

**FOURTH FIVE-YEAR REVIEW REPORT FOR
TUTU WELLFIELD SUPERFUND SITE
ST. THOMAS, U.S. VIRGIN ISLANDS**



Prepared by

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LIST OF ABBREVIATIONS & ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
CVOC	Chlorinated Volatile Organic Compound
DNAPL	Dense Non-Aqueous Phase Liquid
DPNR	U.S. Virgin Islands Department of Planning and Natural Resources
DRO	Diesel Range Organics
EAB	Enhance Anaerobic Biodegradation
EPA	United States Environmental Protection Agency
FS	Feasibility Study
FYR	Five-Year Review
GAC	Granular Activated Carbon
gpm	gallons per minute
GRO	Gasoline Range Organics
GVI	Government of the Virgin Islands
GWTF	Groundwater Treatment Facility
ICs	Institutional Controls
ITP	Initial Testing Program
LNAPL	Light Non-Aqueous Phase Liquid
MCL	Maximum Contaminant Level
MNA	Monitored Natural Attenuation
MTBE	Methyl Tertiary Butyl Ether
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PRG	Preliminary Remediation Goals
PRP	Potentially Responsible Party
PVC	Polyvinyl Chloride
RAO	Remedial Action Objectives
RD	Remedial Design
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
scfm	standard cubic feet per minute
SSL	Site Screening Level
SVE	Soil Vapor Extraction
TPDES	Territorial Pollution Discharge Elimination System
TBC	To be considered
UAO	Unilateral Administrative Orders
UE	Unrestricted Exposure
USVI	United States Virgin Islands
UU	Unlimited Use
WAPA	Water and Power Authority

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP) (40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the fourth FYR for the Tutu Wellfield Superfund Site (Site). The triggering action for this policy review is the date of the third five-year review report. A five-year review is required at this site due to the fact that although the remedial action will ultimately result in the reduction of hazardous substances, pollutants or contaminants to levels that allow for unlimited use and unrestricted exposure, it will take longer than five years to achieve these levels.

The Site consists of two operable units (OUs). OU1 addresses Site-wide groundwater and OU2 addresses source areas at the United States Virgin Islands (USVI) Department of Education Curriculum Center property. OU2 has not been implemented yet. As such, OU1 is the subject of this FYR.

The Tutu Wellfield Superfund Site FYR was led by Caroline Kwan (EPA-RPM). Participants included Rachel Griffiths (EPA-Geologist), Julie McPherson (EPA-Human Health and Ecological Risk Assessor), and Donette Samuel (EPA-Community Involvement Coordinator). This is a Fund-lead site. The review began on November 15, 2023.

Site Background

The Site is located on the eastern end of St. Thomas, USVI, in the Anna's Retreat section (Figures 1 and 2). Overall, the Site is approximately 4,000 feet in length and encompasses a total area of approximately 1.5 square miles (Figures 3 and 4). The site is situated within the upper Turpentine Run surface water drainage basin. The 2.3 square-mile basin trends roughly north-south and is bounded by the steep slopes of the surrounding hills. Land surface elevations along the axis of the basin decrease from about 200 feet above mean sea level (msl) at the northern end of the site to approximately 100 feet above msl at the southern end of the Site. Turpentine Run is a partially channelized, intermittent stream that traverses the length of the basin and ultimately discharges into Mangrove Lagoon and the Caribbean Sea. As a result of development in the area, storm water run-off is collected in a catchment system and combined with secondary sewage before discharging to Turpentine Run.

According to the 2010 U.S. Census, the population of the Town of Anna's Retreat in the area around the Tutu Wells Superfund Site was 7,479. The Site contains a variety of residential and commercial establishments, schools, and churches. The area sustained heavy damage to its buildings and infrastructure during hurricanes Irma and Maria in 2017. Rebuilding efforts continue and it is expected that the area will return to its pre-hurricane land use in the future.

The Curriculum Center property is occupied by a single-story building that formerly housed offices, maintenance shops, warehouse space and walk-in freezers that supported the school district cafeterias. A

paved parking lot is on the south side of the building, facing Smith Bay Road. An unpaved parking area and loading docks are located on the west side of the building. Additional loading and parking areas are located on the north side of the building. The northern groundwater treatment system is also located on the north side of the building. The Curriculum Center building was condemned after extensive damage sustained during Hurricane Irma/Maria in 2017, but it has not been demolished to date. During the construction of Curriculum Center, the property was reportedly graded using imported fill.

A description of the Site operational history and a history of investigations conducted at the Site is provided in Appendix B.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Tutu Wellfield		
EPA ID: VID982272569		
Region: 2	State: USVI	City/County: St. Thomas
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	Has the site achieved construction completion? No	
REVIEW STATUS		
Lead agency: EPA		
Author name (Federal or State Project Manager): Caroline Kwan		
Author affiliation: Remedial Project Manager		
Review period: 11/15/2023 - 6/30/2024		
Date of site inspection: 8/16/2023		
Type of review: Policy		
Review number: 4		
Triggering action date: 6/30/2019		
Due date (<i>five years after triggering action date</i>): 6/30/2024		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

Exposure to groundwater in the Northern and Southern Plumes was found to pose an unacceptable risk to current and future populations. The primary contaminants of concern identified for groundwater were volatile organic compounds (VOCs), primarily BTEX compounds (benzene, toluene, ethylbenzene and xylenes) and chlorinated VOCs (CVOCs) tetrachloroethene (PCE), trichloroethene (TCE), 1,2-dichloroethene (1,2-DCE) and vinyl chloride (VC). In addition, elevated concentrations of semi-volatile organic compounds, pesticides, and metals were also detected.

Concentrations of these contaminants were detected in soil at four source areas; the Curriculum Center, an Esso Service Station (currently operated by Total Petroleum), a Texaco Service Station (currently operated by Puma) and O'Henry Dry Cleaners, Inc. (**Figure 2**). In general, the concentrations in subsurface soil were not found to pose an unacceptable risk to human health but were found to be sources of groundwater contamination. The only unacceptable risk from exposure to surface soil was limited to the Tillett Gardens property where the noncarcinogenic hazard index for surface soil was exceeded for the residential scenario by metals which were found to be at concentrations consistent with background and were not attributed to the site.

The ecological risk assessment identified unacceptable risk to certain ecological receptors, such as the anole and the red-tailed hawk, based on exposure to soil contaminated primarily with PCE.

Response Actions

The Record of Decision (ROD) for OU1 was signed on August 5, 1996. Exposure to groundwater was identified as the principal threat and the selected remedy addressed both groundwater and the source material (primarily unsaturated subsurface soil and bedrock) that may migrate to groundwater. The following Remedial Action Objectives (RAOs) were established for the Site:

- Remove and/or control the sources of groundwater contamination;
- Remove contamination in groundwater. Restore the aquifer to drinking water standards, except to the extent that such full groundwater restoration proves to be technically impracticable due to the presence of Dense Non-Aqueous Phase Liquids (DNAPLs);
- Control the migration of impacted groundwater;
- Prevent human ingestion of groundwater exhibiting excess lifetime cancer risks greater than 1 in 10,000 or a hazard index greater than 1;
- Prevent direct human contact and exposure to contaminated soil that poses excess cancer risks greater than 1 in 10,000 or a hazard index greater than 1; and
- Eliminate leaching of contaminants of concern from soil into groundwater at concentrations which adversely impact groundwater quality and which might ultimately have negative ecological effects.

The groundwater remedy called for area-wide plume/source containment and treatment of contaminated groundwater. The groundwater clean-up goals are the Federal maximum contaminant levels (MCLs) for drinking water. The groundwater remedy included the following:

- Decommission existing domestic and commercial wells within the confines of the groundwater plume if these wells are determined to interfere with the operation of the groundwater pump and treat system to be installed as part of this remedial action. During the remedial design (RD) it would be determined which wells would interfere with this remedial action and which wells would continue to operate to enhance aquifer restoration, which is a goal of this remedial action. For those wells that are decommissioned, EPA would analyze alternative sources of water for the users of those wells and determine appropriate alternate sources of water for the affected users. These wells could be reestablished at some point in the future, when and if groundwater quality improves to allow extraction and use of untreated groundwater.
- Obtain institutional controls in the form of governmental and/or proprietary controls to prohibit unauthorized use of groundwater or the installation of new wells, such that authorization must be obtained from U.S. Virgin Islands (USVI) Department of Planning & Natural Resources (DPNR) and EPA before use of existing wells (i.e., wells that are not decommissioned) or installation of any new wells within the confines of the plume area.
- Implement Source Control Programs (consisting of installation and operation of extraction wells and air strippers) at the Texaco and Esso Service Stations to address impacted groundwater in the immediate vicinity of these facilities.
- Install groundwater recovery wells for hydraulic control of plume migration. The proposed containment program will include the installation of three recovery wells (RW-1, RW-2, and RW-3) strategically placed in an effort to hydraulically contain plume migration.
- Install two groundwater recovery wells (RW-4 and RW-5) for hydraulic control of chlorinated volatile organic compound (CVOC) contaminant sources. The source containment will provide hydraulic barriers around source areas, allowing the reduction of contaminants in other parts of the aquifer and potentially reducing the time needed to reach MCLs.
- Construct a central groundwater treatment facility with a total flow capacity of 100 gallons per minute (gpm). Water will be treated to surface water criteria for discharge to the storm sewer near the O'Henry Dry Cleaners facility leading to Turpentine Run or be treated to MCLs for distribution for potable purposes. EPA, in consultation with the Virgin Islands Government, will choose one of these two options during the RD phase. If a decision is made to treat the water to surface water criteria (not to MCLs), then water will continue to be supplied to affected residents as it is currently being supplied (i.e., through collection of rainwater to cisterns and trucking water by tanker truck).
- Conduct semi-annual groundwater sampling to monitor its quality and contaminant migration. The monitoring program would include the sampling of approximately 15 wells at or near the plume boundary for CVOCs, benzene, toluene, ethylbenzene and xylenes (BTEX); and semivolatile organic compounds, and would last for the duration of the remedial action and operation and maintenance (O&M, estimated, for costing purposes, to be approximately 30 years).
- Natural attenuation of low concentration contaminants at the plume edges and downgradient of RW-2 and RW-3.

Various potable use options for the treated groundwater include:

- connect to the existing Water and Power Authority water main;

- truck the treated water to the impacted residences within the plume area; or
- install a water distribution system from the central treatment facility to the impacted residences within the plume area.

The soil remedy selected addressed multiple locations containing unsaturated zone BTEX/CVOC source materials. The ROD soil cleanup goals were derived using the EPA soil screening level (SSL) methodology for protection of groundwater. The soil remedy included the following for each of the source areas:

- In-situ soil vapor extraction (SVE) treatment of impacted soil with catalytic oxidation for off-gas treatment at the Texaco Service Station;
- In-situ SVE treatment and bioventing of impacted soil with thermal oxidation for off-gas treatment at the Esso Service Station;
- Excavation and off-site disposal of additional soil, if needed (to be determined after confirmatory sampling during the RD) at Four Winds Plaza/Western Auto;
- At O'Henry dry cleaners, in-situ SVE treatment of impacted soil, or, if such in-situ SVE proves to be ineffective, excavation and ex-situ SVE of impacted soil; in-situ SVE treatment in the unsaturated bedrock; and thermal oxidation for off-gas treatment;
- At the Curriculum Center: excavation of impacted soil, followed by either off-site disposal or ex-situ SVE; in-situ SVE treatment in unsaturated bedrock areas and in soil areas not suitable for excavation; and thermal oxidation for off-gas treatment; and
- Institutional controls in the form of governmental and/or proprietary controls to place limitations on property usage and limit disturbance to impacted soil and bedrock.

