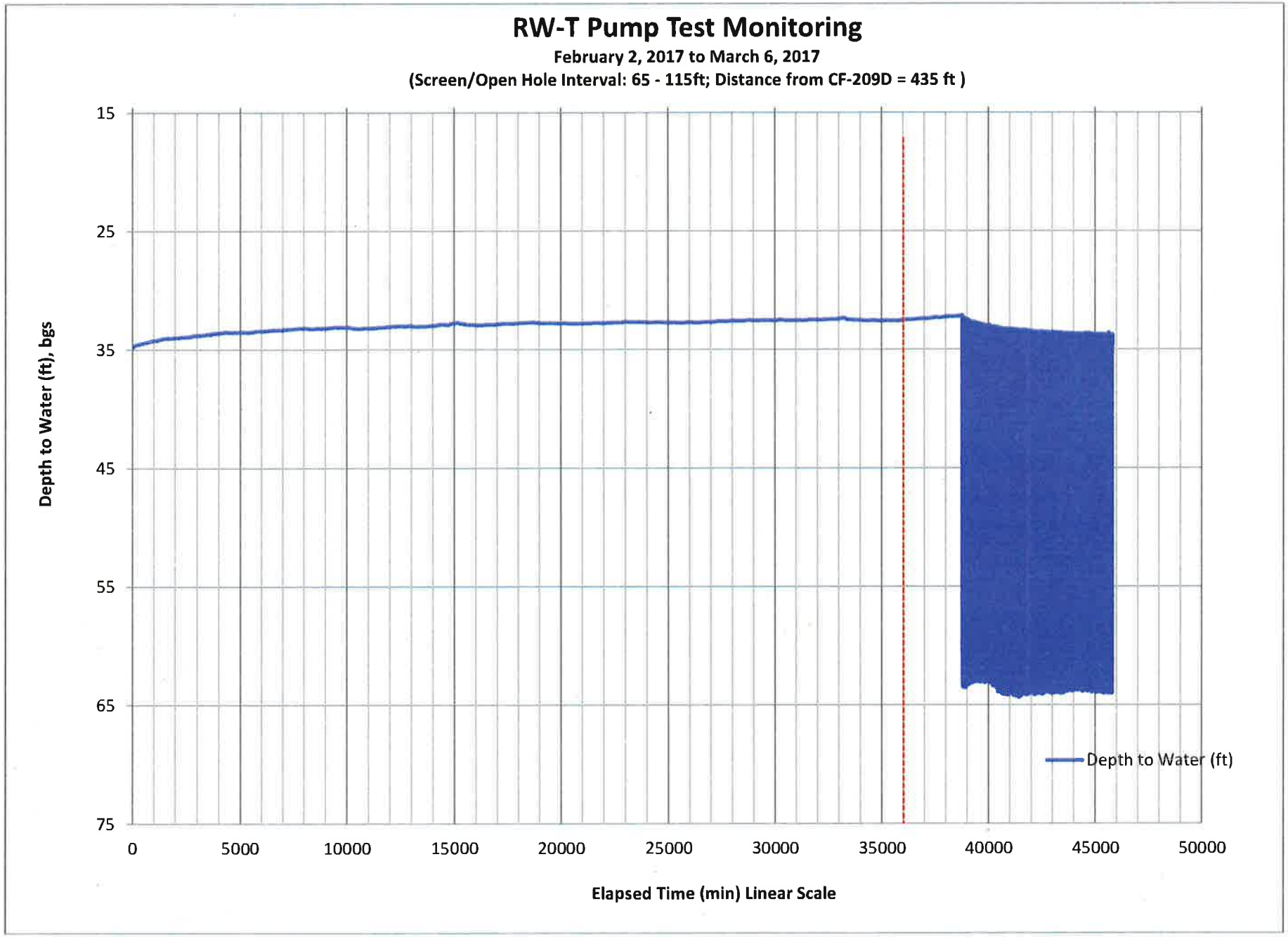

RW-R Background, Step Test, and Recovery Monitoring
January 27, 2017 to February 2, 2017
(Screen/Open Hole Interval: 11 - 51 ft.; Distance from CF-209D: 632 ft.)
Step test
Depth To Water (ft)
Depth to Water (ft), bgs
10
20
30
40
50
60
70
1/27/2017 0:00
1/28/2017 0:00
1/29/2017 0:00
1/30/2017 0:00
1/31/2017 0:00
2/1/2017 0:00
2/2/2017 0:00
2/3/2017 0:00
2/4/2017 0:00
Date & Time

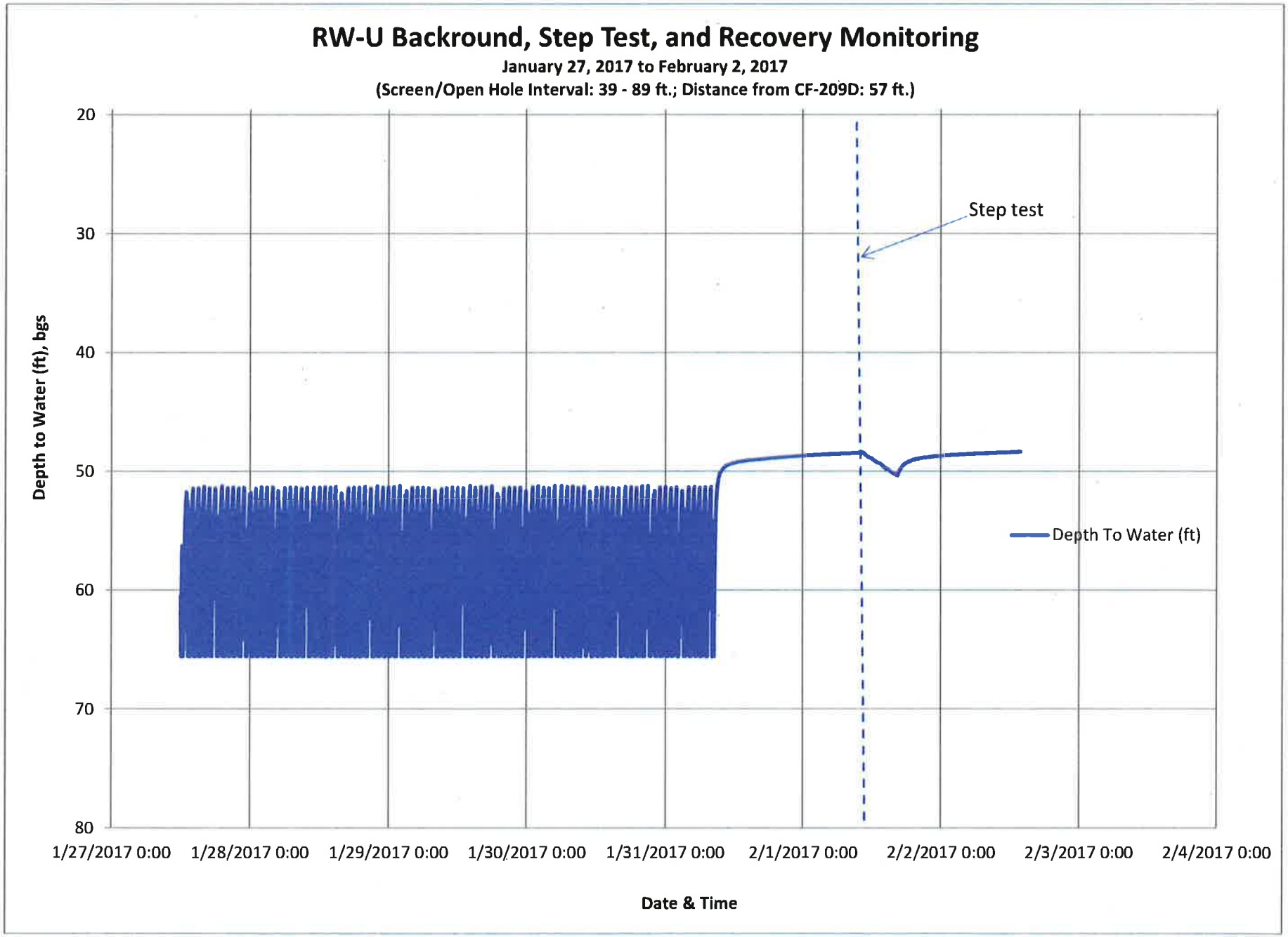

RW-R Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 11 - 51 ft.; Distance from CF-209D: 632 ft.)
Depth to Water (ft)
Depth to Water (ft), bgs
15
20
25
30
35
40
45
50
1
10
100
1000
10000
100000
Elapsed Time (min) Logarithmic Scale

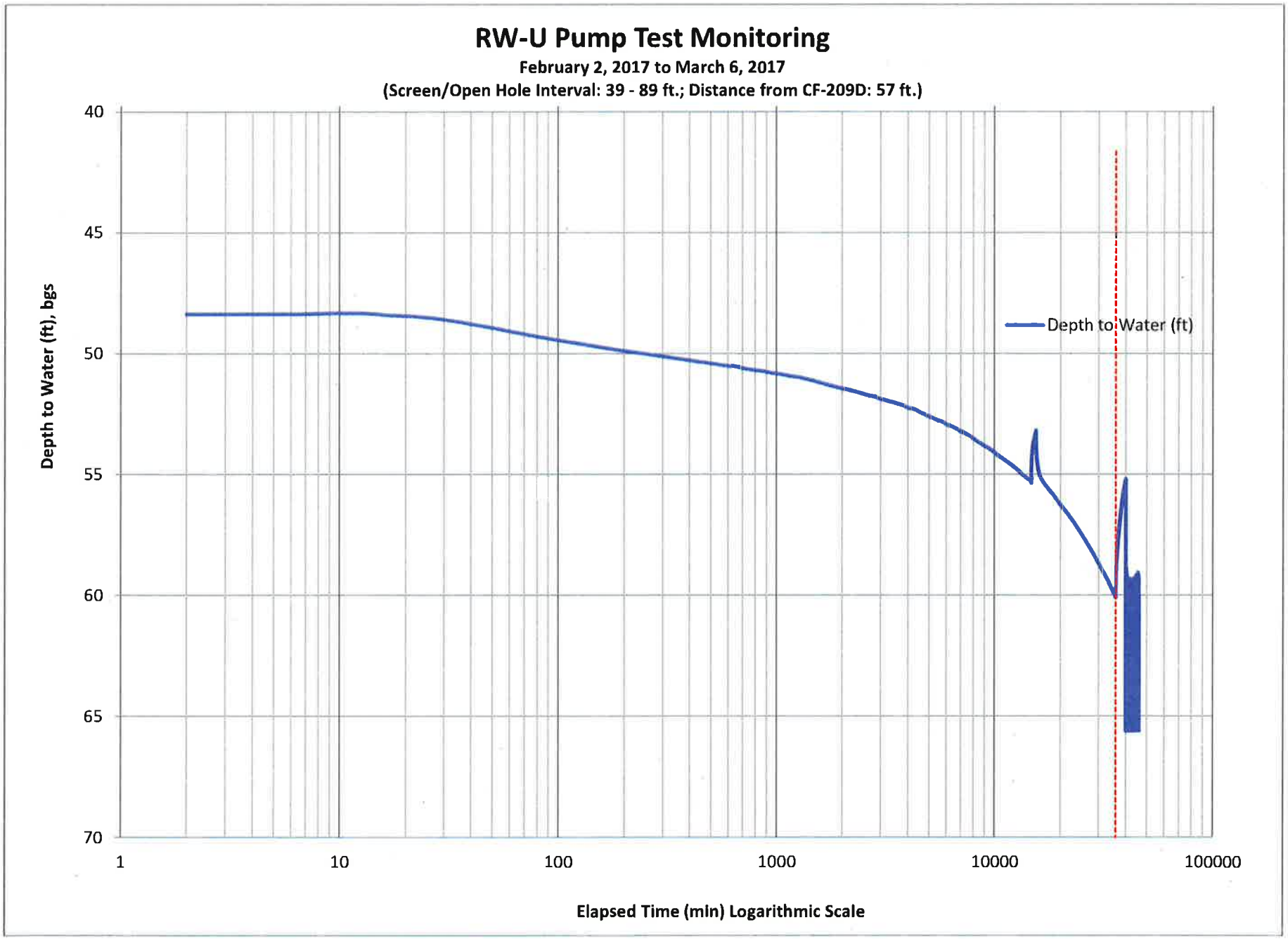

RW-R Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 11 - 51 ft.; Distance from CF-209D: 632 ft.)
Depth to Water (ft)
Depth to Water (ft), bgs
15
20
25
30
35
40
45
50
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
Elapsed Time (min)

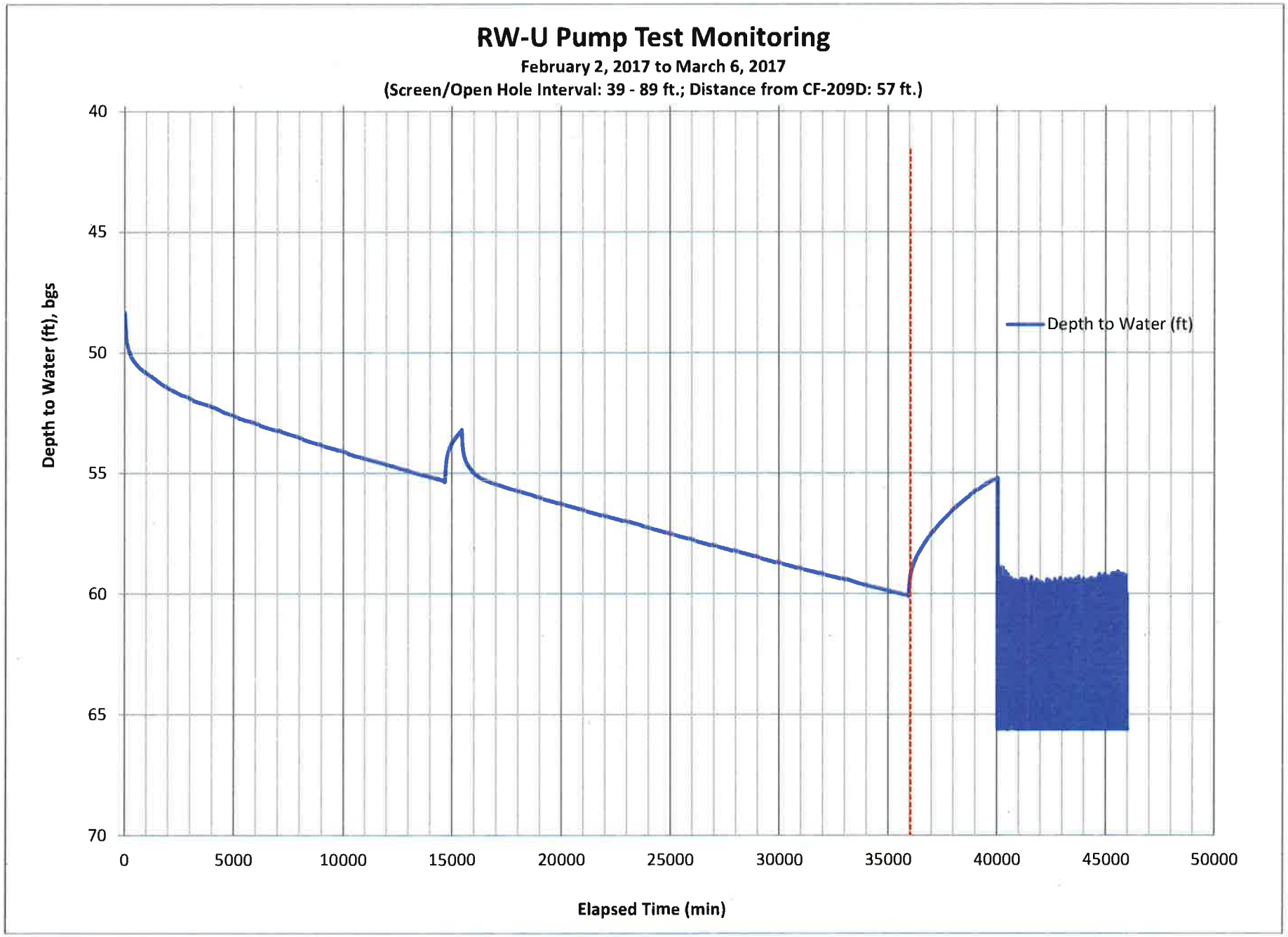

RW-T Background, Step Test, and Recovery Monitoring
January 27, 2017 to February 2, 2017
(Screen/Open Hole Interval: 65 - 115 ft.; Distance from CF-209D: 435 ft.)
Depth to Water (ft), bgs
0
10
20
30
40
50
60
70
80
90
1/27/2017 0:00
1/28/2017 0:00
1/29/2017 0:00
1/30/2017 0:00
1/31/2017 0:00
2/1/2017 0:00
2/2/2017 0:00
2/3/2017 0:00
2/4/2017 0:00
Date & Time
Step test
Depth To Water (ft)

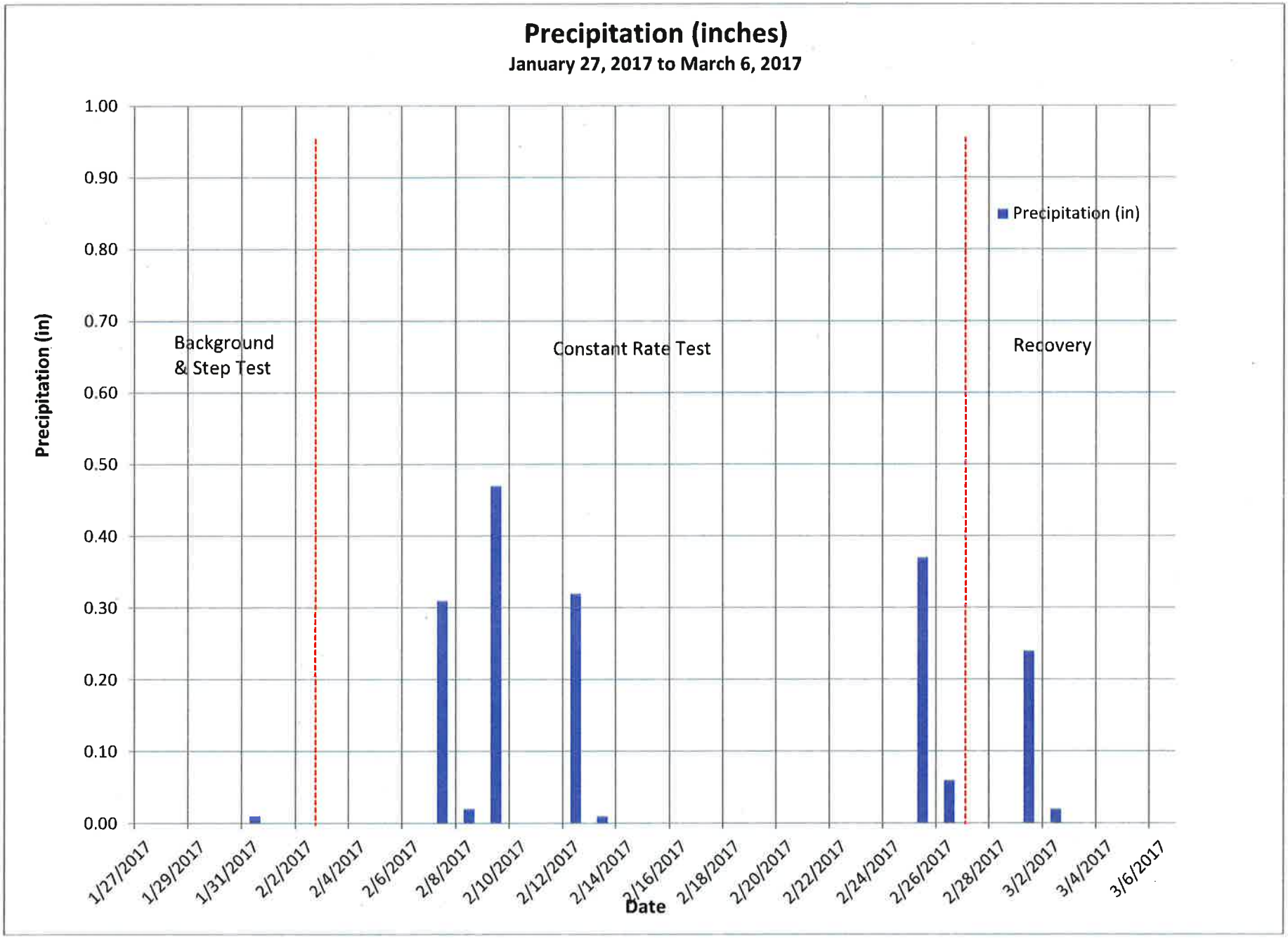

RW-T Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 65 - 115ft; Distance from CF-209D = 435 ft)
Depth to Water (ft), bgs
15
25
35
45
55
65
75
1
10
100
1000
10000
100000
Elapsed Time (min) Logarithmic Scale
Depth to Water (ft)


RW-T Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 65 - 115ft; Distance from CF-209D = 435 ft)
Depth to Water (ft), bgs
15
25
35
45
55
65
75
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
Elapsed Time (min) Linear Scale
Depth to Water (ft)


RW-U Backround, Step Test, and Recovery Monitoring
January 27, 2017 to February 2, 2017
(Screen/Open Hole Interval: 39 - 89 ft.; Distance from CF-209D: 57 ft.)
Depth to Water (ft), bgs
20
30
40
50
60
70
80
1/27/2017 0:00
1/28/2017 0:00
1/29/2017 0:00
1/30/2017 0:00
1/31/2017 0:00
2/1/2017 0:00
2/2/2017 0:00
2/3/2017 0:00
2/4/2017 0:00
Date & Time
Step test
Depth To Water (ft)


RW-U Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 39 - 89 ft.; Distance from CF-209D: 57 ft.)
Depth to Water (ft), bgs
40
45
50
55
60
65
70
1
10
100
1000
10000
100000
Elapsed Time (min) Logarithmic Scale
Depth to Water (ft)


RW-U Pump Test Monitoring
February 2, 2017 to March 6, 2017
(Screen/Open Hole Interval: 39 - 89 ft.; Distance from CF-209D: 57 ft.)
Depth to Water (ft), bgs
40
45
50
55
60
65
70
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
Elapsed Time (min)
Depth to Water (ft)


Precipitation (inches)
January 27, 2017 to March 6, 2017
Precipitation (in)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Background & Step Test
Constant Rate Test
Recovery
Precipitation (in)
1/27/2017
1/29/2017
1/31/2017
2/2/2017
2/4/2017
2/6/2017
2/8/2017
2/10/2017
2/12/2017
2/14/2017
2/16/2017
2/18/2017
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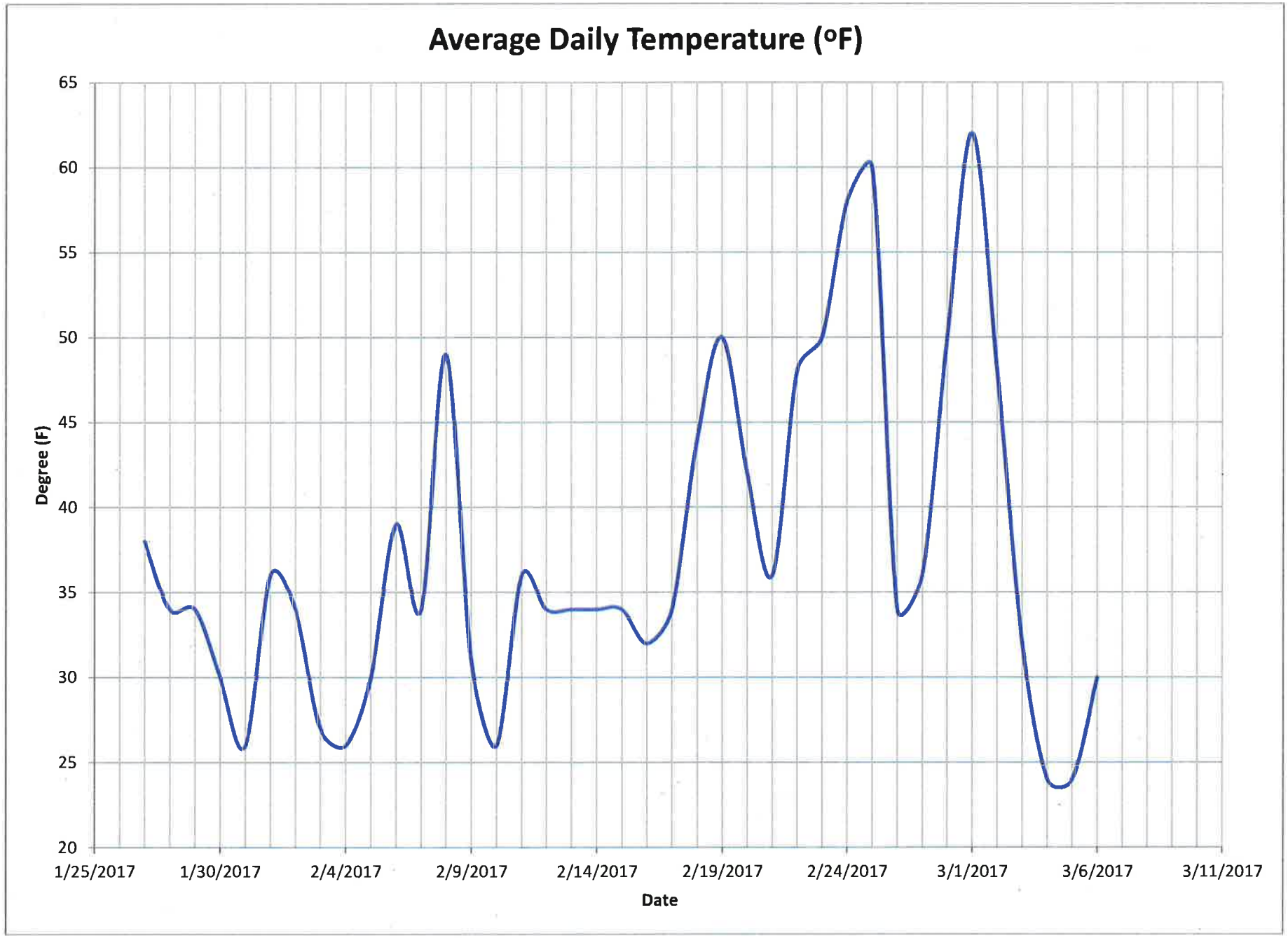
3/4/2017
3/6/2017
Date


Average Daily Temperature (°F)
65
60
55
50
45
40
35
30
25
20
Degree (F)
1/25/2017
1/30/2017
2/4/2017
2/9/2017
2/14/2017
2/19/2017
2/24/2017
3/1/2017
3/6/2017
3/11/2017
Date

APPENDIX C

AMBERSORB™ 560 Treatability Study/Pilot Test

Technical Memorandum

To: Pamela Baxter, RPM/EPA R2

From: Patricia Parvis

Date: April 28, 2017

Subject: 018-RICO-0256 Combe Fill South RI/FS
AMBERSORB™ 560 Treatability Study/ Pilot Test

Executive Summary

This technical memorandum summarizes the methodology and results of the source area groundwater treatability study activities at Combe Fill South Landfill (the Site) from January to April, 2017. The treatability study was part of the Operable Unit 2 (OU-2) Remedial Investigation/ Feasibility Study (RI/FS) activities outlined in the Amended October 2016 Work Plan under Work Assignment No. 018-RICO-0256 of Contract No. EP-W-09-009.

Henningson Durham and Richardson Architecture and Engineering, P.C. in association with HDR Engineering, Inc. (HDR) contracted Emerging Compounds Treatment Technologies (ECT) of Portland, ME to conduct an ex-situ treatability study/pilot test using groundwater from the waste cell source area and effluent from the Site's groundwater treatment plant (GWTP) for the purpose of reducing 1,4-dioxane concentrations. ECT is the exclusive vendor for Dow Chemical, the manufacturer of AMBERSORB™ 560, which is a synthetic media that has been developed for 1,4-dioxane treatment applications and used to conduct this pilot test. The objectives of this treatability study/pilot test were:

- To demonstrate AMBERSORB™ 560's ability to reduce 1,4-dioxane concentrations in groundwater pumped from the fractured bedrock aquifer to below the New Jersey Department of Environmental Protection's Interim Groundwater Quality Criterion (NJDEP IGWQC) of 0.4 micrograms per liter (µg/l);
- To demonstrate the regenerable nature of AMBERSORB™ 560 through multiple loading cycles without significant loss to the media's adsorption capacity; and
- To obtain sufficient design information for a full-scale system to be evaluated as an alternative in the Feasibility Study report.

In addition to this technical memorandum, HDR submitted biweekly reports summarizing the field activities covered during the treatability study period, and trip reports summarizing the sampling activities that were conducted under CLP Case Number 46775.

The treatability study successfully met the objectives set forth in the Work Plan and the AMBERSORB™ 560 treatment technology will be retained as a remedial alternative option in the Feasibility Study report. Based on the findings of this treatability study/pilot test, coupled with the OU-2 hydrogeologic assessment (pump test) conducted simultaneously at well CF-209D and other past investigations, HDR in conjunction with ECT, will develop capital and operation and maintenance (O&M) cost information for a full-scale system.

Treatability Study/ Pilot Test

ECT mobilized its pilot treatment system (pilot skid) to the Site on January 26, 2017. The pilot skid was housed in a 20 foot long by 8 foot wide and 8 foot high conex shipping container, and was equipped with an influent peristaltic feed pump, water filters to remove particulates, three 2-inch diameter by 24-inch long AMBERSORB™ 560 columns, and an electric steam generator to provide super-heated steam for the media regeneration process. The pilot skid was also outfitted with a small refrigerator for sample

preservation, a table workstation and equipment storage space. A temporary single phase, 240 volt electric power service on a 50 amp breaker was provided to power the pilot skid. HDR contracted with a New Jersey licensed electrician to perform the service connection as well as disconnection at the end of the test. The pilot skid was delivered to the Site on a flat-bed truck and offloaded adjacent to the GWTP's sequencing batch reactors (SBR's) via a crane.

The AMBERSORB™ 560 media functions similar to other adsorption media, such as granular activated carbon (GAC), in that it requires sufficient empty bed contact time (EBCT) to treat the contaminants. The media has a specific organic loading capacity based on the constituents present in the water. Once the loading capacity of the media is reached, contaminant breakthrough, or leakage, will occur. Once leakage occurs on the lead column, that column is taken offline, the media is regenerated in place, and the lag column is moved to the lead position. The AMBERSORB™ 560 media is able to be continuously regenerated with negligible impacts to its long-term adsorption capacity.

The treatability study was designed to test bedrock groundwater from well CF-209D located downgradient of the waste cell, a source area with the highest 1,4-dioxane concentrations on Site. The treatability study was conducted in three distinct 5 to 6 day loading cycles with two media regeneration processes in between cycles 1 and 2. Loading cycles 1 and 2 tested 'raw' untreated groundwater to stress the system and demonstrate the media's capacity to treat 1,4-dioxane. Loading cycle 3 tested treated groundwater collected from the lag GAC column of the GWTP, which contained 1,4-dioxane as the only volatile organic compound (VOC). Loading cycle 3 was intended to simulate actual design conditions if the existing GWTP were to be modified with an AMBERSORB™ 560 system. By placing the AMBERSORB™ 560 system after the existing GAC units, the system size and capital costs would be significantly reduced. ECT's full Pilot Test Summary report is included in Appendix A of this technical memorandum.

Loading Cycle 1

ECT began the pilot test with loading cycle 1 on February 2, 2017 and ran continuously until February 8, 2017. Column 1 was regenerated on February 9, 2017. The pilot test setup included column 1 as the lead column, column 2 as the lag and column 3 as the effluent polish. All columns were in series with upward flow throughout. Loading cycle 1 ran at a targeted flow rate of 220 milliliters per minute (ml/min) with an EBCT of 6 minutes per column. The 6 minute EBCT was determined using ECT's proprietary adsorption model using initial conditions assuming an influent 1,4-dioxane concentration of 150 µg/l with no additional VOCs present in the groundwater. The estimated 150 µg/l 1,4-dioxane influent concentration was based on the January 2017 groundwater sampling results from well CF-209D that reported 1,4-dioxane concentrations ranging from 150 – 350 µg/l from the 4 discreet FLUTe™ sampling ports, and accounting for fresh water mixing.

ECT collected daily performance samples at the influent, column 1, column 2, and column 3 (effluent) and analyzed the samples in-house using a modified EPA Method 8015B with a method detection limit (MDL) of 1 µg/l for 1,4-dioxane. The modified EPA Method 8015B consisted of a 60° C heated purge and trap followed by gas chromatography (GC) with flame ionization detection (FID). ECT's performance data reported the influent concentrations ranging from 100 to 131 µg/l with 1,4-dioxane breakthrough occurring on the lead column on day 3. This breakthrough was earlier than predicted due to other VOCs in the groundwater that contributed to mass loading on the media. Non-detectable 1,4-dioxane concentrations were reported for column 2 and the effluent column 3 during the entire loading cycle period.

HDR collected a split sample from the influent on February 6, 2017 and from column 1 on February 8, 2017. The samples were sent to an EPA CLP laboratory for analysis by Method SOW SOM02.3 SIM. The CLP laboratory's analytical results are compared to ECT's results in Table 1.

Table 1: Loading Cycle 1 Results Comparison

Sample Location	1,4-dioxane, µg/l (0.4 µg/l IGWQC)	
	ECT Sample	CLP Sample
Influent	131	50
Column 1	31.1	19
Analytical Method	Modified 8015B	SOM02.3 SIM

The CLP split sample results and ECT's in-house samples were analyzed using different analytical methods which likely contributed to the discrepancies in the reported concentrations. ECT's modified analytical method was developed to provide rapid turnaround of sample results in support of pilot testing activities.

Loading Cycle 2

Based on the data from loading cycle 1, ECT reduced the flow rate for loading cycle 2 from 220 ml/ min to 146 ml/min which increased the EBCT from 6 minutes to 9 minutes. The increased EBCT allows for additional mass loading on the column before leakage occurs. Column 2 was moved to the lead position with the regenerated column 1 in the lag position and column 3 remaining as the polish effluent. The influent water line remained as raw untreated groundwater, the same connection as loading cycle 1.

Loading cycle 2 began on February 15, 2017 and ran continuously until February 20, 2017, and column 2 was regenerated on February 21, 2017. ECT's performance data reported influent 1,4-dioxane concentrations ranging from 98 to 121 µg/l with non-detectable 1,4-dioxane results from the lead column 2, the lag column 1 and the effluent polish column 3 samples. As predicted, the increased EBCT allowed for sufficient treatment within the lead column to prevent any breakthrough leakage during this cycle.

HDR collected confirmatory split samples with ECT on February 20, 2017 at the influent, and normal and field duplicate samples of the effluent at column 3. The results are presented in Table 2.

Table 2: Loading Cycle 2 Results Comparison

Sample Location	1,4-dioxane, µg/l (0.4 µg/l IGWQC)	
	ECT Sample	CLP Sample
Influent	98	51 J
Column 3 (Effluent)	1.0 U	0.28 B / 0.20[1] U
Analytical Method	Modified 8015B	SOM02.3 SIM

Notes: [1]Field duplicate sample. B indicates 1,4-dioxane was detected in the associated blank as well as the sample; J is estimated and U is non-detect.

The effluent CLP parent (normal) sample reported a 1,4-dioxane concentration of 0.28 µg/l with a 'B' flag indicating 1,4-dioxane was detected in the associated laboratory blank and the CLP duplicate sample was reported as non-detectable for 1,4-dioxane with a reporting limit of 0.20 µg/l. Both sample results were below the 0.4 µg/l IGWQC for 1,4-dioxane in New Jersey.

Loading Cycle 3

Loading cycle 3 began on February 22, 2017 and ran continuously until February 27, 2017. Slowing the flow rate and increasing the EBCT during loading cycle 2 proved effective for treating 1,4-dioxane without leakage; however, the slower flow rate would result in a significantly larger tank size for a full-scale system. For loading cycle 3 the influent water was changed from raw untreated groundwater to fully-treated groundwater from the GWTP's lag GAC unit. This change will significantly reduce the presence of other organic constituents, leaving the AMBERSORB™ 560 system to treat 1,4-dioxane. Column 1 was moved to the lead position, regenerated column 2 was moved to the lag position and column 3 remained as the polish effluent. The targeted flow rate was returned to 220 ml/min for an EBCT of 6 minutes as in loading cycle 1.

ECT's performance samples reported influent 1,4-dioxane concentrations ranging from 93 to 107 µg/l. 1,4-dioxane breakthrough of the lead column 1 occurred on February 27, 2017 – the last day of the loading cycle. Non-detectable concentrations were reported for the lag column 2 and the effluent polish column 3 throughout the test.

HDR collected split samples with ECT on February 27, 2017 at the influent and effluent (column 3). The results are presented in Table 3.

Table 3: Loading Cycle 3 Results Comparison

Sample Location	1,4-dioxane, µg/l (0.4 µg/l IGWQC)	
	ECT Sample	CLP Sample
Influent	98	61
Column 3 (Effluent)	1.0 U	0.1 U
Analytical Method	Modified 8015B	SOM02.3 SIM

Notes: U is non-detect

As with loading cycle 2, the effluent CLP sample result for 1,4-dioxane was non-detect with a reporting limit of 0.1 µg/l, well below the 0.4 µg/l IGWQC for 1,4-dioxane in New Jersey.

Conclusions and Recommendations

This pilot test successfully demonstrated that AMBERSORB™ 560 was able to reduce 1,4-dioxane concentrations below the 0.4 µg/l IGWQC. The media was readily regenerated inside the pilot skid without any problems in the same manner as would be for a full-scale system. The technology is directly scalable to fit the design flow rate determined in pre-Feasibility Study calculations or could readily be installed as a component of the current GWTP.

Based on the results of this treatability study/pilot test, and in light of the benefits associated with this technology, a full-scale AMBERSORB™ 560 system will be evaluated as an ex-situ treatment option for the remedial alternatives presented in the Feasibility Study report.

Appendices:

Appendix A – ECT's Synthetic Media Pilot Testing Report

Appendix B – Analytical Summary Data

References:

HDR 2016. Henningson, Durham and Richardson Architecture and Engineering, P.C. Amended Work Plan. Remedial Investigation/Feasibility Study, Combe Fill South Landfill Site OU2, Chester and Washington Townships, Morris County, New Jersey. United State Environmental Protection Agency; Contract Number: EP-W-09-009, Work Assignment Number: 018-RICO-0256. October 17, 2016

HDR 2017a. Henningson, Durham and Richardson Architecture and Engineering, P.C. HDR Biweekly Reports 74 – 78. January – April, 2017

HDR 2017b. Henningson, Durham and Richardson Architecture and Engineering, P.C. Complete Sampling Trip Report CLP Case No. 46712. January 22, 2017

HDR 2017c. Henningson, Durham and Richardson Architecture and Engineering, P.C. Partial Sampling Trip Report CLP Case No. 46775. March 8, 2017

HDR 2017d. Henningson, Durham and Richardson Architecture and Engineering, P.C. Complete Sampling Trip Report CLP Case No. 46775. March 27, 2017

Appendix A – ECT’s Synthetic Media Pilot Testing Report

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Portland, ME 04101-2617

207.482.4650 direct
ect2.com

April 26, 2017

HDR
One International Boulevard
10th Floor
Mahwah, NJ 07495
T: 201.335.9465

Attention: Mr. Andrew Watson

Subject: Synthetic Media Pilot Testing Report
1,4-Dioxane Treatment at the Combe Fill South (CFS) Landfill
Chester & Washington Townships, Morris County, NJ

Andrew:

Enclosed with this letter is ECT's Pilot Testing Report on the use of Synthetic Media for Treatment of extracted groundwater at the Combe Fill South (CFS) Landfill at 98 Parker Road, Chester, NJ. We have thoroughly enjoyed working with HDR and Chapman, Inc. on this project, and look forward to the installation of a full-scale treatment system. Please do not hesitate to contact me at 207-210-1551 if you have any questions related to the Report.

Sincerely yours,
ECT

Steven Woodard, Ph.D., P.E.
President

Enclosure

EXECUTIVE SUMMARY

This Pilot Testing Report was prepared by Emerging Compounds Treatment Technologies (ECT) on behalf of HDR. This report describes the performance of a synthetic media pilot skid to demonstrate the media's ability to remove Site contaminants of concern (COCs), specifically 1,4-dioxane (14D), from extracted ground water at the CFS Landfill in Chester, NJ.

Collectively, the results of the synthetic media pilot test support the following conclusions and recommendations.

- HDR and Chapman personnel were very helpful and safety conscious throughout the test.
- AMBERSORB showed good capacity for 14D, treating to less than the NJDEP GWQS & Interim GWQ Criteria of 0.4 µg/L.
- Based on the pilot test results, a 7.5 min EBCT is recommended for full-scale application. This EBCT balances capital and O&M costs with the ability to consistently generate an effluent with a 14D concentration less than 0.4 µg/L.
- Steam regeneration effectively restored AMBERSORB's capacity for 14D.
- It is recommended that the full scale synthetic media treatment system is installed downstream of a SBR/GAC system like the existing GWTP to protect the AMBERSOB media from compounds that decrease the media's capacity for 14D.
- ECT's synthetic media process is directly scalable in a linear fashion from pilot test results to permit full-scale capital and O&M costing.

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1. INTRODUCTION

1.1. PROJECT BACKGROUND

This Pilot Testing Report was prepared by Emerging Compounds Treatment Technologies (ECT) on behalf of HDR. This report describes the performance of an AMBERSORB 560 synthetic media pilot test to demonstrate the media's ability to remove Site contaminants of concern (COCs), specifically 1,4-dioxane (14D) from extracted ground water at the CFS Landfill in Chester, NJ.

The pilot skid source water (influent) was raw ground water (Cycle 1 and Cycle 2) and treated effluent from the existing groundwater sequencing biological reactor (SBR)/granular activated carbon (GAC) treatment system (Cycle 3).

On-Site pilot testing was performed using ECT's PS1 pilot skid. PS1 is a 20 foot Conex box containing all equipment necessary for forward flow treatment using synthetic media and on-site regeneration of COC loaded synthetic media using steam. Figures 1 and 2 are photographs of PS1.

Figure 1. PS1 - Conex Box

Figure 2. PS1 - Synthetic Media Pilot Skid

Pilot testing began at 14:53 on February 2, 2017 and concluded at 10:15 on February 27, 2017. This report includes the pilot test objectives, methodology, results and discussion, conclusions and recommendations, and estimated full-scale capital and annual O&M costs.

2. OBJECTIVES

The objectives of the synthetic media pilot test were to:

1. Determine AMBERSORB's capacity for 14D in the presence of other site contaminants.

2. Confirm that the synthetic media system can consistently generate an effluent with a 14D concentration less than 0.4 µg/L throughout multiple loading cycles, based on the influent concentration encountered during the pilot test, i.e., 50-60 µg/L.

3. Confirm the empty bed contact time (EBCT) necessary to achieve the 0.4 µg/L 14D effluent limit.

4. Confirm superheated steam requirements to effectively regenerate the AMBERSORB media.

5. Obtain sufficient operating information to develop system sizing and design parameters to be used in the preparation of a full-scale treatment system design.

6. Obtain sufficient operating information to develop estimated capital and annual O&M costs for incorporation into a feasibility study report being developed by HDR.

7. Allow plant personnel to make general observations of the synthetic media process as they relate to:

    a. Ease of operation and need for operator attention and/or maintenance (manpower requirements)
    b. Simplicity and robustness of unit operations
    c. System reliability to ensure minimum equipment downtime
    d. Ability to handle upstream changes in flows and loads
    e. Susceptibility to process upset
    f. Process flexibility
    g. Ease of maintenance and need for specialized tools or skills

3. METHODOLOGY

The performance of synthetic media was evaluated by conducting on-site pilot scale column testing using extracted raw ground water (Cycle 1 and Cycle 2), at two different flow rates, and for Cycle 3 treated effluent from the existing groundwater sequencing batch reactor (SBR)/granular activated carbon (GAC) ground water treatment plant (GWTP), was passed though the pilot skid at a at a single flow rate.

For each loading cycle, Site water was passed through three identical 2-inch diameter by 24-inch long stainless steel columns connected in series; each column contained 1.32 liters (1.6 pounds) of AMBERSORB 560 adsorbent. Effluent from the pilot skid was discharged into an on-site sump connected to the influent of the ground water treatment plant (GWTP). During the synthetic media pilot test the on-site GWTP was processing only ground water extracted from Well CF-209D.

On-Site pilot testing was subdivided into three distinct Cycles as follows:

Cycle 1 – GWTP Influent (Flow Rate A): During Cycle 1, the adsorbent columns were connected in series in the following configuration: Column 1 (Lead) → Column 2 (Lag) → Column 3 (Polish). For testing, a slip stream of the influent to the GWTP was diverted to PS1. An onboard peristaltic pump was used to push GWTP influent water through the adsorbent columns, in an up-flow orientation, at a nominal flow rate of 220 milliliters per minute (mL/min) yielding an approximate 6-minute empty bed contact time (EBCT) through each AMBERSORB column. Throughout the 6-day loading cycle, daily samples were collected from the influent and each column effluent for 14D screening, via a modified EPA Method 8015B (60°C heated purge & trap concentration followed by gas chromatography with flame ionization detection), at ECT's research and development laboratory located in Rochester, NY. A split sample of the influent, midway through the loading cycle, and an effluent sample from the Lead column (Column 1), at the end of the loading cycle, was sent to a CLP laboratory for 14D analysis by EPA Method CLP SOW SOM02.3-SIM. At the end of the loading cycle, Column 1 was regenerated using 15 psig saturated steam superheated to >300°F. After regeneration, Column 1 was placed back into service in the Lag position.

Cycle 2 – GWTP Influent (Flow Rate B): During Cycle 2, the adsorbent columns were connected in series in the following configuration: Column 2 (Lead) → Column 1 (Lag) → Column 3 (Polish). GWTP influent water was pumped through the adsorbent columns, in an up-flow orientation, at a nominal flow rate of 146 mL/min, yielding an approximate 9-minute EBCT through each AMBERSORB column. Throughout the 5-day loading cycle, daily samples were collected from the influent and each column effluent for 14D screening by ECT. Split samples of the influent and effluent from the final column (Column 3) were collected on the last day of the loading cycle and shipped to a CLP laboratory for analysis. At the end of the loading cycle, Column 2 was regenerated using superheated steam. After regeneration, Column 2 was placed back into service in the Lag position.

Cycle 3 – GWTP Final Effluent (Flow Rate A): During Cycle 3, the adsorbent columns were connected in series in the following configuration: Column 1 (Lead) → Column 2 (Lag) → Column 3 (Polish). For testing, a slip stream of the GWTP final effluent was diverted to PS1. As in Cycle 1, an onboard peristaltic pump was used to push GWTP influent water through the adsorbent columns, in an up-flow orientation, at a nominal flow rate of 220 mL/min yielding an approximate 6-minute EBCT through each AMBERSORB column. Throughout the 5-day loading cycle, daily samples were collected from the influent and each column effluent for 14D screening by ECT. Split samples of the influent and effluent from the Polish column (Column 3) were collected on the last day of the loading cycle and shipped to a CLP laboratory for analysis. At the end of the loading cycle, no additional steam regenerations were conducted; adsorbent was removed from all columns for off-site disposal.

4. RESULTS

Table 1 summarizes the 1,4-dioxane sample collection and analysis plan, sample collection times, measured flow rates and field flow rate adjustments for each loading cycle.

TABLE 1. 1,4-DIOXANE SAMPLE COLLECTION AND ANALYSIS PLAN

CYCLE	DATE	Elapsed Time (Day)	COLUMN ORDER	SAMPLE COLLECTION TIMES				Flow Rate (ml/min)	REMARKS
				INF	COL 1	COL 2	COL 3		
1	2/2/2017 14:53	START							
	2/2/2017	0.08	1-2-3	1645	1640	1635	1630	222	
	2/3/2017	0.81	1-2-3	1018	1015	1011	1009	218	Reset flow rate to 220 ml/min after sample collection
	2/4/2017	1.74	1-2-3	0838	0835	0832	0829	218	Reset flow rate to 220 ml/min after sample collection
	2/5/2017	2.94	1-2-3	1320	1317	1315	1312	221	Reset flow rate to 220 ml/min after sample collection
	2/6/2017	3.90	1-2-3	1226*	1213	1209	1205	223	Reset flow rate to 220 ml/min after sample collection
	2/7/2017	4.78	1-2-3	0933	0926	0922	0913	218	Reset flow rate to 220 ml/min after sample collection
	2/8/2017	5.83	1-2-3	1050	1045*	0950	0948	219	Stopped flow immdeiately after INF sample collection
	2/9/2017				REGEN				Regenerating COL 1
2	2/15/2017 8:55	START							
	2/15/2017	0.20	2-1-3	1350	1340	1345	1337	146	
	2/16/2017	1.00	2-1-3	0850	0843	0846	0839	147	Reset flow to 146 ml/min after sample collection
	2/17/2017	1.99	2-1-3	0842	0835	0839	0830	144	Reset flow to 146 ml/min after sample collection
	2/18/2017	3.11	2-1-3	1215	1207	1212	1202	75	Stopped flow: 1040. Replaced pump tubing. Restarted flow @1120 (147 ml/min)
	2/19/2017	4.11	2-1-3	1220	1212	1215	1208	145	Reset flow to 146 ml/min after sample collection
	2/20/2017	5.14	2-1-3	1255*	1236	1238	1224*	146	Stopped flow immdeiately after INF sample collection
	2/21/2017					REGEN			Regenerating COL 2
3	2/22/2017 9:12	START							
	2/22/2017	0.08	1-2-3	1111	1106	1102	1055	223	
	2/23/2017	0.99	1-2-3	0851	0846	0841	0836	200	Reset flow rate to 220 ml/min after sample collection
	2/24/2017	2.20	1-2-3	1400	1355	1352	1347	220	Reset flow rate to 220 ml/min after sample collection
	2/25/2017	3.01	1-2-3	0931	0928	0926	0923	204	Reset flow rate to 220 ml/min after sample collection
	2/26/2017	4.04	1-2-3	1013	1011	1007	1004	179	Reset flow rate to 220 ml/min after sample collection
	2/27/2017	5.03	1-2-3	1015*	0956	0952	0948*	215	Stopped test at 1030

X	In-House GC analysis by ECT
X*	Split samples to CLP lab
X	Collect and hold pending results of other samples

Sample ID: Site-Location-Date-Time
Examples: CFSL-INF-021617-1000
CFSL-COL1-021617-1010

<u>Cycle 1 – GWTP Influent (Flow Rate A):</u> The nominal flow rate for Cycle 1 was 220 mL/min, yielding a 6-min EBCT contact time for each column. Since the columns were operated in series as Column 1 (Lead) → Column 2 (Lag) → Column 3 (Polish), the individual EBCTs are additive. That is, series operation allows the evaluation of performance data for three EBCTs, specifically, a 6-min EBCT (Lead Column), a 12-min EBCT (Lead Column + Lag Column) and an 18-min EBCT (Lead Column + Lag Column + Polish Column).

Table 2 contains the results for Cycle 1, which shows the following:

- Influent 14D concentrations, from ECT's in-house screening, ranged from 100 to 131 µg/L. The one influent sample sent to the CLP laboratory, collected midway through the loading cycle, showed a 14D concentration of 50 µg/L.

- No 14D was detected in either the Lag or Polish effluents; columns representing an overall 12 min and 18 min EBCT, respectively.

- 14D was first detected, at 5.8 µg/L, in the Lead column effluent after 41.7 hours of treatment.

- At the end of the loading cycle (140 hr), the Lead column effluent 14D concentration had increased to 31.1 µg/L, or 26.8% of the average influent concentration. Results from the CLP laboratory showed a final Lead column effluent 14D concentration of 19 µg/L, or 16.4% of the average influent concentration.

GC chromatograms from ECT's in-house screening showed the presence of a large unknown compound that eluted very early in the GC run. Based on its retention time, ECT postulated the identity of the unknown compound as either ethanol or ethyl ether. Since ethers and alcohols in general tend to smear the mass transfer zone for 14D, causing earlier than would be predicted leakage, it was collectively decided to increase the EBCT (i.e., slow down the flow rate for loading cycle 2).

TABLE 2 – 1,4-DIOXANE RESULTS FOR LOADING CYCLE 1

SAMPLE LOCATION	DAY -DATE-TIME	FLOW RATE (ml/min)	ELAPSED TIME (hr)	EBCT (min)	BV TREATED	ECT [14D] (µg/L)	CLP [14D] (µg/L)
START	Thursday, 2/2/2017 14:53	220	0.0	0.0	0.0	NS	NS
INFLUENT	Thursday, 2/2/2017 16:45	222	1.9			**100**	NA
	Friday, 2/3/2017 10:18	218	19.4			NA	NA
	Saturday, 2/4/2017 8:38	218	41.8			**105**	NA
	Sunday, 2/5/2017 13:20	221	70.5			NA	NA
	Monday, 2/6/2017 12:26	223	93.6			**131**	**50**
	Tuesday, 2/7/2017 9:33	218	114.7			NA	NA
	Wednesday, 2/8/2017 10:50	219	140.0			**128**	NA
LEAD AMB (COL 1)	Thursday, 2/2/2017 16:40	222	1.8	5.9	18	1.0 U	NA
	Friday, 2/3/2017 10:15	218	19.4	6.1	193	1.0 U	NA
	Saturday, 2/4/2017 8:35	218	41.7	6.1	415	**5.8**	NA
	Sunday, 2/5/2017 13:17	221	70.4	6.0	706	**11.4**	NA
	Monday, 2/6/2017 12:13	223	93.3	5.9	940	**21.0**	NA
	Tuesday, 2/7/2017 9:26	218	114.6	6.1	1140	**33.3**	NA
	Wednesday, 2/8/2017 10:45	219	139.9	6.0	1395	**31.1**	**19.0**
LAG AMB (COL 2)	Thursday, 2/2/2017 16:35	222	1.7	11.9	9	1.0 U	NA
	Friday, 2/3/2017 10:11	218	19.3	12.1	96	1.0 U	NA
	Saturday, 2/4/2017 8:32	218	41.7	12.1	207	1.0 U	NA
	Sunday, 2/5/2017 13:15	221	70.4	11.9	353	1.0 U	NA
	Monday, 2/6/2017 12:09	223	93.3	11.8	470	1.0 U	NA
	Tuesday, 2/7/2017 9:22	218	114.5	12.1	570	1.0 U	NA
	Wednesday, 2/8/2017 9:50	219	138.9	12.1	693	1.0 U	NA
POLISH EFF (COL 3)	Thursday, 2/2/2017 16:30	222	1.6	17.8	5	1.0 U	NA
	Friday, 2/3/2017 10:09	218	19.3	18.2	64	1.0 U	NA
	Saturday, 2/4/2017 8:29	218	41.6	18.2	138	1.0 U	NA
	Sunday, 2/5/2017 13:12	221	70.3	17.9	235	1.0 U	NA
	Monday, 2/6/2017 12:05	223	93.2	17.8	313	1.0 U	NA
	Tuesday, 2/7/2017 9:13	218	114.3	18.2	379	1.0 U	NA
	Wednesday, 2/8/2017 9:48	219	138.9	18.1	462	1.0 U	NA

NA = Not Analyzed
NS = Not Sampled
11.4 - positive detection at the concentration value shown
1.0 U = non-detect at the concentration value shown

Cycle 2 – GWTP Influent (Flow Rate B): The nominal flow rate for loading cycle 2 was 146 mL/min, yielding a 9-min EBCT for the Lead column, an 18-min EBCT for the combined Lead and Lag columns and a 27-min EBCT for all columns combined.

Table 3 contains the results for Cycle 2, which shows the following:

- Influent 14D concentrations, from ECT's in-house screening, ranged from 98 to 121 µg/L. The one influent sample sent to the CLP laboratory, collected at the end of the loading cycle, showed a 14D concentration of 51 J µg/L.

- No 14D was detected in any column effluent, include the Column 3 effluent split sample at a lower MDL.

- Slowing down the flow rate (i.e., increasing the EBCT), allowed for good 14D removal in the presence of the suspected unknown compound. However, although lengthening the EBCT improved 14D removal, a 9 min EBCT would result in overly large contactor vessels for full-scale application. Since the existing GWTP utilizes a sequencing biological reactor and alcohols and ethers are readily biodegraded, it was collectively decided to process GWTP final effluent at a faster flow rate (i.e., shorter EBCT) to evaluate whether a smaller full-scale synthetic media system could be used if the existing GWTP treatment technologies were to remain as a part of the final treatment package.

TABLE 3 – 1,4-DIOXANE RESULTS FOR LOADING CYCLE 2

SAMPLE LOCATION	DAY -DATE-TIME	FLOW RATE (ml/min)	ELAPSED TIME (hr)	EBCT (min)	BV TREATED	ECT [14D] (µg/L)	CLP [14D] (µg/L)
START	Wednesday, 2/15/2017 8:55	146	0.0	0.0	0.0	NS	NS
INFLUENT	Wednesday, 2/15/2017 13:50	146	4.9			**121**	NA
	Thursday, 2/16/2017 8:50	147	23.9			**119**	NA
	Friday, 2/17/2017 8:42	144	47.8			NA	NA
	Saturday, 2/18/2017 12:15	75	75.3			**115**	NA
	Sunday, 2/19/2017 12:20	146	99.4			**109**	NA
	Monday, 2/20/2017 12:55	146	124.0			**98**	**51 J**
LEAD AMB (COL 2)	Wednesday, 2/15/2017 13:45	146	4.8	9.0	32.1	1.0 U	NA
	Thursday, 2/16/2017 8:46	147	23.8	9.0	158.8	1.0 U	NA
	Friday, 2/17/2017 8:39	144	47.7	9.2	314.6	1.0 U	NA
	Saturday, 2/18/2017 12:12	75	75.3	17.6	378.1	1.0 U	NA
	Sunday, 2/19/2017 12:15	145	99.3	9.1	657.0	1.0 U	NA
	Monday, 2/20/2017 12:38	146	123.7	9.0	821.0	1.0 U	NA
LAG AMB (COL 1)	Wednesday, 2/15/2017 13:40	146	4.7	18.1	15.8	1.0 U	NA
	Thursday, 2/16/2017 8:41	147	23.8	18.0	79.1	1.0 U	NA
	Friday, 2/17/2017 8:35	144	47.7	18.3	157.1	1.0 U	NA
	Saturday, 2/18/2017 12:07	75	75.2	35.2	188.9	1.0 U	NA
	Sunday, 2/19/2017 12:12	145	99.3	18.2	328.3	1.0 U	NA
	Monday, 2/20/2017 12:36	146	123.7	18.1	410.4	1.0 U	NA
POLISH EFF (COL 3)	Wednesday, 2/15/2017 13:37	146	4.7	27.1	10.4	1.0 U	NA
	Thursday, 2/16/2017 8:39	147	23.7	26.9	52.7	1.0 U	NA
	Friday, 2/17/2017 8:30	144	47.6	27.5	104.5	1.0 U	NA
	Saturday, 2/18/2017 12:02	75	75.1	52.8	125.8	1.0 U	NA
	Sunday, 2/19/2017 12:08	145	99.2	27.3	218.7	1.0 U	NA
	Monday, 2/20/2017 12:24	146	123.5	27.1	273.2	1.0 U	0.11 U

NA = Not Analyzed
NS = Not Sampled
FD = Field Duplicate
11.4 - positive detection at the concentration value shown
U = non-detect at the concentration value shown
J = estimated at the concentration value shown

Cycle 3 – GWTP Effluent (Flow Rate A): The nominal flow rate for loading cycle 3 was 220 mL/min, yielding a 6-min EBCT for the Lead column, a 12-min EBCT for the combined Lead and Lag columns and an 18-min EBCT for all columns combined.

Table 4 contains the results for Cycle 3, which shows the following:

- Influent 14D concentrations, from ECT's in-house screening, ranged from 93 to 107 µg/L. The one influent sample sent to the CLP laboratory, collected at the end of the loading cycle, showed a 14D concentration of 61 µg/L. The unknown compound, detected in both Cycle 1 and Cycle 2 was also present in Cycle 3, but at an estimated concentration less than 1% (based on gas chromatograph peak area) of the value observed in the previous 2 cycles. The unknown compound was later identified as ethyl ether by the CLP lab.

- No 14D was detected in the Lag or Polish column effluents. The CLP split sample for the Polish column, collected at the end of the loading cycle, showed a non-detect result at 0.1 µg/L.

- 14D was only detected in the Lead column effluent at the end of the loading cycle at a concentration of 1.6 µg/L, or approximately 1.6% of the average influent 14D concentration.

- Loading cycle 3 results confirmed placing a full-scale synthetic media system after a SBR/GAC system like the existing GWTP as the best option for the following reasons:

    - Installation after the existing GWTP results in a smaller, more cost effective AMBERSORB treatment system.

    - The SBR/GAC system reduces influent variability to the AMBERSORB system resulting in a more consistent effluent quality.

    - The SBR/GAC system protects the AMBERSORB media from compounds, such as alcohols or ethers, that can cause premature 14D breakthrough.

TABLE 4 – 1,4-DIOXANE RESULTS FOR LOADING CYCLE 3

SAMPLE LOCATION	DAY -DATE-TIME	FLOWRATE (ml/min)	ELAPSED TIME (hr)	EBCT (min)	BV TREATED	[14D] (ug/L)	[14D] (ug/L)
START	Wednesday, 2/22/2017 9:12	220	0.0	0.0	0.0	NS	NS
INFLUENT	Wednesday, 2/22/2017 11:11	223	2.0			105	NA
	Thursday, 2/23/2017 8:51	200	23.7			93	NA
	Friday, 2/24/2017 14:00	220	52.8			107	NA
	Saturday, 2/25/2017 9:31	204	72.3			107	NA
	Sunday, 2/26/2017 10:13	179	97.0			98	NA
	Monday, 2/27/2017 10:15	215	121.1			98	61
LEAD AMB (COL 1)	Wednesday, 2/22/2017 11:06	223	1.9	5.9	19.1	1.0 U	NA
	Thursday, 2/23/2017 8:46	200	23.6	6.6	225.0	1.0 U	NA
	Friday, 2/24/2017 13:55	220	52.7	6.0	527.2	1.0 U	NA
	Saturday, 2/25/2017 9:28	204	72.3	6.5	696.4	1.0 U	NA
	Sunday, 2/26/2017 10:11	179	97.0	7.4	879.5	1.0 U	NA
	Monday, 2/27/2017 9:56	215	120.7	6.1	1193.6	1.6	NA
LAG AMB (COL 2)	Wednesday, 2/22/2017 11:02	223	1.8	11.8	9.2	1.0 U	NA
	Thursday, 2/23/2017 8:41	200	23.5	13.2	112.1	1.0 U	NA
	Friday, 2/24/2017 13:52	220	52.7	12.0	263.3	1.0 U	NA
	Saturday, 2/25/2017 9:26	204	72.2	12.9	348.0	1.0 U	NA
	Sunday, 2/26/2017 10:07	179	96.9	14.7	439.4	1.0 U	NA
	Monday, 2/27/2017 9:52	215	120.7	12.3	596.5	1.0 U	NA
POLISH EFF (COL 3)	Wednesday, 2/22/2017 10:55	223	1.7	17.8	5.8	1.0 U	NA
	Thursday, 2/23/2017 8:36	200	23.4	19.8	74.5	1.0 U	NA
	Friday, 2/24/2017 13:47	220	52.6	18.0	175.3	1.0 U	NA
	Saturday, 2/25/2017 9:23	204	72.2	19.4	231.9	1.0 U	NA
	Sunday, 2/26/2017 10:04	179	96.9	22.1	292.8	1.0 U	NA
	Monday, 2/27/2017 9:48	215	120.6	18.4	397.4	1.0 U	0.1 U

NA = Not Analyzed
NS = Not Sampled
11.4 - positive detection at the concentration value shown
1.0 U = non-detect at the concentration value shown

The reasons for the discrepancy between ECT's results and the CLP lab results are possibly due to the use of different analytical methods. To date, ECT has designed all full-scale 14D treatment systems based on analytical results from in-house screening.

5. CONCLUSIONS AND RECOMMENDATIONS

Collectively, the results of the synthetic media pilot test support moving forward with the following conclusions and recommendations.

- AMBERSORB showed good capacity for 14D, treating to less than the NJDEP GWQS & Interim GWQ Criteria of 0.4 µg/L.
- Based on the pilot test results, a 7.5 min EBCT is recommended for full-scale application. This EBCT balances capital and O&M costs with the ability to consistently generate an effluent with a 14D concentration less than 0.4 µg/L.
- Steam regeneration effectively restored AMBERSORB's capacity for 14D.
- It is recommended that the full scale synthetic media treatment system is installed downstream of a SBR/GAC system like the existing GWTP to protect the AMBERSOB media from compounds that decrease the media's capacity for 14D.
- ECT's synthetic media process is directly scalable in a linear fashion from pilot test results to permit full-scale capital and O&M costing.

Appendix B – Analytical Summary Data

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD6Z2	Lab Code: EQI

Sample Number: BD6Z4	Method: Semivolatiles	Matrix: Water	MA Number:
Sample Location: PilotSkid-INF	pH: 8	Sample Date: 02/06/2017	Sample Time: 12:26:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
1,4-Dioxane	Target	50		ug/L	50	D	5.0	YES	S3VEM
Benzaldehyde	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Phenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Bis(2-Chloroethyl) ether	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
2-Chlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Methylphenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
2,2'-Oxybis(1-chloropropane)	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Acetophenone	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
3-Methylphenol + 4-Methylphenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
N-Nitroso-di-n propylamine	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Hexachloroethane	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Nitrobenzene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Isophorone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Nitrophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,4-Dimethylphenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Bis(2-chloroethoxy)methane	Target	1.7	J	ug/L	1.7	J	1.0	YES	S3VEM
2,4-Dichlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Naphthalene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
4-Chloroaniline	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Hexachlorobutadiene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Caprolactam	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
4-Chloro-3-methylphenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Methylnaphthalene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Hexachlorocyclo-pentadiene	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
2,4,6-Trichlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,4,5-Trichlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
1,1'-Biphenyl	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Chloronaphthalene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Nitroaniline	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Dimethylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,6-Dinitrotoluene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Acenaphthylene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
3-Nitroaniline	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Acenaphthene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
2,4-Dinitrophenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
4-Nitrophenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Dibenzofuran	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,4-Dinitrotoluene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Diethylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Fluorene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
4-Chlorophenyl-phenyl ether	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
4-Nitroaniline	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
4,6-Dinitro-2-methylphenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
N-Nitrosodiphenylamine	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
1,2,4,5-Tetrachlorobenzene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
4-Bromophenyl-phenylether	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Hexachlorobenzene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Atrazine	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Pentachlorophenol	Target	10	UJ	ug/L	10	U	1.0	YES	S3VEM
Phenanthrene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Anthracene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Carbazole	Target	10	U	ug/L	10	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775 **Contract: EPW14035** **SDG: BD6Z2** **Lab Code: EQI**

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Di-n-butylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Fluoranthene	Target	10	U	ug/L	10	U	1.0	NO	S3VEM
Pyrene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Butylbenzylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
3,3'-Dichlorobenzidine	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Benzo(a)anthracene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Chrysene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Bis(2-ethylhexyl)phthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Di-n-octylphthalate	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Benzo(b)fluoranthene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Benzo(k)fluoranthene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Benzo(a)pyrene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Indeno(1,2,3-cd)pyrene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Dibenzo(a,h)anthracene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Benzo(g,h,i)perylene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
2,3,4,6-Tetrachlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Unknown-04	TIC	5.6	J	ug/L	5.6	J	1.0	YES	S3VEM
Unknown-01	TIC	4.5	J	ug/L	4.5	J	1.0	YES	S3VEM
Unknown-02	TIC	5.0	J	ug/L	5.0	J	1.0	YES	S3VEM
Unknown-03	TIC	4.2	J	ug/L	4.2	J	1.0	YES	S3VEM
Phenobarbital	TIC	3.3	NJ	ug/L	3.3	NJ	1.0	YES	S3VEM

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD6Z2	Lab Code: EQI

Sample Number: BD6Z4	Method: Semivolatiles by SIM	Matrix: Water	MA Number: 2682.0
Sample Location: PilotSkid-INF	pH: 8	Sample Date: 02/06/2017	Sample Time: 12:26:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Naphthalene	Target	0.022	J	ug/L	0.022	J	1.0	YES	S3VEM
2-Methylnaphthalene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Acenaphthylene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Acenaphthene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Fluorene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Pentachlorophenol	Target	0.10	R	ug/L	0.10	U	1.0	NO	S3VEM
Phenanthrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Anthracene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Fluoranthene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Pyrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(a)anthracene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Chrysene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Benzo(b)fluoranthene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(k)fluoranthene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(a)pyrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Indeno(1,2,3-cd)pyrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Dibenzo(a,h)anthracene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(g,h,i)perylene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Hexachlorobenzene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD6Z2	Lab Code: EQI

Sample Number: BD6Z5	Method: Semivolatiles	Matrix: Water	MA Number:
Sample Location: PilotSkid-COL1	pH: 8	Sample Date: 02/08/2017	Sample Time: 10:45:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
1,4-Dioxane	Target	19		ug/L	19		1.0	YES	S3VEM
Benzaldehyde	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Phenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Bis(2-Chloroethyl) ether	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
2-Chlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Methylphenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
2,2'-Oxybis(1-chloropropane)	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Acetophenone	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
3-Methylphenol + 4-Methylphenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
N-Nitroso-di-n propylamine	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Hexachloroethane	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Nitrobenzene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Isophorone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Nitrophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,4-Dimethylphenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Bis(2-chloroethoxy)methane	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,4-Dichlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Naphthalene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
4-Chloroaniline	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Hexachlorobutadiene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Caprolactam	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
4-Chloro-3-methylphenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Methylnaphthalene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Hexachlorocyclo-pentadiene	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
2,4,6-Trichlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,4,5-Trichlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
1,1'-Biphenyl	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Chloronaphthalene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Nitroaniline	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Dimethylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,6-Dinitrotoluene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Acenaphthylene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
3-Nitroaniline	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Acenaphthene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
2,4-Dinitrophenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
4-Nitrophenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Dibenzofuran	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,4-Dinitrotoluene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Diethylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Fluorene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
4-Chlorophenyl-phenyl ether	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
4-Nitroaniline	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
4,6-Dinitro-2-methylphenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
N-Nitrosodiphenylamine	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
1,2,4,5-Tetrachlorobenzene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
4-Bromophenyl-phenylether	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Hexachlorobenzene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Atrazine	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Pentachlorophenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Phenanthrene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Anthracene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Carbazole	Target	10	U	ug/L	10	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775 **Contract: EPW14035** **SDG: BD6Z2** **Lab Code: EQI**

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Di-n-butylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Fluoranthene	Target	10	U	ug/L	10	U	1.0	NO	S3VEM
Pyrene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Butylbenzylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
3,3'-Dichlorobenzidine	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Benzo(a)anthracene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Chrysene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Bis(2-ethylhexyl)phthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Di-n-octylphthalate	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Benzo(b)fluoranthene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Benzo(k)fluoranthene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Benzo(a)pyrene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Indeno(1,2,3-cd)pyrene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Dibenzo(a,h)anthracene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
Benzo(g,h,i)perylene	Target	5.0	U	ug/L	5.0	U	1.0	NO	S3VEM
2,3,4,6-Tetrachlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Unknown-02	TIC	2.5	J	ug/L	2.5	J	1.0	YES	S3VEM
Unknown-03	TIC	3.2	J	ug/L	3.2	J	1.0	YES	S3VEM
Octadec-9-enoic acid	TIC	2.3	NJ	ug/L	2.3	NJ	1.0	YES	S3VEM
Unknown-04	TIC	2.1	J	ug/L	2.1	J	1.0	YES	S3VEM
Unknown-01	TIC	2.5	J	ug/L	2.5	J	1.0	YES	S3VEM

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD6Z2	Lab Code: EQI

Sample Number: BD6Z5	Method: Semivolatiles by SIM	Matrix: Water	MA Number: 2682.0
Sample Location: PilotSkid-COL1	pH: 8	Sample Date: 02/08/2017	Sample Time: 10:45:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Naphthalene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
2-Methylnaphthalene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Acenaphthylene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Acenaphthene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Fluorene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Pentachlorophenol	Target	0.10	R	ug/L	0.10	U	1.0	NO	S3VEM
Phenanthrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Anthracene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Fluoranthene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Pyrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(a)anthracene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Chrysene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Benzo(b)fluoranthene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(k)fluoranthene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(a)pyrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Indeno(1,2,3-cd)pyrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Dibenzo(a,h)anthracene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(g,h,i)perylene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Hexachlorobenzene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD6Z7	Lab Code: EQI