Buried 4-inch diameter polyvinyl chloride (PVC) piping was identified as a potential source of contamination at the Four Winds Plaza, near the former Western Auto underground storage tank area. The ROD specified that additional investigation be conducted to determine the need for remedial work in the area of Four Winds Plaza. The ROD also specified confirmatory sampling in the area of the underground storage tank removed in 1994 be completed to confirm that no residually contaminated soil above the cleanup levels (SSLs) had been left in-place, with excavation and off-site disposal of impacted soil if contamination were found to be present.

Pursuant to a site inspection performed of all properties at the Site in 1995 following Hurricane Marilyn, it was determined that no soil remedial action was required at that time for the Ramsay Motors property, which is next to the Curriculum Center. The concrete floor in the area of subsurface soil contamination that had been thought to be cracked appeared to be of sound integrity. However, the ROD specified that institutional controls be applied to this property.

In April 2003, an explanation of significant differences (ESD) was signed outlining the following changes to the soil remedy at the Curriculum Center:

- Excavation is not required, because the shallow, overburden soils are not contaminated above the ROD cleanup goals.
- Activated carbon, followed by potassium permanganate is more feasible than thermal oxidation for SVE off-gas treatment.

- Standard, performance-based cleanup criteria will be used in lieu of the ROD soil cleanup goals (SSLs). The ROD SSLs are not appropriate for application in a fractured bedrock setting, because contaminants are non-uniformly distributed in the rock fractures, and rock sample analyses will not provide an accurate representation regarding how much contamination is present. The performance-based cleanup criteria are generally based upon the net reduction of contaminants in soil gas. Remedial progress will routinely be evaluated by collecting soil gas samples and field measurements from permanent vapor monitoring points screened within the contaminated area and from the SVE system.

The OU2 ROD was signed on September 30, 2021, and addresses the source area located at the Curriculum Center property. The property is located at 386 Smith Bay Road (Highway 38) in the Anna's Retreat section of St. Thomas. The OU2 remedy includes the following key components:

- Expansion of the existing pump and treat system to include additional downgradient extraction wells.
- Upgrading the existing OU1 pump and treat system to accommodate a higher flow rate.
- Upgrading all existing treatment equipment to accommodate additional flow and improve efficiency.
- Reinjection of treated groundwater downgradient from the Curriculum Center to act as a hydraulic barrier to further mitigation of contamination from the source area, as well as discharge to Turpentine Run.
- Instituting alternate and dual-phase extraction (DPE)/ enhanced fluid recovery (EFR) from existing monitoring wells that exhibit high contaminant concentrations.
- Implementation of long-term monitoring to track and monitor changes in groundwater contamination to ensure the remedial action objectives (RAOs) are attained.
- Retention of existing ICs, including USVI GVI well use laws, to ensure that the remedy remains protective until the Remedial Action Objectives (RAOs) are achieved for protection of human health over the long-term.
- Development of a Site Management Plan to ensure proper management of the Site remedy post-construction that would include long-term groundwater monitoring, ICs, vapor intrusion (VI) restrictions and periodic reviews, as applicable.

Additionally, the OU2 ROD has a contingency for air sparge/soil vapor extraction if the following conditions occur:

- Plume containment is not maintained by the upgraded extraction/injection system, under normal operating conditions, because of the inability of the formation to accept water at the injection wells; or
- High CVOC concentrations at monitoring wells persist in the source area where concentrations have been detected above one percent of a COCs solubility limit. If concentrations do not reduce to levels below one percent of a COCs solubility limit by the fifth year following remedy implementation, then the contingency remedy will be evaluated.

The RAOs were outlined in the OU2 ROD were:

- Reduce DNAPL mass in the bedrock aquifer to the maximum extent practicable;
- Restore the groundwater so that concentrations of Site-related contaminants are below the Federal MCLs;
- Prevent migration of groundwater contamination from the source areas; and
- Prevent human exposure to contaminants in ground water by way of dermal contact, ingestion, and inhalation that are above levels that pose an unacceptable risk for commercial/industrial use and future residential use.

Status of Implementation

EPA funded the RD for the Curriculum Center soil and the site-wide groundwater portions of the remedy in September 1997 and the remedial action of these portions in September 2003. EPA issued separate Unilateral Administrative Orders (UAOs) to Texaco, Esso, and Western Auto/Four Winds Plaza in May of 1998 and to O'Henry in May of 1999, requiring the responsible parties to implement their respective portion of the ROD remedy. EPA provided trucked water to affected residents until permanent water supply lines to the local Water and Power Authority (WAPA) were completed in September 2014.

OU1 Remedy Implementation for Curriculum Center Soil and Site-Wide Groundwater

A pre-design investigation (PDI) of the Curriculum Center soil and site-wide groundwater was conducted from August 1998 to November 1999 to further define the extent of Curriculum Center soil and site-wide CVOC groundwater contamination and to collect hydrologic and geologic information to be used for the corresponding RD. The RD for the Curriculum Center soil and site-wide groundwater was completed in September 2001. During the PDI and RD activities, it was determined that soil excavation at the curriculum Center was not required. Activated carbon was determined to be more feasible than thermal oxidation for off-gas treatment. In addition, it was determined that the SSLs defined in the ROD are not appropriate for evaluating the fractured bedrock. Therefore, shutdown of the SVE system was to be based upon a significant contaminant decrease and asymptotic conditions in the SVE system influent. A number of RD wells and piezometers were installed during pre-design and design phases to fine tune the extent of contamination of the site-wide plumes.

Site construction was completed in March 2004, and consisted of the following activities:

- Construction of a groundwater extraction and treatment system at the Curriculum Center, referred to as Groundwater Treatment Facility (GWTF) #1, to achieve hydraulic control and remove contaminant mass from the saturated-zone source of CVOC groundwater contamination.
- Construction of a groundwater extraction and treatment system downgradient of the Northern Plume (referred to as GWTF #2) to achieve hydraulic control and remove contaminant mass.
- Construction of an SVE system at the Curriculum Center to remediate the unsaturated zone source of the CVOC groundwater contamination.
- Construction of injection and monitoring wells at the Curriculum Center to support the performance of an enhanced anaerobic bioremediation (EAB) pilot study, which was performed following treatment system startup. Based on the unsuccessful results of the initial phase of the pilot study, no additional pilot testing or bioremediation was performed.

An initial testing program (ITP) for the facilities was completed between March 19 to April 16, 2004, to confirm achievement of the treatment system performance requirements, and to obtain data for supporting decisions regarding system treatment system operation and optimization. The results of the ITP indicated that the facilities were operating as intended. Both facilities discharge to surface water in accordance with the Territorial Pollutant Discharge Elimination System (TPDES) permit equivalent. Both facilities were operated on a continuous basis from startup through September 2017 when they were taken offline in preparation for Hurricanes Irma and Maria. The groundwater extraction and treatment systems were restarted for a short period and then ceased operation due to the failure of the GVI to issue a contract for continued plant operations. The facilities have been operating on a periodic basis since 2020 due to USVI contractual issues.

Remedy Implementation for the Texaco Service Station

Texaco completed an RD for groundwater and the soil treatment system in 1995. Construction of an on-site SVE and groundwater treatment system and a downgradient groundwater treatment system was completed in early 1998. One shallow (TEW-1) and one deep (TEW-1D) extraction well was installed. In addition, 11 soil vapor probes were constructed for monitoring of the site soil gas. The downgradient groundwater treatment system consists of two groundwater extraction wells and an air stripper for removing hydrocarbons from extracted groundwater. One shallow (TEW-2) and one deep (TEW-2D) extraction well were installed. Treated water was discharged to catch basins located within the storm drainage system in the Turpentine Run in accordance with the facility's TPDES permit.

Groundwater start-up testing for the Texaco Service Station was performed in January 1998. The results of the start-up testing indicated that the system was operating as intended. Operation of the SVE system at the Texaco Service Station was initiated in April 1998. After conducting a pulsing period, the SVE and groundwater treatment system at the Texaco plant were shut down in July 2003. Monitored natural attenuation (MNA) activities have been conducted at the Texaco site since system shut down and remain on-going. Initially groundwater monitoring was performed on a quarterly basis and the frequency of the sampling events was reduced to semi-annually starting in 2004. Groundwater samples are typically collected from four to nine monitoring wells, and samples are analyzed for BTEX and methyl tertiary butyl ether (MTBE). Removal and replacement of three underground storage tanks and associated fuel lines was performed in December 2006. In January 2007, an enhanced bioremediation application was conducted at the site to further reduce the source area groundwater concentrations. Following implementation of the bioremediation program, semi-annual groundwater sampling was performed from November 2007 through December 2011 and annual groundwater monitoring was performed from June 2012 through July 2019 and January and November 2021.

Remedy Implementation and System Operations, Maintenance, and Monitoring Programs for the Esso Service Station

Esso groundwater and soil treatment system construction was completed in February 1999. System start-up testing was performed in March 1999. Start-up of the SVE system was performed in June 1999. Although hydraulic capture was achieved by the groundwater remediation system, neither the soil nor the groundwater remediation system produced substantial rates of source mass removal. As a result, a modified source control program was implemented, which incorporated soil excavation and off-site treatment via bio-piles; installation of a groundwater "hot-spot" remediation system, and natural attenuation of distal plume areas.

Construction of the of the “hot-spot” remediation system was performed in 2002. Operation of the groundwater “hot-spot” remediation system was conducted until April 2005.

MNA activities have been conducted at the site since May 2005 and remain on-going. The existing groundwater treatment system remains on site and operable should it be concluded that natural attenuation alone is not sufficient to maintain plume stability. Groundwater monitoring was initially performed quarterly and the frequency of monitoring was reduced to annually beginning in 2006. Typically, five to seven groundwater monitoring wells are analyzed for BTEX and both gasoline range and diesel range total petroleum hydrocarbons (TPH-GRO and TPH-DRO) and five wells are analyzed for a suite of biological indicator parameters (nitrite, nitrate, sulfate, sulfide, chloride, total iron, total organic carbon (TOC), alkalinity, hardness, and methane). Recent data are not available from the Esso wells. However, as noted below, BTEX compounds have not been detected in recent site-wide monitoring events, which include monitoring wells in the area of the former service station.

Remedy Implementation and System Operations, Maintenance, and Monitoring Programs for the O’Henry Dry Cleaners

O’Henry completed a removal action in March 1995 to address CVOC contaminated soil. Pursuant to the UAO issued in May of 1999, O’Henry completed a pre-design investigation of the unsaturated zone soil and fractured bedrock in November 1999. The results of the pre-design soil delineation investigation and post soil excavation reports did not identify the presence of unsaturated source materials exceeding the ROD soil cleanup goals/objectives. In July 2000, EPA concurred with the recommendation of No further Action for unsaturated zone soil and fractured bedrock at the O’Henry property.