Sample Number: BD700	Method: Semivolatiles	Matrix: Water	MA Number:
Sample Location: CFS-PilotTest-INF	pH: 8	Sample Date: 02/20/2017	Sample Time: 12:55:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
1,4-Dioxane	Target	51	J-	ug/L	51	D	5.0	YES	S3VE
Benzaldehyde	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Phenol	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Bis(2-Chloroethyl) ether	Target	11	U	ug/L	11	U	1.0	YES	S3VE
2-Chlorophenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2-Methylphenol	Target	11	U	ug/L	11	U	1.0	YES	S3VE
2,2'-Oxybis(1-chloropropane)	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Acetophenone	Target	11	U	ug/L	11	U	1.0	YES	S3VE
3-Methylphenol + 4-Methylphenol	Target	11	U	ug/L	11	U	1.0	YES	S3VE
N-Nitroso-di-n propylamine	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Hexachloroethane	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Nitrobenzene	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Isophorone	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2-Nitrophenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2,4-Dimethylphenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Bis(2-chloroethoxy)methane	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2,4-Dichlorophenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Naphthalene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
4-Chloroaniline	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Hexachlorobutadiene	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Caprolactam	Target	11	U	ug/L	11	U	1.0	YES	S3VE
4-Chloro-3-methylphenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2-Methylnaphthalene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Hexachlorocyclo-pentadiene	Target	11	U	ug/L	11	U	1.0	YES	S3VE
2,4,6-Trichlorophenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2,4,5-Trichlorophenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
1,1'-Biphenyl	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2-Chloronaphthalene	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2-Nitroaniline	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Dimethylphthalate	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2,6-Dinitrotoluene	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Acenaphthylene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
3-Nitroaniline	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Acenaphthene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
2,4-Dinitrophenol	Target	11	U	ug/L	11	U	1.0	YES	S3VE
4-Nitrophenol	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Dibenzofuran	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2,4-Dinitrotoluene	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Diethylphthalate	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Fluorene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
4-Chlorophenyl-phenyl ether	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
4-Nitroaniline	Target	11	U	ug/L	11	U	1.0	YES	S3VE
4,6-Dinitro-2-methylphenol	Target	11	U	ug/L	11	U	1.0	YES	S3VE
N-Nitrosodiphenylamine	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
1,2,4,5-Tetrachlorobenzene	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
4-Bromophenyl-phenylether	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Hexachlorobenzene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Atrazine	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Pentachlorophenol	Target	11	U	ug/L	11	U	1.0	NO	S3VE
Phenanthrene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Anthracene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Carbazole	Target	11	U	ug/L	11	U	1.0	YES	S3VE

Sample Summary Report

Case: 46775 **Contract: EPW14035** **SDG: BD6Z7** **Lab Code: EQI**

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Di-n-butylphthalate	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Fluoranthene	Target	11	U	ug/L	11	U	1.0	NO	S3VE
Pyrene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Butylbenzylphthalate	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
3,3'-Dichlorobenzidine	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Benzo(a)anthracene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Chrysene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Bis(2-ethylhexyl)phthalate	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Di-n-octylphthalate	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Benzo(b)fluoranthene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Benzo(k)fluoranthene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Benzo(a)pyrene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Indeno(1,2,3-cd)pyrene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Dibenzo(a,h)anthracene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Benzo(g,h,i)perylene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
2,3,4,6-Tetrachlorophenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Unknown-01	TIC	4.2	J	ug/L	4.2	J	1.0	YES	NV
Unknown-02	TIC	4.1	J	ug/L	4.1	J	1.0	YES	NV
Unknown-03	TIC	3.0	J	ug/L	3.0	J	1.0	YES	NV
Phenobarbital	TIC	4.9	NJ	ug/L	4.9	NJ	1.0	YES	NV
cis-13-Octadecenoic acid	TIC	3.2	NJ	ug/L	3.2	NJ	1.0	YES	NV
Unknown-04	TIC	3.6	J	ug/L	3.6	J	1.0	YES	NV

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD6Z7	Lab Code: EQI

Sample Number: BD700	Method: Semivolatiles by SIM	Matrix: Water	MA Number: 2682.0
Sample Location: CFS-PilotTest-INF	pH: 8	Sample Date: 02/20/2017	Sample Time: 12:55:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Naphthalene	Target	0.10	U	ug/L	0.017	JB	1.0	YES	S3VE
2-Methylnaphthalene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE
Acenaphthylene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE
Acenaphthene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE
Fluorene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE
Pentachlorophenol	Target	0.10	UJ	ug/L	0.10	U	1.0	YES	S3VE
Phenanthrene	Target	0.052	U	ug/L	0.012	JB	1.0	YES	S3VE
Anthracene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE
Fluoranthene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Pyrene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Benzo(a)anthracene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Chrysene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE
Benzo(b)fluoranthene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Benzo(k)fluoranthene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Benzo(a)pyrene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Indeno(1,2,3-cd)pyrene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Dibenzo(a,h)anthracene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Benzo(g,h,i)perylene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE
1,4-Dioxane	Target	27	J	ug/L	27	EB	1.0	NO	S3VE
Hexachlorobenzene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD6Z7	Lab Code: EQI

Sample Number: BD700	Method: Trace Volatiles	Matrix: Water	MA Number: 2683.0
Sample Location: CFS-PilotTest-INF	pH: 8	Sample Date: 02/20/2017	Sample Time: 12:55:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Dichlorodifluoromethane	Target	0.36	J	ug/L	0.36	J	1.0	YES	S3VEM
Chloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Vinyl chloride	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Bromomethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Trichlorofluoromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1-Dichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,2-Trichloro-1,2,2-Trifluoroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Acetone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Carbon disulfide	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methyl acetate	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methylene chloride	Target	0.50	U	ug/L	0.19	J	1.0	YES	S3VEM
trans-1,2-Dichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methyl tert-butyl ether	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1-Dichloroethane	Target	0.50		ug/L	0.50		1.0	YES	S3VEM
cis-1,2-Dichloroethene	Target	3.3		ug/L	3.3		1.0	YES	S3VEM
2-Butanone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Bromochloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chloroform	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,1-Trichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Cyclohexane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Carbon tetrachloride	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Benzene	Target	6.1		ug/L	6.1		1.0	YES	S3VEM
1,2-Dichloroethane	Target	3.8		ug/L	3.8		1.0	YES	S3VEM
Trichloroethene	Target	0.31	J	ug/L	0.31	J	1.0	YES	S3VEM
Methylcyclohexane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dichloropropane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Bromodichloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
cis-1,3-Dichloropropene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
4-Methyl-2-pentanone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Toluene	Target	0.32	J	ug/L	0.32	J	1.0	YES	S3VEM
trans-1,3-Dichloropropene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,2-Trichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Tetrachloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
2-Hexanone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Dibromochloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dibromoethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chlorobenzene	Target	1.2		ug/L	1.2		1.0	YES	S3VEM
Ethylbenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
o-Xylene	Target	0.14	J	ug/L	0.14	J	1.0	YES	S3VEM
m, p-Xylene	Target	0.34	J	ug/L	0.34	J	1.0	YES	S3VEM
Styrene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Bromoform	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Isopropylbenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,2,2-Tetrachloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,3-Dichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,4-Dichlorobenzene	Target	1.2		ug/L	1.2		1.0	YES	S3VEM
1,2-Dichlorobenzene	Target	0.22	J	ug/L	0.22	J	1.0	YES	S3VEM
1,2-Dibromo-3-chloropropane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2,4-Trichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2,3-Trichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
tert-Butyl Alcohol	Target	50	R	ug/L	50	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775 **Contract: EPW14035** **SDG: BD6Z7** **Lab Code: EQI**

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Ethyl ether	Target	240		ug/L	240		1.0	YES	S3VEM
Unknown-01	TIC	0.53	J	ug/L	0.53	J	1.0	YES	S3VEM
Unknown Alkane-01	TIC	1.1	J	ug/L	1.1	J	1.0	YES	S3VEM
Unknown-02	TIC	1.2	J	ug/L	1.2	J	1.0	YES	S3VEM

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD6Z7	Lab Code: EQI

Sample Number: BD701	Method: Semivolatiles	Matrix: Water	MA Number:
Sample Location: CFS-PilotTest-COL3	pH: 8	Sample Date: 02/20/2017	Sample Time: 12:24:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
1,4-Dioxane	Target	2.0	UJ	ug/L	2.0	U	1.0	NO	S3VE
Benzaldehyde	Target	10	U	ug/L	10	U	1.0	YES	S3VE
Phenol	Target	10	U	ug/L	10	U	1.0	YES	S3VE
Bis(2-Chloroethyl) ether	Target	10	U	ug/L	10	U	1.0	YES	S3VE
2-Chlorophenol	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
2-Methylphenol	Target	10	U	ug/L	10	U	1.0	YES	S3VE
2,2'-Oxybis(1-chloropropane)	Target	10	U	ug/L	10	U	1.0	YES	S3VE
Acetophenone	Target	10	U	ug/L	10	U	1.0	YES	S3VE
3-Methylphenol + 4-Methylphenol	Target	10	U	ug/L	10	U	1.0	YES	S3VE
N-Nitroso-di-n propylamine	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
Hexachloroethane	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
Nitrobenzene	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
Isophorone	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
2-Nitrophenol	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
2,4-Dimethylphenol	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
Bis(2-chloroethoxy)methane	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
2,4-Dichlorophenol	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
Naphthalene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
4-Chloroaniline	Target	10	U	ug/L	10	U	1.0	YES	S3VE
Hexachlorobutadiene	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
Caprolactam	Target	10	U	ug/L	10	U	1.0	YES	S3VE
4-Chloro-3-methylphenol	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
2-Methylnaphthalene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
Hexachlorocyclo-pentadiene	Target	10	U	ug/L	10	U	1.0	YES	S3VE
2,4,6-Trichlorophenol	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
2,4,5-Trichlorophenol	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
1,1'-Biphenyl	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
2-Chloronaphthalene	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
2-Nitroaniline	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
Dimethylphthalate	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
2,6-Dinitrotoluene	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
Acenaphthylene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
3-Nitroaniline	Target	10	U	ug/L	10	U	1.0	YES	S3VE
Acenaphthene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
2,4-Dinitrophenol	Target	10	U	ug/L	10	U	1.0	YES	S3VE
4-Nitrophenol	Target	10	U	ug/L	10	U	1.0	YES	S3VE
Dibenzofuran	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
2,4-Dinitrotoluene	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
Diethylphthalate	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
Fluorene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
4-Chlorophenyl-phenyl ether	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
4-Nitroaniline	Target	10	U	ug/L	10	U	1.0	YES	S3VE
4,6-Dinitro-2-methylphenol	Target	10	U	ug/L	10	U	1.0	YES	S3VE
N-Nitrosodiphenylamine	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
1,2,4,5-Tetrachlorobenzene	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
4-Bromophenyl-phenylether	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
Hexachlorobenzene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
Atrazine	Target	10	U	ug/L	10	U	1.0	YES	S3VE
Pentachlorophenol	Target	10	U	ug/L	10	U	1.0	NO	S3VE
Phenanthrene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
Anthracene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
Carbazole	Target	10	U	ug/L	10	U	1.0	YES	S3VE

Sample Summary Report

Case: 46775 **Contract: EPW14035** **SDG: BD6Z7** **Lab Code: EQI**

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Di-n-butylphthalate	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
Fluoranthene	Target	10	U	ug/L	10	U	1.0	NO	S3VE
Pyrene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
Butylbenzylphthalate	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
3,3'-Dichlorobenzidine	Target	10	U	ug/L	10	U	1.0	YES	S3VE
Benzo(a)anthracene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
Chrysene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
Bis(2-ethylhexyl)phthalate	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE
Di-n-octylphthalate	Target	10	U	ug/L	10	U	1.0	YES	S3VE
Benzo(b)fluoranthene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
Benzo(k)fluoranthene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
Benzo(a)pyrene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
Indeno(1,2,3-cd)pyrene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
Dibenzo(a,h)anthracene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
Benzo(g,h,i)perylene	Target	5.1	U	ug/L	5.1	U	1.0	NO	S3VE
2,3,4,6-Tetrachlorophenol	Target	5.1	U	ug/L	5.1	U	1.0	YES	S3VE

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD6Z7	Lab Code: EQI

Sample Number: BD701	Method: Semivolatiles by SIM	Matrix: Water	MA Number: 2682.0
Sample Location: CFS-PilotTest-COL3	pH: 8	Sample Date: 02/20/2017	Sample Time: 12:24:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Naphthalene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE
2-Methylnaphthalene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE
Acenaphthylene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE
Acenaphthene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE
Fluorene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE
Pentachlorophenol	Target	0.10	UJ	ug/L	0.10	U	1.0	YES	S3VE
Phenanthrene	Target	0.052	U	ug/L	0.0090	JB	1.0	YES	S3VE
Anthracene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE
Fluoranthene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Pyrene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Benzo(a)anthracene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Chrysene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE
Benzo(b)fluoranthene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Benzo(k)fluoranthene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Benzo(a)pyrene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Indeno(1,2,3-cd)pyrene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Dibenzo(a,h)anthracene	Target	0.052	U	ug/L	0.052	U	1.0	YES	S3VE
Benzo(g,h,i)perylene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE
1,4-Dioxane	Target	0.28		ug/L	0.28	B	1.0	YES	S3VE
Hexachlorobenzene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VE

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD6Z7	Lab Code: EQI

Sample Number: BD701	Method: Trace Volatiles	Matrix: Water	MA Number: 2683.0
Sample Location: CFS-PilotTest-COL3	pH: 8	Sample Date: 02/20/2017	Sample Time: 12:24:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Dichlorodifluoromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Vinyl chloride	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Bromomethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Trichlorofluoromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1-Dichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,2-Trichloro-1,2,2-Trifluoroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Acetone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Carbon disulfide	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methyl acetate	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methylene chloride	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
trans-1,2-Dichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methyl tert-butyl ether	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1-Dichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
cis-1,2-Dichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
2-Butanone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Bromochloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chloroform	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,1-Trichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Cyclohexane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Carbon tetrachloride	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Benzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Trichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methylcyclohexane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dichloropropane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Bromodichloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
cis-1,3-Dichloropropene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
4-Methyl-2-pentanone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Toluene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
trans-1,3-Dichloropropene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,2-Trichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Tetrachloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
2-Hexanone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Dibromochloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dibromoethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Ethylbenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
o-Xylene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
m, p-Xylene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Styrene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Bromoform	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Isopropylbenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,2,2-Tetrachloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,3-Dichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,4-Dichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dibromo-3-chloropropane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2,4-Trichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2,3-Trichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
tert-Butyl Alcohol	Target	50	R	ug/L	50	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775 **Contract: EPW14035** **SDG: BD6Z7** **Lab Code: EQI**

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Ethyl ether	Target	50	U	ug/L	50	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD6Z7	Lab Code: EQI

Sample Number: BD702	Method: Semivolatiles	Matrix: Water	MA Number:
Sample Location: CFS-PilotTest-COL3	pH: 8	Sample Date: 02/20/2017	Sample Time: 12:25:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
1,4-Dioxane	Target	2.1	UJ	ug/L	2.1	U	1.0	NO	S3VE
Benzaldehyde	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Phenol	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Bis(2-Chloroethyl) ether	Target	11	U	ug/L	11	U	1.0	YES	S3VE
2-Chlorophenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2-Methylphenol	Target	11	U	ug/L	11	U	1.0	YES	S3VE
2,2'-Oxybis(1-chloropropane)	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Acetophenone	Target	11	U	ug/L	11	U	1.0	YES	S3VE
3-Methylphenol + 4-Methylphenol	Target	11	U	ug/L	11	U	1.0	YES	S3VE
N-Nitroso-di-n propylamine	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Hexachloroethane	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Nitrobenzene	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Isophorone	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2-Nitrophenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2,4-Dimethylphenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Bis(2-chloroethoxy)methane	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2,4-Dichlorophenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Naphthalene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
4-Chloroaniline	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Hexachlorobutadiene	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Caprolactam	Target	11	U	ug/L	11	U	1.0	YES	S3VE
4-Chloro-3-methylphenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2-Methylnaphthalene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Hexachlorocyclo-pentadiene	Target	11	U	ug/L	11	U	1.0	YES	S3VE
2,4,6-Trichlorophenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2,4,5-Trichlorophenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
1,1'-Biphenyl	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2-Chloronaphthalene	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2-Nitroaniline	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Dimethylphthalate	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2,6-Dinitrotoluene	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Acenaphthylene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
3-Nitroaniline	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Acenaphthene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
2,4-Dinitrophenol	Target	11	U	ug/L	11	U	1.0	YES	S3VE
4-Nitrophenol	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Dibenzofuran	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
2,4-Dinitrotoluene	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Diethylphthalate	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Fluorene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
4-Chlorophenyl-phenyl ether	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
4-Nitroaniline	Target	11	U	ug/L	11	U	1.0	YES	S3VE
4,6-Dinitro-2-methylphenol	Target	11	U	ug/L	11	U	1.0	YES	S3VE
N-Nitrosodiphenylamine	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
1,2,4,5-Tetrachlorobenzene	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
4-Bromophenyl-phenylether	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Hexachlorobenzene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Atrazine	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Pentachlorophenol	Target	11	U	ug/L	11	U	1.0	NO	S3VE
Phenanthrene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Anthracene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Carbazole	Target	11	U	ug/L	11	U	1.0	YES	S3VE

Sample Summary Report

Case: 46775 **Contract: EPW14035** **SDG: BD6Z7** **Lab Code: EQI**

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Di-n-butylphthalate	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Fluoranthene	Target	11	U	ug/L	11	U	1.0	NO	S3VE
Pyrene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Butylbenzylphthalate	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
3,3'-Dichlorobenzidine	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Benzo(a)anthracene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Chrysene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Bis(2-ethylhexyl)phthalate	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE
Di-n-octylphthalate	Target	11	U	ug/L	11	U	1.0	YES	S3VE
Benzo(b)fluoranthene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Benzo(k)fluoranthene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Benzo(a)pyrene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Indeno(1,2,3-cd)pyrene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Dibenzo(a,h)anthracene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
Benzo(g,h,i)perylene	Target	5.3	U	ug/L	5.3	U	1.0	NO	S3VE
2,3,4,6-Tetrachlorophenol	Target	5.3	U	ug/L	5.3	U	1.0	YES	S3VE

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD6Z7	Lab Code: EQI

Sample Number: BD702	Method: Semivolatiles by SIM	Matrix: Water	MA Number: 2682.0
Sample Location: CFS-PilotTest-COL3	pH: 8	Sample Date: 02/20/2017	Sample Time: 12:25:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Naphthalene	Target	0.11	U	ug/L	0.11	U	1.0	YES	S3VE
2-Methylnaphthalene	Target	0.11	U	ug/L	0.11	U	1.0	YES	S3VE
Acenaphthylene	Target	0.11	U	ug/L	0.11	U	1.0	YES	S3VE
Acenaphthene	Target	0.11	U	ug/L	0.11	U	1.0	YES	S3VE
Fluorene	Target	0.11	U	ug/L	0.11	U	1.0	YES	S3VE
Pentachlorophenol	Target	0.11	UJ	ug/L	0.11	U	1.0	YES	S3VE
Phenanthrene	Target	0.054	U	ug/L	0.054	U	1.0	YES	S3VE
Anthracene	Target	0.11	U	ug/L	0.11	U	1.0	YES	S3VE
Fluoranthene	Target	0.054	U	ug/L	0.054	U	1.0	YES	S3VE
Pyrene	Target	0.054	U	ug/L	0.054	U	1.0	YES	S3VE
Benzo(a)anthracene	Target	0.054	U	ug/L	0.054	U	1.0	YES	S3VE
Chrysene	Target	0.11	U	ug/L	0.11	U	1.0	YES	S3VE
Benzo(b)fluoranthene	Target	0.054	U	ug/L	0.054	U	1.0	YES	S3VE
Benzo(k)fluoranthene	Target	0.054	U	ug/L	0.054	U	1.0	YES	S3VE
Benzo(a)pyrene	Target	0.054	U	ug/L	0.054	U	1.0	YES	S3VE
Indeno(1,2,3-cd)pyrene	Target	0.054	U	ug/L	0.054	U	1.0	YES	S3VE
Dibenzo(a,h)anthracene	Target	0.054	U	ug/L	0.054	U	1.0	YES	S3VE
Benzo(g,h,i)perylene	Target	0.11	U	ug/L	0.11	U	1.0	YES	S3VE
1,4-Dioxane	Target	0.20	U	ug/L	0.11	B	1.0	YES	S3VE
Hexachlorobenzene	Target	0.11	U	ug/L	0.11	U	1.0	YES	S3VE

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD6Z7	Lab Code: EQI

Sample Number: BD702	Method: Trace Volatiles	Matrix: Water	MA Number: 2683.0
Sample Location: CFS-PilotTest-COL3	pH: 8	Sample Date: 02/20/2017	Sample Time: 12:25:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Dichlorodifluoromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Vinyl chloride	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Bromomethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Trichlorofluoromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1-Dichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,2-Trichloro-1,2,2-Trifluoroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Acetone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Carbon disulfide	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methyl acetate	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methylene chloride	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
trans-1,2-Dichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methyl tert-butyl ether	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1-Dichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
cis-1,2-Dichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
2-Butanone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Bromochloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chloroform	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,1-Trichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Cyclohexane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Carbon tetrachloride	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Benzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Trichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methylcyclohexane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dichloropropane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Bromodichloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
cis-1,3-Dichloropropene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
4-Methyl-2-pentanone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Toluene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
trans-1,3-Dichloropropene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,2-Trichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Tetrachloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
2-Hexanone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Dibromochloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dibromoethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Ethylbenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
o-Xylene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
m, p-Xylene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Styrene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Bromoform	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Isopropylbenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,2,2-Tetrachloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,3-Dichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,4-Dichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dibromo-3-chloropropane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2,4-Trichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2,3-Trichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Ethyl ether	Target	50	U	ug/L	50	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775 **Contract: EPW14035** **SDG: BD6Z7** **Lab Code: EQI**

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
tert-Butyl Alcohol	Target	50	R	ug/L	50	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD705	Lab Code: EQI

Sample Number: BD708	Method: Semivolatiles	Matrix: Water	MA Number:
Sample Location: CFS-PilotTest-INF	pH: 8	Sample Date: 02/27/2017	Sample Time: 10:15:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
1,4-Dioxane	Target	61		ug/L	61	D	5.0	YES	S3VEM
Benzaldehyde	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Phenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Bis(2-Chloroethyl) ether	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
2-Chlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Methylphenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
2,2'-Oxybis(1-chloropropane)	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Acetophenone	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
3-Methylphenol + 4-Methylphenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
N-Nitroso-di-n propylamine	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Hexachloroethane	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Nitrobenzene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Isophorone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Nitrophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,4-Dimethylphenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Bis(2-chloroethoxy)methane	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,4-Dichlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Naphthalene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
4-Chloroaniline	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Hexachlorobutadiene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Caprolactam	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
4-Chloro-3-methylphenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Methylnaphthalene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Hexachlorocyclo-pentadiene	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
2,4,6-Trichlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,4,5-Trichlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
1,1'-Biphenyl	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Chloronaphthalene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Nitroaniline	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Dimethylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,6-Dinitrotoluene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Acenaphthylene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
3-Nitroaniline	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Acenaphthene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
2,4-Dinitrophenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
4-Nitrophenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Dibenzofuran	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,4-Dinitrotoluene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Diethylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Fluorene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
4-Chlorophenyl-phenyl ether	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
4-Nitroaniline	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
4,6-Dinitro-2-methylphenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
N-Nitrosodiphenylamine	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
1,2,4,5-Tetrachlorobenzene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
4-Bromophenyl-phenylether	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Hexachlorobenzene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Atrazine	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Pentachlorophenol	Target	10	U	ug/L	10	U	1.0	N	S3VEM
Phenanthrene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Anthracene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Carbazole	Target	10	U	ug/L	10	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775 **Contract: EPW14035** **SDG: BD705** **Lab Code: EQI**

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Di-n-butylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Fluoranthene	Target	10	U	ug/L	10	U	1.0	N	S3VEM
Pyrene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Butylbenzylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
3,3'-Dichlorobenzidine	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Benzo(a)anthracene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Chrysene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Bis(2-ethylhexyl)phthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Di-n-octylphthalate	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Benzo(b)fluoranthene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Benzo(k)fluoranthene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Benzo(a)pyrene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Indeno(1,2,3-cd)pyrene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Dibenzo(a,h)anthracene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Benzo(g,h,i)perylene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
2,3,4,6-Tetrachlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Benzoic acid	TIC	4.6	NJ	ug/L	4.6	NJ	1.0	YES	S3VEM

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD705	Lab Code: EQI

Sample Number: BD708	Method: Semivolatiles by SIM	Matrix: Water	MA Number: 2682.0
Sample Location: CFS-PilotTest-INF	pH: 8	Sample Date: 02/27/2017	Sample Time: 10:15:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Naphthalene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
2-Methylnaphthalene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Acenaphthylene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Acenaphthene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Fluorene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Pentachlorophenol	Target	0.10	UJ	ug/L	0.10	U	1.0	YES	S3VEM
Phenanthrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Anthracene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Fluoranthene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Pyrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(a)anthracene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Chrysene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Benzo(b)fluoranthene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(k)fluoranthene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(a)pyrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Indeno(1,2,3-cd)pyrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Dibenzo(a,h)anthracene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(g,h,i)perylene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
1,4-Dioxane	Target	30		ug/L	30	EB	1.0	N	S3VEM
Hexachlorobenzene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD705	Lab Code: EQI

Sample Number: BD708	Method: Trace Volatiles	Matrix: Water	MA Number: 2683.0
Sample Location: CFS-PilotTest-INF	pH: 8	Sample Date: 02/27/2017	Sample Time: 10:15:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Dichlorodifluoromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Vinyl chloride	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Bromomethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Trichlorofluoromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1-Dichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,2-Trichloro-1,2,2-Trifluoroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Acetone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Carbon disulfide	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methyl acetate	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methylene chloride	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
trans-1,2-Dichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methyl tert-butyl ether	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1-Dichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
cis-1,2-Dichloroethene	Target	0.13	J	ug/L	0.13	J	1.0	YES	S3VEM
2-Butanone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Bromochloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chloroform	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,1-Trichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Cyclohexane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Carbon tetrachloride	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Benzene	Target	0.17	J	ug/L	0.17	J	1.0	YES	S3VEM
1,2-Dichloroethane	Target	0.60		ug/L	0.60		1.0	YES	S3VEM
Trichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methylcyclohexane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dichloropropane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Bromodichloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
cis-1,3-Dichloropropene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
4-Methyl-2-pentanone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Toluene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
trans-1,3-Dichloropropene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,2-Trichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Tetrachloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
2-Hexanone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Dibromochloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dibromoethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Ethylbenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
o-Xylene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
m, p-Xylene	Target	0.13	J	ug/L	0.13	J	1.0	YES	S3VEM
Styrene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Bromoform	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Isopropylbenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,2,2-Tetrachloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,3-Dichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,4-Dichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dibromo-3-chloropropane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2,4-Trichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2,3-Trichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
tert-Butyl Alcohol	Target	50	R	ug/L	50	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775 **Contract: EPW14035** **SDG: BD705** **Lab Code: EQI**

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Ethyl ether	Target	50	U	ug/L	50	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD705	Lab Code: EQI

Sample Number: BD709	Method: Semivolatiles	Matrix: Water	MA Number:
Sample Location: CFS-PilotTest-COL3	pH: 2	Sample Date: 02/27/2017	Sample Time: 09:48:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
1,4-Dioxane	Target	2.0	U	ug/L	2.0	U	1.0	N	S3VEM
Benzaldehyde	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Phenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Bis(2-Chloroethyl) ether	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
2-Chlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Methylphenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
2,2'-Oxybis(1-chloropropane)	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Acetophenone	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
3-Methylphenol + 4-Methylphenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
N-Nitroso-di-n propylamine	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Hexachloroethane	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Nitrobenzene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Isophorone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Nitrophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,4-Dimethylphenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Bis(2-chloroethoxy)methane	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,4-Dichlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Naphthalene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
4-Chloroaniline	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Hexachlorobutadiene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Caprolactam	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
4-Chloro-3-methylphenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Methylnaphthalene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Hexachlorocyclo-pentadiene	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
2,4,6-Trichlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,4,5-Trichlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
1,1'-Biphenyl	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Chloronaphthalene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2-Nitroaniline	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Dimethylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,6-Dinitrotoluene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Acenaphthylene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
3-Nitroaniline	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Acenaphthene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
2,4-Dinitrophenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
4-Nitrophenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Dibenzofuran	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
2,4-Dinitrotoluene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Diethylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Fluorene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
4-Chlorophenyl-phenyl ether	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
4-Nitroaniline	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
4,6-Dinitro-2-methylphenol	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
N-Nitrosodiphenylamine	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
1,2,4,5-Tetrachlorobenzene	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
4-Bromophenyl-phenylether	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Hexachlorobenzene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Atrazine	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Pentachlorophenol	Target	10	U	ug/L	10	U	1.0	N	S3VEM
Phenanthrene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Anthracene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Carbazole	Target	10	U	ug/L	10	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775 **Contract: EPW14035** **SDG: BD705** **Lab Code: EQI**

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Di-n-butylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Fluoranthene	Target	10	U	ug/L	10	U	1.0	N	S3VEM
Pyrene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Butylbenzylphthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
3,3'-Dichlorobenzidine	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Benzo(a)anthracene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Chrysene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Bis(2-ethylhexyl)phthalate	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Di-n-octylphthalate	Target	10	U	ug/L	10	U	1.0	YES	S3VEM
Benzo(b)fluoranthene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Benzo(k)fluoranthene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Benzo(a)pyrene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Indeno(1,2,3-cd)pyrene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Dibenzo(a,h)anthracene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
Benzo(g,h,i)perylene	Target	5.0	U	ug/L	5.0	U	1.0	N	S3VEM
2,3,4,6-Tetrachlorophenol	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD705	Lab Code: EQI

Sample Number: BD709	Method: Semivolatiles by SIM	Matrix: Water	MA Number: 2682.0
Sample Location: CFS-PilotTest-COL3	pH: 2	Sample Date: 02/27/2017	Sample Time: 09:48:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Naphthalene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
2-Methylnaphthalene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Acenaphthylene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Acenaphthene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Fluorene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Pentachlorophenol	Target	0.10	UJ	ug/L	0.10	U	1.0	YES	S3VEM
Phenanthrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Anthracene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Fluoranthene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Pyrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(a)anthracene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Chrysene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Benzo(b)fluoranthene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(k)fluoranthene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(a)pyrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Indeno(1,2,3-cd)pyrene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Dibenzo(a,h)anthracene	Target	0.050	U	ug/L	0.050	U	1.0	YES	S3VEM
Benzo(g,h,i)perylene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
1,4-Dioxane	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM
Hexachlorobenzene	Target	0.10	U	ug/L	0.10	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775	Contract: EPW14035	SDG: BD705	Lab Code: EQI

Sample Number: BD709	Method: Trace Volatiles	Matrix: Water	MA Number: 2683.0
Sample Location: CFS-PilotTest-COL3	pH: 2	Sample Date: 02/27/2017	Sample Time: 09:48:00
% Moisture:		% Solids: 0.00	

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
Dichlorodifluoromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Vinyl chloride	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Bromomethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Trichlorofluoromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1-Dichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,2-Trichloro-1,2,2-Trifluoroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Acetone	Target	2.6	J	ug/L	2.6	J	1.0	YES	S3VEM
Carbon disulfide	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methyl acetate	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methylene chloride	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
trans-1,2-Dichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methyl tert-butyl ether	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1-Dichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
cis-1,2-Dichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
2-Butanone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Bromochloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chloroform	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,1-Trichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Cyclohexane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Carbon tetrachloride	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Benzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Trichloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Methylcyclohexane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dichloropropane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Bromodichloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
cis-1,3-Dichloropropene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
4-Methyl-2-pentanone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Toluene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
trans-1,3-Dichloropropene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,2-Trichloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Tetrachloroethene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
2-Hexanone	Target	5.0	U	ug/L	5.0	U	1.0	YES	S3VEM
Dibromochloromethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dibromoethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Chlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Ethylbenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
o-Xylene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
m, p-Xylene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Styrene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Bromoform	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Isopropylbenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,1,2,2-Tetrachloroethane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,3-Dichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,4-Dichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2-Dibromo-3-chloropropane	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2,4-Trichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
1,2,3-Trichlorobenzene	Target	0.50	U	ug/L	0.50	U	1.0	YES	S3VEM
Ethyl ether	Target	50	U	ug/L	50	U	1.0	YES	S3VEM

Sample Summary Report

Case: 46775 **Contract: EPW14035** **SDG: BD705** **Lab Code: EQI**

Analyte Name	Analyte Type	Validation Result	Validation Flag	Units	Lab Result	Lab Flag	Dilution Factor	Reportable	Validation Level
tert-Butyl Alcohol	Target	140	J+	ug/L	140		1.0	YES	S3VEM

APPENDIX D

Treatability Studies Conducted by the NJDEP

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APPENDIX A
APPENDIX B

1.0 INTRODUCTION

This Report on the Results of Pilot Testing of Treatment Alternatives for 1,4-dioxane in Groundwater (Report) for the Combe Fill South Landfill in Chester Township, Morris County, New Jersey was prepared by L.R. Kimball for the New Jersey Department of Environmental Protection (NJDEP) under the Remedial Design Services Term Contract No. A68678.

This Report provides the results of two Pilot Test Treatability Studies (Pilot Test), conclusions based on these results, and recommendations for treatment alternatives capable of removing 1,4-dioxane from groundwater treated at the Combe Fill South treatment plant to below NJDEP groundwater quality criteria. The two vendors that performed pilot testing are Purifics ES, Inc. with their Photo-Cat system, and Kerfoot Technologies, Inc. with their Nanozox™ system.

1.1 Site Location and Background

The Combe Fill South Landfill is located in a semi-rural area between Chester and Washington Townships, located at 98 Parker Road in Morris County, New Jersey. The Combe Fill South Landfill consists of three separate fill areas comprising 65 acres of a 115 acre parcel of land.

The site was operated as a municipal landfill from the 1940s until 1981, and was licensed to accept domestic and non-hazardous industrial wastes, sewage sludge, septic tank wastes, chemicals, and waste oils. In 1978, Combe Fill Corporation (CFC) bought the landfill. While under CFC management, procedures at the landfill violated many of the New Jersey Solid Waste administrative codes. CFC then went bankrupt in 1981, before the landfill was properly closed. A citizens' group, one of two formed by residents who were concerned over disposal practices at the site, sampled the groundwater, leachate, and surface water and found them to be contaminated. Testing indicated that the fill material consisted mainly of highly decomposed rubbish. Although no hot spots or localized sources of hazardous substances could be located during that study, contaminants were noted in the aquifer beneath the site.

The United States Environmental Protection Agency (USEPA) added the Combe Fill South Landfill to the Superfund National Priority List on September 1, 1983. In 1986, the USEPA and the State of New Jersey selected a containment remedy for the site. The containment remedial action was completed and the groundwater treatment has been operational since June 1997.

A mixture of contaminated groundwater and landfill leachate are currently treated biologically in one sequencing batch reactor (SBR) following metals removal in one clarification tank (inclined plate settler). Water is then filtered through sand packs and granular activated carbon (GAC) prior to surface water discharge, via a New Jersey Pollutant Discharge Elimination System (NJPDES) permit, equivalent to the East Branch of Trout Brook. The groundwater treatment plant treats over 25 million gallons of groundwater per year. Nearby Trout Brook is used for fishing and recreational activities. Approximately 170 people live within 1/2 mile of the landfill. Most of the residents use private wells as their source of drinking water. Vegetable and grain farms, orchards, and horse farms are also located near the site.

1.2 Bench Scale Treatability Tests

In order to properly evaluate the most effective and economically feasible treatment alternative, three bench scale treatability studies were conducted by independent vendors (Purifics ES, Inc. with their Photo-Cat system, Kerfoot Technologies, Inc. with their Nanozox™ system, and APT's HiPOx treatment system) utilizing samples of effluent water collected on August 16, 2011 from the Combe Fill South Treatment Plant effluent. At the request of the vendors, effluent samples were collected off of the sand filter, prior to carbon filtration. Once the samples were received, each vendor sent samples to third party laboratories for spiking to 200 parts per billion (ppb) of 1,4-dioxane prior to the initiation of the Bench Scale Tests.