Remedy Implementation and System Operations, Maintenance, and Monitoring Programs for the Western Auto/Four Winds Plaza

The UAO issued to Western Auto/Four Winds Plaza required that characterization in the area of the buried 4-inch diameter PVC piping be performed and confirmatory sampling of the tank grave area be completed to confirm that no residual contaminated soil above the cleanup levels (SSLs) was present. Investigation work was performed in January and February of 1999. No investigation or confirmation sampling results exceeded the ROD specified cleanup criteria with the exception of ethylbenzene results in samples collected in the vicinity of the buried PVC piping. Western Auto/Four Winds Plaza consultants calculated a revised contaminant specific SSL for ethylbenzene, which was approved by EPA and GVI. No sample results exceeded the revised criteria. The subsequent No Further Action recommendation was approved by EPA in January of 2000.

OU2 Remedy Implementation for Source Area Groundwater at the Curriculum Center Property

A PDI of the Curriculum Center groundwater was conducted from December 2022 to May 2023 to confirm groundwater contamination and to collect hydrologic and geologic information to be used for the OU2 RD. The OU2 RD was completed in September 2023. During the PDI and RD activities, it was determined that the contaminant plume at the Curriculum Center property can be contained using a combination of extraction and injection wells that target geologic features controlling groundwater movement at the site. The maximum design flow rate for the extraction and treatment system during wet weather conditions was determined to be 150 gallons per minute (gpm). Lower rates can be expected during the dry season. The PDI also determined that aquifer hydraulic properties would not support dual-phase extraction (DPE)/enhanced fluid recovery (EFR). Intermittent extraction of groundwater and NAPL was included in the

design to address wells completed in high concentration/low permeability portions of the source area. The Remedial design of the OU2 remedy was completed in December 2023.

IC Summary

Table 1: Summary of Planned and/or Implemented ICs

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Groundwater	Yes	Yes	Parcels within or near the plume boundary	Governmental controls and/or proprietary controls to prohibit unauthorized use of groundwater or the installation of new wells. Authorization must be obtained from GVI and EPA before use of existing wells (i.e., wells that are not decommissioned) or installation of any new wells within the confines of the plume area.	Virgin Islands Code: Title 12, Chapter 5 (in effect)

Systems Operations/Operation & Maintenance

The O&M, which consists of operation, maintenance, and monitoring activities, is ongoing although operation is intermittent as discussed below. The facilities are operated and maintained in accordance with the site documents, manufacturer's specifications with the USVI DPNR TPDES permit equivalency and Air Pollution Control permit equivalency.

Groundwater monitoring is performed at site-wide groundwater monitoring wells to assess remedial action progress. Groundwater sampling was performed on a quarterly basis from system start-up until April 2007 and annual groundwater sampling is supposed to be performed thereafter. Samples are collected from approximately 28 groundwater monitoring wells and approximately 6 residential wells during each groundwater sampling event. The actual number varies slightly due to access during the sampling events. Based on existing information and recent conversations with area residents, the known remaining residential wells in the area are no longer used for drinking purposes since they have been connected to the WAPA line. Samples from all monitoring wells are analyzed for VOCs. In addition, samples from five groundwater monitoring wells located in the southern plume area are analyzed for nitrate, sulfate, chloride, TOC and ethane/ethene to assess monitored natural attenuation in this area. Groundwater monitoring levels are collected on a monthly basis from 36 monitoring wells. Additional information regarding the sampling of residential wells can be found in the Data Review section of this FYR.

The Curriculum Center SVE system was operated for approximately two years. Due to a significant decrease in SVE influent concentrations since system startup and achievement of asymptotic conditions, it was determined that the SVE system was no longer cost-effective and the system was shut down in April 2006.

GWTF #1 and #2 operated continuously through mid to late September 2017, when damage to the USVI power grid during Hurricane Irma/Maria resulted in a shutdown of both treatment facilities. Before both treatment plants became inoperable, the average extraction rate at GWTF #1 dropped from 20 gpm in 2014 to 11.1 gpm in 2017. The average extraction rate at GWTF #2 also dropped, from 17 gpm to 13 gpm, but then recovered to an average of 16.3 gpm in 2017. No other significant operational problems were encountered, other than continued frequent shutdowns attributed to power outages. In addition, frequent replacement of equipment is typically necessary due to the humid conditions that exist on the island. Both facilities have been operated on a periodic basis as allowed by funding from the USVI.

Prior to transfer of the facilities to the USVI Government (GVI) in April 2013, a series of final inspections were performed to ensure the facility components were in good working order. Repairs were performed as necessary to transfer the facilities in an acceptable condition.

Climate Change

Potential site impacts from climate change have been assessed (see Appendix D), and the performance of the remedy is currently not at risk due to the expected effects of climate change in the region and near the site. However, the Site will continue to be at risk from inland flooding, high winds and power outages from hurricanes and tropical storms, as was experienced during hurricanes Irma and Maria. The current systems have been constructed with resilience measures for these weather events. All equipment is housed in concrete structures to guard against flooding and heavy winds. Wells are sealed in heavy duty vaults, and the systems are shut down when there is an approaching storm to protect electrical systems from power surges or outages.

See Appendix D for the complete climate change analysis. The current O&M plan is sufficient to address climate resiliency for the foreseeable future. Should climate risk increase to the point that current provisions are not sufficient, the O&M plan will be updated to include measures to protect the treatment facilities from future climate-related risk.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the **last** FYR as well as the recommendations from the **last** FYR and the current status of those recommendations.

Table 2: Protectiveness Determinations/Statements from the 2019 FYR

OU #	Protectiveness Determination	Protectiveness Statement
1	Protectiveness Deferred	A protectiveness determination for the OU1 remedy at Tutu Wellfield cannot be made until further information is obtained. Further information will be obtained by taking the following actions: the treatment system will be repaired and restarted; data to delineate the current extent of the plume will be collected; and a survey will be conducted to determine if additional private wells or homes are impacted by the contaminated plume or vapor intrusion. It is expected that these actions will take approximately two years to complete, at which time a protectiveness determination will be made.

The status of each of the actions described in the above Protectiveness Statement was initially addressed

in a 2022 memorandum for the site and has been updated in Table 3. Additional discussion pertaining to each of these items is presented below this table.

Table 3: Status of Recommendations from the 2019 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
OU1	The treatment facilities are offline and there is no hydraulic capture of the plumes.	Repair and restart operation of the treatment system using the recommendations provided in the RSE.	Ongoing	EPA is discussing the restart of the systems with the GVI who has the responsibility of operating the OU1 treatment system under the existing state superfund contract.	
OU1	The impact of the treatment system being offline since September 2017 cannot be fully evaluated with existing data.	Continue with regular groundwater monitoring to evaluate whether the groundwater plume is expanding.	Ongoing	Additional sampling was completed in 2019 and 2022 by EPA. Discussions with the GVI to resume the regular monitoring that is required in the existing state superfund contract are ongoing.	
OU1	It is currently unknown if the plume has expanded beyond its previous boundaries and may have impacted additional private wells or potentially resulted in additional structures being impacted by vapor intrusion	Continue with regular groundwater monitoring to evaluate whether plume is expanding. Consult with VIDPNR and WAPA on additional private wells that may exist in the area of the plume.	Ongoing	Although not collected with the appropriate frequency, groundwater and private well monitoring data continues to be evaluated to determine whether the plume is expanding and if additional private wells are located in the area of the plume. The potential for vapor intrusion continues to be evaluated based on available data. See discussion below.	

The treatment facilities are offline and there is no hydraulic capture of the plumes.

After the September 2019 FYR was finalized, treatment system repairs from Hurricanes Irma/Maria were completed, and additional groundwater sampling was performed to delineate the current extent of the CVOC plume. EPA completed repairs to treatment equipment, instrumentation, controls, and process piping at both treatment facilities in September 2020. The groundwater extraction and treatment systems were restarted and turned back over to GVI to continue operation and O&M in August 2021. The system has been operating sporadically ever since, as allowed by USVI funding.

The impact of the treatment system being offline since September 2017 cannot be fully evaluated with existing data.

Additional groundwater sampling was conducted by the EPA Superfund and Emergency Management Division (SEMD) with support from Weston Solutions, Inc., Superfund Technical Assessment Team V (START V) in October 2019. A comprehensive round of sampling that included 36 monitoring wells and four residential wells (Smith, Steele, Delegard and Tillett) was performed. Samples were analyzed for Target Compound List (TCL) VOCs. The list of monitoring wells included wells from both the long-term monitoring program and the OU2 source area investigation. EPA also conducted groundwater sampling in August 2022 at residential wells and a representative subset of monitoring wells. Samples were analyzed for TCL VOCs.

The October 2019 sampling results were generally comparable to previous years in terms of total CVOC concentration. The data show some fluctuation, both increases and decreases, that are consistent with those previously observed over the course of long-term monitoring, which has been ongoing since 2004. The data were also consistent with overall trends, which had shown little to no reduction over recent years. The comprehensive round, which included an expanded group of wells near Treatment Facility #2, also indicated that the plume extends further to the west than depicted on 2017 and 2018 maps.

The August 2022 results were generally comparable to previous results over the majority of the plume footprint. However, wells in the source area at the Curriculum Center showed a 1 to 3 order of magnitude increase in total CVOC concentration over 2019 levels. The increase is attributed to limited operation of the extraction and treatment facility during recent years.

It is currently unknown if the plume has expanded beyond its' previous boundaries and may have impacted additional private wells or potentially resulted in additional structures being impacted by vapor intrusion.

EPA used the Virgin Islands GIS system to collect property information for all properties within the Tutu groundwater plume boundaries. This information was forwarded to the Virgin Islands Water and Power Authority (WAPA) to verify the presence of accounts and associated water supply connections at each of the properties. All commercial and industrial properties were excluded from this list as they are required by DPNR to obtain a well permit. Most residential properties appear to be connected to the WAPA water supply system. However, the status of 11 residential properties located primarily in the downgradient part of the contamination plume could not be determined. In August 2022, EPA staff used the list of the 11 residential properties to field verify the current status of their usage of the water supply system. The field verification showed:

- Three of the properties have no dwellings.
- Five of the properties have no wells and are either connected to WAPA, use water from another source outside the plume area, use collected rainwater for non-potable purposes and/or purchase water from private haulers for drinking purposes.
- Three of the properties have insufficient information. One of the properties has an abandoned dwelling; the second did not respond to EPA's request; and the last one has a new owner and is under construction. The new owner noted that there is a well on the property, but it cannot be located.

Soil vapor intrusion was not evaluated as a potential future exposure pathway during the RI. However, to address this potential pathway a soil vapor intrusion investigation was initiated in 2008 at the Curriculum Center, which was located at one of the source areas. The results of this investigation determined that the vapor intrusion pathway was not a concern considering the relatively low concentrations of site-related

contaminants found in the indoor air of the Curriculum Center. As a result of the damage caused by Hurricane Maria in September 2017, the Curriculum Center has been condemned due to being structurally unsound. There has been no occupancy at this property since it has been impacted by Hurricane Maria. The fate of the rebuilding the Curriculum Center is unknown.

Based on existing limited groundwater data, along with more recent data collected as part of the PDI, the plume footprint does not appear to have expanded. As such, impacts to additional structures from vapor intrusion are not anticipated. EPA will continue to evaluate data as it becomes available to determine whether additional sampling is needed.

EPA will continue to evaluate the potential for vapor intrusion based on current conditions as part of its ongoing efforts at the site.

Other Findings in the 2019 FYR

The 3rd FYR suggested that potential source material beneath the Curriculum Center Building be investigated to improve performance of the remedy, reduce costs, improve management of O&M, accelerate site close out, conserve energy, promote sustainability, etc.), even though it would not affect current and/or future protectiveness.

Although the Curriculum Center has not been reoccupied, direct sampling beneath the building was not permitted because it remains condemned and was deemed unsafe for those activities. The OU2 PDI attempted to perform a non-intrusive surface geophysical survey to identify potential NAPL deposits beneath the building. However, the survey was unsuccessful because of interference from steel reinforcement in the concrete floor and other overhead materials. The OU2 ROD signed in 2021 addresses the source area located at the Curriculum Center property.

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

On August 7, 2023, EPA Region 2 posted a notice on its website indicating that it would be reviewing site cleanups and remedies at Superfund sites in New York, New Jersey, Puerto Rico, and the U.S. Virgin Islands, including the Tutu Wellfield Superfund site. The announcement can be found at the following web address: <https://www.epa.gov/superfund/R2-fiveyearreviews>.

In addition to this notification, the EPA Community Involvement Coordinator (CIC) for the site, Natalie Loney, posted a public notice on the EPA site webpage www.epa.gov/superfund/tutu-wellfield and provided the notice to St. Thomas by email on April 5, 2024 with a request that the notice be posted in municipal offices and on their webpage. This notice indicated that a FYR would be conducted at the Tutu Wellfield Superfund site to ensure that the cleanup at the site continues to be protective of people's health and the environment. Once the FYR is completed, the results will be made available at the following repository/ies: EPA's Record Center located at 290 Broadway, NY and EPA's Virgin Islands office at the Tunick Building, Room 102, 1336 Beltjen Road, St. Thomas, USVI. In addition, the final report will be posted on the following website: www.epa.gov/superfund/tutu-wellfield. Efforts will be made to reach out to local public officials to inform them of the results.

Data Review

The site has a plume of groundwater contaminated with CVOCs, which is divided into the Northern and Southern portions, and two plumes of groundwater contaminated with gasoline components (the Texaco and Esso plumes). The CVOC plume originated at or near the Curriculum Center and extended beyond the former O’Henry Dry Cleaners building (potential secondary source), following an eastward path towards the discharge area of Turpentine Run. The two CVOC groundwater plumes were previously co-mingled, but recent data indicate that there may now be two separate plumes. Contaminants in the Northern CVOC Plume migrate southwest from north of the Curriculum Center. This plume extends vertically from 15-30 feet bgs to about 140 feet bgs. Contaminants in the Southern CVOC Plume migrate southeast from the former O’Henry Dry Cleaners and along Turpentine Run.

Two Category 5 hurricanes, Irma and Maria, hit St. Thomas USVI and caused extensive damage to St. Thomas and the treatment facilities (GWTF #1 & GWTF #2). Efforts were made to prepare for the storms and protect process equipment; however, the initial impact, flooding, and lack of electricity followed by inconsistent voltage left the systems inoperable from September 2017 through September 2020 when EPA completed repairs to the facilities and transferred control to the U.S. Virgin Islands Department of Planning and Natural Resources (DPNR). Since September 2020, the facilities have only been operated on a periodic basis as funding from the USVI allowed as discussed in the Systems Operations/Operation and Maintenance section of this FYR.

Three site-wide groundwater monitoring events were performed during this five year review period by EPA with support from Weston Solutions, Inc., START V in October 2019 and August 2022. A total of 40 wells were sampled in 2019 and 13 wells were sampled in 2022. The samples were analyzed for target compound list (TCL) VOCs. In addition to the site-wide monitoring events, 35 wells, 17 of which are included in the site-wide monitoring well network, were sampled during May 2023 during the OU2 PDI. PDI samples were analyzed for TCL VOCs. BTEX were detected below their respective MCLs in the October 2019 sampling results and were not detected in the sampling results from August 2022 or May 2023, therefore the data discussed in this FYR focuses on CVOCs.

Groundwater level measurements were collected during each of the monitoring events. As the groundwater treatment systems were operated periodically during this time, there was little to no hydraulic control of the aquifer during the review period. Please refer to Figures 3, 4, and 5 for depictions of the CVOC plume maps in 2018 vs. 2019, 2019 vs. 2022, and 2023, respectively. Figures 6 and 7 depict Groundwater Contour Maps of the whole site and the source area, respectively.

CVOC Northern Plume:

GWTF #1 Area

CVOC concentration trends in the vicinity of Facility #1 were variable over the course of the fourth five year review period. Concentrations at wells north of the Curriculum Center generally increased over the review period and many approached baseline levels. Concentrations at wells further downgradient were generally consistent with January 2018 levels and remained below baseline levels.

Total CVOC concentration increases of 1 to 2 orders of magnitude were observed at RD-9, IW-1, and IW-2 located north of the Curriculum Center building, and up to an order of magnitude increases were observed at OU2-MW3, OU2-MW6, MW-1D, and RD-13 located along major migration pathways downgradient of the source area. Total CVOC concentrations were as high as 340,395 micrograms per

liter ($\mu\text{g/L}$) at RD-9 and 371,822 $\mu\text{g/L}$ at IW-1. The ratio of individual CVOCs were similar between the August 2022 and May 2023 sampling results and to pre-hurricane distributions and the mapped extent of the Northern Plume in 2023 (Figure 5) is similar to the 2019 extent.

Comparison of PCE concentrations observed at Northern Plume wells to MCLs identified exceedances during both the 2022 and 2023 events. The 5 $\mu\text{g/L}$ MCL for PCE was exceeded at nearly all monitoring wells and the Tillett residential well (note: this well is no longer used but is retained as a sampling location) at concentrations ranging from 20 $\mu\text{g/L}$ at the Tillett well in 2023 to 13,100 $\mu\text{g/L}$ at OU2-MW6 in 2023.

TCE concentrations were detected at or its above 5 $\mu\text{g/L}$ MCL in more than half of the monitoring wells at concentrations ranging from 10.2 $\mu\text{g/L}$ at MW-15 in 2023 to 539 $\mu\text{g/L}$ at OU2-MW5 in 2023.

Cis-1,2-DCE concentrations were detected above its MCL of 70 $\mu\text{g/L}$ in monitoring wells RD-9 (24,100 $\mu\text{g/L}$) and OU2-MW2 (699 $\mu\text{g/L}$) in 2022 and RD-13 (248 $\mu\text{g/L}$), RD-9 (179,000 $\mu\text{g/L}$), IW-1 (126,000 $\mu\text{g/L}$), IW-1S (115 $\mu\text{g/L}$), IW-2 (33,800 $\mu\text{g/L}$), OU2-MW3 (355 $\mu\text{g/L}$), OU2-MW5 (73.5 $\mu\text{g/L}$) and OU2-MW6 (91 $\mu\text{g/L}$) in 2023. The 100 $\mu\text{g/L}$ MCL for trans-1,2-DCE was also exceeded at RD-9 (534 $\mu\text{g/L}$) in 2022 and RD-9 (3,660 $\mu\text{g/L}$), IW-1 (2,760 $\mu\text{g/L}$) and IW-2 (814 $\mu\text{g/L}$) in 2023.

Vinyl chloride concentrations were detected above its MCL of 2 $\mu\text{g/L}$ in monitoring wells RD-13 (35.1 $\mu\text{g/L}$), RD-9 (22,700 $\mu\text{g/L}$) and OU2-MW2 (204 $\mu\text{g/L}$) in 2022. In 2023, the MCL for vinyl chloride was exceeded in RD-13 (21.2 $\mu\text{g/L}$), RD-9 (157,000 $\mu\text{g/L}$), IW-1 (126,000 $\mu\text{g/L}$), IW-1S (89.1 $\mu\text{g/L}$), IW-2 (79,800 $\mu\text{g/L}$), OU2-MW4 (23.5 $\mu\text{g/L}$) and OU2-MW5 (14.8 $\mu\text{g/L}$).

GWTF #2 Area

CVOC concentrations at groundwater monitoring wells near and just downgradient of GWTF #2 generally remained below baseline levels in both the 2019 and 2022 monitoring events (Figure 4), but showed slight increases compared to January 2018 levels. Only wells DW-2 and MW-11D were sampled in the August 2022 monitoring event and no wells in the area of GWTF #2 were sampled in the May 2023 monitoring event.

Concentrations of PCE in the GWTF #2 area only marginally exceeded its 5 $\mu\text{g/L}$ MCL in DW-2 (7.2 $\mu\text{g/L}$), MW-12D (12 $\mu\text{g/L}$), and RD-7 (10 $\mu\text{g/L}$) in October 2019 and DW-2 (7.34 $\mu\text{g/L}$) and MW-11D (5.48 $\mu\text{g/L}$) in August 2022. There were no MCL exceedances for TCE, cis or trans 1,2-DCE or vinyl chloride during either monitoring event. The data suggest that since the Northern Plume hasn't been consistently hydraulically controlled since the 2017 hurricanes, contaminants may be migrating downgradient.

CVOC Southern Plume:

In the CVOC Southern Plume, total CVOC concentrations in the vicinity of GWTF #2 have decreased since baseline monitoring. The southern extent of the plume continues south of O'Henry. The monitoring wells in this area include Steele, MW-21D, Laplace, Smith, RD-14, RD-6, Delegard, PZ-4, RD-2, and RD-3.

Total CVOC concentrations observed during the October 2019 sampling event in the Southern Plume area wells have since remained low, consistent with 2018 levels and below baseline levels. Only four locations (RD-3, RD-8, Smith, and Steele) were sampled in August 2022 and no Southern Plume wells were sampled in 2023. Total CVOC concentrations in August 2022 were comparable to October 2019 levels.

Comparison of concentrations observed at the Southern Plume wells to the MCLs indicates that vinyl chloride exceedances were observed in MW-21D (3 µg/L) in 2019, and PCE and TCE exceedances were observed in the Steele residential well (5.18 µg/L and 7.93 µg/L, respectively) in 2022 (Figure 8). MW-21D was not sampled in 2022. Note that the Steele well is no longer used for residential purposes.