An interpretation of the analytical data from the bench scale study, as well as the results from each of the three vendors, were presented in a summary report entitled *Report on Treatment Alternatives for 1,4-Dioxane in Groundwater*, dated February 2012.

Among other findings, the Bench Scale Report concluded that:

- Each of the three alternatives can achieve the objective of oxidizing 1,4-dioxane below the discharge criteria requirement of three ppb.
- All three systems are self-contained units shipped in either their own enclosure or on pallets. All systems are relatively easy to install and connect to the existing treatment train and utilities. All three systems can be situated pre- or post-carbon within the existing treatment train.
- Capital cost projection – the least expensive system is the Nanozox™ system (Kerfoot) at $339,228
- Capital cost projection – the most expensive system is the Photo-Cat system (Purifics) at $580,000.
- The Kerfoot system also was projected to have the lowest annual operation and maintenance (O&M) cost expectations at approximately $34,800.
- The Photo-Cat system was projected to have the highest annual O&M cost of $68,183.
- Present worth costs for operation and maintenance over 15 years were projected to range from $361,214 for the Nanozox™ system, to $707,720 for the Photo-Cat system.

Based on the results of the bench scale studies and evaluation of information provided by the three vendors, L.R. Kimball recommended that the Kerfoot Technologies Nanozox™ system be used for the treatment of 1,4-dioxane at the Combe Fill South Landfill site, based on the following:

- This system was effective in the oxidation of 1,4-dioxane below three ppb;
- This alternative had the lowest predicted capital costs; and
- This alternative had the lowest predicted cost for operation and maintenance.

The Bench Scale Report also recommended that larger-scale pilot testing be conducted to determine optimal operating parameters for the full-scale design of this treatment alternative. It was recommended that the Pilot Tests should also include the evaluation of bromate discharge levels from the system, and alternative testing of the Kerfoot Nanozox™ system with varying levels of ozone and hydrogen peroxide, as well as to assess several operational issues associated with chemical storage and use of a holding tank. To address the possibility that the additional data obtained for the Kerfoot Nanozox™ system determined that it was <u>not</u> a suitable treatment alternative; the Report further recommended that pilot testing also be conducted on one of the other two treatment alternatives.

Subsequently, two Pilot Test agreements (the subject of this report) were issued for:

- <u>Kerfoot Technologies, Inc. (Kerfoot)</u> – Nanozox™ Treatment system consisting of ozone and hydrogen peroxide oxidation, with the Pilot Test initiated the third week of August 2012.
- <u>Purifics ES, Inc. (Purifics)</u> – Photo-Cat treatment system consisting of UV light and titanium dioxide (TiO_2) catalyst, with the Pilot Test beginning the first week of May 2012. A second, abbreviated Pilot Test of the Photo-Cat system equipped with a ceramic ultra filter (CUF) commenced in early December 2012.

1.3 Purpose

The purpose of this report is to summarize the relevant information and supporting data collected from the 2012 pilot testing, that will be used as the basis to evaluate treatment alternatives, and identify constraints and the costs associated with the reduction of concentration levels of 1,4-dioxane below the quality criteria of 3.0 ppb.

1.4 Project Objectives

The objectives of this report are to:

- Provide results and an assessment of the two Pilot Tests.
- Evaluate the two alternatives for the treatment of 1,4-dioxane for effectiveness, implementation, cost, operations and maintenance, and other requirements for set-up and operation of a full-scale treatment system.
- Provide recommendation as to which treatment alternative should be selected for implementation.

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2.0 ANALYSIS OF PILOT TEST TREATABILITY STUDIES

Based on the results of the 2011 Bench Scale Testing, two companies (Kerfoot Technologies, Inc. and Purifics ES, Inc.) were selected for further assessment by initiation of field Pilot Tests, utilizing different treatment technologies.

The specific scope of the Pilot Tests involved engineering and field effort to further evaluate the most effective and economically-feasible treatment technology, utilizing on-site pilot testing of up to two treatment technologies. It was anticipated that pilot testing would generate real process operating data that could be used to scale up to a full-size treatment process, and provide for the complete demonstration of the treatment equipment. This data would:

- Demonstrate that unit treatment processes utilized during the Bench Scale Testing can be successfully scaled up;
- Demonstrate the technical and economic viability of the treatment processes;
- Obtain a better determination of key process parameters;
- Quantify the relationships between these parameters and process performance and scale-up;
- Provide a preliminary basis of design for the full-scale treatment system;
- Complete a detailed mass balance around each tested unit treatment process;
- Develop an accurate operations cost estimate and increase confidence in the cost estimate of the proposed full-scale system; and
- Demonstrate the performance of each unit operation with regard to treatment efficiency, as well as the robustness and reliability of each process under real-time operational circumstances (e.g. changes in composition, flow, etc.)

The initial plan was that each Pilot Test would be conducted for a period of a least one month (20 work days) for each technology, with the treatment systems installed at the end of the existing water treatment system process (after the sand filter, but before carbon filtration).

2.1 Pilot Test Treatability Study Objectives

Specific objectives for the Pilot Tests were to:

- Verify the efficiency of the two selected treatment alternatives in reducing 1,4-dioxane concentration in the treatment plant effluent to levels below three ppb.
- Generate dose-response curves for 1,4-dioxane.
- Determine the optimal dosing requirements for treatment.
- Determine estimated capital expense to install each treatment alternative.
- Determine the estimated O&M costs for each treatment alternative.

2.2 Discussion of 1,4-Dioxane and Impacts to Human Health and the Environment

1,4-dioxane, often called dioxane because the other isomers of dioxane are rare, is a heterocyclic organic compound. It is a colorless liquid with a faint, sweet odor similar to that of diethyl ether, and is classified as an ether. This colorless liquid is mainly used as a stabilizer for the solvent 1,1,1-trichloroethane, and is occasionally used as a solvent for a variety of practical applications, as well as in the laboratory. Apart from its use as a stabilizer, 1,4-dioxane is also used in a variety of applications as a solvent, (e.g. in inks and adhesives) and can be formed as a by-product in several ethoxylation reactions used to produce surfactants, detergents, shampoos, and certain pharmaceuticals.

1,4-dioxane has a low toxicity to aquatic life and cannot be readily biodegraded. It has affected groundwater supplies in several areas near the Combe Fill South Landfill site, and the impacts to groundwater are exacerbated since 1,4-dioxane is highly soluble in water, does not readily bind to soils, and thus readily leaches to groundwater. Due to these properties, a 1,4-dioxane plume is often much larger (and further downgradient) than the associated solvent plume.

Effects of 1,4-dioxane on human health and the environment depend on how much 1,4-dioxane is present and the length and frequency of exposure. Effects also depend on the health of a person or the condition of the environment when exposure occurs. Breathing 1,4-dioxane for short periods of time causes irritation of the eyes, nose and throat in humans, and exposure to large amounts of 1,4-dioxane can cause kidney and liver damage. Accidental worker exposure to large amounts of 1,4-dioxane has resulted in several deaths. Symptoms associated with these industrial deaths suggest 1,4-dioxane causes adverse nervous system effects, which are not likely to occur at concentrations of 1,4-dioxane that are normally found in the environment.

Limited evidence suggests that repeatedly breathing small amounts of 1,4-dioxane over long periods of time causes no adverse effects in workers, although laboratory studies show that exposure to 1,4-dioxane over a lifetime causes cancer in animals, and may likewise cause cancer in humans. Laboratory studies also show that repeated exposure to large amounts of 1,4-dioxane in drinking water, in air, or on the skin causes liver and kidney damage in animals.

The USEPA has listed the compound as a probable human carcinogen based on the results of animal studies, but little information is available on the long-term effects of 1,4-dioxane on human health.

2.3 Methodology of Pilot Test Treatability Study

1. Two vendors were selected to perform field pilot testing:

    - Kerfoot Technologies, Inc. – Nanozox™ Treatment system consists of ozone and hydrogen peroxide oxidation.
    - Purifics ES, Inc. – Photo-Cat treatment system consists of UV light and titanium dioxide (TiO_2) catalyst.

2. NJDEP collected performance samples during the Pilot Tests, and submitted these samples to the designated third-party laboratory for testing and reporting.

3. The vendors modified their field treatment methodology during the Pilot Test to reflect the results of the periodic sampling. These modifications were used to assess the minimum treatment levels to achieve required effluent results, and to assess the performance of the pilot test units under varying influent conditions.

4. The vendors provided an evaluation of the results of the Pilot Test and were requested to identify the estimated capital costs, space requirements, operating requirements, and other requirements for full-scale treatment system installation.

5. L.R. Kimball then provided a summary report of the overall Pilot Test results, with recommendations for future treatment implementation.

2.4 Pilot Test Unit Descriptions

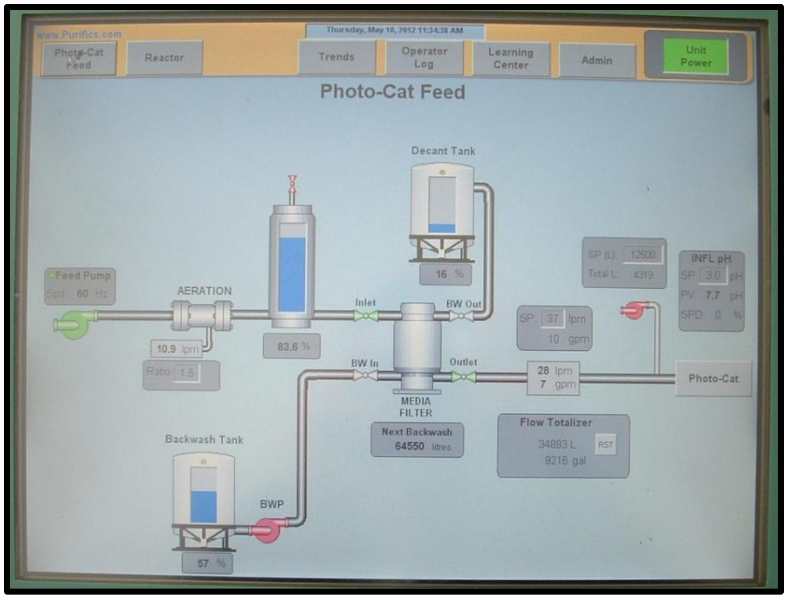
2.4.1 Purifics Photo-Cat Pilot Test Unit – First Pilot Test

Purifics ES, Inc. Photo-Cat treatment alternative uses a titanium dioxide (TiO_2)/ultraviolet (UV) light process in which the TiO_2 semiconductor absorbs UV light and generates hydroxyl free radicals from dissolved oxygen to treat various compounds, including 1,4-dioxane and chlorinated solvents. In the Photo-Cat process, essentially all of the UV light is absorbed by the TiO_2 photocatalyst. A modified version of the unit utilized for the bench scale testing was prepared for use at the Combe Fill South Landfill Site.

The Purifics Pilot Test equipment was delivered to the site on May 4, 2012. The Pilot Test unit was constructed inside an 8' x 40' shipping container that was unloaded by a crane provided by the NJDEP. Power for the Pilot Test unit was from a portable generator rented by the NJDEP. Because the Combe Fill South Landfill treatment facility operates in batch mode, Purifics programmed its control system to turn off the Photo-Cat when there was no forward flow through the system. Purifics performed their initial Pilot Test beginning on May 7, 2012. The Pilot Test treatment unit initially obtained influent water from the Combe Fill South Landfill treatment plant after the sand filtration treatment process (near the "downstream" end of the existing treatment process).

Purifics Photo-Cat Pilot Test Enclosure

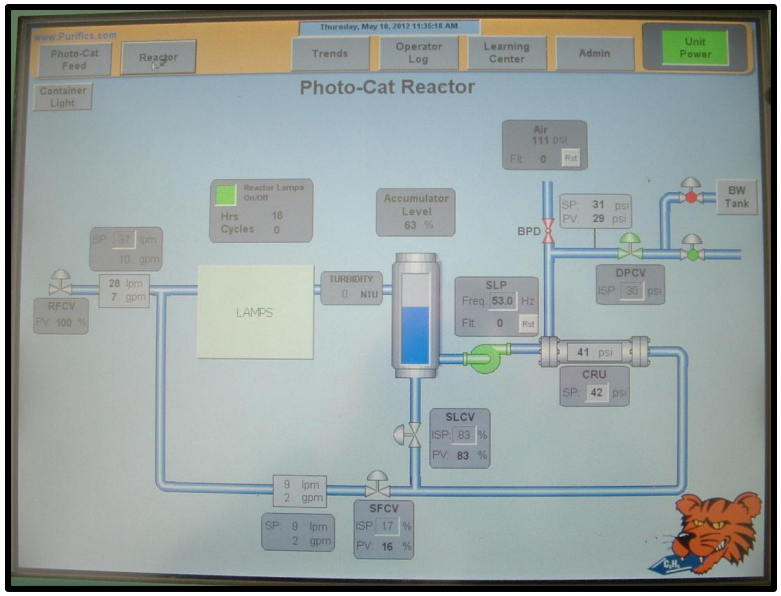
Influent water was pumped at a flow rate of between seven and ten gallons per minute (gpm) during the first week, and then five gpm the remaining weeks of the Pilot Test. The influent water was aerated and filtered through an iron removal media filter, prior to entering the Photo-Cat. Below is the control system screen that provides a schematic for this iron removal media filter feed system to the Photo-Cat.



Purifics Photo-Cat Feed Schematic

Purifics ES, Inc. Photo-Cat Pilot Test Unit

The filtered flow enters the Photo-Cat skid, is pressurized, and then TiO_2 is added. The mixture then flows through stainless steel tube reactors with internal UV lamps. The TiO_2/UV process provides the oxidizer for the reduction of the 1,4-dioxane concentration. Flow from the UV reactors passes through a ceramic filter that removes the titanium dioxide to result in the treated effluent. The effluent was then discharged back to the Combe Fill South Landfill treatment system. The titanium dioxide removed by the ceramic filter is returned to the accumulator for reuse. The accumulator, an open top tank, contains a slurry of TiO_2 for use in the treatment process. During the process, approximately 25 percent to 30 percent of the treated flow is re-cycled through the treatment process.



Purifics ES, Inc. Control System Photo-Cat Screen

After the first week of testing, acceptable post-treatment results were not being achieved, and the decision was made by Purifics to temporarily suspend pilot testing because the polymer used in the existing metals removal process was interfering with the TiO_2. After conferring with the plant operator, Purifics requested that the Pilot Test unit receive influent water from the ground water equalization tank, T-101. This tank is located at the head of the plant, prior to the metals removal process, but may contain trace polymer from sand filter reject and carbon backwash waters. Purifics flushed and replaced the TiO_2 from the Pilot Test unit on May 17, 2012 and resumed testing using the new influent source. Results continued to be unsatisfactory, and the Pilot Test unit was turned off on May 23, 2012 so that the plant operator could tap the raw water feed line to tank T-101. On May 30, 2012, Purifics flushed and replaced the $TiO_2$and resumed testing using the raw water feed to tank T-101. Results continued to be unsatisfactory, and the test was suspended on June 8, 2012 at the advice of Purifics, who determined that the unit needed to be returned to Canada for inspection and equipment modification.

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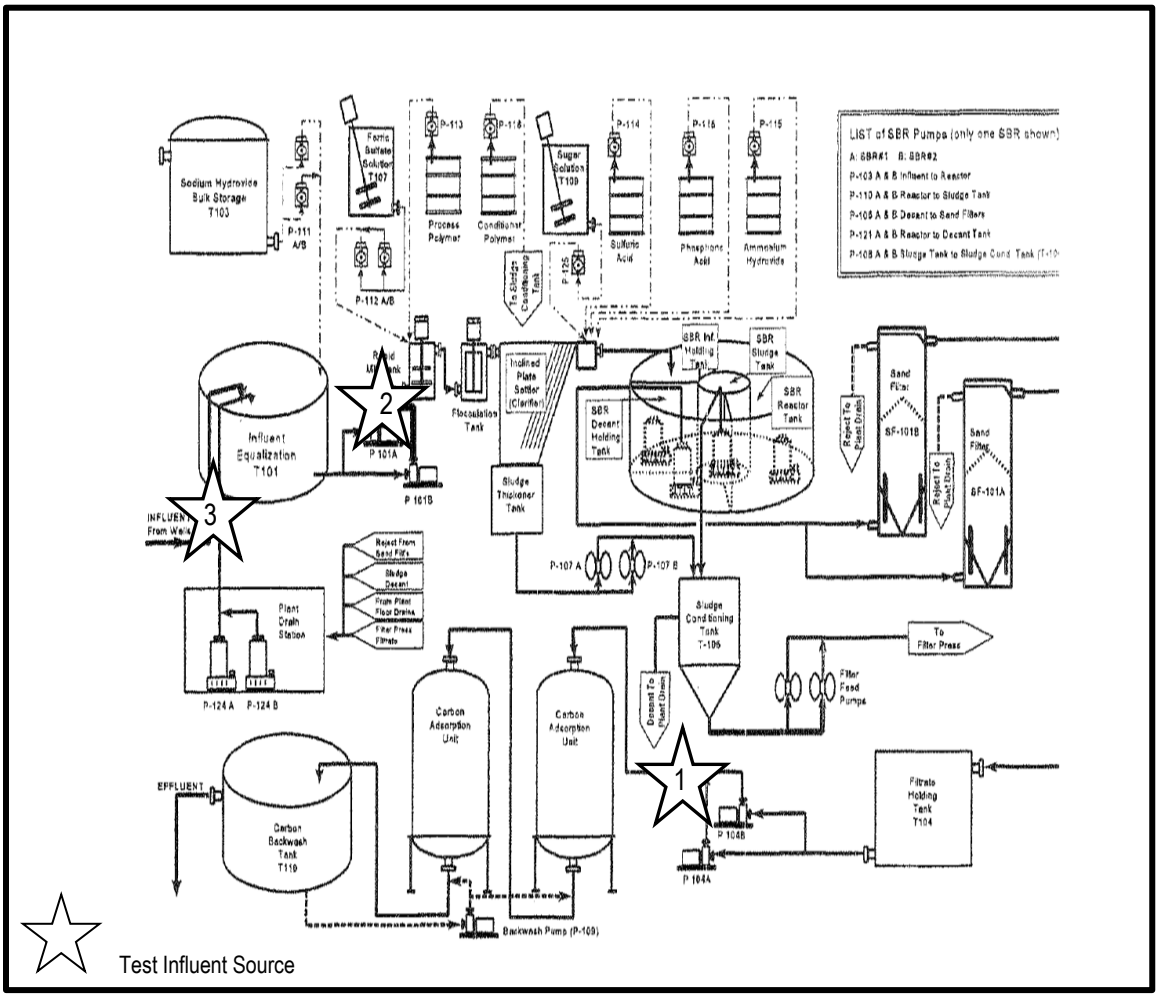
The process schematic below sequentially shows the influent sources to the Purifics system during the first Pilot Test.



2.4.2 Purifics Photo-Cat Pilot Test Unit – Second Pilot Test

Purifics technicians determined that the polymer and iron levels in the influent to the Photo-Cat were coating the TiO_2, thus blocking the UV light and limiting the treatment effectiveness. Purifics returned to the site on November 30, 2012 with a modified Pilot Test unit that included a Ceramic Ultra Filtration (CUF) unit and a pH adjustment system for metals precipitation to address this problem. The Pilot Test equipment was connected to the Combe Fill South Landfill Treatment Plant tank T-101 influent line to obtain raw water from the ground water recovery wells (at the "upstream" end, prior to the equalization tank and addition of the polymer in the existing treatment system). The raw water source is marked by star number three in the process schematic in Section 2.4.1.

Purifics Second Pilot Test influent connection to Combe South Landfill Treatment Plant

The raw water pH was adjusted and aerated to assist with metals oxidation prior to filtration by the CUF unit for iron removal. The CUF unit (as shown below) is a 100 percent Silicon Carbide (SiC) Hydrophilic Membrane filter. Treated water passes through the filter membranes, and the iron being removed accumulates outside the filter membranes. These solids are periodically wasted from the raw water containment of recycling water. The wasting does not take the filter off line but continues to operate and does not require a backwash cycle.

Purifics ES, Inc. Ceramic Ultrafiltration (CUF) Unit for Fe Removal

The filtered water then flows to the Photo-Cat unit for the 1,4-dioxane reduction treatment. The second Pilot Test Photo-Cat unit was unchanged from the first, except the unit was cleaned to remove polymer and iron residues and new TiO_2 was provided. Additional photographs of the system units are included in Appendix A.

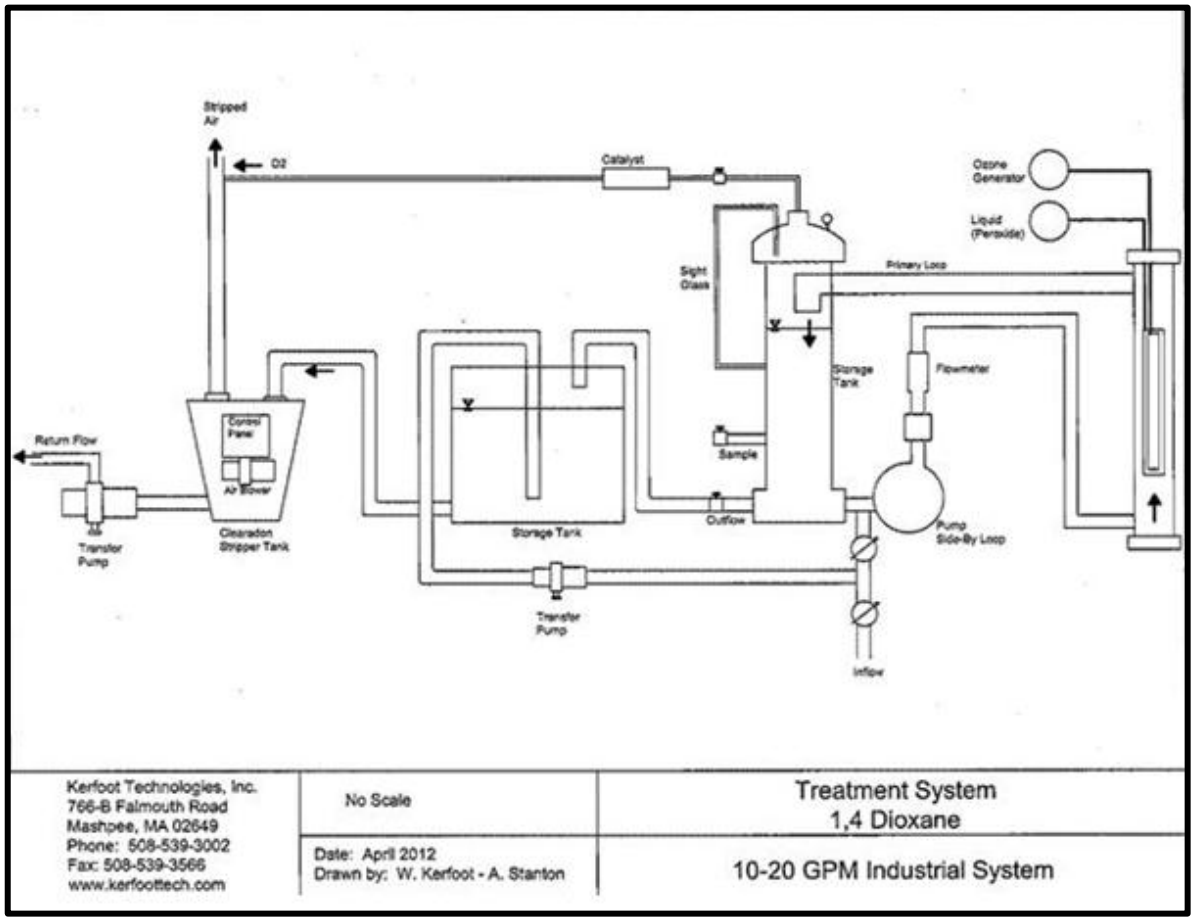
2.4.3 Kerfoot Pilot Test Unit Description

The Kerfoot Nanozox™ Loop System (Nanozox™) treatment alternative utilizes a process in which hydrogen peroxide (H_2O_2) reacts with ozone to generate hydroxyl free radicals that treat various compounds, including 1,4-dioxane and chlorinated solvents. The Nanozox™ system uses a pulsed injection of gaseous microbubbles of ozone to effectively remediate chlorinated contaminants, removing the 1,4-dioxane without leaving any detectable byproducts. Kerfoot created laminar sparge points to allow liquid hydrogen peroxide coating on the nanobubbles which further enhances the effectiveness of the chemical oxidation process.

The Kerfoot Pilot Test unit arrived at the Combe Fill South Landfill Treatment Plant on August 17, 2012. The pilot unit was mounted in the box trailer shown in the following photograph. The Kerfoot unit was powered by a portable generator rented by the NJDEP. Influent water was taken from the Combe Fill South Landfill Treatment Plant, after the sand filtration process (marked by star number one in the process schematic in Section 2.4.1). The control panel for the treatment unit was located on the exterior of the front of the box trailer as seen in the following photograph.

Kerfoot Technologies, Inc. Pilot Test Enclosure

A schematic of the Kerfoot process is shown below. Influent water enters the system and is pumped through an ozone sparge point.



Kerfoot Technologies, Inc. Pilot Test Flow Schematic

The ozone system consists of an oxygen concentrator and the ozone generator. The ozone is injected inside the sparge that creates the nano-bubbles which discharge into a solution of hydrogen peroxide that coats the bubbles and improves the oxidation of 1,4-dioxane. The Kerfoot technology utilizes a “loop” system where a percentage of the flow re-circulates through the loop.

Week One of the Pilot Test used an inflow of ten gallons per minute (gpm), with a loop flow of 40 gpm and a discharge of ten gpm to a storage tank, with approximately 125 gallons of live storage. The flow rate was later changed to five gpm inflow, a loop flow of 40 gpm, and a discharge of five gpm for weeks one, three and four. As water was added to the loop, a portion was sent to a storage tank to increase the contact time, for additional treatment. When there was no raw water inflow to the loop because plant forward flow had stopped, the loop system drew water equal to the influent rate from the storage tank and continued to dose this return water with ozone and hydrogen peroxide. Contrary to the Purifics pilot tests in which the unit shut off when there was no forward flow, the Kerfoot re-circulation operation continued until raw water influent was added to the loop and discharge began again. This re-circulation continued to provide treatment to the wastewater.

Prior to discharge, the water passed through a membrane filter and air stripper. However, when the test unit was returned to the Kerfoot shop, Kerfoot determined that a bag filter had not been installed in the filter housing. Despite the omission of the bag filter, Kerfoot reported that no bottom residue was detected in the 125 gallon storage tank.

See the photographs below of the treatment loop system, and a close-up of the sparge that creates the nanobubbles for the treatment to occur. For additional photographs of system components see Appendix B.

Rotated view of Kerfoot Pilot Test Loop Apparatus

Rotated view of Kerfoot Pilot Test Sparge (inside vertical tube on left)

2.5 Pilot Test Treatability Results

Results from the two vendors, and an interpretation of the analytical data from the pilot test treatability studies are provided in this section.

2.5.1 Purifics Pilot Test Treatability Results

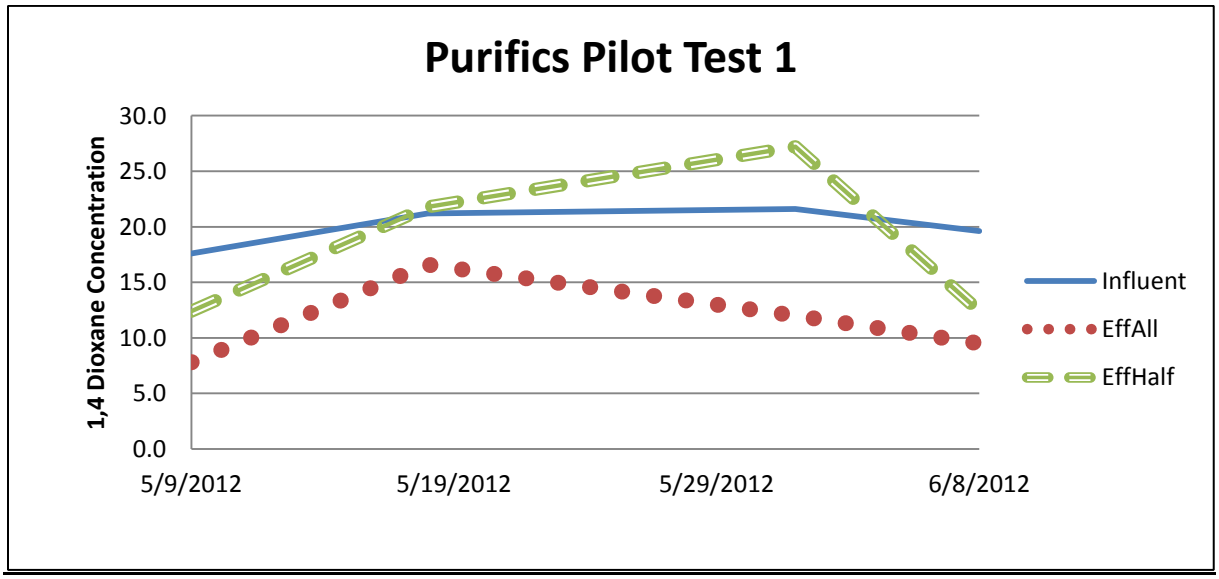
The Purifics Pilot Test equipment was delivered to the site on Friday, May 4, 2012, and the self-contained system was connected to the existing Combe Fill South Landfill Treatment Plant and flushed on Tuesday, May 8, 2012, with the first round of influent/effluent samples collected on Wednesday, May 9, 2012. Samples were analyzed by

Accutest Laboratories (Dayton, New Jersey). Acceptable post-treatment results were not achieved, and the test was temporarily suspended while the Pilot Test influent source and titanium dioxide were changed. Testing resumed on May 17, 2012 and performance samples were collected on May 18, 2012. Results continued to be unsatisfactory, and the Pilot Test unit was turned off on May 23, 2012 to again change the influent water source and the TiO_2. The unit was restarted on May 30, 2012, and performance samples were collected on June 1, 2012 and June 8, 2012. Results of these analytical tests are shown below.

Purifics Pilot Test Number 1
1,4-dioxane concentration (ug/l)

Week	Week 1	Week 2	Week 5	Week 6
Date Sampled	**5/9/2012**	**5/18/2012**	**6/1/2012**	**6/8/2012**
Inflow, gpm	7-10	5	5	5
Influent – INF[1]	17.6	21.2	21.6	19.6
Effluent All – EALL[2]	7.8 (55.7%[4])	16.6 (21.7%)	12.0 (44.4%)	9.5 (51.5%)
Effluent ½ – EHALF[3]	12.4 (29.5%)	21.8 (-2.8%)	27.2 (-25.9%)	12.4 (36.7%)

Notes:INF is the influent from the plant
1 EALL represents treated effluent with all of the UV lamps ON
2 EHALF represents treated effluent with 1/2 of the UV lamps ON
3 % represents the percentage removed from influent



The results of this testing showed that the treatment methodology was not working, and a decision was made to stop the Pilot Test following the final sampling event. Initial assessment of the issue indicated that the polymer that is added to the existing treatment system, as part of the metals removal process was coating the TiO_2,and decreasing its effectiveness, resulting in effluent concentrations of 1,4-dioxane that were higher than anticipated. (It was speculated that the polymer did not cause a problem during the Bench Scale Test because the process volume was too small.) Given the need for equipment modifications to the Purifics test unit and the fact that the TiO_2 would need to be drained and replaced, a decision was made to postpone the remainder of the pilot test until a later date. Purifics removed their pilot treatment unit from the Combe Fill South Landfill Treatment Plant.

After further consideration at the Purifics laboratory, it was concluded that the pilot test was also having trouble with the relatively high levels of iron (Fe) and manganese (Mn) in the influent. A series of tests were completed in the laboratory, and no solution to the polymer problem was developed. Purifics concluded that the polymer disabled the photocatalytic activity by adsorbing onto the TiO_2 catalyst, wicking around the entire surface area of the catalyst, such that the light energy was blocked. The TiO_2 used in the pilot test was found to have been coagulated into very large 'chunks' of catalyst, causing the TiO_2 to settle out rapidly.

Purifics recommended returning to the site with the test unit after it was retrofitted with a CUF membrane and pH adjustment system to precipitate metals in raw water without the use of polymer. Purifics suggested that the CUF metals removal system may be able to replace the existing coagulant-polymer-inclined plate process for Fe and Mn removal.

Purifics then returned to the site on November 20, 2012 with a modified unit that included a CUF unit. The pilot test equipment was connected to the Combe South Landfill treatment plant tank T-101 influent line to obtain raw water from the ground water recovery wells (prior to the equalization tank and addition of the polymer in the existing treatment system). The raw water source is marked by star number three in the process schematic in Section 2.4.1.

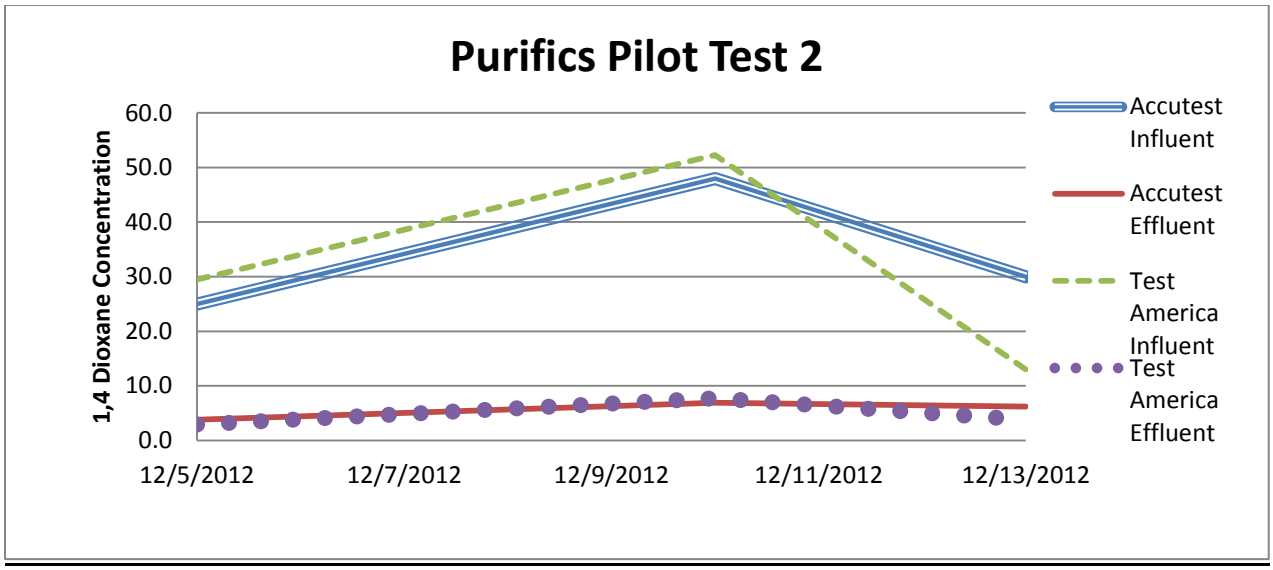
For the second round of pilot testing, duplicate samples were obtained for 1,4-dioxane analysis, and sent to two different laboratories (Accutest Laboratories and TestAmerica Edison) for comparison of test results.

Purifics Pilot Test Number 2
1,4-dioxane concentration (ug/l)

Company Name	***TestAmerica***	***Accutest***	***TestAmerica***	***Accutest***	***TestAmerica***	***Accutest***
Week	**Week 1a**	**Week 1a**	**Week 2a**	**Week 2a**	**Week 2a**	**Week 2a**
Date Sampled	**12/5/12**	**12/5/12**	**12/10/12**	**12/10/12**	**12/13/12**	**12/13/12**
Inflow, gpm	5	5	5	5	5	5
Influent	25.0	29.5	48.0	52.3	30.0	13.0
Effluent	3.8 J (84.8%)	2.9 (90.2%)	6.9 J (85.6%)	7.7 (85.3%)	6.2 J (79.3%)	3.8 (70.8%)

Notes:

- % represents the percentage removed from influent
- 24 of 32 UV lamps were on when the 12/5/12 samples were collected. All 32 UV lamps were on when the remaining samples were collected.



The results of Purifics pilot test two showed several things of importance.