Site Inspection

The inspection of the Site was conducted on 8/16/2023. In attendance were Caroline Kwan, Demetrios Klerides, Remedial Design Consultant for OU2, and Austin Callwood, Director of Environmental Protection at the Department of Planning and Natural Resources. At the time of the inspection the treatment facilities were not in operation due to contractual issues among the US Virgin Islands Government and the remediation contractor. The Curriculum Center was still abandoned and condemned due to damages from hurricanes Irma and Maria in 2017.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

As discussed in the 2019 FYR, when operational, GWTF #1, is successful in removing contaminant mass and retarding the migration of the CVOC groundwater plume. GWTF #1 has only been operated periodically through this five-year review period. A 2011 Remedial Systems Evaluation (RSE) concluded that hydraulic capture associated with the GWTF #1 area was incomplete and recommended that the current extraction system be enhanced with more extraction wells, as is called for by the OU2 ROD. It was also suggested that GWTF #2 provides minimal benefit to controlling the plume and that this system be discontinued after modifications to GWTF #1 are completed. Remedial design of the enhanced groundwater extraction and treatment system was completed in January 2024. The RD addresses both complete capture of the CVOC plume at the Curriculum Center Property and containment and treatment of residual NAPL sources in the fractured rock aquifer. However, these modifications have not been made to date.

The data reviewed in the CVOC Northern Plume generally show some fluctuation, both increases and decreases, that are consistent with those previously observed over the course of long-term monitoring that began in 2004. The data were also consistent with overall trends, which had shown little to no reduction over recent years. Data at the Curriculum Center property, particularly north of the building, indicate that CVOC concentrations are rebounding; 1 to 3 orders of magnitude between 2019 and 2022, and continuing through the 2023 PDI monitoring event. With GWTF #1 only operating on a periodic basis, contaminant mass is not being controlled to the extent it was when the facility was operating on a regular basis.

Generally, CVOC concentrations in the Southern Plume monitoring wells have decreased since baseline sampling in March 2004, but the upward trend at the Steele well observed during the last five-year review period continued through this review period. This trend will be closely followed. While there were not MCL exceedances in the last FYR period, PCE and TCE marginally exceeded MCLs in the most recent sampling results for the Steele well.

Data reported for the BTEX plume during the current five-year review period indicate the constituents were detected below their respective MCLs in select wells during the October 2019 sampling event, and not detected during the August 2022 or May 2023 sampling events.

The treatment facilities were taken offline in preparation for hurricanes Irma and Maria in September 2017. EPA completed repairs to the systems in 2020 and transferred control back to the GVI. Since that time, the facilities have only been operated on a periodic basis as funding from the USVI allowed. Since the treatment facilities are intermittently offline, hydraulic capture of the plumes has not been consistent. As a result, the remedy is not functioning as intended by the decision documents and protectiveness cannot be determined at this time as further data is needed to adequately evaluate whether the expanding plume may be impacting additional private wells beyond those examined in the 2022 site memorandum or potentially resulting in vapor intrusion.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

The risk assessment process has changed somewhat since the original risk assessment was performed in 1995. Chemical-specific toxicity values have changed since the original risk assessment was conducted. The risk assessment addressed exposure to the surface soil, subsurface soil and groundwater. This review will include an evaluation of the cleanup goals and objectives for each medium that was evaluated in the risk assessment.

Soil cleanup goals for organic compounds were based on impact to groundwater concerns. Even though the ROD included an RAO to prevent risks associated with direct contact to contaminated soil, the subsequent investigations did not identify areas where this applied. In order to determine if the remedy is currently protective of human health, the cleanup goals established for the chemicals of concern, BTEX and CVOCs, were compared to EPA's Industrial Soil Risk Screening Levels (RSLs) and were found to be within or below the Superfund risk range.

Soil vapor intrusion was not evaluated as a potential future exposure pathway during the RI. The evaluation of this pathway is based on the conservative, health-protective assumption that buildings are located above the maximum detected concentration of the chemicals of concern in the groundwater and accumulating vapors migrating up through the vadose zone may impact inhabitants. Considering the high concentrations of volatiles in the groundwater, it was recommended that the vapor intrusion pathway be evaluated, and this was initiated in 2008. Although concentrations of site-related contaminants are above the screening criteria in the sub-slab, the vapor intrusion pathway was determined to not be a concern at this site considering the relatively low concentrations of site-related contaminants found in the indoor air at the Curriculum Center.

The Virgin Islands was impacted by Hurricane Maria in September 2017. As a result of the damage caused by Hurricane Maria, the Curriculum Center was condemned due to being structurally unsound. There has been no occupancy at this property since it was impacted by Hurricane Maria. Therefore, the exposure has been interrupted at this location throughout the current FYR period. The vapor intrusion pathway will be further evaluated as additional data become available to determine whether vapor intrusion sampling is appropriate at additional downgradient properties. A review of the current data indicates that the plume potentially has expanded and that vapor intrusion is potentially a complete exposure pathway.

While ARARs have not changed, certain screening levels used in the risk assessment have been updated. In order to account for these changes, the concentrations of site related contaminants in groundwater within the last 5 years were compared to their respective MCLs. MCLs are promulgated standards that apply to public water systems and are intended to protect human health by limiting the

levels of contaminants in drinking water. This evaluation indicates that the concentrations of several contaminants continue to exceed their respective MCLs in several wells.

One of the RAOs for groundwater is restoration as a potable water supply, and the remedial goals are MCLs. Although the RAO has not been met yet, the RAO continues to remain valid. Additionally, institutional controls prevent the installation of new wells in the contaminated area. All residential wells currently located in the plume are used for irrigation purposes only. All residents in the area were connected to public water as part of the 1996 ROD. More current groundwater data will be necessary to ensure that the plume has not expanded to impact additional residents.

The ecological risk assessment conducted in 1995 identified unacceptable risk to certain ecological receptors, such as the anole and red-tailed hawk, based on exposure to surface soil contaminated primarily with PCE. During the pre-design and RD activities, it was determined that soil excavation was not required at the Curriculum Center and unsaturated soils would be remediated only via a soil-vapor extraction system that would operate until a significant decrease and asymptotic conditions in the system influent were achieved. This system was installed and operated for two years when the decrease/asymptotic conditions of its influent were met and the system was shutdown. The RAO relating to eliminating leaching of COCs from soils into groundwater which might have negative ecological effects remains valid and has been met as related to ecological receptors.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

The groundwater treatment systems were severely damaged by Hurricane Maria. EPA completed repairs in 2020 and transferred the operations and maintenance of the facilities back to GVI. Since that time, the groundwater extraction and treatment facilities have only operated periodically due to USVI contractual issues. Available post-hurricane data show increases in the concentrations throughout the plume. More current data is necessary to properly assess the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations				
OU(s) without Issues/Recommendations Identified in the Five-Year Review:				
None				

Issues and Recommendations Identified in the Five-Year Review:				
OU(s): 1	Issue Category: Remedy Performance			
	Issue: The treatment system has been operating intermittently during the review period.			
	Recommendation: GVI must resume regular operation of the groundwater and extraction treatment system			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
Yes	Yes	GVI	EPA	9/30/2026

Issues and Recommendations Identified in the Five-Year Review:				
OU(s): 1	Issue Category: Monitoring			
	Issue: It is currently unknown if the plume has expanded beyond its previous boundaries and may be impacting additional private wells or potentially resulting in vapor intrusion.			
	Recommendation: - GVI needs to conduct groundwater monitoring to evaluate whether the plume is expanding so that EPA can use that data to determine if: 1. there are additional private wells that may be impacted by the plume and 2. additional vapor intrusion evaluation is warranted.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
Yes	Yes	GVI	EPA	9/30/2026

OTHER FINDINGS

It is currently unknown if emerging contaminants such as PFAS and 1,4-dioxane are present in groundwater at the Site. Under OU2, sampling and analysis for PFAS and 1,4-dioxane will be conducted to determine if the emerging contaminants are present in groundwater at the Site.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)		
<i>Operable Unit:</i> OU1	<i>Protectiveness Determination:</i> Protectiveness Deferred	<i>Planned Addendum Completion Date:</i> 9/30/2026
<i>Protectiveness Statement:</i> A protectiveness determination of the OU1 remedy at Tutu Wellfield cannot be made until further information is obtained. Further information will be obtained by taking the following actions: resuming regular operation of the groundwater and extraction treatment system and obtaining data to delineate the current extent of the plume. Additionally, EPA will continue to evaluate whether additional private wells or homes are impacted by the contaminated plume or vapor intrusion. It is expected that these actions will take approximately two years to complete, at which time a protectiveness determination will be made.		

VIII. NEXT REVIEW

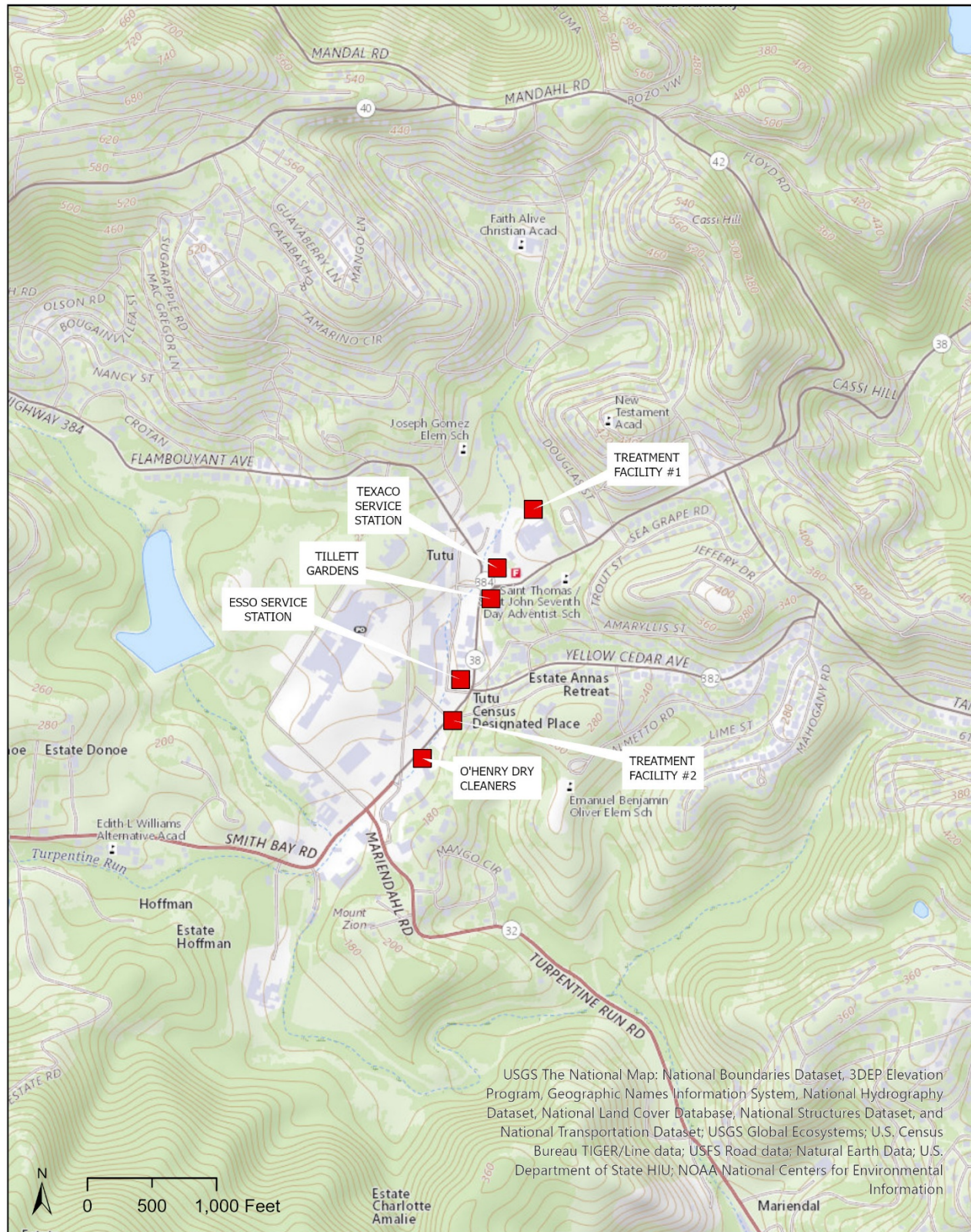
The next FYR report for the Tutu Wellfield Superfund Site is required five years from the completion date of this review.