- The laboratories showed slightly different results for duplicate samples. It was noted during a review of the data that longer holding times by the laboratories appeared to result in lower concentrations of 1,4-dioxane. This is shown in a comparison of the December 13, 2012 duplicate samples, for which TestAmerica Edison had a six day lag and an influent concentration of 30.0 ug/l; whereas Accutest had an 11 day turnaround and an influent concentration of 13.0 ug/l. However, based on polar nature and low Henry's Law constant, 1,4-dioxane is not expected to volatilize from a liquid sample. As such, the NJDEP Office of Data Quality rejects the apparent correlation between sample turnaround time and concentration. In addition, the NJDEP Office of Data Quality notes that data repeatability can be problematic when 1,4-dioxane is analyzed by the standard 8270 method.

- Influent concentrations have been shown to fluctuate considerably, with the lowest concentration (13.0 ppb) noted on December 13, 2012, and the highest (48.0-52.3 ppb) noted on December 10, 2012. Although each of the sampling events showed a substantial decrease between influent and effluent concentration of 1,4-dioxane (between 70.8 percent and 90.2 percent reduction), none of the effluent concentrations (except the Accutest results for the December 5, 2012 sampling event) met the NJDEP requirement of less than 3.0 ppb. There was also a reduction in 1,4-dioxane removal efficiency over time. Purifics acknowledged the reduction and stated that this phenomenon was not previously experienced in 18 years of pilot testing by the company. Unidentified contaminants in the raw water, such as inorganic compounds, may have decreased reaction efficiency, as suggested by Purifics in conversation.

- For the first week of the second round of the pilot test, a total of 24 UV lamps were utilized; however, the first round of testing on December 5, 2012 showed lower than expected results. As such, the number of lamps was increased from 24 to 32 for the remainder of the pilot test.

- Purifics noted that the second round of samples on December 10, 2012 may have been collected too soon after the citric acid chemical rinse, which may have not permitted adequate start up time to fully treat unfiltered water in the loop, so those results may be questionable.

As a result of the above observations, it is felt that the Purifics Pilot Tests have provided insufficient data to reach specific conclusions regarding the efficacy of using the Purifics ES, Inc. Photo-Cat treatment alternative for removal of 1,4-dioxane from the Combe Fill South Landfill leachate. Variability in the reported concentrations makes it difficult to compare the results from test to test. Additionally, the Photo-Cat process seems susceptible to competing reactions with influent impurities, first as experienced with the process polymer in test one and then as experienced with unidentified contaminants in test two.

Although Purifics is convinced that their system can be optimized to achieve the desired treatment goals, there is currently insufficient evidence to support that conclusion without additional field testing.

During the second Purifics pilot test, metals analyses were also performed to evaluate the effectiveness of the CUF membrane. Samples were collected of the raw influent, the CUF effluent, and the Photo-Cat effluent on December 5, 10 and 13, 2012 and were sent to TestAmerica Edison for analysis by Method 6020. The reported results are tabulated below.

Metals Analyses from the Purifics Pilot Testing

Method 6020 Analyte	***12/5/12***			***12/10/12***			***12/13/12***		
ug/l	**Raw**	**CUF**	**Photo-Cat**	**Raw**	**CUF**	**Photo-Cat**	**Raw**	**CUF**	**Photo-Cat**
Silver	4.1U	4.1U	4.1U	4.1U	4.1U	4.1U	4.1U	4.1U	4.1U
Arsenic	1.8U	1.8U	1.8U	**2.4J**	1.8U	1.8U	1.8U	1.8U	1.8U
Barium	NR	NR	NR	**56.9**	**35.6**	**39.2**	NR	NR	NR
Beryllium	0.80U	0.80U	0.80U	0.80U	0.80U	0.80U	0.80U	0.80U	0.80U
Cadmium	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U
Chromium	3.9U	3.9U	3.9U	3.9U	3.9U	**5.4**	3.9U	3.9U	3.9U
Copper	3.8U	3.8U	3.8U	3.8U	3.8U	3.8U	3.8U	3.8U	3.8U
Manganese	NR	NR	NR	**3350**	**1930**	**2090**	NR	NR	NR
Nickel	4.1U	4.1U	**4.2J**	**5.2**	4.1U	**5.2**	**7.3**	4.1U	4.1U
Lead	1.2U	1.2U	1.2U	1.2U	1.2U	1.2U	1.2U	1.2U	1.2U
Antimony	1.9U	1.9U	1.9U	1.9U	1.9U	1.9U	1.9U	1.9U	1.9U
Selenium	1.5U	1.5U	1.5U	1.5U	1.5U	1.5U	1.5U	1.5U	1.5U
Zinc	19.7U	19.7U	19.7U	19.7U	19.7U	19.7U	19.7U	19.7U	19.7U
Aluminum	NR	NR	NR	43.8U	43.8U	43.8U	NR	NR	NR
Magnesium	NR	NR	NR	**17300**	**15500**	**15300**	NR	NR	NR
Calcium	NR	NR	NR	**51100**	**41600**	**41400**	NR	NR	NR
Iron	NR	NR	NR	**12200**	119U	119U	NR	NR	NR
Thallium	0.79U	0.79U	0.79U	0.79U	0.79U	0.79U	0.79U	0.79U	0.79U
Mercury	0.16U	0.16U	0.16U	0.16U	0.16U	0.16U	0.16U	0.16U	0.16U

NR = not reported.

The following is noted regarding these results:

- For the December 5, 2012 and December 13, 2012 sampling events, TestAmerica Edison reported only the analytes governed by the NJPDES permit equivalent. This occurred because TestAmerica routinely performs permit compliance analyses for the plant, and there was miscommunication for some of the Pilot Test samples.

- Nearly all of the analytes were undetected in the December 5, 2012 and December 13, 2012 samples; therefore, the data cannot be compared or evaluated.
- Additional analytes and multiple detections were reported for the December 10, 2012 samples. Arsenic, barium, manganese, nickel, magnesium, calcium, and iron were detected in the raw influent; however, the NJPDES permit equivalent regulates only arsenic and nickel, both of which were detected below regulatory concentrations. Arsenic appeared to be removed by the CUF unit and was not reported in either the CUF or Photo-Cat effluent samples. Nickel was reported at the same concentration in the raw influent and Photo-Cat effluent samples, but was not detected in the CUF unit effluent. The CUF unit appeared to reduce the influent concentrations of barium, manganese, magnesium, and calcium on the order of 10 – 42 percent, but barium and manganese were reported at higher concentrations in the Photo-Cat effluent than in the CUF effluent. Iron, which had an influent concentration of 12,200 ppb, had concentrations below the detection limit after passing through the CUF unit and was not detected in the Photo-Cat effluent. Purifics previously noted that the CUF unit is particularly effective against iron.

- Chromium was reported in the December 10, 2012 Photo-Cat effluent at a concentration of 5.4 ppb, but was undetected in either the raw influent or the CUF effluent. The reported chromium concentration is below the regulatory limit established in the NJPDES permit equivalent for this analyte.

- Zinc is also regulated by the NJPDES permit equivalent and is typically present in greater concentration than the other regulated analytes. Unfortunately, zinc was not detected in any of the samples collected, and the effectiveness of the CUF unit could not be evaluated.

2.5.2 Kerfoot Pilot Test Treatability Results

The Kerfoot treatment alternative utilizes a process in which hydrogen peroxide (H_2O_2) reacts with ozone to generate hydroxyl free radicals that treat various compounds, including 1,4-dioxane and chlorinated solvents. A detailed description of the Kerfoot system is included in Section 2.4.3.

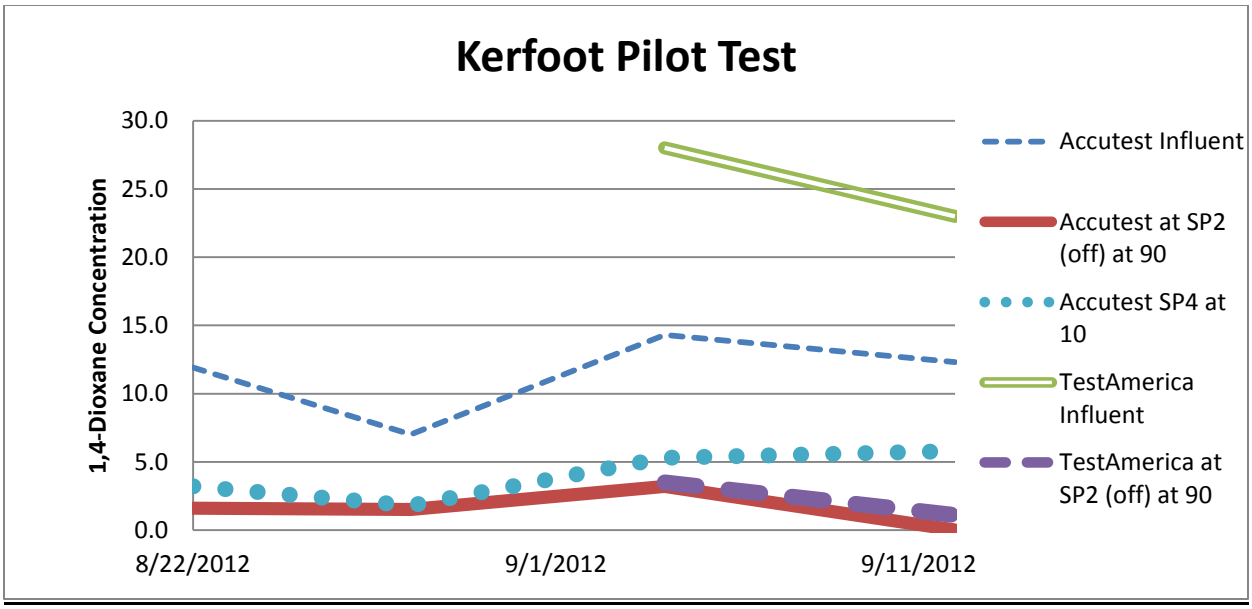
The Bench Scale Testing completed in 2011 showed that the Kerfoot techniques were effective in removal of 1,4-dioxane. At that time, L.R. Kimball, based on information provided by Kerfoot, estimated that Kerfoot's technology had the lowest capital equipment and operating costs, although, a tank would need to be installed to allow for the 120 minutes of residence time needed for this treatment alternative. It was discovered during the Pilot Test that the estimated Kerfoot costs were under-reported because Kerfoot provided costs for a system capable of treating only 60 GPM, which is half of the treatment system design flow.

The Kerfoot Pilot Test equipment was delivered to the site on Friday, August 17, 2012, and the system was connected to the existing treatment system on Monday, Augutst 20, 2012. Two rounds of samples were collected on August 22, 2012 and August 28, 2102, and were analyzed for 1,4-dioxane by Accutest Laboratories. Additional samples were collected in Week Three, on September 4, 2012, and in Week Four, on September 21, 2012, and duplicate samples were submitted to both Accutest and TestAmerica Edison for analysis of 1,4-dioxane. Samples were also collected in Weeks Three and Four for bromide and bromate analysis by the Brick Utilities Laboratory (Brick, New Jersey).
A summary of the 1,4-dioxane test results is shown below:

1,4-Dioxane Test Results

Company Name	*Accutest*		*TestAmerica*	*Accutest*		*TestAmerica*
Week	**Week 1**	**Week 2**	**Week 3**	**Week 3**	**Week 4**	**Week 4**
Date Sampled	**8/22/2012**	**8/28/2012**	**9/4/2012**	**9/4/2012**	**9/12/2012**	**9/12/2012**
Inflow, gpm	10	5	5	5	5	5
O3, gm/hr	14	14	14	14	14	14
Peroxide, ml/min	12	12	12	12	0	0
SP1 60-65 minutes after forward flow starts	11.9	7.0	28	14.3	12.3	23.0
SP4 10 minutes after forward flow starts	3.2 (73.1%)	1.8J (74.3%)		5.3 (62.9%)	5.8 (52.8%)	
SP2 60-65 minutes after forward flow starts	6.0 (49.6%)			10.7 (25.2%)	6.0 (51.2%)	
SP3 60-65 minutes after forward flow starts	5.5 (53.8%)			13.0 (9.1%)	5.3 (56.9%)	
SP4 60-65 minutes after forward flow starts	6.0 (49.6%)			12.6 (11.9%)	4.7 (61.8%)	
SP2 120 minutes after forward flow starts		5.5 (21.4%)				
SP3 120 minutes after forward flow starts		5.3 (24.3%)				
SP4 120 minutes after forward flow starts		5.4 (22.9%)				
SP2 90 minutes after forward flow stops (loop recirculating)	1.6J (86.6%)	1.5J (78.6%)	3.5J (87.5%)	3.2 (77.6%)	0.27U (>97.8%)	1.1U (>95.2%)
SP3 90 minutes after forward flow stops (loop recirculating)					0.27U (>97.8%)	1.1U (>95.2%)

- % represents the percentage removed from influent
- SP1 is the influent from the plant
- SP2 is the effluent from the Nanozox loop system .
- SP3 is the storage tank contents (influent to the air stripper during forward flow) .
- SP4 is the air stripper effluent that is discharged back to the treatment plant.



Influent and loop effluent samples were collected from sample ports SP1 and SP2 on September 4, 2012 and September 12, 2012 for analysis of bromide in the raw water and bromate in the treated effluent. During the Bench Scale Tests, one of the ozone-based advanced oxidation processes under consideration (APT's HiPOx technology) produced bromate at a concentration above the Federal Maximum Contaminant Level (MCL. Technology used by Kerfoot also utilizes ozone, but Kerfoot did not perform bromide or bromate analyses during the Bench Scale Test to determine whether bromate formation was a concern. Accordingly, samples were collected for analysis during Weeks Three and Four of the Pilot Test to ascertain whether secondary treatment for bromate may be required for this technology. The bromate and bromide results are tabulated below.

Bromate and Bromide Test Results

	9/4/12	9/12/12
Bromide *ug/l* SP1	470**	370
Bromate *ug/l* SP2 90 minutes after forward flow stops- loop recirculating	< 5	< 5

** The laboratory exceeded holding time for this sample due to instrument issues.

Based on these results, bromate formation does not appear to be a concern for the Kerfoot technology.

The Kerfoot technology utilizes a "loop" system. Because the existing ground water treatment system operates in batch mode, the incoming flow to the loop system used by Kerfoot cycled on and off throughout the day, depending on the plant batch cycle. When plant forward flow stopped and there was no inflow to the Pilot Test unit, partially treated water was re-circulated through the loop process for additional treatment until forward flow resumed. At the start of the pilot test, the inflow was set at ten gpm, with the cycles set at four hours on, followed by two hours off. After discussion with the plant operator, the on/off flow times were changed to two hours on, and 1.5 hours off in a continuous cycle. After Week One, the inflow to the Pilot Test unit was reduced from ten gpm to five gpm for the duration of the test. There were four sampling ports available within the loop

system, and the above data reflects results at each sampling location at various time increments within the cycles.

As discussed in the Kerfoot Pilot Test Report located in Appendix B, "…*when flow was occurring, it was sent to the central loop, cycled five times, and then sent to a 250-gallon holding tank, which held for about 12.5 minutes, then to a stripper, followed by one micron filtration, and then pumped out the exit line at 10 gpm, identical to the inflow rate. If the inflow stopped, the volume in the holding tank was recycled back to the central loop, which had about 50 gallons of capacity, to be cycled 4 times before returning to the storage tank. During this phase, the stripper, filter and discharge pump were turned off*." As noted above, after Week One, the influent and exit flow was reduced to five gpm.

As noted above, during cycles with the inflow on, there was also a continuous discharge equal to the rate of inflow. As such, during these periods, the level of treatment was significantly lower than during periods when the inflow had been stopped, and the volume re-circulated through the system.

In addition, the system utilized both peroxide and nanobubble ozone for removal of the 1,4-dioxane. As noted above in the data chart, peroxide was utilized for Weeks One through Three, but discontinued in Week Four; whereas the ozone level was consistent at 14 grams per hour (gm/hr) for the entire test. It is noted that the ozone feed rate was the maximum feed rate that could be produced by the ozone generator installed in the Pilot Test unit. After the 1,4-dioxane concentrations were reported for Week One, Kerfoot considered the possibility of increasing the ozone feed rate, by either replacing the ozone generator with a larger unit or installing a second identically-sized unit in series. This modification would allow Kerfoot to increase ozone and hydrogen peroxide dosage proportionally and possibly improve treatment. When Kerfoot determined that neither a larger nor a second ozone generator was feasible, Kerfoot elected to reduce inflow from ten gpm to five gpm to double the contact time. Because the ozone feed rate could not be varied, the hydrogen peroxide feed rate was maintained at 12 milliliters (ml)/min for Weeks One through Three. Kerfoot indicated in their Pilot Test Report that "…*if the water flow is free of trivalent chromium, bromine and chlorinated compounds, peroxide may be discontinued.*"

The results of Kerfoot Pilot Test show several things of importance.

- The laboratories did not agree on the influent concentrations for the duplicate samples, but were in agreement for the loop and storage tank effluent concentrations.

- Influent concentrations fluctuated considerably, with the lowest concentration (7.0 ppb) noted on August 28, 2012, and the highest (14.3-28.0 ppb) noted on September 4, 2012.

- Although each of the sampling events showed a substantial decrease between influent and effluent concentration of 1,4-dioxane (between 11.9 percent and 74.3 percent reduction) at the exit line point (SP4), all but one of the effluent concentrations failed to meet the NJDEP requirement of less than 3.0 ppb. (The above observation was based strictly on the discharge point (SP4), even though the concentrations were less than 3.0 ppb at other points when forward flow stopped and the loop continually recirculated.)

- For the first week of the pilot test, the inflow was set at ten GPM, but this was changed to five GPM for Weeks Two through Four to double residence time; however, this change did not appreciably improve 1,4-dioxane removal under forward flow conditions In multiple instances, 1,4-dioxane removal efficiencies actually decreased.

- In addition, the treatment process utilized 12 ml/min of peroxide for Weeks One through Three, but no peroxide in week Four. Because Kerfoot could not proportionally vary the ozone and peroxide feed rates due to an undersized ozone generator, Kerfoot could not demonstrate whether increased ozone and

peroxide dosing would improve 1,4-dioxane removal. This is viewed as a testing deficiency. Although ozone-only treatment yielded undetected 1,4-dioxane values at SP2 and SP3, these values were achieved after forward flow stopped and the loop recirculated for 90 minutes. Conversely, during forward flow conditions and ozone only-treatment, SP2, SP3 and SP4 exhibited 1,4-dioxane removal efficiencies of 51.2 percent to 61.8 percent and concentrations of 4.7 to 6.0 ppb.

- During Weeks One, Three and Four, samples were collected at SP2, SP3 and SP4 at 60-65 minutes after inflow startup, but during Week Two, they were sampled at 120 minutes. The 120 minute interval was selected to check Kerfoot's bench scale results showing a reaction time of 100 – 120 minutes. Poor 1,4-dioxane removal was recorded at SP2, SP3 and SP4 after 120 minutes of forward flow, where average concentrations and removal efficiencies of 5.4 ppb and 22.9 percent, respectively, were observed.

- As a result of the variation in inflow rates, sample collection times and peroxide dosing, it is somewhat difficult to directly compare the test results.

- The most consistently low concentrations of 1,4-dioxane were noted at the loop effluent sample port SP2, roughly 90 minutes after the inflow was stopped. This is logical, since these samples represent the volume of water that has been re-circulated for the maximum time, with the inflow stopped.

- At the discharge location (SP4) ten minutes after restarting the inflow, concentrations were shown to increase to above the NJDEP requirement of less than 3.0 ppb in all but one instance. This is significant because this sample interval was expected to produce a "best case" sample. When forward flow resumed, water that had been recirculated in the loop system was transferred from the storage tank to the air stripper receiver tank. When the level in the receiver tank reached the set point, the air stripper blower energized and the stripper began to discharge water. A sample could not be collected at sample point SP4 until discharge began, which was approximately ten minutes after forward flow resumed. Hence, this sample was expected to represent maximum treatment.

As a result of the above observations, the Kerfoot Pilot Test has provided insufficient data to reach specific conclusions regarding the efficacy of using the Kerfoot Nanozox™ Loop System (Nanozox™) for removal of 1,4-dioxane from the Combe Fill South Landfill leachate. Although the sampling indicated that the concentrations were acceptable at <u>some</u> locations and times within the cycles/loops, the <u>effluent</u> concentrations showed acceptable results only once during the four week test.

Although Kerfoot submitted a series of calculations indicating that the system should work under actual site conditions, there is currently insufficient evidence to support that conclusion without additional field testing.

3.0 COMPARITIVE ANALYSIS OF TREATMENT ALTERNATIVES

3.1 Effectiveness

An analysis of the effectiveness of the two Pilot Test treatment alternatives is summarized as follows:

- Neither of the two treatment pilot test alternatives were successful in showing that the technology can consistently achieve the objective of oxidizing 1,4-dioxane below the discharge criteria requirement of 3.0 ppb.

- Following the Bench Scale Testing, recommended dosing levels and dose response requirements had been established for the various treatment alternatives to treat effluent containing 1,4-dioxane from the Combe site. However, the pilot tests had enough variables such that the dosing levels and response requirements are now back in question. Neither vendor was able to optimize their systems during the pilot test periods.

- The Purifics ES, Inc. Photo-Cat treatment alternative utilized UV light with a titanium dioxide catalyst to reduce the concentration of 1,4-dioxane. For the first week of the second round of the Pilot Test, a total of 24 UV lamps were utilized; however, the first round of testing (on December 15, 2012) showed lower than expected results. As such, the number of lamps was increased from 24 to 32 for the remainder of the pilot test. No additional lamps were available in the Pilot Test unit to further increase the UV level. If this increased requirement in UV is typical of future operations, the cost of operating the treatment system could be greater than what had been estimated following the bench scale testing.

- The Purifics ES, Inc. Photo-Cat treatment alternative had decaying results during the second pilot test that is not understood by Purifics. Their subsequent recommendation is that additional pilot testing would be necessary to try to understand the cause and to document that it can be overcome.

- During the Bench Scale Testing, the Kerfoot Nanozox™ Loop System (Nanozox™) treatment alternative utilized ozone in combination with hydrogen peroxide to reduce the concentration of 1,4-dioxane from 138 ppb to < 1.27 ppb (99 percent oxidation). The Pilot Test treatment process utilized 12 ml/mm of peroxide for weeks 1 through 3, but no peroxide in week 4. Kerfoot concluded that "…*if the water flow is free of trivalent chromium, bromine and chlorinated compounds, peroxide may be discontinued.*" However, this conclusion during the Pilot Test was based on one round of sampling, which showed inadequate concentration reduction at the discharge location (SP4) ten minutes after restarting the inflow.

- The Kerfoot Nanozox™ treatment alternative utilizes both ozone and peroxide, which would require additional storage areas for strong oxidizing chemicals. Strong oxidizing agents are always a concern for workers of the treatment operations. The recommendation from Kerfoot was that both ozone and peroxide storage units be provided, even though peroxide may not be required.

- Cost estimates associated with the Kerfoot Nanozox™ treatment alternative were provided, based on a 60 GPM Loop System. However, the requested flow design was for a 120 GPM system, and Kerfoot's recommendation was to double the cost and size requirements, with the idea that one unit would be utilized during low inflow periods, and the second only as required.

3.2 Implementation

An analysis of the ability to implement the treatment alternatives is summarized as follows:

- Both treatment alternatives are self-contained units shipped in either their own enclosure (Purifics), or on forklift-ready skids or pallets (Kerfoot). Both systems are relatively easy to install and connect to the existing treatment train and utilities.

- Interconnecting influent and effluent lines, electrical, and signal wiring can be installed to integrate the systems with the existing treatment train.

- The Kerfoot Nanozox™ system would require two 600 gallon surge tanks and a 40,000 gallon mixing tank to provide 120 minutes of residence time. Kerfoot also stated that a new structure approximately 15 feet wide by 78 feet long would be required to house its equipment. (Note that a standard building size of 15'x80' was used in the cost estimates.)

- Both treatment systems would be equipped with dedicated Programmable Logic Control (PLC) units that can be connected to the existing control system, allowing for remote monitoring and operation. The Purifics system was noted as being well developed and user-friendly.

- The Kerfoot Nanozox™ system will require the supply and storage of hydrogen peroxide. The hydrogen peroxide recommended storage capacity is 300 gallons (10 percent H_2O_2), and the projected consumption rate is 150 gallons per week. Kerfoot recommended that the peroxide be stored in a 300 gallon stainless steel tank, which seems to be undersized based on projected usage.

- The Kerfoot Nanozox™ systems may require additional permitting for ozone generation and hydrogen peroxide storage.

- System start-up time is relatively short for the Purifics Photo-cat systems (one to two weeks), and slightly longer (four to eight weeks) for start-up of the Kerfoot Nanozox™ system.

- The Kerfoot Nanozox™ system has been used exclusively for in-situ ground water treatment. If used at Combe Fill South Landfill, it would be the first full-scale ex-situ installation of this technology.

3.3 Capital and O&M Costs

An analysis of the capital and O&M costs to operate the treatment alternatives is summarized as follows:

- Following completion of the bench scale testing, cost estimates associated with each technology were prepared and the highest capital cost associated with implementation was estimated for the Photo-Cat treatment system manufactured by Purifics, at roughly $580,000. Following the first pilot test, Purifics recommended adding a CUF system for metals removal at an extra cost of $200,000. Accordingly, the revised capital cost is estimated as follows for the Purifics technology, with additional costs associated with site development issues anticipated to be necessary for the proposed system:

Purifics PhotoCat System Pricing

Item No.	Item Description	Quantity	Unit	Unit Price	Total Price
1	Photo-Cat in shipping container	1	EA	$ 400,000.00	$ 400,000.00
2	CUF unit	1	EA	$ 200,000.00	$ 200,000.00
3	60,000 Gallon Equalization Tank	1	EA	$ 175,000.00	$ 175,000.00
4	Piping connection to WWTP	100	LF	$ 90.00	$ 9,000.00
5	Site grading & seeding	1	LS	$ 6,000.00	$ 6,000.00
6	Sidewalks	1	LS	$ 2,000.00	$ 2,000.00
7	Erosion and Sedimentation Control	1	LS	$ 2,000.00	$ 2,000.00
8	Concrete pad for treatment unit	12	CY	$ 400.00	$ 4,800.00
9	Aggregate under concrete pad	12	CY	$ 35.00	$ 420.00
10	Electrical	1	LS	$ 50,000.00	$ 50,000.00
	SUBTOTAL				**$ 849,220.00**
	Contingency (20% of construction cost)	1	LS	$ 169,844.00	$ 169,844.00
	TOTAL CONSTRUCTION COST				**$ 1,019,064.00**
	Engineering & Design (10% construction cost)	1	LS	$ 101,906.40	$ 101,906.40
	Construction Mgmt & Admin (15% construction cost)	1	LS	$ 152,859.60	$ 152,859.60

TOTAL PROJECT COST = $ 1,273,830.00

- Based on the bench scale testing, the lowest capital cost estimate associated with implementation was the Nanozox™ treatment system manufactured by Kerfoot, at roughly $339,228; however, this cost was based on a 60 GPM system rather than the required 120 GPM system. Following the Pilot Test, a revised price of roughly $504,000 was estimated by Kerfoot, plus an additional $60,000 for two peroxide feed systems (if required) and $4,000 for two surge tanks. Kerfoot also recommended a 300 gallon stainless steel peroxide storage tank, but it is unclear whether the price of the tank is included in the peroxide feed system cost of $60,000. Additionally, Kerfoot stated that an approximate 1,200 square foot structure and a 40,000 gallon fiberglass-reinforced plastic (FRP) or lined storage tank were required, but did not furnish estimated costs for these items.

- Using the revised costs furnished by Kerfoot, as well as costs associated with site development issues anticipated to be necessary for the proposed system, the capital cost is recalculated as follows:

Kerfoot Loop System Pricing

Item No.	Item Description	Quantity	Unit	Unit Price	Total Price
1	Revised Loop System	1	LS	$ 504,000.00	$ 504,000.00
2	Peroxide Feed System	1	LS	$ 60,000.00	$ 60,000.00
3	40,000 Gallon Recycle Tank	1	EA	$ 150,000.00	$ 150,000.00
4	Surge Tanks	1	EA	$ 4,000.00	$ 4,000.00
5	60,000 Gallon Equalization Tank	1	EA	$ 175,000.00	$ 175,000.00
6	Piping connection to WWTP	100	LF	$ 90.00	$ 9,000.00
7	Site grading and seeding	1	LS	$ 6,000.00	$ 6,000.00
8	Sidewalks	1	LS	$ 2,000.00	$ 2,000.00
9	Erosion and Sedimentation Control	1	LS	$ 2,000.00	$ 2,000.00
10	15'x80' steel building & erection	1	EA	$ 49,000.00	$ 49,000.00
11	Concrete Building Pad	30	CY	$ 400.00	$ 12,000.00
12	Aggregate Base Pad for Building	25	CY	$ 55.00	$ 1,375.00
13	Electrical and lighting	1	LS	$ 35,000.00	$ 35,000.00
14	Building Heating	1	LS	$ 10,000.00	$ 10,000.00
15	Building Ventilation	1	LS	$ 8,000.00	$ 8,000.00
	SUBTOTAL				**$ 1,027,375.00**
	Contingency (20% of construction cost)	1	LS	$ 26,875.00	$ 26,875.00
	TOTAL CONSTRUCTION COST				**$ 1,054,250.00**
	Engineering & Design (10% construction cost)	1	LS	$ 105,425.00	$ 105,425.00
	Construction Mgmt & Admin (15% construction cost)	1	LS	$ 158,137.50	$ 158,137.50

TOTAL PROJECT COST = $ 1,317,812.50

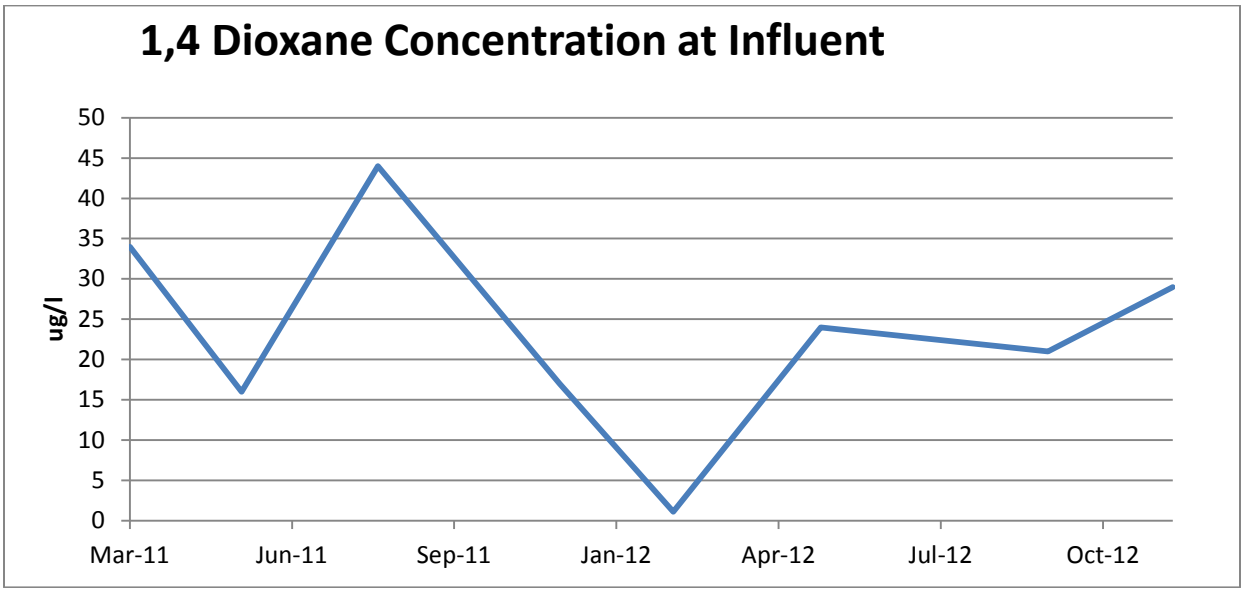
- Following the bench scale testing, the Kerfoot Nanozox™ system was identified with the lowest estimated overall annual O&M costs of roughly $30,300 per year. The estimate following the pilot test was roughly the same, although it is not clear if all anticipated costs have been accounted for.

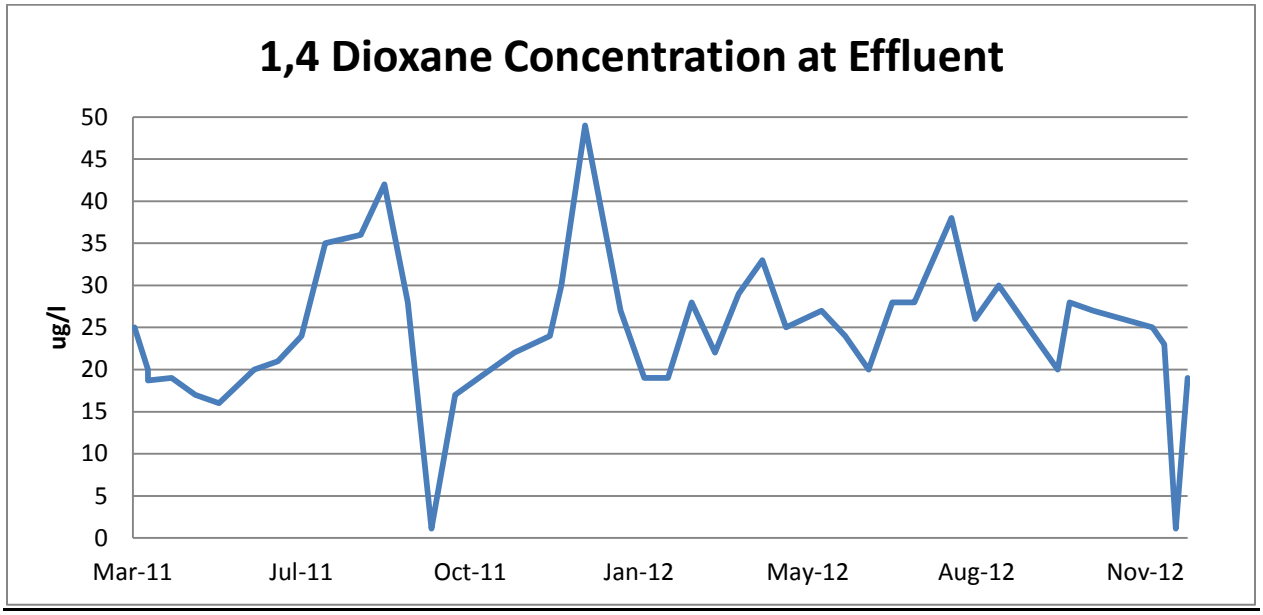
- The Purifics Photo-Cat system was estimated to have the highest overall annual O&M costs following the bench scale test, at roughly $68,183 per year. This was mainly due to the annual energy costs of $53,850. A revised O&M cost was not available from Purifics following the pilot test since it was felt that additional field testing would be required to optimize the system prior to preparing another estimate.

4.0 INFLUENT CONCENTRATIONS ANTICIPATED FOR FINAL DESIGN

The pilot test assessments were completed based on the assumption that concentrations of 1,4-dioxane of up to 160 micrograms(ug)/liter(l) would be periodically encountered at the influent, at flows of up to 120 GPM. This estimate was based on limited historic data, from periodic sampling of the influent water quality.

Prior to finalizing the recommendations for future treatment, available concentration data was evaluated to further assess the reasonableness of these design parameters. This information was supplied by the Combe Fill South Landfill treatment plant operator, based on periodic sampling since March 2011, and is summarized on the graphs below.





Note that additional data is available as to the 1,4-dioxane concentrations at individual wells located throughout the landfill; however, pumps located at some of the wells operate on an as-needed basis, such that the flow that arrives at the treatment plant represents contributions from multiple locations, in a rather unpredictable manner.

The graphs above indicate that the influent 1,4-dioxane concentration at the treatment plant has varied from a minimum of "undetected" (less than 1.1 ug/l) in February 2012 to a maximum of 160 ug/l in April 2009. The second highest spike noted was 53 ug/l in October 2007, and 48-52 ug/l was also observed in the Purifics Pilot Test influent on December 10, 2012. It would appear that concentrations at the treatment plant exceeding 50 ug/l are rare occurrences, and the April 2009 occurrence was somewhat of an anomaly.