FIGURES

Figure 1: Site Location Map



Figure 2: Topographic Site Map



HDR APTIM
a Joint Venture

TOPOGRAPHIC SITE MAP
ST. THOMAS, U.S. VIRGIN ISLANDS

FIGURE 1-2

TUTU WELLFIELD SUPERFUND SITE

Figure 3: 2018 vs. 2019 CVOC Plume Extent

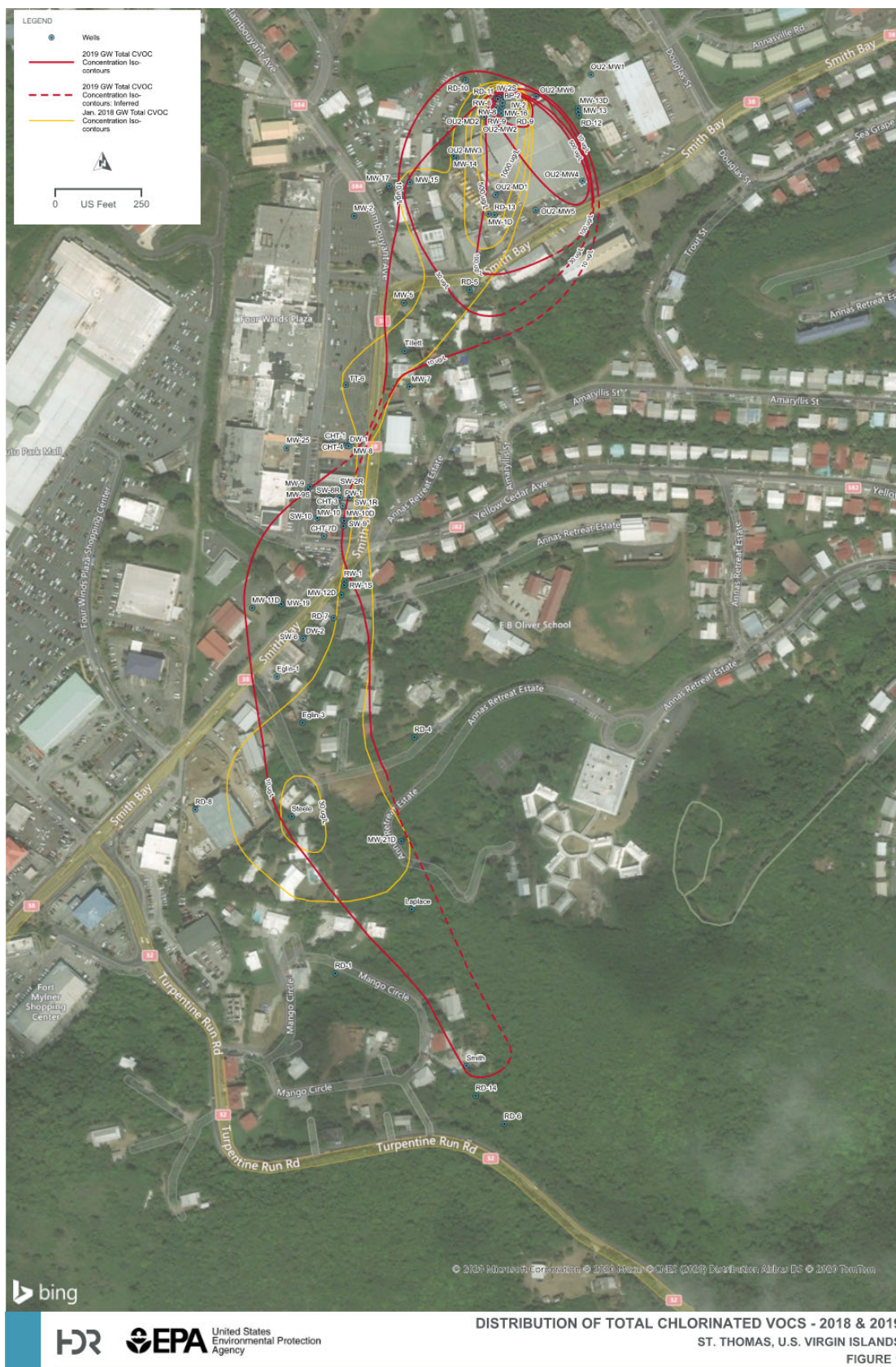


Figure 4: 2019 vs. 2022 CVOC Plume Extent



Figure 5: 2023 Pre-Design Investigation Plume Extent



Figure 6: 2018 Groundwater Level Contour Map (Figure 2-1 from Tutu Wellfield Annual Remedial Action Report)

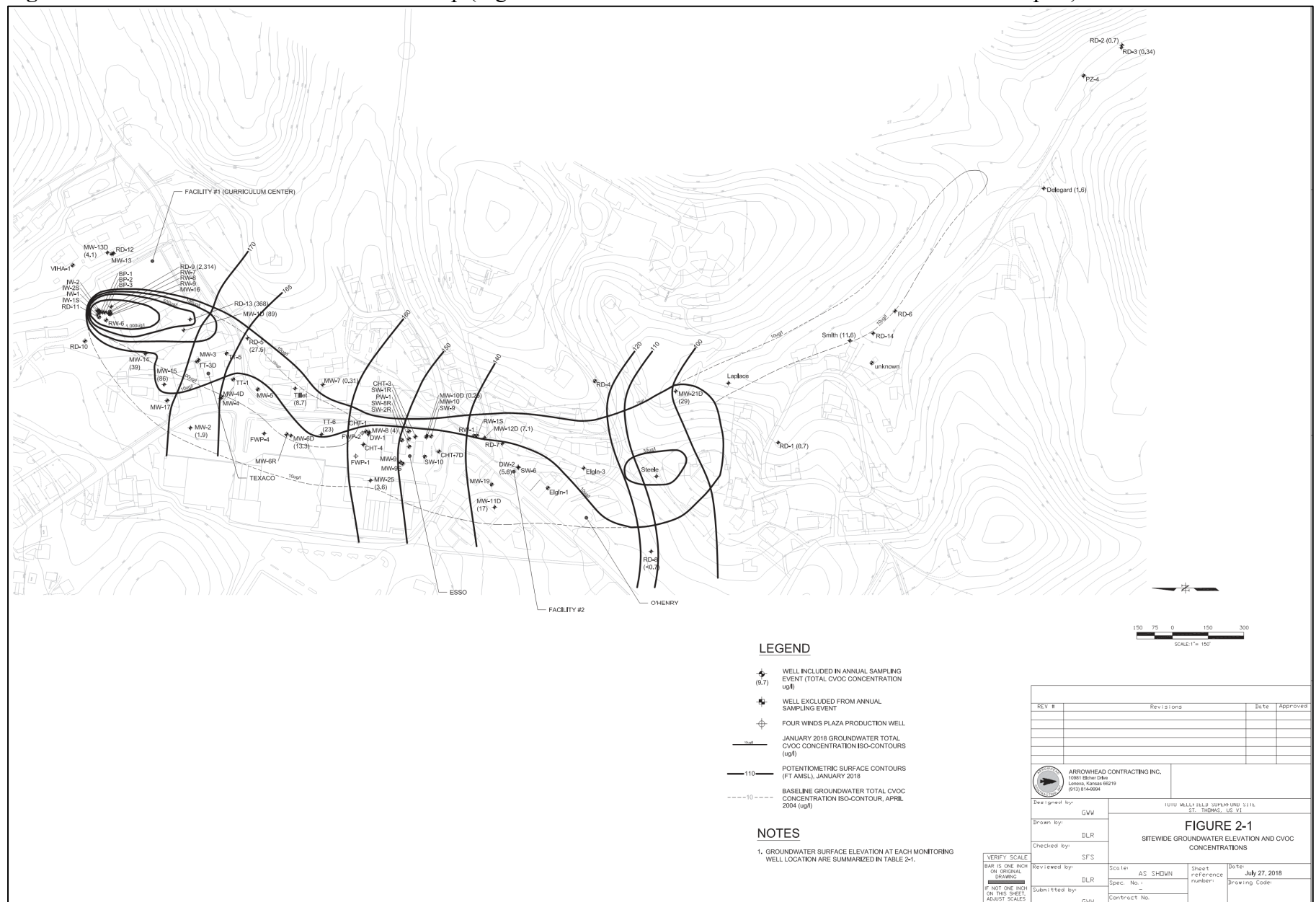


Figure 7: 2023 OU2 Groundwater Level Contour Map (Figure 2-3 from Tutu Wellfield Remedial Design Report)