From an examination of the concentration data from the individual wells, 1,4-dioxane concentrations in excess of 100 ug/l have occurred in Wells D-2, D-6, MW-16, RW-G, PZ-6, and PZ-7, and concentrations exceeding 200 ug/l have been reported in wells D-5R, D-7, MW-17, MW-19D, RW-B, RW-U, PZ-1, PZ-21R, and PZ-27. Furthermore, multiple detections exceeding 540 ug/l (ranging from 540-970 ug/l) were reported at locations D-5R, RW-U, and PZ-21R. The data would appear to show that 1,4-dioxane is distributed across a considerable portion of the landfill, at potentially high concentrations.

Unfortunately, it is difficult to correlate directly between well concentration levels and the concentration that would be observed at the influent to the treatment plant.

Given the limited data available, it is recommended that additional evaluations of the well concentrations, pumping rates and sequence of pumping be attempted prior to settling on a final influent flow and 1,4-dioxane concentration to be used for the optimization design at the treatment plant.

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5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on the Pilot Test results, the following conclusions are made for the treatment of 1,4-dioxane in groundwater at the Combe Fill South Landfill site.

- Both of the pilot test alternatives failed to adequately demonstrate that they can consistently achieve the objective of oxidizing 1,4-dioxane to below the discharge criteria requirement of 3.0 ppb.

- Laboratory testing methods for 1,4-dioxane appear to have limitations regarding repeatability as shown by the variation in the two lab results provided on duplicate samples. Documentation of achieving a 1,4-dioxane level below 3.0 ppb uniformly will be challenging.

- The methodology for performance of additional pilot testing will need to consider the laboratory turn-around time for 1,4-dioxane to accommodate adjustment of variables. Suites of samples may be required prior to the modification of individual variables without awaiting feedback and then adjustment of another variable. Prior pilot testing length was too short when considering the sampling program turn-around time, which did not allow for sufficient time to optimize adjusted parameters.

- The Purifics Photo-Cat system performance was influenced by other contaminants in the groundwater, which caused a reduction in treatment over time. The cause of this treatment reduction, with time, will need to be determined before this alternative can be a viable long-term treatment solution.

- The Purifics Photo-Cat system would need to treat raw water and may need to be provided with an equalization tank prior to treatment. The CUF unit for Fe removal would be necessary to control the effects of Fe on the TiO_2 without chemical addition. The existing metals removal system may not be required for use with this alternative, if found to be viable by additional testing.

- Neither vendor provided detailed, revised capital nor O&M, cost estimates since the pilot testing was not conclusive; however, it is noted that the system required by Kerfoot (based on the pilot test) is significantly different and more costly than the system quoted by Kerfoot following the bench scale study.

- Bisco Environmental recently purchased Kerfoot Technologies, Inc. (and retained Bill Kerfoot as a consultant). Leo McDunough of Bisco understood that there were some glitches in the pilot test but feels that Bisco could resolve those issues if there was a second pilot test or if the NJDEP chose to go forward with the retrofit.

5.2 Recommendations

- Based on the results of the Pilot Test Treatability Studies and evaluation of information provided by the two vendors, L.R. Kimball does not recommend that either treatment system be implemented without additional pilot testing to confirm that the facilities will produce the desired discharge limit for 1,4-dioxane. The results of the two vendor pilot tests did not provide sufficient data to support moving forward with either technology.

- Future pilot tests and the ultimate design of a plant retrofit should be based on an influent concentration of 1,4-dioxane of 50 ppb at a flow rate of 120 gpm, since the plant effluent data appears to reflect a declining trend in the level of 1,4-dioxane.

- With any treatment alternative, it appears that it would be prudent to provide an equalization tank prior to ("upstream" from) the treatment process to create a more uniform concentration level of 1,4-dioxane in the plant raw water influent.

- Consideration should be given to the potential merits of pilot testing the third alternative investigated during the Bench Scale Testing (the APT – HiPOx treatment system), since it showed a similar ability to treat for 1,4-dioxane during the bench scale testing, and may be more successful in the field.

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APPENDIX A

Purifics Photo-Cat First Pilot Test

Purifics Photo-Cat Pilot Test Enclosure and Power Generator

Photo-Cat Influent Connection to Combe WWTP

Photo-Cat Influent and Effluent Hose Connections to Combe WWTP

Photo-Cat Influent Aeration Prior to Iron Removal Filter

Photo-Cat Influent Iron Removal Filter

Purifics Photo-Cat Pilot Test Unit View from Rear Doors of Photo-Cat

Photo-Cat Pilot Test Unit

Photo-Cat Control Panel

Photo-Cat Concentrator (stainless steel vert. tank)

Photo-Cat UV Reactors (Rack System for Expandability)

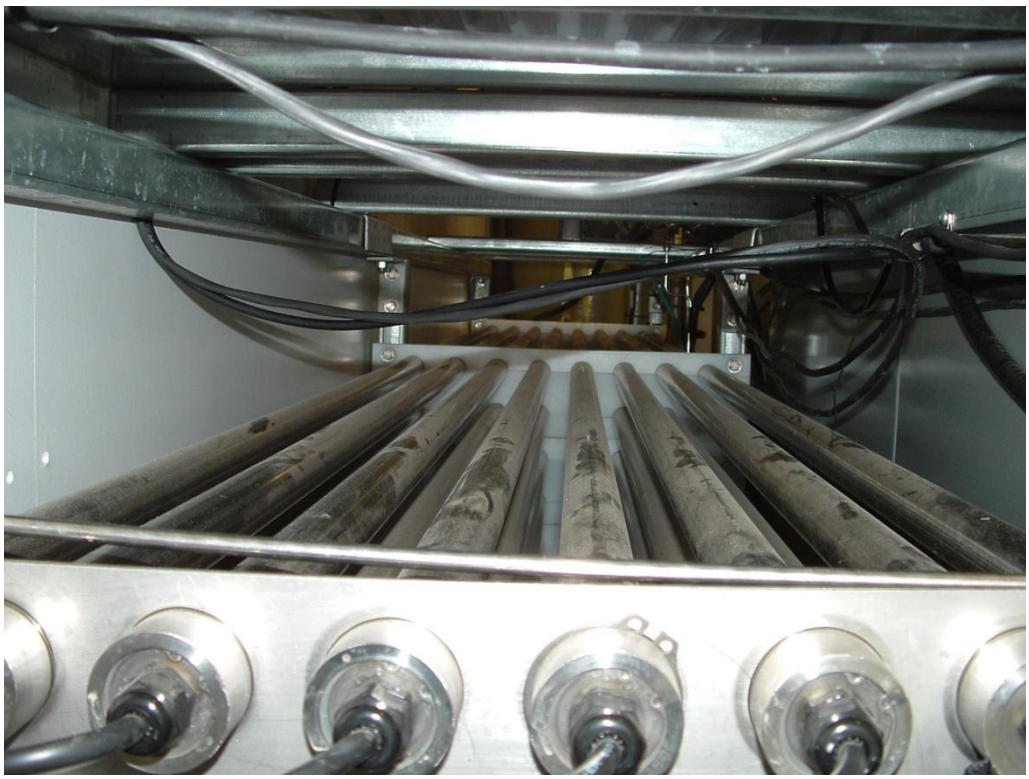


Photo-Cat UV Reactors (stainless steel with internal UV lamps)

Photo-Cat Flow Connection to UV Reactors

Photo-Cat Ceramic Filter to Remove Titanium Dioxide

Photo-Cat Pilot Test Effluent Connection to Combe WWTP

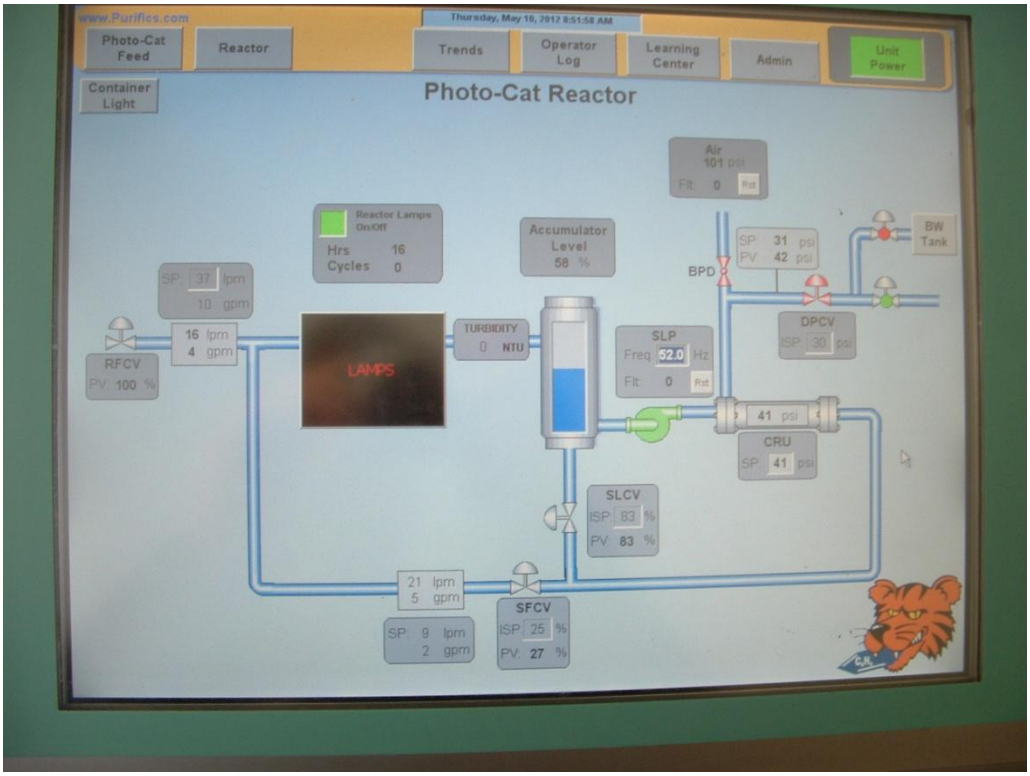


Photo-Cat Screen

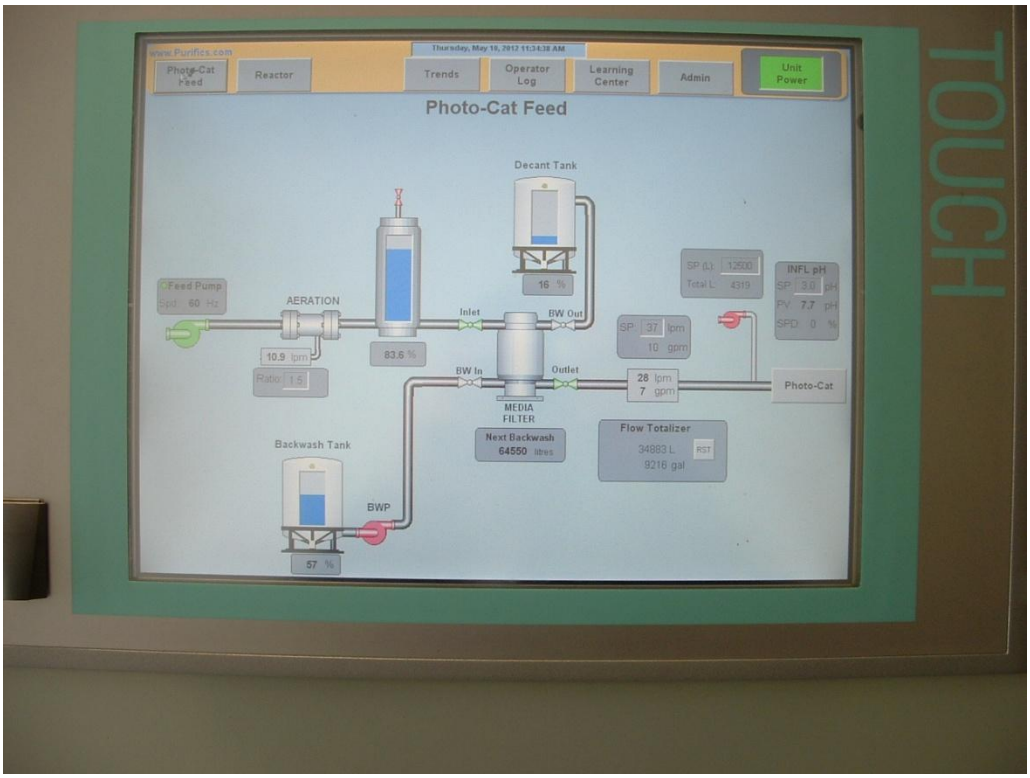


Photo-Cat Feed System Screen

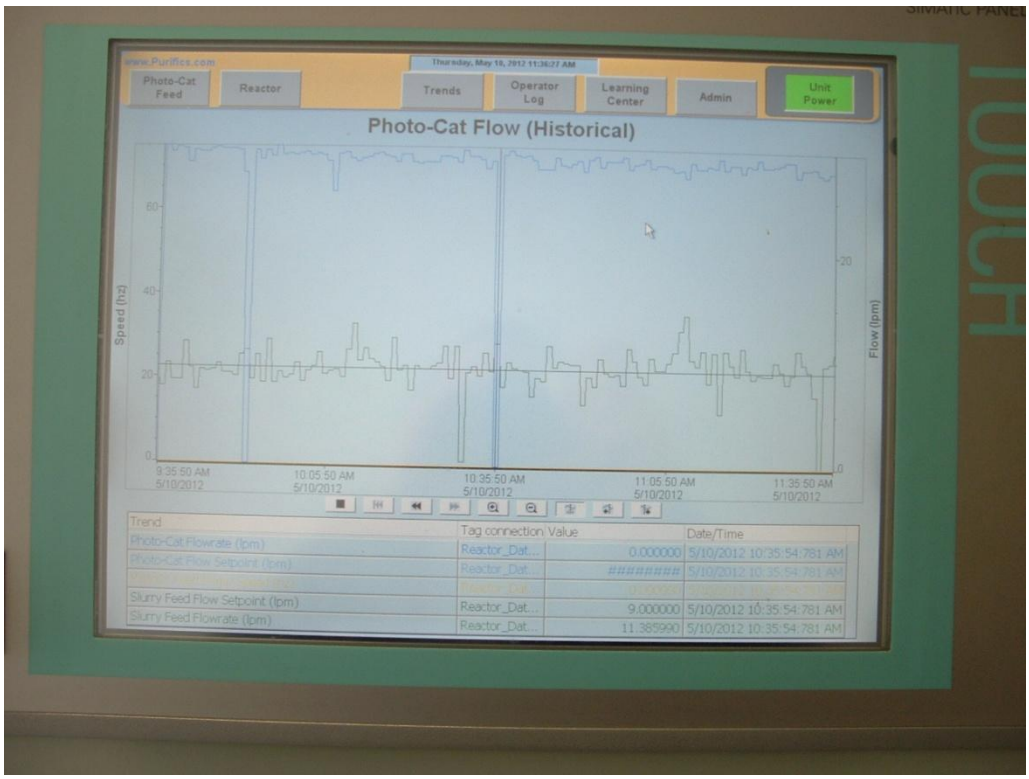


Photo-Cat Historical Flow Plot

Photo-Cat Accumulator Historical Screen

Photo-Cat Flow Screen

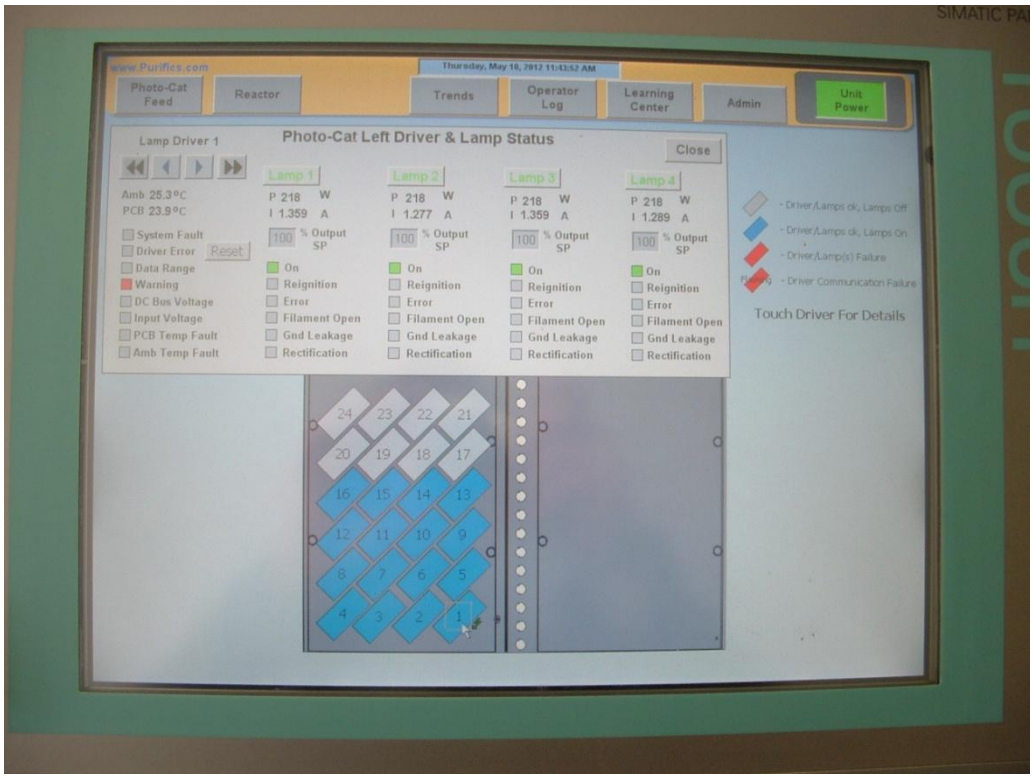


Photo-Cat Left Driver & Lamp Status Screen

Purifics Photo-Cat Second Pilot Test

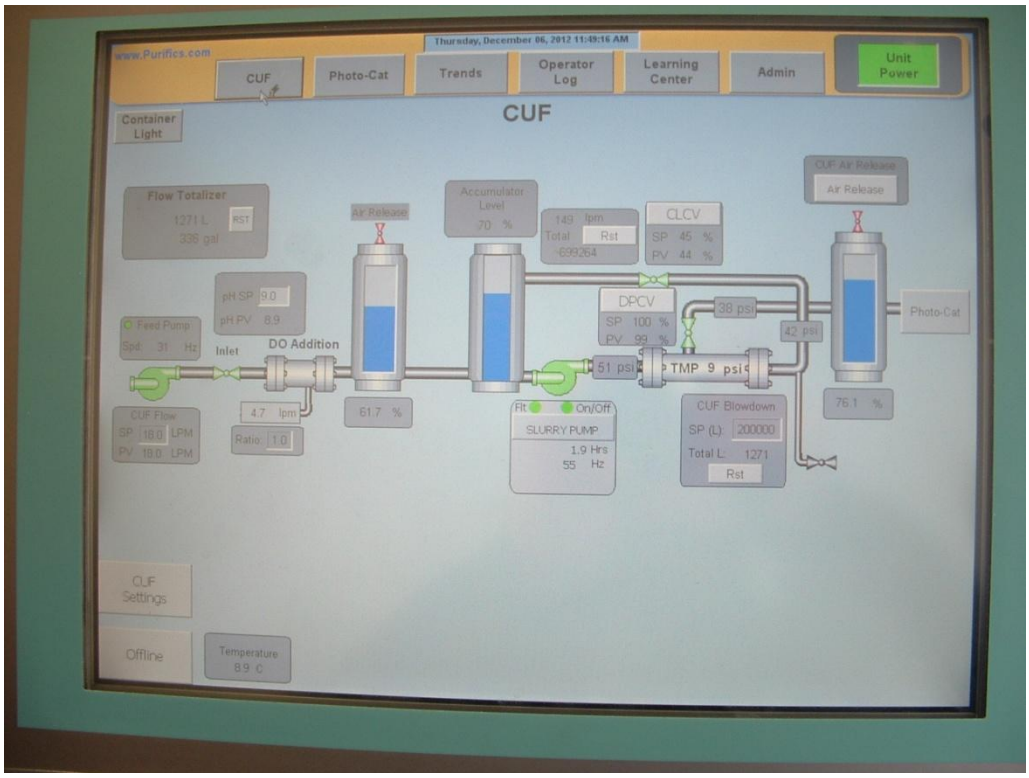
Purifics Photo-Cat Pilot Test Enclosure and Power Generator

Photo-Cat Influent Connection to Combe WWTP

CUF Unit for Iron Removal

CUF Unit Control Panel

CUF Unit for Iron Removal



CUF Unit Control Screen

Photo-Cat Effluent Discharge to Combe WWTP

PROJECT NO. 11P0303

ON-SITE PILOT REPORT PHOTO-CAT GWS TREATMENT RECOMMENDATIONS FOR METALS REMOVAL & 1,4-DIOXANE DESTRUCTION

ATTN: Paula Walshe
<email: Paula.Walshe@dep.state.nj.us>

NJ Dept. of Environmental Protection

401 E. State Street, 6th Floor, Trenton NJ, 08625
Tel: 717-221-8820

January 15, 2013

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3 DATA COMPARISON 4
4 RESULTS & RECOMMENDATIONS 5

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1 BACKGROUND

A successful in-house test program was performed in 2011 on leachate water from the Combe Landfill taken downstream of the inclined plate separator. In the test program, a spiked sample of 1,4-dioxane was destroyed below the 3ppb discharge specification (see 'In-House Test Report Photo-Cat GWS Treatment Of 1,4-Dioxane In Leachate', dated September 20, 2011).

In May of 2012, a pilot Photo-Cat system was installed at the Landfill, treating water downstream of the inclined plate separator. It was quickly found that the ionic polymer used in the plant's existing metals removal process was adsorbing onto the TiO_2 catalyst, wicking around the entire surface area of the catalyst such that the light energy was blocked. The polymer disabled the photocatalytic activity. This phenomena was not observed in bench testing as there was insufficient polymer in a 5 gallon sample to affect the TiO_2 catalyst.

Attempts were made in the pilot program to eliminate the effects of the polymer, however, Purifics concluded that the pilot system did not have the required equipment (ie. Ceramic Ultra filter or CUF system) to properly pre-treat the leachate prior to Photo-Cat destruction of 1,4-dioxane. Consequently, the pilot unit was shipped back to Purifics.

After receiving the pilot unit back to our facility, the TiO_2 that was used in the pilot program was inspected. It was found to have been coagulated into very large 'chunks' of catalyst. Usually TiO_2 in water takes a couple of hours to settle out, however the majority of the TiO_2 from the pilot unit settled out in minutes.

When a sample of the polymer used at Combe Fill South was added to new TiO_2, the exact same coagulation phenomena was observed and the TiO_2 settled out in minutes. This qualitative finding supports the conclusion of the polymer affecting the TiO_2.

Thus, in order for the chemical free Photo-Cat to effectively destroy 1,4-dioxane, the full-scale metals removal process used at Combe Fill South must be operated without the use of polymer. Since the current equipment at Combe Fill South will not effectively function without the use of polymer, Purifics' recommended utilizing its CUF (ceramic ultrafiltration) system instead of the existing coagulant-polymer-inclined plate process.

In December 2012 Purifics Returned to the site with a pilot CUF unit integrated with a Photo-Cat in order to demonstrate the proposed treatment process. The two week pilot was successful in reducing both the metals and 1,4-dioxane concentrations below regulatory requirements. This confirmed that the residual polymer in the first phase of piloting was affecting Photo-Cat performance.

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The CUF technology performed exceptionally well at removing metals upstream of the Photo-Cat.

However, for some unknown reason, rates of 1,4-dioxane destruction slightly reduced over the 2 week pilot (which has never been observed in 18 years of piloting), and the rates were less than those rates obtained in bench testing. Since the majority of the data was not obtained until after the equipment was demobilized, Purifics was not able to optimize the process and/or determine the reasons for the above discrepancies. Before the GRS system can be employed at Combe Landfill, additional piloting efforts would be required to fully understand the complex groundwater to be able to optimize the process for consistent run-time performance.

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2 PHASE 2 PILOT FIELD REPORT

WEEK ONE - Purifics field testing staff arrived on site December 3rd to commence a second round of on site testing. Electrical and plumbing hook-ups went smoothly and the unit was able to begin testing. The unit ran mechanically exceptionally well over night and the first set of samples were taken December 5th (results below). After the third straight day of operation a blow down of the concentrated metals was performed in order to reduce TMP of the CUF unit. On Thursday the 6th the unit was shut down pending lab results.

WEEK TWO- December 10th , The preliminary lab results returned showed the all COC's (Chemicals of Concern) had been reduced below regulatory levels but were not within an expectable region of safety. It was decided that more lamps needed to be employed and 8 more lamps were turned on bringing the total to 32 lamps in service. An in-situ chemical rinse procedure with citric acid was performed to re-established clean water flow rates. Unfortunately due to sampling time restraints the unit was only able to run for ½ hour before the next set of samples were taken. When the measurements are in ppb levels dilution tables show that this may not have been enough start up time to fully treat unfiltered water in the loop.

The Pilot ran for two more days constant and all 32 of the lamps were employed for the final round of samples December 13th.

* all sample results are shown below

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3 DATA COMPARISON

Test America

	Dec 5th	Dec 10th	Dec 13th
1.4 Dioxane Raw	25	48	30
1.4 Dioxane Eff	3.8	6.9	6.2

AccuTest	Dec 5th	Dec 10th	Dec 13th
1.4 Dioxane Raw	29.5	52.3	13
1.4 Dioxane Eff	2.9	7.7	3.8

Metals

Dec 10th			
	Raw	Post Cuf	Effluent
Barium	56.9	35.6	39.2
Manganese	3350	1930	2090
Magnesium	17300	15500	15300
Zinc	nd	nd	nd
Iron	12200	nd	
Calcium	51100	41600	41400

*** all results are in ug/L**

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4 RESULTS & RECOMMENDATIONS

Initial bench testing and secondary pilot results show that Purifics was successful in reducing or removing completely all COC's below regulatory requirements.

Purifics demonstrated that the Landfill's process polymer was responsible for the coagulation of the TiO2 and extremely low destruction rates in Phase 1 piloting efforts.

The CUF technology performed exceptionally well at removing metals upstream of the Photo-Cat. It was determined that the level flux appeared to reach an equilibrium after about 6 hours in service and remained relatively unchanged for another 30 hours after which the system began to reduce flux again until an in-situ chemical rinse was performed.

Phase 2 of the pilot proved that with CUF pre-treatment (ie. no polymer addition) the 1,4-dioxane rates of removal increased and the treated water met regulatory discharge limits on both organic and inorganic constituents.

It was found that for some unknown reason, rates of 1,4-dioxane destruction slightly reduced over the 2 week pilot (which has never been observed in 18 years of piloting), and also the rates were less than those rates obtained in bench testing.

Since the majority of the data was not obtained until after the equipment was demobilized, Purifics was not able to optimize the process and find out the reasons for the above discrepancies. Before the GRS system can be employed at Combe Landfill, additional piloting efforts would be required to fully understand the complex groundwater to be able to optimize the process for consistent run-time performance.

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Figure 3: Loading / Unloading Pictures

4.2 Enclosed Photo-Cat System Specifications

The system consists of a 20’ x 8’ wide enclosure, fully insulated on all sides for +/-40°C and has electric heat. Internally the walls are lined with Stainless Steel, the ceiling is Aluminum and the floor is raised Aluminum T tie downs designed for fork lift travel. Drains and plugs are located in each corner. Standard barn doors at one end, and the other end has typical double man doors with key lock and commercial handles (no door knobs). Internal lighting is 110/230 Volt. Fan ventilation is also incorporated. The container weighs approximately 10,000 lbs or 4800kg.

APPENDIX B

Kerfoot Nanozox™ Pilot Test

Kerfoot Pilot Test Enclosure and Power Generator

Nanozox™ Influent Connection to Combe WWTP

Nanozox™ Loop System

Nanozox™ Pilot Test Unit from Rear Door

Nanozox™ Hydrogen Peroxide

Nanozox™ Oxygen Concentrator

Nanozox™ Ozone Generator

Nanozox™ Sparge

Nanozox™ Sparge Close-up showing Ozone and Hydrogen Peroxide Injection Locations

Nanozox™ Storage Tank and Recycle Pump

Nanozox™ Effluent Air Stripper Prior to Discharge

Nanozox™ Effluent Connection to Combe WWTP

BRIEF FINAL REPORT
COMBE FILL SOUTH LANDFILL SITE
KERFOOT 1,4 DIOXANE PILOT TEST

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Prepared by:
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October 10, 2012

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A one-month (4-week) pilot test was conducted with the Kerfoot Technologies, Inc. (KTI) Loop system for removal of 1,4 dioxane in treatment process flow at the Combe Fill South Landfill site. The trailer wad tested prior to arrival with the use of an MTBE tracer to verify expected performance (KTI, May 2012, Appendix A). The trailer arrived on-site on August 20, 2012. The unit was powered by a diesel generator, 100 amp capacity, 230V single phase. Peroxide was supplied with 10% solution in 55-gallon drums. Two drums were expected to be sufficient for the four weeks of testing.

A single line from the plant facility supplied the test process water from a sand filter bed unit, initially at 10 gallons per minute. A single discharge line hooked to an intrail pump discharged the treated water. Flow was uniformed when flowing, but intermittent at regular intervals, on for four hours, off for two hours. After discussion, the on/off flow times were changed to 120 minutes (two hours) on, and 90 minutes (1.5 hours) off in a continuous cycle.

The trailer programmer was modified to handle the intermittent operation. When flow was occurring, it was sent to the central loop cycled five times and then sent to a 250-gallon holding tank which held for about 12.5 minutes, then to a stripper, followed by one micron filtration, and then pumped out the exit line at 10 gpm, identical to the inflow rate. If the flow stopped, the volume in the holding tank was recycled back to the central loop which had about 50 gallons' capacity to be cycled four times returning the storage tank. During this phase, the stripper, filter, and discharge pump were turned off.

The rate of decay of the 1,4 dioxane within the pilot treatment system can be represented as a first-order decay system at a fixed concentration of ozone/peroxide, i.e., $C = C_o e^{-kt}$. In this case, t can be given in time of exposure to mass or number of loops (recycling to point). Either way, the answer is the same. Start conditions were as follows:

<u>First Week Set</u>

Inflow: 10 gpm
O_3 load: 14 gm/hr
Peroxide: 12 ml/min, 10% concentration
Volume: Internal loop, 50 g, 40 g/min loop, 10 g/min flow
: Great loop, 125 g + 50 g = 175 g, 10 g/min flow

Theoretical concentrations*		Sum of Loops			Loop Difference	Residence Time	
	µg/L (ppb)	Actual**		Actual			
Start	12	11.9	0	0	0	0	
Loop – 65	6	6	>5	(5)	5	5 min.	
Air Strip (On)	3	3.2	>10	(12.5)	5	12.5 min.	
Tank (Off)	1.5	1.6	>15	(17.5)	5	17.5 min.	

*Theoretically, each exposure of five loops would attenuate by one-half the preceding value.
**Accutest, New Jersey

Second Week Set

Inflow: 5 gpm
O_3 load: 14 gm/hr
Peroxide: 12 ml/min, 10% concentration
Volume: Internal loop, 50 g, 40 g/min loop, 5 g/min flow
: Great loop, 125 g + 50 g = 175 g, 5 g/min flow

	Theoretical	Actual	Residence Time
Start	24.0	7.0 (?)	0
Loop	6.0	5.5	25 min.
Tank (Off)	1.5	1.5J	35 min.

Start value much lower than expected – repeat test with second laboratory. Theoretical start value should be more like 24 µg/L, if you started at bottom with 1.5.

Third Week Set

Inflow: 5 gpm
O_3 load: 14 gm/hr
Peroxide: 12 mg/min, 10% concentration

	Theoretical**	Actual+	Residence Time
Start	28 µg/L (ppb)	28	10 min.
10 min (On)	7 µg/L	5.3	25 min.
Tank (Off)	1.7 µg/L	3.2	35 min.

**Theoretically, each exposure of 10 loops would attenuate to ¼ (1/2 x ½) the preceding value.

Fourth Week Set

Inflow: 5 gpm
O_3 load: 14 gm/hr
Peroxide: None

	Theoretical**	Accutest America	Actual+	Residence Time
Start	23	12.3	23	0 min
10 min (On)	5.7	5.8	--	25 min
65 min (On)	3.2	4.7	--	--
90 min Tank (Off)	1.4	0.27	1.1	35 min

SP1-65 is the influent sample
SP2-65 on and SP2-90 off are the Kerfoot Loop discharge samples
SP3-65 on and SP3-90 off are the 250 gallon holding tank/air stripper feed samples
SP4-65 and SP4-10 are the air stripper discharge samples.

+Second laboratory, Test America

Comments on Pilot Test Results

1. On a relative removal basis, the first week results came very close to expected theoretical removal rates and those expected by the MTBE tracer pretest.
2. The fourth week testing showed as good or better removal with nanobubble ozone without peroxide. This has been previously found with "cleaner" water. If the water flow is free of trivalent chromium, bromine, and chlorinated compounds, peroxide may be discontinued.
3. There appears to be some discrepancies between analytical laboratories on the absolute value of 1,4 dioxane which exists in the process inflow. This needs to be resolved in the future, perhaps by a paired comparison on a known spiked sample added to the process water matrix.
4. KTI feels fairly confident about the determination of critical ratios for nanobubble ozone for effective removal of the 1,4 dioxane below 3.0 µg/L MCL. Even with the difference between the two laboratories, if you compare ratios of inlet water to 90-minute off (SP1-65 on versus SP3-90 off), you have 97.8% versus 95.2% removal efficiency, using their nondetect values. They are close in proportion but vary in the start values (12.3 versus 23 µg/L).
5. What would be the actual discharge concentration if the outflow went to an accumulating tank? This question can be provided by a running average of the results, dividing the flow into equal segments, and dividing by two. For the 210 minute cycle, we add the 65 minute on to the 90 minute off and divide by 2.

   SP4-65 on 4.7 µg/L
   SP90-off 0.27 µg/L

   $$\frac{4.7 + 0.27}{2} = 2.48 \ \mu g/L$$

   If you have a cumulator tank, your final effluent would be less than 2.48 µg/L, since 0.27 is the limit of detection. For instance, if you flow from (2) 5,000 gallon tanks into a 20,000 or 40,000 gallon holding tank before discharging.

6. What sized unit would you use to treat 120 gpm flow? From the results of the pilot test, we would recommend the following design for a 60 gpm unit. This is based upon the mass ratio found during the first week.

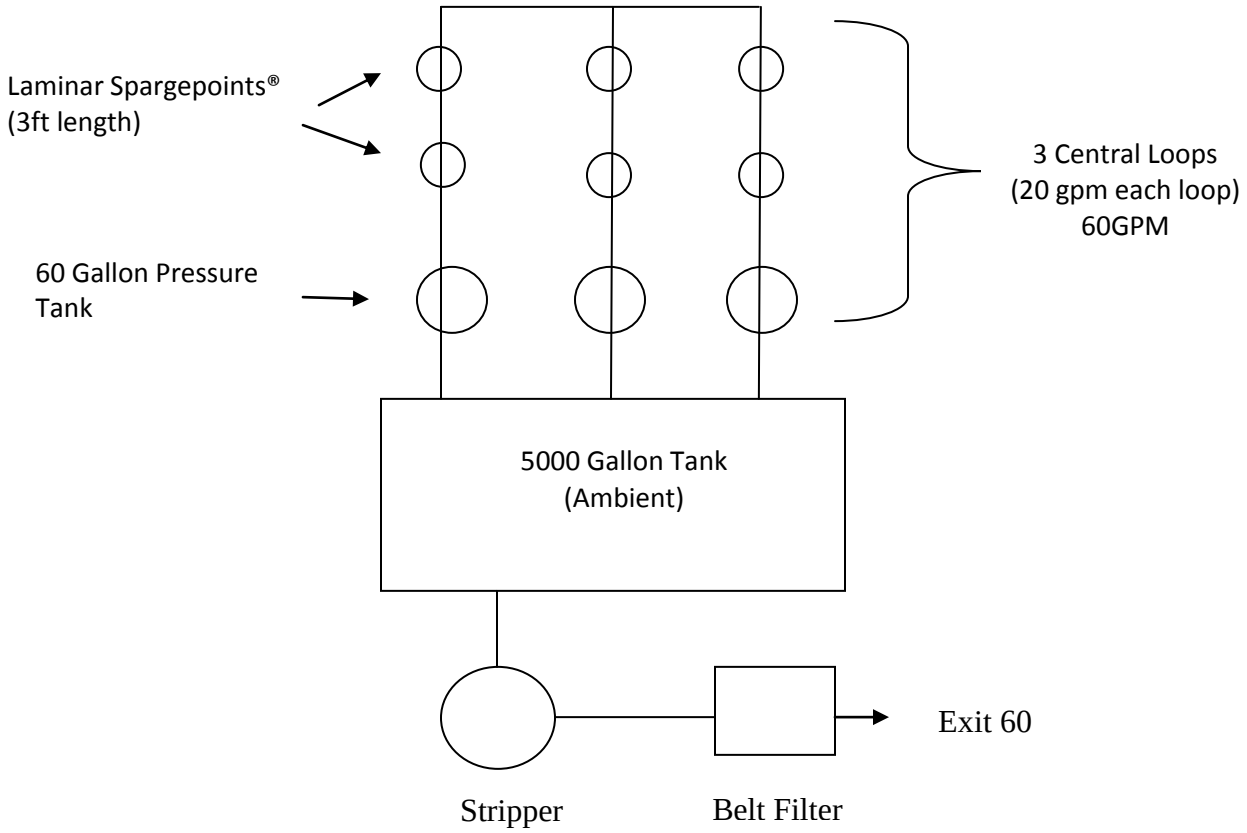
   Flow: 60 gpm
   Loop systems: (3)receiving 20 gpm
   No. of points: (6) laminar type
   Primary loop: 80 gpm recirculation
   Pressure vessels: (3) 60 gallon
   Storage tank: (1) 5,000 gallon
   (2) Ozone generators: 160 gm/hr each
   (2) Oxygen generators
   (1) Compressor

   Note: This design schematicincludes the laminar points to take peroxide, but does not show the feed pumps or storage tanks. Also note that ozone mass addition has been

doubled in ratio to original pilot test. Storage tank (ambient pressure) has been doubled in size proportionately.