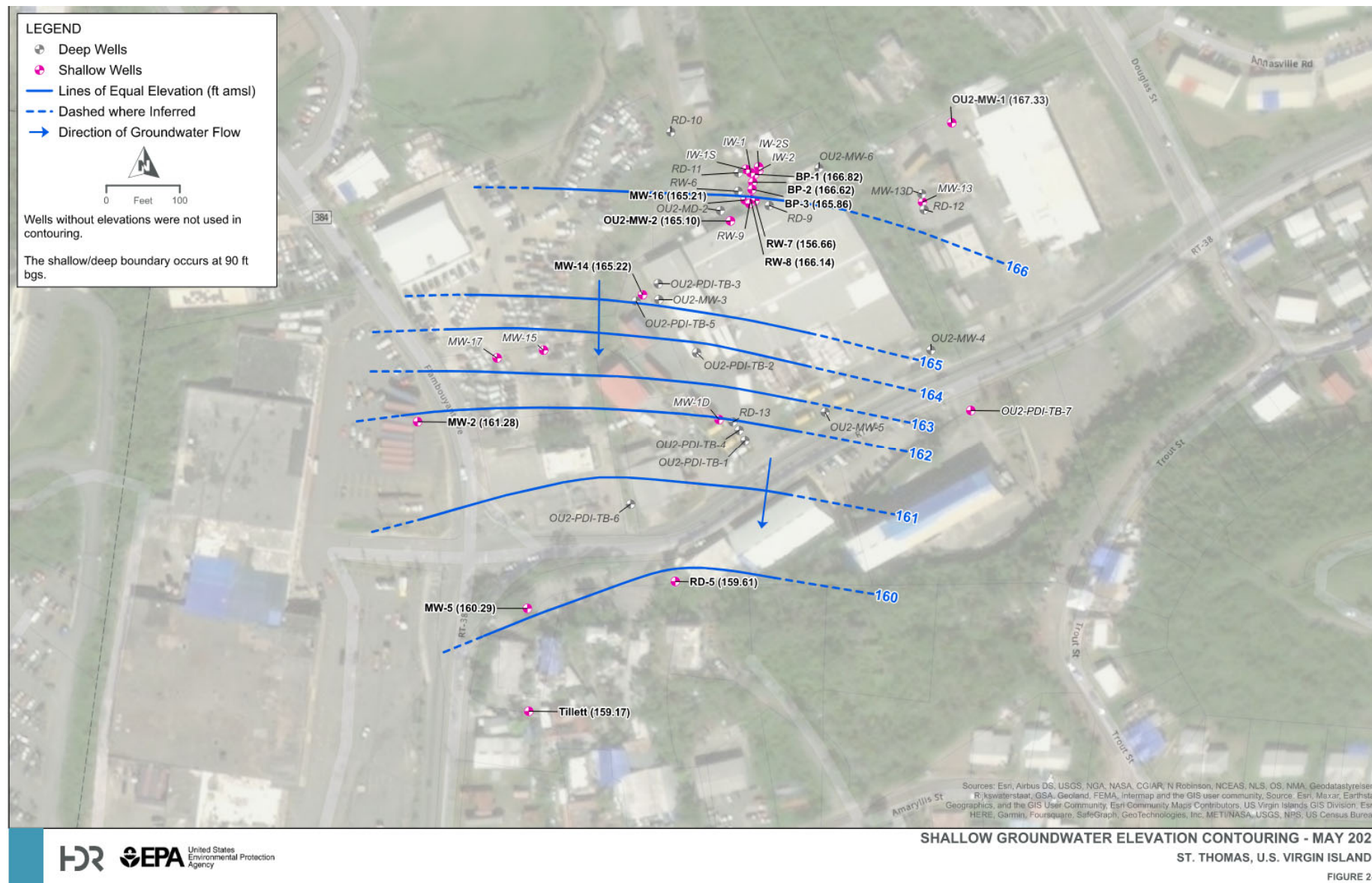
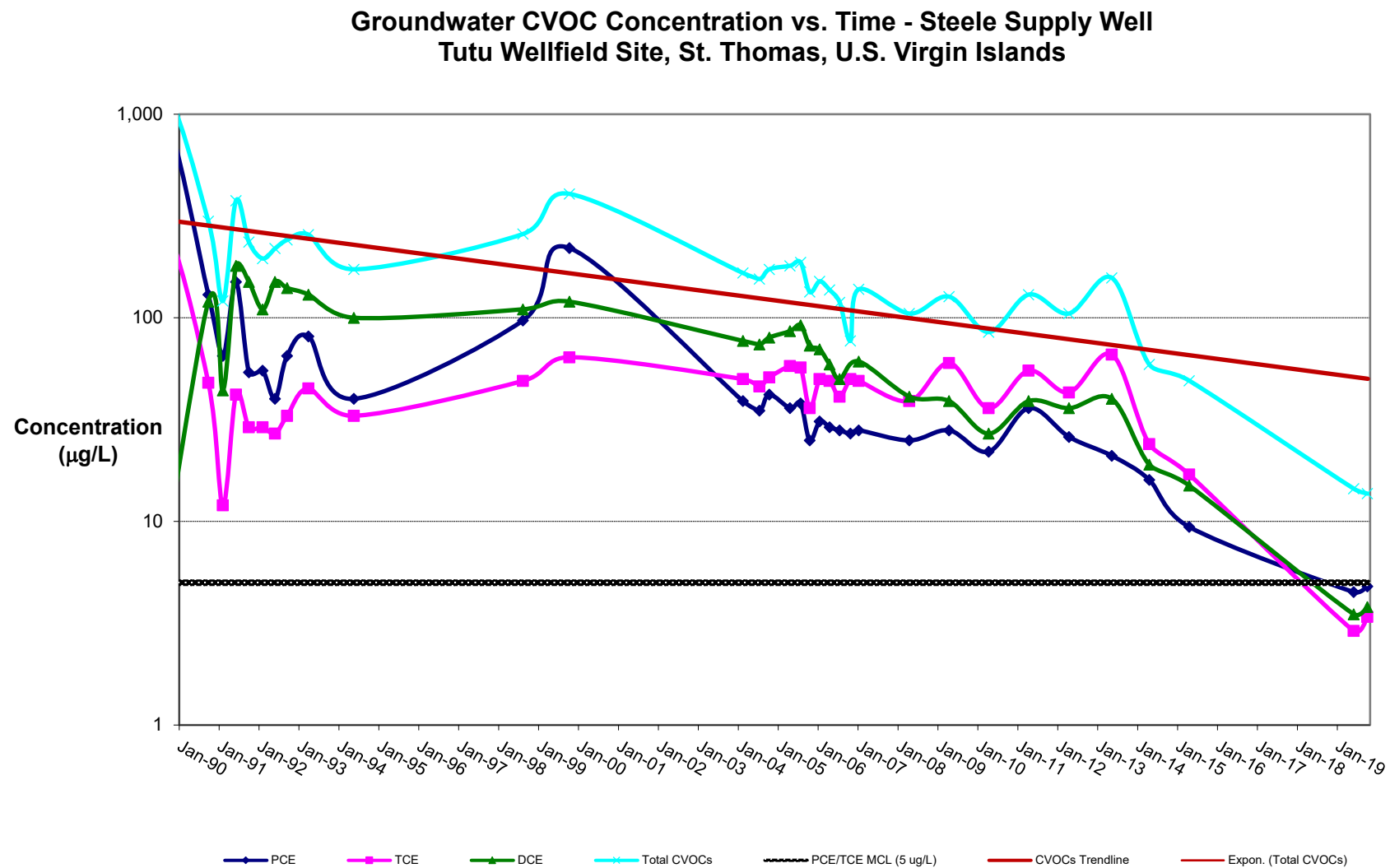


Figure 8: Concentration Trend Plot – Steele Supply Well (Update of Figure 2-2 from the 2018 Tutu Wellfield Annual Remedial Action Report)



TABLES

Table 4 – Groundwater Analytical Results Summary Table Tutu Wellfield Site St. Thomas, U.S. Virgin Islands October 2019

Area	Well ID	Concentration (µg/L)																						
		Total CVOC																						
		Baseline March 2004	July 2004	October 2004	January 2005	April 2005	July 2005	October 2005	January 2006	April 2006	July 2006	October 2006	January 2007	April 2008	October 2009	April 2010	April 2011	April 2012	May 2013	April 2014	April 2015	April 2016	January 2017	
Curriculum Center/ Facility #1	MW-1D	701	917	589	1312	704	694	772	684	705	775	532	25	158	–	125	686	109	153	190	144	160	113.9	
	MW-13D	0	–	–	–	2	–	–	–	2	–	–	–	0	–	2	3	6	5	4	3	4	4.91	
	MW-14	11	252	16	22	11	0	25	12	28	32	1	0	58	–	23	58	31	13	5	1	6	9.6	
	MW-15	55	90	39	20	47	30	43	31	36	41	37	46	37	50	39	41	30	52	31	36	40	50	
	MW-2	11	–	–	–	2	–	–	–	0	–	–	–	1	1	1	0	1	3	0	0.4	1.1	0.43	
	MW-6D	31	–	–	–	4	–	10	–	8	–	–	8	4	–	2	3	2	3	2	2	3	3.88	
	MW-7	1	–	4	0	8	–	0	–	31	–	16	–	12	–	19	8	6	19	1	1	5	2.68	
	RD-13	780	–	–	–	687	–	–	–	807	–	–	–	1060	1430	736	712	380	590	580	460	511	340	
	RD-9	152,020	–	–	–	71,540	–	–	–	280,000	–	–	–	–	–	15,211	478,500	165,800	2,909	3,539	2,588	601	237	
	RD-5	204	221	139	115	137	–	–	–	–	–	2	92	–	–	70	50	57	98	44	44	37	21.9	
	TT-6	165	–	–	–	–	–	–	–	–	–	–	27	34	40	28	29	20	40	24	22.6	30.0	16.7	
	Tillett	100	105	18	10	37	23	5	24	39	56	36	44	39	–	36	35	3.1	68	17	7	22	20.9	
	MW-10D	48	–	–	–	–	–	–	–	–	–	0	–	1	–	3	0	0.4	1.3	<2.5	6.7	1.8	1.2	
	MW-25	26	–	–	–	7	–	–	–	–	–	6	–	4	–	2	3	2	2	2	2	3	2.42	
	IW-1																							
	MW-8	44	–	–	–	–	–	–	–	–	–	2	31	0	2	2	3	1	1	1	2	4	2.87	
	MW-5																							
	IW-15																							
	IW-2																							
	OU2-MD-2																							
	OU2-MW-1																							
	OU2-MW-2																							
	OU2-MW-3																							
	OU2-MW-4																							
	OU2-MW-5																							
	OU2-MW-6																							
Facility #2	DW-2	16	16	12	10	12	6	4	8	5	6	0	0	7	–	1	4	1	3	3	4	5	2.97	
	Eglin-3	33	–	–	–	–	–	–	–	5	–	–	–	17	–	48	30	10	–	–	–	–	–	
	MW-11D	0	–	–	–	9	–	–	–	5	–	–	–	4	–	4	2	3	2	3	5	5	4.5	
	MW-12D	71	46	36	26	17	18	12	15	29	12	16	0	0	–	12	12	9	12	10	10	14	6.4	
	RD-7	74	31	23	18	16	–	8	–	9	–	–	8	10	–	7	7	9	8	7	7	3	3.88	
Southern Plume	Delegard	12	9	9	8	6	7	5	4	4	4	4	4	1	–	1	0	1	2	7	2	2	1.33	
	Laplace	24	18	3	–	19	8	11	10	9	4	8	9	3	–	5	7	4	6	6	5	4	5.4	
	Mathias	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	–	
	MW-21D	72	–	–	–	9	–	–	–	45	–	–	–	39	–	31	27	13	11	15	21	20	13.21	
	RD-1	6	–	–	–	4	–	–	–	4	–	–	–	0	–	1	1	1	1	1	0.3	0.3	0.68	
	RD-2	1	1	0	0	0	–	0	–	0	–	–	0	0	–	0	0	0	1	0	0.0	0.7	0	
	RD-3	4	9	4	6	2	2	5	1	5	3	1	2	4	–	0	0	0.5	0.6	1	0.4	0.0	0	
	RD-6	8	14	10	13	10	9	10	8	7	8	6	7	4	–	0	2	2	4	7	7	7	7.9	
	RD-8	14	–	–	–	8	–	–	–	8	–	–	–	5	–	3	50	NS	0	<0.50	<0.50	0.6	0	
	RD-14																							
	RD-4																							
	Smith	11	–	–	–	15	–	6	–	11	–	–	–	4	–	4	2	6	3	9	10	13	8.2	
	Steele	169	158	175	160	182	190	135	154	138	119	78	139	106	–	85	130	105	159	60	41	–	–	