The estimated cost of a 60 gpm 1,4 dioxane treatment unit would be $252,000. Two units would therefore be $504,000.

60 GPM INFLOW



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Appendix A
Pretest

May 21, 2012

Nanozox™ Loop System Testing

The following test was conducted on the Loop System to confirm the likely removal of 1,4 dioxane for the upcoming NJDEP pilot test. Earlier tests had shown a very similar removal of methyl tertiary-butyl ether (MTBE) and 1,4 dioxane (Kerfoot, 2012) when treated by Nanozox™. MTBE was injected into the Loop System containing a central looping at 40 gpm with 30 gallon storage at 40 psi and a secondary storage volume at 280 gallons at ambient pressure, to approach a concentration of 1 ppm (1,000 µg/L).

Water samples were removed from two locations in the Loop System as time progressed to see the effectiveness of removal. The test type was a fully stirred container under treatment as an introduced slug compared to a continual flow introduction. By looking at the decay rates at the two sampling locations, the rate of reaction can be reviewed.

During recirculation at Time=0, the concentration of 703 ppb was obtained with the MTBE. At 60 minutes' time after injection with ozone/peroxide being added to form nanobubbles, the concentration of MTBE had reduced to 109 ppb (loop) and 47 ppb (storage tank outflow). These correspond to 85% and 95% removal from the maximum value of 703 ppb MTBE. At 120 minutes, the MTBE concentration had reduced to 8 ppb (loop) and <8 ppb (storage tank). If we were maintaining a similar ozone/peroxide loading, and the 1,4 dioxane level was removed similar to MTBE, a 100 ppb entering concentration would be reduced to 5.0 ppb, very close to the acceptable 3 ppb level for the NJDEP. The tests were also run at 180 minutes, when all readings for MTBE were nondetect (<0.5 ppb).

At four hours on and two hours off, with the loop running continuously, we expect the mean output from the storage tank to be much less than 3 ppb.

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Table 1.

KERFOOT TECHNOLOGIES, INC.

SPIKE AND ANALYTICAL STANDARDS AUTO CALCULATION TEMPLATE for Nanozox™ Loop System Test

PROJECT: Combe Fill South Pilot Test

1. ANALYTICAL EQUIPMENT STANDARDS									
COMPOUND(s) of CONCERN (SOLUTE)	DESIRED CONCENTRATION of COCs	(Units)	SOLUTE (COCs) DENSITY (mg/uL)	INJECT VOLUME (uL)	INITIAL SOLVENT VOLUME (mL)	FINAL SOLVENT VOLUME (mL)	SOLVENT DENSITY (g/mL)	SOLVENT	REMARKS
MtbE	1.0	mg/mL	0.740	13.51	9.99	10	0.792	MeOH	stock solution of COCs
MtbE	1.0	mg/mL	0.740	13.51	9.99	10	0.792	MeOH	QA
MtbE	500	ppb	1.000	7.50	14.99	15	1.000	Water	Stock dilution / GC standard
MtbE	500	ppb	1.000	7.50	14.99	15	1.000	Water	QA
2. STOCK DILUTION STANDARDS									
START CONCENTRATION OF STOCK SOLUTION	END CONCENTRATION STOCK SOLUTION	(Units)	SOLUTE (COCs) DENSITY (mg/uL)	INJECT VOLUME (uL)	INITIAL SOLVENT VOLUME (mL)	FINAL SOLVENT VOLUME (mL)	SOLVENT DENSITY (g/mL)	SOLVENT	REMARKS
220.0	1.0	mg/mL	0.740	45.45	9.95	10	0.792	MeOH	dilution of loop system spike
220.0	1.0	mg/mL	0.740	45.45	9.95	10	0.792	MeOH	QA
3. REACTION CELL SPIKING									
COMPOUND(s) of CONCERN (SOLUTE)	DESIRED CONCENTRATION of COCs	(Units)	SOLUTE (COCs) DENSITY (mg/uL)	INJECT VOLUME (uL)	INITIAL SOLVENT VOLUME (mL)	FINAL SOLVENT VOLUME (mL)	SOLVENT DENSITY (g/mL)	SOLVENT	REMARKS
MtbE	220.00	mg/mL	0.740	**2,971.4**	**7.0**	10	0.792	MeOH	stock solution of spike for loop system
		mg/mL		**#DIV/0!**	**#DIV/0!**				
MtbE	1.000	ppm	1.000	**4,343.5**	**955,565.7**	955,570	1.000	Water	Nanozox system loop volume
		ppm		**#DIV/0!**	**#DIV/0!**				
MtbE	0.000	ppm	1.000	**0.0**	**0.0**				
		ppm		**#DIV/0!**	**#DIV/0!**				

Reaction Cell volume #1 (gals)	Length (inches)	Width (inches)	Height (inches)	Reaction Cell volume #1 (L)	Reaction Cell Shape
233.32	35	44	35	**881.94**	**Rectangular**
19.48	45	10	10	**73.63**	**Rectangular**
252.80	**Total Volume of Nanozox™ Loop System**			**955.57**	

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Table 2. Nanozox™ Pilot Test System Test with MTBE Standard

	Sampling Locations			
Time (min)	**Central Loop**	**% Removal**	**Off Storage Tank**	**% Removal**
0	703		703	
60	109	85	47	95
120	8	99	<8	>99
180	<8	>99.5	<8	>99.5

Appendix B
First Week Results

Attached is a spreadsheet of the data presently available. Samples "SP2-90off" and "INFTDS" are not reported yet. SP2-90off represents the Kerfoot loop effluent after 90 minutes in recirc mode. INFTDS is the influent total dissolved solids concentration.

The other samples are defined as follows:
SP1-65on - influent sample 65 minutes after raw water processing resumed
SP2-65on - Kerfoot loop effluent 65 minutes after raw water processing resumed SP3-65on - air stripper feed 65 minutes after raw water processing resumed SP4-65on - air stripper discharge 65 minutes after raw water processing resumed SP4-10on - air striper discharge 10 minutes after raw water processing resumed

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Paula Walshe
NJDEP/ PFRE/ BSM
Cell No. 609-203-1957

Accutest New Jersey								8/31/2012 9:25
Job Number:	JB14839		PRELIMINARY Data					
Account:	Atlantic Response DEP							
Project:	P0700390, NJDEP NERAS Contract							
Project Number:								
							Legend:	Hit

Client Sample ID:		3 PPB 1,4 DIOXANE LCS	SP1-120 ON	SP2-120 ON	SP2-90 OFF	SP3-120 ON	SP4-10 ON	SP4-120 ON
Lab Sample ID:		JB14839-7	JB14839-1	JB14839-2	JB14839-5	JB14839-3	JB14839-6	JB14839-4
Date Sampled:		8/28/2012	8/28/2012	8/28/2012	8/28/2012	8/28/2012	8/28/2012	8/28/2012
Matrix:		Water	Water	Water	Water	Water	Water	Water
GC/MS Semi-volatiles (SW846 8270D)								
2-Chlorophenol	ug/l	-	ND (0.99)	ND (0.97)	ND (0.97)	ND (0.97)	ND (0.97)	ND (0.97)
4-Chloro-3-methyl phenol	ug/l	-	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)
2,4-Dichlorophenol	ug/l	-	ND (1.2)	ND (1.2)	ND (1.2)	ND (1.2)	ND (1.2)	ND (1.2)
2,4-Dimethylphenol	ug/l	-	ND (1.6)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)
2,4-Dinitrophenol	ug/l	-	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
4,6-Dinitro-o-cresol	ug/l	-	ND (1.0)	ND (0.99)	ND (0.99)	ND (0.99)	ND (0.99)	ND (0.99)
2-Methylphenol	ug/l	-	ND (1.1)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
3&4-Methylphenol	ug/l	-	ND (0.94)	ND (0.93)	ND (0.93)	ND (0.93)	ND (0.93)	ND (0.93)
2-Nitrophenol	ug/l	-	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)
4-Nitrophenol	ug/l	-	ND (5.3)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)
Pentachlorophenol	ug/l	-	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)
Phenol	ug/l	-	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)
2,3,4,6-Tetrachlorophenol	ug/l	-	ND (0.95)	ND (0.94)	ND (0.94)	ND (0.94)	ND (0.94)	ND (0.94)
2,4,5-Trichlorophenol	ug/l	-	ND (1.6)	ND (1.6)	ND (1.6)	ND (1.6)	ND (1.6)	ND (1.6)
2,4,6-Trichlorophenol	ug/l	-	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)
Acenaphthene	ug/l	-	ND (0.27)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
Acenaphthylene	ug/l	-	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Acetophenone	ug/l	-	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
Anthracene	ug/l	-	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
Atrazine	ug/l	-	ND (0.50)	ND (0.49)	ND (0.49)	ND (0.49)	ND (0.49)	ND (0.49)
Benzo(a)anthracene	ug/l	-	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Benzo(a)pyrene	ug/l	-	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Benzo(b)fluoranthene	ug/l	-	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)
Benzo(g,h,i)perylene	ug/l	-	ND (0.33)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)
Benzo(k)fluoranthene	ug/l	-	ND (0.52)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
4-Bromophenyl phenyl ether	ug/l	-	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)
Butyl benzyl phthalate	ug/l	-	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
2-Chloronaphthalene	ug/l	-	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)
4-Chloroaniline	ug/l	-	ND (0.54)	ND (0.53)	ND (0.53)	ND (0.53)	ND (0.53)	ND (0.53)
Carbazole	ug/l	-	ND (0.37)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)
Chrysene	ug/l	-	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
bis(2-Chloroethoxy)methane	ug/l	-	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
bis(2-Chloroethyl)ether	ug/l	-	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
bis(2-Chloroisopropyl)ether	ug/l	-	ND (0.46)	ND (0.45)	ND (0.45)	ND (0.45)	ND (0.45)	ND (0.45)
4-Chlorophenyl phenyl ether	ug/l	-	ND (0.32)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
2,4-Dinitrotoluene	ug/l	-	ND (0.43)	ND (0.43)	ND (0.43)	ND (0.43)	ND (0.43)	ND (0.43)
2,6-Dinitrotoluene	ug/l	-	ND (0.47)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)
3,3'-Dichlorobenzidine	ug/l	-	ND (0.37)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)
1,4-Dioxane	ug/l	ND (0.27)	7	5.5	1.5 J	5.3	1.8 J	5.4
Dibenzo(a,h)anthracene	ug/l	-	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)
Dibenzofuran	ug/l	-	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)
Di-n-butyl phthalate	ug/l	-	ND (0.56)	ND (0.56)	ND (0.56)	ND (0.56)	ND (0.56)	ND (0.56)
Di-n-octyl phthalate	ug/l	-	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
Diethyl phthalate	ug/l	-	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)
Dimethyl phthalate	ug/l	-	ND (0.29)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)

bis(2-Ethylhexyl)phthalate	ug/l	-	ND (0.59)	ND (0.59)	ND (0.59)	ND (0.59)	ND (0.59)	ND (0.59)
Fluoranthene	ug/l	-	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)
Fluorene	ug/l	-	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)
Hexachlorobenzene	ug/l	-	ND (0.34)	ND (0.34)	ND (0.34)	ND (0.34)	ND (0.34)	ND (0.34)
Hexachlorobutadiene	ug/l	-	ND (0.52)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
Hexachlorocyclopentadiene	ug/l	-	ND (7.2)	ND (7.1)	ND (7.1)	ND (7.1)	ND (7.1)	ND (7.1)
Hexachloroethane	ug/l	-	ND (0.56)	ND (0.55)	ND (0.55)	ND (0.55)	ND (0.55)	ND (0.55)
Indeno(1,2,3-cd)pyrene	ug/l	-	ND (0.38)	ND (0.37)	ND (0.37)	ND (0.37)	ND (0.37)	ND (0.37)
Isophorone	ug/l	-	ND (0.28)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)
2-Methylnaphthalene	ug/l	-	ND (0.39)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)
2-Nitroaniline	ug/l	-	ND (1.1)	ND (1.1)	ND (1.1)	ND (1.1)	ND (1.1)	ND (1.1)
3-Nitroaniline	ug/l	-	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)
4-Nitroaniline	ug/l	-	ND (1.7)	ND (1.7)	ND (1.7)	ND (1.7)	ND (1.7)	ND (1.7)
Naphthalene	ug/l	-	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
Nitrobenzene	ug/l	-	ND (0.43)	ND (0.42)	ND (0.42)	ND (0.42)	ND (0.42)	ND (0.42)
N-Nitroso-di-n-propylamine	ug/l	-	ND (0.31)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)
N-Nitrosodiphenylamine	ug/l	-	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
Phenanthrene	ug/l	-	ND (0.30)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
Pyrene	ug/l	-	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)
1,2,4,5-Tetrachlorobenzene	ug/l	-	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
1,2,4-Trichlorobenzene	ug/l	-	ND (0.32)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)

Appendix C
Second Week Results

Attached are the 9/4 sample results. We split the influent (SP1) and loop effluent sample (SP2) with TestAmerica to compare results.

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Cell No. 609-203-1957

Accutest New Jersey							9/7/2012 9:42
Job Number:	JB15368	PRELIMINARY / PARTIAL Data					
Account:	Atlantic Response DEP						
Project:	P0700390, NJDEP NERAS Contract						
Project Number:							
						Legend:	Hit

Client Sample ID:		SP1-60 ON	SP2-60 ON	SP2-90 OFF	SP3-60 ON	SP4-10 ON	SP4-60 ON
Lab Sample ID:		JB15368-3	JB15368-4	JB15368-1	JB15368-6	JB15368-2	JB15368-5
Date Sampled:		9/4/2012	9/4/2012	9/4/2012	9/4/2012	9/4/2012	9/4/2012
Matrix:		Water	Water	Water	Water	Water	Water
GC/MS Semi-volatiles (SW846 8270D)							
2-Chlorophenol	ug/l	ND (0.97)	ND (0.97)	ND (0.97)	ND (0.97)	ND (0.97)	ND (0.97)
4-Chloro-3-methyl phenol	ug/l	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)
2,4-Dichlorophenol	ug/l	ND (1.2)	ND (1.2)	ND (1.2)	ND (1.2)	ND (1.2)	ND (1.2)
2,4-Dimethylphenol	ug/l	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)
2,4-Dinitrophenol	ug/l	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
4,6-Dinitro-o-cresol	ug/l	ND (0.99)	ND (0.99)	ND (0.99)	ND (0.99)	ND (0.99)	ND (0.99)
2-Methylphenol	ug/l	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
3&4-Methylphenol	ug/l	ND (0.93)	ND (0.93)	ND (0.93)	ND (0.93)	ND (0.93)	ND (0.93)
2-Nitrophenol	ug/l	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)
4-Nitrophenol	ug/l	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)
Pentachlorophenol	ug/l	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)
Phenol	ug/l	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)
2,3,4,6-Tetrachlorophenol	ug/l	ND (0.94)	ND (0.94)	ND (0.94)	ND (0.94)	ND (0.94)	ND (0.94)
2,4,5-Trichlorophenol	ug/l	ND (1.6)	ND (1.6)	ND (1.6)	ND (1.6)	ND (1.6)	ND (1.6)
2,4,6-Trichlorophenol	ug/l	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)
Acenaphthene	ug/l	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
Acenaphthylene	ug/l	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Acetophenone	ug/l	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
Anthracene	ug/l	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
Atrazine	ug/l	ND (0.49)	ND (0.49)	ND (0.49)	ND (0.49)	ND (0.49)	ND (0.49)
Benzo(a)anthracene	ug/l	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Benzo(a)pyrene	ug/l	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Benzo(b)fluoranthene	ug/l	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)
Benzo(g,h,i)perylene	ug/l	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)
Benzo(k)fluoranthene	ug/l	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
4-Bromophenyl phenyl ether	ug/l	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)
Butyl benzyl phthalate	ug/l	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
2-Chloronaphthalene	ug/l	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)
4-Chloroaniline	ug/l	ND (0.53)	ND (0.53)	ND (0.53)	ND (0.53)	ND (0.53)	ND (0.53)
Carbazole	ug/l	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)
Chrysene	ug/l	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
bis(2-Chloroethoxy)methane	ug/l	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
bis(2-Chloroethyl)ether	ug/l	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
bis(2-Chloroisopropyl)ether	ug/l	ND (0.45)	ND (0.45)	ND (0.45)	ND (0.45)	ND (0.45)	ND (0.45)
4-Chlorophenyl phenyl ether	ug/l	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
2,4-Dinitrotoluene	ug/l	ND (0.43)	ND (0.43)	ND (0.43)	ND (0.43)	ND (0.43)	ND (0.43)

2,6-Dinitrotoluene	ug/l	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)
3,3'-Dichlorobenzidine	ug/l	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)
1,4-Dioxane	ug/l	14.3	10.7	3.2	13	5.3	12.6
Dibenzo(a,h)anthracene	ug/l	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)
Dibenzofuran	ug/l	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)
Di-n-butyl phthalate	ug/l	ND (0.56)	ND (0.56)	ND (0.56)	ND (0.56)	ND (0.56)	ND (0.56)
Di-n-octyl phthalate	ug/l	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
Diethyl phthalate	ug/l	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)
Dimethyl phthalate	ug/l	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)
bis(2-Ethylhexyl)phthalate	ug/l	ND (0.59)	ND (0.59)	ND (0.59)	ND (0.59)	ND (0.59)	ND (0.59)
Fluoranthene	ug/l	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)
Fluorene	ug/l	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)
Hexachlorobenzene	ug/l	ND (0.34)	ND (0.34)	ND (0.34)	ND (0.34)	ND (0.34)	ND (0.34)
Hexachlorobutadiene	ug/l	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
Hexachlorocyclopentadiene	ug/l	ND (7.1)	ND (7.1)	ND (7.1)	ND (7.1)	ND (7.1)	ND (7.1)
Hexachloroethane	ug/l	ND (0.55)	ND (0.55)	ND (0.55)	ND (0.55)	ND (0.55)	ND (0.55)
Indeno(1,2,3-cd)pyrene	ug/l	ND (0.37)	ND (0.37)	ND (0.37)	ND (0.37)	ND (0.37)	ND (0.37)
Isophorone	ug/l	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)
2-Methylnaphthalene	ug/l	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)
2-Nitroaniline	ug/l	ND (1.1)	ND (1.1)	ND (1.1)	ND (1.1)	ND (1.1)	ND (1.1)
3-Nitroaniline	ug/l	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)
4-Nitroaniline	ug/l	ND (1.7)	ND (1.7)	ND (1.7)	ND (1.7)	ND (1.7)	ND (1.7)
Naphthalene	ug/l	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
Nitrobenzene	ug/l	ND (0.42)	ND (0.42)	ND (0.42)	ND (0.42)	ND (0.42)	ND (0.42)
N-Nitroso-di-n-propylamine	ug/l	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)
N-Nitrosodiphenylamine	ug/l	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
Phenanthrene	ug/l	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
Pyrene	ug/l	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)
1,2,4,5-Tetrachlorobenzene	ug/l	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
1,2,4-Trichlorobenzene	ug/l	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

SUMMARY OF ANALYTICAL RESULTS: 460-44158-1

Client ID	NJ Higher of	SP2-90 OFF			SP1		
Lab Sample ID	PQLs and GW	460-44158-1			460-44158-2		
Sampling Date	Quality	09/04/2012 11:24:00			09/04/2012 13:42:00		
Matrix	2005-2010	Water			Water		
Dilution Factor	Criteria	1			1		
Unit	ug/l	ug/l			ug/l		
SVOA-8270C-WATER		Result	Q	MDL	Result	Q	MDL
WATER BY 8270C							
1,2,4-Trichlorobenzene	9	0.26	U	0.26	0.27	U	0.27
1,2-Dichlorobenzene	600	2.5	U	2.5	2.6	U	2.6
1,2-Diphenylhydrazine	20	2.5	U	2.5	2.6	U	2.6
1,3-Dichlorobenzene	600	2.4	U	2.4	2.4	U	2.4
1,4-Dichlorobenzene	75	2.5	U	2.5	2.6	U	2.6
1,4-Dioxane	10	3.5	J	1.1	**28**		1.1
2,4,5-Trichlorophenol	700	2.6	U	2.6	2.7	U	2.7
2,4,6-Trichlorophenol	20	2.4	U	2.4	2.4	U	2.4
2,4-Dichlorophenol	20	2.6	U	2.6	2.7	U	2.7
2,4-Dimethylphenol	100	3.4	U	3.4	3.5	U	3.5
2,4-Dinitrophenol	40	5.5	U	5.5	5.5	U	5.5
2,4-Dinitrotoluene	NA	0.47	U	0.47	0.48	U	0.48
2,6-Dinitrotoluene	NA	0.62	U	0.62	0.62	U	0.62
2-Chloronaphthalene	600	2.7	U	2.7	2.8	U	2.8
2-Chlorophenol	40	2.2	U	2.2	2.2	U	2.2
2-Methylnaphthalene	NA	3.0	U	3.0	3.1	U	3.1
2-Methylphenol	NA	1.8	U	1.8	1.8	U	1.8
2-Nitroaniline	NA	4.9	U	4.9	5.0	U	5.0
2-Nitrophenol	NA	2.4	U	2.4	2.4	U	2.4
3,3'-Dichlorobenzidine	30	4.9	U	4.9	5.0	U	5.0
3-Nitroaniline	NA	5.1	U	5.1	5.1	U	5.1
4,6-Dinitro-2-methylphenol	NA	4.7	U	4.7	4.8	U	4.8
4-Bromophenyl phenyl ether	NA	2.5	U	2.5	2.6	U	2.6
4-Chloro-3-methylphenol	NA	2.5	U	2.5	2.6	U	2.6
4-Chloroaniline	30	2.0	U	2.0	2.0	U	2.0
4-Chlorophenyl phenyl ether	NA	2.5	U	2.5	2.6	U	2.6
4-Methylphenol	NA	1.6	U	1.6	1.6	U	1.6
4-Nitroaniline	NA	5.9	U	5.9	5.9	U	5.9
4-Nitrophenol	NA	6.8	U	6.8	6.8	U	6.8
Acenaphthene	400	2.7	U	2.7	2.8	U	2.8
Acenaphthylene	NA	2.7	U	2.7	2.8	U	2.8
Aniline	6	1.8	U	1.8	1.8	U	1.8
Anthracene	2000	2.8	U	2.8	2.9	U	2.9
Benzidine	20	0.90	U	0.90	0.91	U	0.91
Benzo[a]anthracene	0.1	0.27	U	0.27	0.28	U	0.28
Benzo[a]pyrene	0.1	0.14	U	0.14	0.14	U	0.14
Benzo[b]fluoranthene	0.2	0.26	U	0.26	0.27	U	0.27
Benzo[g,h,i]perylene	NA	2.0	U	2.0	2.0	U	2.0
Benzo[k]fluoranthene	0.5	0.26	U	0.26	0.27	U	0.27
Benzoic acid	30000	51	U *	51	51	U *	51

Benzyl alcohol	2000	1.5	U	1.5	1.5	U	1.5
bis (2-chloroisopropyl) ether	NA	2.0	U	2.0	2.0	U	2.0
Bis(2-chloroethoxy)methane	NA	2.6	U	2.6	2.7	U	2.7
Bis(2-chloroethyl)ether	7	0.28	U	0.28	0.29	U	0.29
Bis(2-ethylhexyl) phthalate	3	2.0	U	2.0	2.0	U	2.0
Butyl benzyl phthalate	100	2.5	U	2.5	2.6	U	2.6
Carbazole	NA	3.2	U	3.2	3.3	U	3.3
Chrysene	5	3.1	U	3.1	3.2	U	3.2
Dibenz(a,h)anthracene	0.3	0.091	U	0.091	0.092	U	0.092
Dibenzofuran	NA	2.8	U	2.8	2.9	U	2.9
Diethyl phthalate	6000	2.9	U	2.9	3.0	U	3.0
Dimethyl phthalate	100	2.8	U	2.8	2.9	U	2.9
Di-n-butyl phthalate	700	2.9	U	2.9	3.0	U	3.0
Di-n-octyl phthalate	100	1.5	U	1.5	1.5	U	1.5
Fluoranthene	300	3.2	U	3.2	3.3	U	3.3
Fluorene	300	2.8	U	2.8	2.9	U	2.9
Hexachlorobenzene	0.02	0.29	U	0.29	0.30	U	0.30
Hexachlorobutadiene	1	0.58	U	0.58	0.58	U	0.58
Hexachlorocyclopentadiene	40	1.7	U	1.7	1.7	U	1.7
Hexachloroethane	7	0.25	U	0.25	0.26	U	0.26
Indeno[1,2,3-cd]pyrene	0.2	0.15	U	0.15	0.15	U	0.15
Isophorone	40	2.7	U	2.7	2.8	U	2.8
Naphthalene	300	2.7	U	2.7	2.8	U	2.8
Nitrobenzene	6	0.30	U	0.30	0.31	U	0.31
N-Nitrosodimethylamine	0.8	0.99	U	0.99	1.0	U	1.0
N-Nitrosodi-n-propylamine	10	0.25	U	0.25	0.26	U	0.26
N-Nitrosodiphenylamine	10	2.9	U	2.9	3.0	U	3.0
Pentachlorophenol	0.3	5.4	U	5.4	5.4	U	5.4
Phenanthrene	NA	3.1	U	3.1	3.2	U	3.2
Phenol	2000	0.82	U	0.82	0.83	U	0.83
Pyrene	200	2.9	U	2.9	3.0	U	3.0
Pyridine	NA	0.92	U	0.92	0.93	U	0.93
Total Conc	NA	3.5			28.0		
Total Estimated Conc. (TICs)	NA	0.0*T			0.0*T		

*T There are no TICs reported for the sample
Highlighted Concentrations shown in bold type face exceed limits
J : Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
U : Indicates the analyte was analyzed for but not detected.
U * : Indicates the analyte was analyzed for but not detected.

Appendix D
Third Week Results

Attached are preliminary analytical reports from Accutest and TestAmerica. The sample designations are the standard ones used previously.
SP1-65 on is the influent sample.
SP2-65 on and SP2-90 off are the Kerfoot loop discharge samples.
SP3-65 on and SP3-90 off are the 250 gallon holding tank /air stripper feed samples.
SP4-65 on and SP4-10 on are the air stripper discharge samples (effluent to existing plant).

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Paula Walshe
NJDEP/PFRE/Bureau of Site Management
Cell No. 609-203-1957

Accutest New Jersey								9/17/2012 9:55
Job Number:	JB16175	PRELIMINARY / PARTIAL Data						
Account:	Atlantic Response DEP							
Project:	P0700390, NJDEP NERAS Contract							
Project Number:								
							Legend:	Hit

Client Sample ID:		SP1-65 ON	SP2-65 ON	SP2-90 OFF	SP3-65 ON	SP3-90 OFF	SP4-10 ON	SP4-65 ON
Lab Sample ID:		JB16175-1	JB16175-2	JB16175-5	JB16175-3	JB16175-6	JB16175-7	JB16175-4
Date Sampled:		9/12/2012	9/12/2012	9/12/2012	9/12/2012	9/12/2012	9/12/2012	9/12/2012
Matrix:		Water	Water	Water	Water	Water	Water	Water
GC/MS Semi-volatiles (SW846 8270D)								
2-Chlorophenol	ug/l	ND (0.97)	ND (0.97)	ND (0.97)	ND (0.97)	ND (0.97)	ND (0.97)	ND (0.97)
4-Chloro-3-methyl phenol	ug/l	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)
2,4-Dichlorophenol	ug/l	ND (1.2)	ND (1.2)	ND (1.2)	ND (1.2)	ND (1.2)	ND (1.2)	ND (1.2)
2,4-Dimethylphenol	ug/l	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)
2,4-Dinitrophenol	ug/l	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
4,6-Dinitro-o-cresol	ug/l	ND (0.99)	ND (0.99)	ND (0.99)	ND (0.99)	ND (0.99)	ND (0.99)	ND (0.99)
2-Methylphenol	ug/l	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
3&4-Methylphenol	ug/l	ND (0.93)	ND (0.93)	ND (0.93)	ND (0.93)	ND (0.93)	ND (0.93)	ND (0.93)
2-Nitrophenol	ug/l	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)
4-Nitrophenol	ug/l	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)
Pentachlorophenol	ug/l	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)
Phenol	ug/l	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)
2,3,4,6-Tetrachlorophenol	ug/l	ND (0.94)	ND (0.94)	ND (0.94)	ND (0.94)	ND (0.94)	ND (0.94)	ND (0.94)
2,4,5-Trichlorophenol	ug/l	ND (1.6)	ND (1.6)	ND (1.6)	ND (1.6)	ND (1.6)	ND (1.6)	ND (1.6)
2,4,6-Trichlorophenol	ug/l	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)
Acenaphthene	ug/l	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
Acenaphthylene	ug/l	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Acetophenone	ug/l	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
Anthracene	ug/l	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
Atrazine	ug/l	ND (0.49)	ND (0.49)	ND (0.49)	ND (0.49)	ND (0.49)	ND (0.49)	ND (0.49)
Benzo(a)anthracene	ug/l	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Benzo(a)pyrene	ug/l	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Benzo(b)fluoranthene	ug/l	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)
Benzo(g,h,i)perylene	ug/l	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)
Benzo(k)fluoranthene	ug/l	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
4-Bromophenyl phenyl ether	ug/l	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)
Butyl benzyl phthalate	ug/l	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
2-Chloronaphthalene	ug/l	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)
4-Chloroaniline	ug/l	ND (0.53)	ND (0.53)	ND (0.53)	ND (0.53)	ND (0.53)	ND (0.53)	ND (0.53)
Carbazole	ug/l	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)
Chrysene	ug/l	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
bis(2-Chloroethoxy)methane	ug/l	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
bis(2-Chloroethyl)ether	ug/l	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
bis(2-Chloroisopropyl)ether	ug/l	ND (0.45)	ND (0.45)	ND (0.45)	ND (0.45)	ND (0.45)	ND (0.45)	ND (0.45)
4-Chlorophenyl phenyl ether	ug/l	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
2,4-Dinitrotoluene	ug/l	ND (0.43)	ND (0.43)	ND (0.43)	ND (0.43)	ND (0.43)	ND (0.43)	ND (0.43)
2,6-Dinitrotoluene	ug/l	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)
3,3'-Dichlorobenzidine	ug/l	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)
1,4-Dioxane	ug/l	12.3	6	ND (0.27)	5.3	ND (0.27)	5.8	4.7

Dibenzo(a,h)anthracene	ug/l	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)
Dibenzofuran	ug/l	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)
Di-n-butyl phthalate	ug/l	ND (0.56)	ND (0.56)	ND (0.56)	ND (0.56)	ND (0.56)	ND (0.56)	ND (0.56)
Di-n-octyl phthalate	ug/l	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
Diethyl phthalate	ug/l	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)
Dimethyl phthalate	ug/l	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)
bis(2-Ethylhexyl)phthalate	ug/l	ND (0.59)	ND (0.59)	ND (0.59)	ND (0.59)	ND (0.59)	ND (0.59)	ND (0.59)
Fluoranthene	ug/l	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)
Fluorene	ug/l	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)
Hexachlorobenzene	ug/l	ND (0.34)	ND (0.34)	ND (0.34)	ND (0.34)	ND (0.34)	ND (0.34)	ND (0.34)
Hexachlorobutadiene	ug/l	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
Hexachlorocyclopentadiene	ug/l	ND (7.1)	ND (7.1)	ND (7.1)	ND (7.1)	ND (7.1)	ND (7.1)	ND (7.1)
Hexachloroethane	ug/l	ND (0.55)	ND (0.55)	ND (0.55)	ND (0.55)	ND (0.55)	ND (0.55)	ND (0.55)
Indeno(1,2,3-cd)pyrene	ug/l	ND (0.37)	ND (0.37)	ND (0.37)	ND (0.37)	ND (0.37)	ND (0.37)	ND (0.37)
Isophorone	ug/l	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)
2-Methylnaphthalene	ug/l	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)
2-Nitroaniline	ug/l	ND (1.1)	ND (1.1)	ND (1.1)	ND (1.1)	ND (1.1)	ND (1.1)	ND (1.1)
3-Nitroaniline	ug/l	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)
4-Nitroaniline	ug/l	ND (1.7)	ND (1.7)	ND (1.7)	ND (1.7)	ND (1.7)	ND (1.7)	ND (1.7)
Naphthalene	ug/l	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
Nitrobenzene	ug/l	ND (0.42)	ND (0.42)	ND (0.42)	ND (0.42)	ND (0.42)	ND (0.42)	ND (0.42)
N-Nitroso-di-n-propylamine	ug/l	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)
N-Nitrosodiphenylamine	ug/l	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
Phenanthrene	ug/l	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
Pyrene	ug/l	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)
1,2,4,5-Tetrachlorobenzene	ug/l	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
1,2,4-Trichlorobenzene	ug/l	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

SUMMARY OF ANALYTICAL RESULTS: 460-44492-1

Client ID	NJ Higher of	SP1-65 ON			SP2-90 OFF			SP3-90 OFF		
Lab Sample ID	PQLs and GW	460-44492-1			460-44492-2			460-44492-3		
Sampling Date	Quality	09/12/2012 11:19:00			09/12/2012 14:04:00			09/12/2012 14:12:00		
Matrix	2005-2010	Water			Water			Water		
Dilution Factor	Criteria	1			1			1		
Unit	ug/l	ug/l			ug/l			ug/l		
SVOA-8270C-WATER		Result	Q	MDL	Result	Q	MDL	Result	Q	MDL
WATER BY 8270C										
1,2,4-Trichlorobenzene	9	0.26	U	0.26	0.26	U	0.26	0.27	U	0.27
1,2-Dichlorobenzene	600	2.5	U	2.5	2.5	U	2.5	2.6	U	2.6
1,2-Diphenylhydrazine	20	2.5	U	2.5	2.5	U	2.5	2.6	U	2.6
1,3-Dichlorobenzene	600	2.4	U	2.4	2.4	U	2.4	2.4	U	2.4
1,4-Dichlorobenzene	75	2.5	U	2.5	2.5	U	2.5	2.6	U	2.6
1,4-Dioxane	10	23		1.1	1.1	U	1.1	1.1	U	1.1
2,4,5-Trichlorophenol	700	2.6	U	2.6	2.6	U	2.6	2.7	U	2.7
2,4,6-Trichlorophenol	20	2.4	U	2.4	2.4	U	2.4	2.4	U	2.4
2,4-Dichlorophenol	20	2.6	U	2.6	2.6	U	2.6	2.7	U	2.7
2,4-Dimethylphenol	100	3.4	U	3.4	3.4	U	3.4	3.5	U	3.5
2,4-Dinitrophenol	40	5.4	U	5.4	5.5	U	5.5	5.5	U	5.5
2,4-Dinitrotoluene	NA	0.47	U	0.47	0.47	U	0.47	0.48	U	0.48
2,6-Dinitrotoluene	NA	0.61	U	0.61	0.62	U	0.62	0.62	U	0.62
2-Chloronaphthalene	600	2.7	U	2.7	2.7	U	2.7	2.8	U	2.8
2-Chlorophenol	40	2.2	U	2.2	2.2	U	2.2	2.2	U	2.2
2-Methylnaphthalene	NA	3.0	U	3.0	3.0	U	3.0	3.1	U	3.1
2-Methylphenol	NA	1.8	U	1.8	1.8	U	1.8	1.8	U	1.8
2-Nitroaniline	NA	4.9	U	4.9	4.9	U	4.9	5.0	U	5.0
2-Nitrophenol	NA	2.4	U	2.4	2.4	U	2.4	2.4	U	2.4
3,3'-Dichlorobenzidine	30	4.9	U	4.9	4.9	U	4.9	5.0	U	5.0
3-Nitroaniline	NA	5.0	U	5.0	5.1	U	5.1	5.1	U	5.1
4,6-Dinitro-2-methylphenol	NA	4.7	U	4.7	4.7	U	4.7	4.8	U	4.8
4-Bromophenyl phenyl ether	NA	2.5	U	2.5	2.5	U	2.5	2.6	U	2.6
4-Chloro-3-methylphenol	NA	2.5	U	2.5	2.5	U	2.5	2.6	U	2.6
4-Chloroaniline	30	2.0	U	2.0	2.0	U	2.0	2.0	U	2.0
4-Chlorophenyl phenyl ether	NA	2.5	U	2.5	2.5	U	2.5	2.6	U	2.6
4-Methylphenol	NA	1.6	U	1.6	1.6	U	1.6	1.6	U	1.6
4-Nitroaniline	NA	5.8	U	5.8	5.9	U	5.9	5.9	U	5.9
4-Nitrophenol	NA	6.7	U	6.7	6.8	U	6.8	6.8	U	6.8
Acenaphthene	400	2.7	U	2.7	2.7	U	2.7	2.8	U	2.8
Acenaphthylene	NA	2.7	U	2.7	2.7	U	2.7	2.8	U	2.8
Aniline	6	1.8	U	1.8	1.8	U	1.8	1.8	U	1.8
Anthracene	2000	2.8	U	2.8	2.8	U	2.8	2.9	U	2.9
Benzidine	20	0.89	U	0.89	0.90	U	0.90	0.91	U	0.91
Benzo[a]anthracene	0.1	0.27	U	0.27	0.27	U	0.27	0.28	U	0.28
Benzo[a]pyrene	0.1	0.14	U	0.14	0.14	U	0.14	0.14	U	0.14
Benzo[b]fluoranthene	0.2	0.26	U	0.26	0.26	U	0.26	0.27	U	0.27
Benzo[g,h,i]perylene	NA	2.0	U	2.0	2.0	U	2.0	2.0	U	2.0
Benzo[k]fluoranthene	0.5	0.26	U	0.26	0.26	U	0.26	0.27	U	0.27
Benzoic acid	30000	50	U *	50	51	U *	51	51	U *	51
Benzyl alcohol	2000	1.5	U	1.5	1.5	U	1.5	1.5	U	1.5
bis (2-chloroisopropyl) ether	NA	2.0	U	2.0	2.0	U	2.0	2.0	U	2.0
Bis(2-chloroethoxy)methane	NA	2.6	U	2.6	2.6	U	2.6	2.7	U	2.7
Bis(2-chloroethyl)ether	7	0.28	U	0.28	0.28	U	0.28	0.29	U	0.29
Bis(2-ethylhexyl) phthalate	3	2.0	U	2.0	2.0	U	2.0	2.0	U	2.0
Butyl benzyl phthalate	100	2.5	U	2.5	2.5	U	2.5	2.6	U	2.6
Carbazole	NA	3.2	U	3.2	3.2	U	3.2	3.3	U	3.3
Chrysene	5	3.1	U	3.1	3.1	U	3.1	3.2	U	3.2
Dibenz(a,h)anthracene	0.3	0.090	U	0.090	0.091	U	0.091	0.092	U	0.092

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Dibenzofuran	NA	2.8	U	2.8	2.8	U	2.8	2.9	U	2.9
Diethyl phthalate	6000	2.9	U	2.9	2.9	U	2.9	3.0	U	3.0
Dimethyl phthalate	100	2.8	U	2.8	2.8	U	2.8	2.9	U	2.9
Di-n-butyl phthalate	700	2.9	U	2.9	2.9	U	2.9	3.0	U	3.0
Di-n-octyl phthalate	100	1.5	U	1.5	1.5	U	1.5	1.5	U	1.5
Fluoranthene	300	3.2	U	3.2	3.2	U	3.2	3.3	U	3.3
Fluorene	300	2.8	U	2.8	2.8	U	2.8	2.9	U	2.9
Hexachlorobenzene	0.02	0.29	U	0.29	0.29	U	0.29	0.30	U	0.30
Hexachlorobutadiene	1	0.57	U	0.57	0.58	U	0.58	0.58	U	0.58
Hexachlorocyclopentadiene	40	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Hexachloroethane	7	0.25	U	0.25	0.25	U	0.25	0.26	U	0.26
Indeno[1,2,3-cd]pyrene	0.2	0.15	U	0.15	0.15	U	0.15	0.15	U	0.15
Isophorone	40	2.7	U	2.7	2.7	U	2.7	2.8	U	2.8
Naphthalene	300	2.7	U	2.7	2.7	U	2.7	2.8	U	2.8
Nitrobenzene	6	0.30	U	0.30	0.30	U	0.30	0.31	U	0.31
N-Nitrosodimethylamine	0.8	0.98	U	0.98	0.99	U	0.99	1.0	U	1.0
N-Nitrosodi-n-propylamine	10	0.25	U	0.25	0.25	U	0.25	0.26	U	0.26
N-Nitrosodiphenylamine	10	2.9	U	2.9	2.9	U	2.9	3.0	U	3.0
Pentachlorophenol	0.3	5.3	U	5.3	5.4	U	5.4	5.4	U	5.4
Phenanthrene	NA	3.1	U	3.1	3.1	U	3.1	3.2	U	3.2
Phenol	2000	0.81	U	0.81	0.82	U	0.82	0.83	U	0.83
Pyrene	200	2.9	U	2.9	2.9	U	2.9	3.0	U	3.0
Pyridine	NA	0.91	U	0.91	0.92	U	0.92	0.93	U	0.93
Total Conc	NA	23.0			0.0			0.0		
Total Estimated Conc. (TICs)	NA	0.0*T			0.0*T			0.0*T		

*T There are no TICs reported for the sample
Highlighted Concentrations shown in bold type face exceed limits
U : Indicates the analyte was analyzed for but not detected.
U * : Recovery or RPD exceeds control limits

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Appendix E
Fourth Week Results

Accutest New Jersey								8/31/2012 9:25
Job Number:	JB14839		PRELIMINARY Data					
Account:	Atlantic Response DEP							
Project:	P0700390, NJDEP NERAS Contract							
Project Number:								
							Legend:	Hit

Client Sample ID:		3 PPB 1,4 DIOXANE LCS	SP1-120 ON	SP2-120 ON	SP2-90 OFF	SP3-120 ON	SP4-10 ON	SP4-120 ON
Lab Sample ID:		JB14839-7	JB14839-1	JB14839-2	JB14839-5	JB14839-3	JB14839-6	JB14839-4
Date Sampled:		8/28/2012	8/28/2012	8/28/2012	8/28/2012	8/28/2012	8/28/2012	8/28/2012
Matrix:		Water	Water	Water	Water	Water	Water	Water
GC/MS Semi-volatiles (SW846 8270D)								
2-Chlorophenol	ug/l	-	ND (0.99)	ND (0.97)	ND (0.97)	ND (0.97)	ND (0.97)	ND (0.97)
4-Chloro-3-methyl phenol	ug/l	-	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)
2,4-Dichlorophenol	ug/l	-	ND (1.2)	ND (1.2)	ND (1.2)	ND (1.2)	ND (1.2)	ND (1.2)
2,4-Dimethylphenol	ug/l	-	ND (1.6)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)
2,4-Dinitrophenol	ug/l	-	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)	ND (17)
4,6-Dinitro-o-cresol	ug/l	-	ND (1.0)	ND (0.99)	ND (0.99)	ND (0.99)	ND (0.99)	ND (0.99)
2-Methylphenol	ug/l	-	ND (1.1)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
3&4-Methylphenol	ug/l	-	ND (0.94)	ND (0.93)	ND (0.93)	ND (0.93)	ND (0.93)	ND (0.93)
2-Nitrophenol	ug/l	-	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)
4-Nitrophenol	ug/l	-	ND (5.3)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)	ND (5.2)
Pentachlorophenol	ug/l	-	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)
Phenol	ug/l	-	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)
2,3,4,6-Tetrachlorophenol	ug/l	-	ND (0.95)	ND (0.94)	ND (0.94)	ND (0.94)	ND (0.94)	ND (0.94)
2,4,5-Trichlorophenol	ug/l	-	ND (1.6)	ND (1.6)	ND (1.6)	ND (1.6)	ND (1.6)	ND (1.6)
2,4,6-Trichlorophenol	ug/l	-	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)
Acenaphthene	ug/l	-	ND (0.27)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
Acenaphthylene	ug/l	-	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Acetophenone	ug/l	-	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
Anthracene	ug/l	-	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
Atrazine	ug/l	-	ND (0.50)	ND (0.49)	ND (0.49)	ND (0.49)	ND (0.49)	ND (0.49)
Benzo(a)anthracene	ug/l	-	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Benzo(a)pyrene	ug/l	-	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Benzo(b)fluoranthene	ug/l	-	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)
Benzo(g,h,i)perylene	ug/l	-	ND (0.33)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)
Benzo(k)fluoranthene	ug/l	-	ND (0.52)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
4-Bromophenyl phenyl ether	ug/l	-	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)
Butyl benzyl phthalate	ug/l	-	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
2-Chloronaphthalene	ug/l	-	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)
4-Chloroaniline	ug/l	-	ND (0.54)	ND (0.53)	ND (0.53)	ND (0.53)	ND (0.53)	ND (0.53)
Carbazole	ug/l	-	ND (0.37)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)
Chrysene	ug/l	-	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
bis(2-Chloroethoxy)methane	ug/l	-	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
bis(2-Chloroethyl)ether	ug/l	-	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
bis(2-Chloroisopropyl)ether	ug/l	-	ND (0.46)	ND (0.45)	ND (0.45)	ND (0.45)	ND (0.45)	ND (0.45)
4-Chlorophenyl phenyl ether	ug/l	-	ND (0.32)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
2,4-Dinitrotoluene	ug/l	-	ND (0.43)	ND (0.43)	ND (0.43)	ND (0.43)	ND (0.43)	ND (0.43)
2,6-Dinitrotoluene	ug/l	-	ND (0.47)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)	ND (0.46)
3,3'-Dichlorobenzidine	ug/l	-	ND (0.37)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)	ND (0.36)
1,4-Dioxane	ug/l	ND (0.27)	7	5.5	1.5 J	5.3	1.8 J	5.4
Dibenzo(a,h)anthracene	ug/l	-	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)
Dibenzofuran	ug/l	-	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)
Di-n-butyl phthalate	ug/l	-	ND (0.56)	ND (0.56)	ND (0.56)	ND (0.56)	ND (0.56)	ND (0.56)
Di-n-octyl phthalate	ug/l	-	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
Diethyl phthalate	ug/l	-	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)
Dimethyl phthalate	ug/l	-	ND (0.29)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)

bis(2-Ethylhexyl)phthalate	ug/l	-	ND (0.59)	ND (0.59)	ND (0.59)	ND (0.59)	ND (0.59)	ND (0.59)
Fluoranthene	ug/l	-	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)	ND (0.32)
Fluorene	ug/l	-	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)
Hexachlorobenzene	ug/l	-	ND (0.34)	ND (0.34)	ND (0.34)	ND (0.34)	ND (0.34)	ND (0.34)
Hexachlorobutadiene	ug/l	-	ND (0.52)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)	ND (0.51)
Hexachlorocyclopentadiene	ug/l	-	ND (7.2)	ND (7.1)	ND (7.1)	ND (7.1)	ND (7.1)	ND (7.1)
Hexachloroethane	ug/l	-	ND (0.56)	ND (0.55)	ND (0.55)	ND (0.55)	ND (0.55)	ND (0.55)
Indeno(1,2,3-cd)pyrene	ug/l	-	ND (0.38)	ND (0.37)	ND (0.37)	ND (0.37)	ND (0.37)	ND (0.37)
Isophorone	ug/l	-	ND (0.28)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)
2-Methylnaphthalene	ug/l	-	ND (0.39)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)
2-Nitroaniline	ug/l	-	ND (1.1)	ND (1.1)	ND (1.1)	ND (1.1)	ND (1.1)	ND (1.1)
3-Nitroaniline	ug/l	-	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)
4-Nitroaniline	ug/l	-	ND (1.7)	ND (1.7)	ND (1.7)	ND (1.7)	ND (1.7)	ND (1.7)
Naphthalene	ug/l	-	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
Nitrobenzene	ug/l	-	ND (0.43)	ND (0.42)	ND (0.42)	ND (0.42)	ND (0.42)	ND (0.42)
N-Nitroso-di-n-propylamine	ug/l	-	ND (0.31)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)	ND (0.30)
N-Nitrosodiphenylamine	ug/l	-	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
Phenanthrene	ug/l	-	ND (0.30)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)
Pyrene	ug/l	-	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)	ND (0.27)
1,2,4,5-Tetrachlorobenzene	ug/l	-	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)
1,2,4-Trichlorobenzene	ug/l	-	ND (0.32)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)	ND (0.31)

Appendix F
Operating Parameters

Operating Parameters

FM-104	Peroxide Flow:	35-40
PI-104	Peroxide Pressure:	44-47
FM-202	Ozone Flow:	25-30
PI-209	Ozone Pressure:	44-47
PI-202	Ozone Gen. Pressure:	20-21
PI-203	Ozone BP Pressure:	0-1
FM-301	Air Stripper Flow:	10
FM-103	Loop Output Flow:	8
PI-103	Loop Output Pressure:	32-40
FM-105	Recirculation Flow:	8 (when active)
FM-102	Loop Flow:	40
PI-101	Loop Pressure:	32-40

Contact Information

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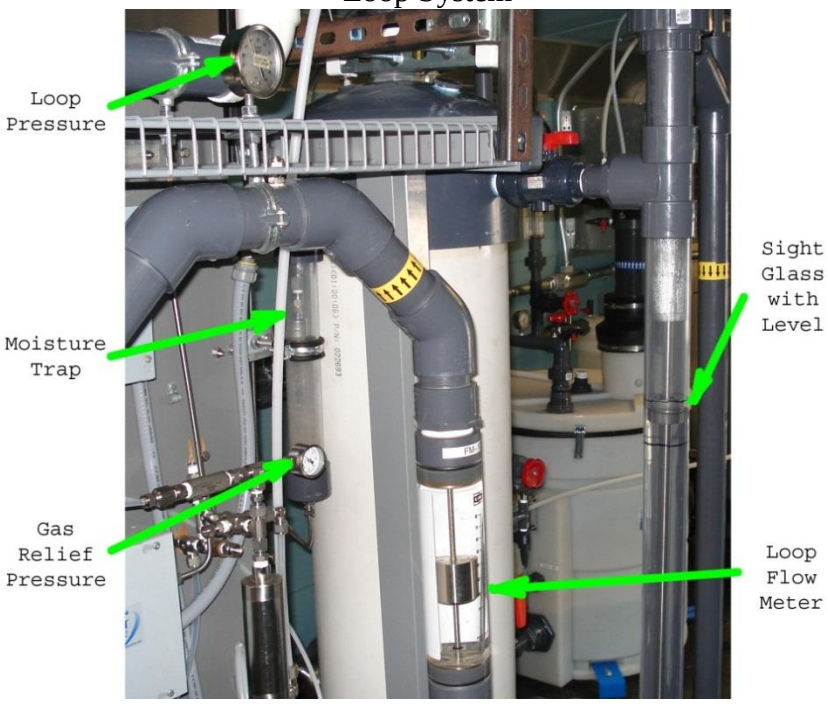
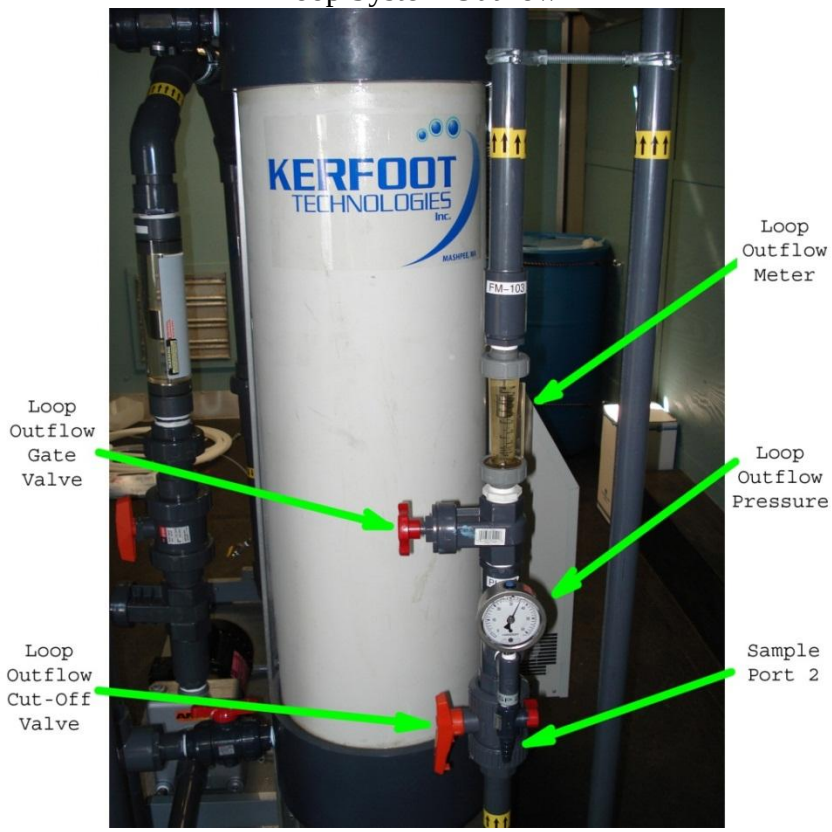
Loop System



Loop System Outflow



Inflow Assembly

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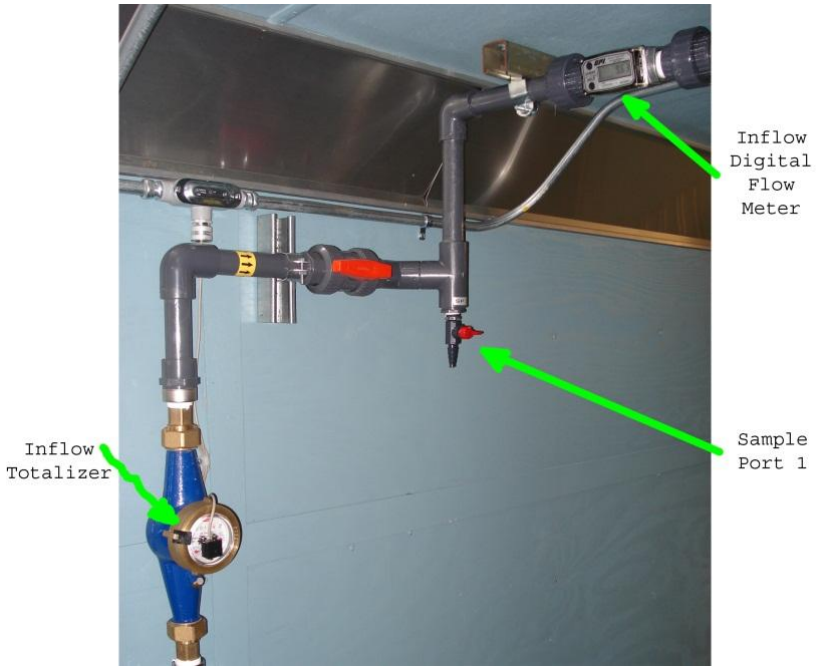

After Storage Tank Assembly

Outflow Assembly

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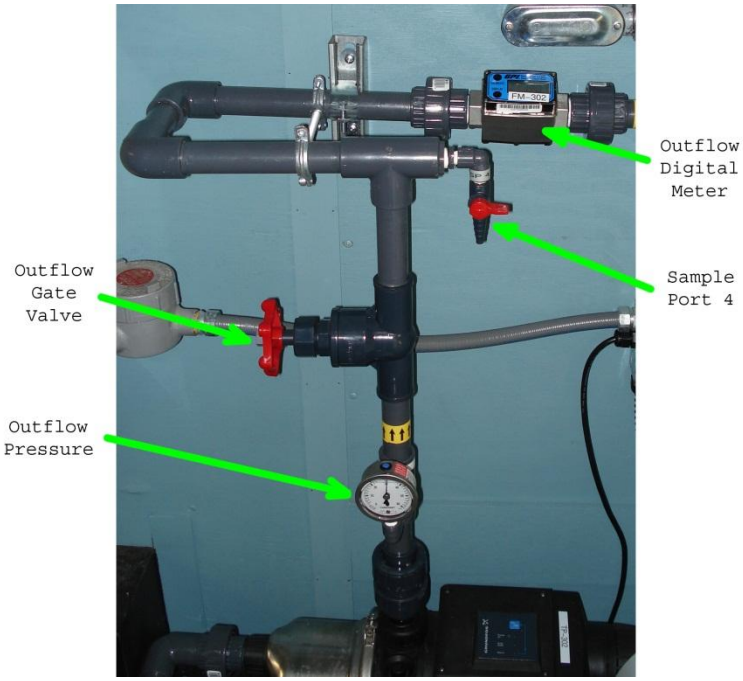
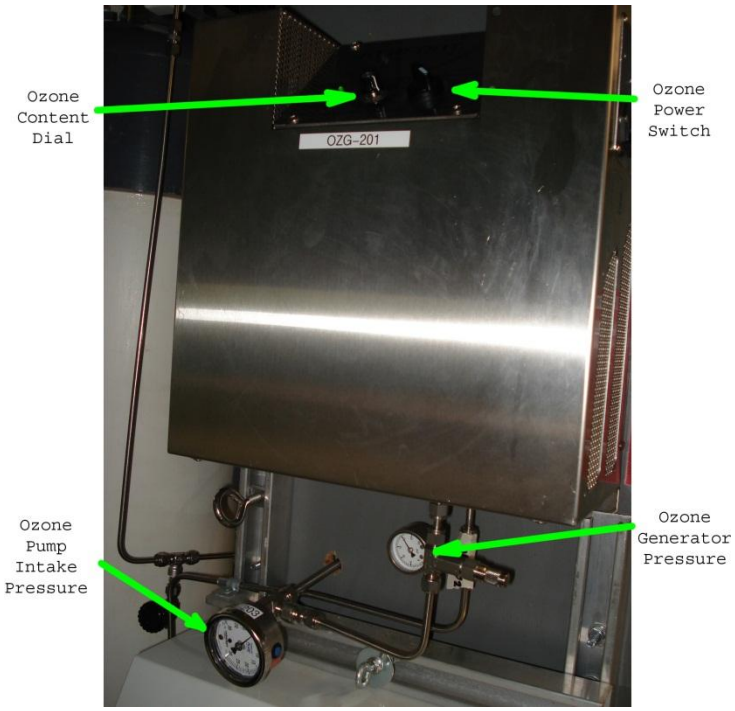


Ozone Generator



Ozone & Peroxide

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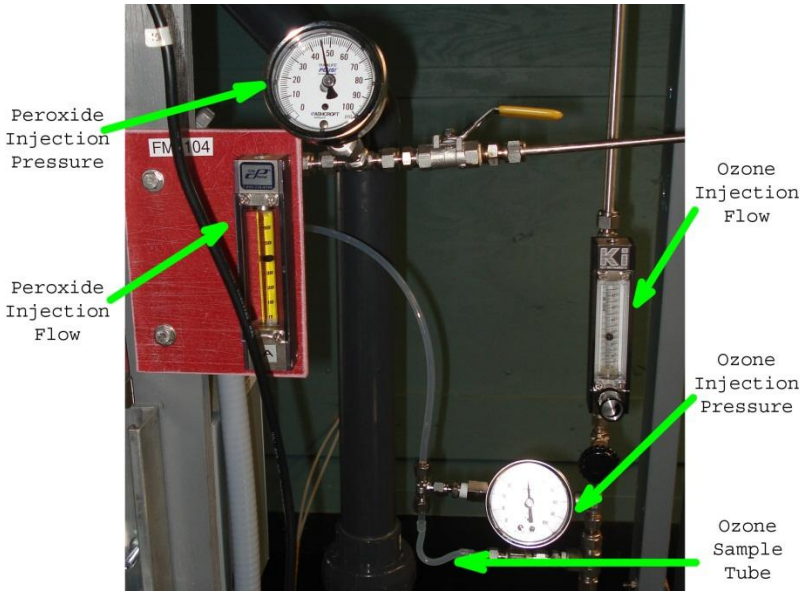

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Comments from NJDEP and responses from Bill Kerfoot (in *italics*), dated 11/14/12

1. Kerfoot should provide a concise itemized list of the equipment and costs included in the estimate of $252,000 x 2, particularly because the schematic includes an air stripper and belt filter which are not itemized under comment 6. Also, confirm whether or not a PLC is included.
   For each 60 GPM Loop System

   Equipment Listing

   (2) Ozone Generator (160g/hr)
   (2) Oxygen Concentrator
   Compressor to feed oxygen concentrator
   (3) Pressure Tank Well Mate Fiberglass (60 gallon)
   (3) Ozone Injection pump
   (3) Ozone destruct unit 3 cfm (catalyst)
   (6) Laminar Spargepoint assembly (SS)
   Ozone detector/shut off
   (6) Liquid feed pump
   (3) Peroxide drums
   (3) Level Switch adapter
   (3) Level Switch rod - 30"
   (3) Level Switch
   Hydrogen Peroxide (35% solution to be diluted to 10%)
   5000 gallon - Loop Storage Tank (ambient)
   (3) Transfer Pump (Loop to storage tank)
   (3) Return Pump
   Transfer Pump (Stripper inflow)
   Transfer Pump (Stripper outflow)
   Inflow Pump
   Blower
   Air Stripper
   Control box (Allen-Bradley)
   (Adding back in the peroxide feed adds $30,000 to the system costs for each 60 gpm unit)

2. The pilot test unit had an in-line cartridge or bag filter on the effluent end. Was the cartridge or bag filter removed from the filter housing and inspected upon return to Kerfoot's shop? If so, what did the inspection show? Is it necessary to filter the loop system effluent if filtration is provided by the carbon units prior to discharge? Is Kerfoot's use of the term "belt filter" in the schematic deliberate? Can bag or cartridge filters be used instead if they are needed?
   Unfortunately, inspection found the bag filter was evidently not put in place. Inspection of the 250 gallon tank showed no bottom residue, so it is thought that negligible weight of residue would have been collected. Based upon 100% precipitation of iron from the system, only 265 gms of residue would be expected since the concentration was quote low and only 250,000 gallons processed during the month period.

3. The maximum available ozone concentration was the limiting factor during the pilot test. After the Week 1 results were reported, Kerfoot would have increased the ozone and hydrogen peroxide proportionally if a larger ozone generator was available. Because one was unavailable, the residence time was increased instead by reducing inflow from 10 GPM to 5 GPM for the remainder of the test. Kerfoot's scaled up design addresses this limitation by doubling the size of the ozone generators. If a full-scale Nanozox system is installed at the site, start-up and performance testing would be performed using varying feed rates of ozone and hydrogen peroxide. Accordingly, the full-scale system should include a hydrogen peroxide feed system.
   We have added in the cost for a hydrogen peroxide feed system if you desire it to be added. The system would be installed with a laminar-type point used in the pilot test which would accept a hydrogen peroxide feed, regardless.

4. (Bullet 5 below) Annual operating costs should exclude labor.
   We have removed labor from annual operating costs.

5. Would an economy of scale be realized if there were fewer and larger loop system components?
   Yes, to some extent. Please note that the flow per line has been increased to 20 gpm compared to the 10 gpm in the pilot test. The central loop tanks have been doubled in size, and the storage reservoir receiving the three-line flow is 5000 gallon capacity. Two 60 gpm systems are presented because your total flow was under 60 gpm, although we were told it can approach 120 gpm during high rainfall periods. This way you can simply turn off one unit unless needed.

6. Kerfoot's case studies, including the one forwarded via e-mail on 9/18/12, focus on in situ ground water treatment. Are there existing Nanozox installations at ex situ pump and treat facilities, or would Combe Fill South be the first installation?
   Combe Fill South would be the first installation of a 60+ gpm unit, operating full time. In-line systems, operating with 175 gpm flow have been demonstrated during month-long pilot testing at the MMR base.

7. The pilot test was initiated with a flow of 10 gpm, and then switched to 5 gpm for weeks 2-4. Can you clarify whether the design for the full system at 120 gpm (2 units at 60 gpm, each), uses the proportions based on the 5 gpm or 10 gpm operations? (We assume it is based on 5 gpm)
   The design for the full system at 120 gpm uses the proportions based on both the 10 gpm and 5 gpm operations. The ratio was set on the first week (10 gpm) and 4th week (5 gpm) tests. The recommended capacity is twice that of the fourth week test (2 x 160 gm/hr = 320 gm/hr).

   Recommend for 60 gpm
   With 10 gpm:
   14 gm/hr/10 gpm = 84 gm/hr *160 gm/hr x 2 = 320 gm/hr*
   60 gpm
   With 5 gpm (4th wk):
   14 gm/hr/5gpm = 168 gm/hr *160 gm/hr x 2 = 320 gm/hr*
   60 gpm

   Please note that the testing found 1.2 to 3.2 µg/L removal during retention in the storage tank. The time in the storage tank has been quadrupled.

8. What initial concentration is your design based on? We saw influent concentration fluctuations of between 7.0 µg/l to 28.0 µg/l, and even higher concentrations could be anticipated. During Week 3, the test results show that with an influent concentration of 28.0 µg/l, the best result (for point SP2-90) had a concentration of 3.2 µg/l, which is higher than the 3.0 that had been requested in the RFP.
   Refer back to question 7. We used the ratios based upon 12 and 23 µg/L 1,4 dioxane inflow. The 4th week showed capacity to treat below 3.0 µg/L to 0.27 from 12.3 or 1.1 µg/L from 23, depending upon the laboratory results you choose. To be safe, we have doubled the ozone mass supplied.

9. The 60 gpm inflow treatment system is presented conceptually, but it is not clear what would be included with that system for the estimated price of $252,000 ($504,000 for the 2 units). Are the following items included, or would they need to be purchased individually:
   A. Heat/AC/dehumidifier as recommended for operation throughout the year?
      No. The prices for these were not included.
   B. Electrical connections and hardware for lighting and testing equipment?
      No. The building lighting (fluorescent fixtures) and electrical supply were not included. Units will be supplied as pallets for hookup to electrical supply.
   C. Pumps – how many and what capacity?
      See listing in #1. These are included in costing.
   D. Redundancy in the event of breakdowns or O&M?
      1. *Two systems – one could be used for the other if you are under low flow conditions.*
      2. *Within a 60 gpm system you have three treatment train units, which allows flexibility of turning one off for repair/replacement of laminar point generator or centrifugal pump while others run.*
      3. *There are duplicate ozone generators (160 gm/hr each) and oxygen supplies. You could operate at ½ ozone supply in an emergency.*
   E. Is the unit a "black box", such that the NJDEP merely has to connect the inlet and outlet ends, or would the system need to be incorporated within or adjacent to the existing treatment system?
      As with the pilot test, you need only to hook up an inlet flow and an outlet flow to your system.
   F. How large will the system be (assuming a "black box"), and where do you anticipate placing it?
      We assumed that a building, about 15 ft. wide by 78 ft. long could house the two units plus storage tanks. The footprint of each unit would be 10 ft. x 15 ft. without the storage tank.
   G. We had discussed the possibility of a surge tank at the inlet end of the system to equalize inflow and concentration. Is that included? How big would that unit be?
   H. Would it be advantageous to include an equalization tank at the outlet end to average the treatment effluent concentrations prior to discharge? How large would this tank need to be? Cost?
      It would be desirable to have a small surge tank (600 gallons each for each 60 gpm unit) at the inflow and a larger mixing tank on the outflow to mix the volume of, say three times the 120 minute inflow cycle = 3 x 120 minutes x 120 gallon/minute or 43,200 gallon capacity. Relative to cost, a 600 gallon tank costs about $2,000 each. The 40,000 gallon tank is the capacity of an existing unused tank in the current treatment system. It need to be fiberglass or equivalent coated.

10. Comment 6 indicates that "the design schematic includes laminar points to take peroxide, but does not show the feed pumps or storage tanks." Should we assume that this means that peroxide units are not included in the cost estimate, although future connections (if required) are provided? The Week 4 test results seem to indicate that the system worked better without peroxide – is that an anomaly, or does that seem reasonable?
    The peroxide support equipment was not included in the cost estimate. Adding them in will add $30,000 to each 60 gpm unit cost. Attached is another report prepared by Michelle Simon of EPA's Cincinnati lab which further substantiates that microbubble ozone alone can treat 1,4 dioxane.

11. What do you anticipate to be the annual operating costs? With and without peroxide?
    For a 60 gpm unit, we estimate a maximum $/day for electrical at $26.53 per day or $795/month, running two 160 gm/hr ozone generators. If you are running both units, your electrical cost would be doubled to $1,590/month. If we add in peroxide, if you had 10% supplied to a 300 gallon SS tank at 150 gallons/week, your charge would be about $650/month peroxide supply costs.

12. How will the system be operated? The pilot test used a cycle (inflow for 120 minutes, followed by 90 minutes of circulation without inflow) – is that the plan for this unit?
    We have assumed the same cycle as the pilot test (inflow for 120 minutes, followed by 90 minutes of circulation without inflow).

13. Would the system be capable of continuous operation, using a surge tank to permit 24/7 inflow? Is there an advantage to continuous operation versus cycling?
    There is no advantage to continuous water flow operation. The control system operates well with a cycling system and intermittent flow, as shown during the pilot test.

14. The pilot test used an inflow of 5 gpm, with recirculation at 40 gpm (during the 120 minute inflow cycle). For the 60 gpm concept, it appears that you are using a primary loop recirculation flow of 80 gpm. Proportionally, it would seem that the recirculation flow should be 480 gpm. Please clarify.
    The "looping" frequency was maintained at four times the inflow. At 10 gpm inflow, the looping was 40 gpm. At the 5 gpm inflow, the internal loop was 40 gpm, but the large loop 20 gpm. Here we use a 20 gpm inflow and an 80 gpm internal loop, still at four times the inflow stream. Technically you could say the total recirculation is 3 x 80 gpm since there are three lines or 240 gpm. Any reduction in mass reduction is covered by doubling the ozone mass.

15. Comment 4 indicates that "KTI feels fairly confident…" Given that we may be recommending a $500,000 expenditure, can you be more specific in your confidence levels with respect to varying influent concentrations and the ability of your system to treat the required inflows to a specific effluent concentration?
    We feel confident because a bench scale test and pilot test has been conducted showing a high predictability of 1,4 dioxane reduction to below the 3 ppb goal. The feed water is fairly clean as wastewaters go with relatively low total dissolved solids and low iron content. The capacity to have high performance with nanobubble ozone alone also attests to freedom of inhibitors and interfering substances. We plan to offer a one year warrantee on the equipment and performance.

16. Assuming that the proposed system would cycle in the same way that the pilot test did (120 min on/90 min off) at an inflow rate of 120 gpm, the system would process 14,400 gallons each 210 minute cycle. If that cycling ran continuously 24/7, then the system would run through 6.86 cycles per day, and process 98,742 gallons. Is that what your system is designed for? What would happen if the inflow volume had to increase (or decrease)?
    Yes, this is what the system is designed for – 24/7 continuous intermittent (inflow for 120 minutes, followed by 90 minutes of circulation without inflow) operation at an inflow rate of a maximum of 120 gpm, with a mean of 60 gpm or less under drought conditions. The current flow is 60 gpm.

The system is designed to handle increases to 120 gpm and decreases, incrementally, below 60 gpm.

As you could see during the pilot test, the loop system is not affected by changing the inflow rate, as long as inflow equals outflow. The ozone output can be adjusted downwards if the retention time increases. This would reduce operating costs by reducing amperage needed. Similarly, 60 gpm can be taken offline, if flows fall below 60 gpm.