Notes:

1. Non-detects were assumed to have a value of 0 µg/L.
2. The Smith and Steele VOC samples were most likely mislabeled in April 2007. These wells will continue to be monitored to verify contaminant trends.
3. Samples were not collected from the Eglin-3 well in April 2013 because the supply well pump was broken.
4. The Steele well has not been sampled since April 2015 due to an inoperable well pump.
5. The Steele and Eglin-3 wells have been removed from the list of wells to be sampled annually until well pumps are repaired.
6. Samples were not collected at Delegard or Laplace during the 2018 sampling event. There was no power available and both well pumps were damaged in hurricanes Irma and Maria.
7. Data obtained from Year 14 Tutu Wellfield Annual Report and Final Monitoring and Residential Well Sampling Report

Acronyms:

CVOCs – chlorinated volatile organic compounds DCE – dichloroethene

ID – identification NS – not sampled

TCE – trichloroethene PCE – tetrachloroethene VC – vinyl chloride

µg/L – microgram per liter

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Table 4 (cont'd) – Groundwater Analytical Results Summary Table Tutu Wellfield Site St. Thomas, U.S. Virgin Islands October 2019

Area	Well ID	Concentration (µg/L)						Concentration (µg/L)						Concentration (µg/L)						Concentration (µg/L)					
		Total CVOC						October 2019 - CVOC Breakdown						August 2022 - CVOC Breakdown						May 2023 - CVOC Breakdown					
		Baseline March 2004	January 2018	June 2019	October 2019	August 2022	May 2023	PCE	TCE	cis-1,2- DCE	trans-1,2- DCE	VC		PCE	TCE	cis-1,2- DCE	trans-1,2- DCE	VC		PCE	TCE	cis-1,2- DCE	trans-1,2- DCE	VC	
Curriculum Center/ Facility #1	MW-1D	701	88.94	-	74.33	-	711.46	25	7.4	41	0.93	0.5 U	-	-	-	-	-	-	-	628	28.2	53.3	1.96	1 U	-
	MW-13D	0	4.1	-	0	-	16.66	13 U	0.58 U	0.5 U	0.5 U	0.5 U	-	-	-	-	-	-	-	15.1	1.56	0.5 U	0.5 U	2 U	-
	MW-14	11	39.1	-	8.9	-	37.78	4.1	1.7	3.1	0.18 J	0.5 U	-	-	-	-	-	-	-	14.2	4.01	18.5	1.07	2.82 J	-
	MW-15	55	85.6	-	53.4	25.1	31.64	35	3.4	15	0.16 J	0.5 U	16.5	2.7	5.93	1 U	1 U	1 U	19.7	4.33	7.61	0.5 U	1 U	-	-
	MW-2	11	1.88	-	3.09	-	2.42	2.4	0.45 J	0.69	0.5 U	0.5 U	-	-	-	-	-	-	-	1.67	0.5 U	0.75	0.5 U	1 U	-
	MW-6D	31	13.32	-	1.96	-	-	13 U	0.56	1.4	0.5 U	0.5 U	-	-	-	-	-	-	-	-	-	-	-	-	-
	MW-7	1	0.31	-	5.82	-	-	5	0.37 J	0.82	0.5 U	0.5 U	-	-	-	-	-	-	-	-	-	-	-	-	-
	RD-13	780	368	-	147.6	259.1	751.9	2.6 J	1.6 J	7.4	130	6	1 U	1 U	111	113	35.1	12.2	374	248.0	96.5	21.2	-	-	-
	RD-9	152,020	2,314	-	47.5	47,334	340,395	0.5 U	0.5 U	6.5	17	24	100 U	100 U	24,100	534	22,700	735	250 U	179,000	3660	157,000	-	-	-
	RD-5	204	27.5	-	55.6	74.2	-	44	3.3	8.3	0.18 J	0.5 U	54.8	5.4	8.57	1 U	1 U	-	-	-	-	-	-	-	-
	IT-6	165	23.1	-	-	-	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-	-	-	-	-	-	-
	Tillett	100	8.69	-	27.6	37.9	27.6	20	2.3	5.3	0.5 U	0.5 U	25.9	3.83	8.15	0.5 U	0.5 U	20	2.3	5.3	0.5 U	0.5 U	-	-	-
	MW-10D	48	0.25	-	0	-	-	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	-	-	-	-	-	-	-	-	-	-	-	-	-
	MW-25	26	3.6	-	3.96	2.41	-	2	0.76	1.2	0.5 U	0.5 U	2.41	1 U	1 U	1 U	1 U	-	-	-	-	-	-	-	-
	IW-1	-	-	-	14,289	-	371,823	100 U	100 U	49 J	240 J	14,000	-	-	-	-	-	-	39	23.5	243,000	2,760	126,000 J	-	-
	MW-8	44	2.14	-	4.49	-	-	3.3	0.51	0.68	0.5 U	0.5 U	-	-	-	-	-	-	-	-	-	-	-	-	-
	MW-5	-	-	-	0	-	-	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	-	-	-	-	-	-	-	-	-	-	-	-	-
	IW-15	-	-	-	26.2	-	309	19	4	3.2	0.11 J	0.5 U	-	-	-	-	-	-	87.6	10.2	115.0	6.77	89.1 J	-	-
	IW-2	-	-	-	23.97	-	114,416	0.5 U	0.5 U	0.87	14	9.1	-	-	-	-	-	-	0.95	1.43	33,800	814 J	79,800 J	-	-
	OU2-MD-2	-	-	-	747.3	-	-	300	42	290	5.3	110	-	-	-	-	-	-	-	-	-	-	-	-	-
	OU2-MW-1	-	-	-	0	-	1.03	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	-	-	-	-	-	-	1.03	0.5 U	0.5 U	0.5 U	2 U	-	-
	OU2-MW-2	-	-	-	160.5	1,381	24.72	63	16	64	1.5	16	308	147	699	21.1	204	15.3	2.37	7.05	0.5 U	1 U	-	-	-
	OU2-MW-3	-	-	-	668	-	3,688	580	27	61	20 U	20 U	-	-	-	-	-	3,210	123	355	25 U	50 U	-	-	-
	OU2-MW-4	-	-	-	949	-	757	810	73	66	25 U	25 U	-	-	-	-	-	677	29.5	25	2.48	23.5 J	-	-	-
	OU2-MW-5	-	-	-	308.6	-	669	85	190	30	3.6	0.37 J	-	-	-	-	-	9.55	539	73.5	32.1	14.8 J	-	-	-
	OU2-MW-6	-	-	-	16.7	-	13,351	0.23 J	1.7	15	0.15 J	0.15 J	-	-	-	-	-	13,100	160	91	25 U	100 U	-	-	-
Facility #2	DW-2	16	5.57	-	13.5	12.0	-	7.2	2.7	3.6	0.1 J	0.5 U	7.34	2.38	2.28	1 U	1 U	-	-	-	-	-	-	-	-
	Eglin-3	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MW-11D	0	17.31	-	10.5	14.5	-	3.7	3.3	3.5	0.5 U	0.5 U	5.48	4.51	4.46	1 U	1 U	-	-	-	-	-	-	-	-
	MW-12D	71	7.12	-	18.9	-	-	12	2.5	4.4	0.5 U	0.5 U	-	-	-	-	-	-	-	-	-	-	-	-	-
	RD-7	74	5.98	-	17.1	-	-	10	2.8	4.3	0.5 U	0.5 U	-	-	-	-	-	-	-	-	-	-	-	-	-
Southern Plume	Delegard	12	-	1.52	1.87	-	-	0.36 J	0.87	1	0.5 U	0.5 U	-	-	-	-	-	-	-	-	-	-	-	-	-
	Laplace	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mathias	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MW-21D	72	29.45	-	25.1	-	-	0.32 J	3.1	19	0.15 J	3	-	-	-	-	-	-	-	-	-	-	-	-	-
	RD-1	6	0.71	-	0	-	-	0.5 U	0.14 J	0.5 U	0.5 U	0.5 U	-	-	-	-	-	-	-	-	-	-	-	-	-
	RD-2	1	0	-	0	-	-	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	-	-	-	-	-	-	-	-	-	-	-	-	-
	RD-3	4	1.6	-	1.5	1.0	-	0.5 U	0.5 U	1.5	0.5 U	0.5 U	2 U	2 U	2 U	2 U	2 U	-	-	-	-	-	-	-	-
	RD-6	8	5.8	-	5.69	-	-	0.99	2	2.7	0.5 U	0.5 U	-	-	-	-	-	-	-	-	-	-	-	-	-
	RD-8	14	0.66	-	0	0	-	0.5 U	0.14 J	0.16 J	0.5 U	0.5 U	1 U	1 U	1 U	1 U	1 U	-	-	-	-	-	-	-	-
	RD-14	-	-	-	0.98	-	-	0.5 U	0.22 J	0.98	0.5 U	0.5 U	-	-	-	-	-	-	-	-	-	-	-	-	-
	RD-4	-	-	-	0	-	-	0.5 U	0.5 U	0.4 J	0.5 U	0.5 U	-	-	-	-	-	-	-	-	-	-	-	-	-
	Smith	11	11.6	21.9	10	4	-	1.7	3.3	5	0.5 U	0.5 U	0.802	1.86	1.62	0.5 U	0.5 U	-	-	-	-	-	-	-	-
	Steele	169	-	7.9	12	19	-	4.8	3.4	3.8	0.08 J	0.5 U	5.18	7.93	6.37	0.5 U	0.5 U	-	-	-	-	-	-	-	-

Notes:

1. Non-detects were assumed to have a value of 0 µg/L.
2. The Smith and Steele VOC samples were most likely mislabeled in April 2007. These wells will continue to be monitored to verify contaminant trends.
3. Samples were not collected from the Eglin-3 well in April 2013 because the supply well pump was broken.
4. The Steele well has not been sampled since April 2015 due to an inoperable well pump.
5. The Steele and Eglin-3 wells have been removed from the list of wells to be sampled annually until well pumps are repaired.
6. Samples were not collected at Delegard or Laplace during the 2018 sampling event. There was no power available and both well pumps were damaged in hurricanes Irma and Maria.
7. Data obtained from Year 14 Tutu Wellfield Annual Report and Final Monitoring and Residential Well Sampling Report

Acronyms:

CVOCs – chlorinated volatile organic compounds DCE – dichloroethene

ID – identification NS – not sampled

TCE – trichloroethene PCE – tetrachloroethene VC – vinyl chloride

µg/L – microgram per liter

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Table 5 – Preliminary Residential Water Analytical Results Summary Table – TCL VOCs
Tutu Wellsfield Site
Anna's Retreat, St. Thomas, U.S. Virgin Island
June 4, 2019

RST 3 Sample Number	EPA MCL ¹	P0001-SMITH-190604-01	P0001-SMITH-190604-02	P0002-STEELE-190604-01	P0003-DELEGARD-190604-01	TB-190604
Sample Matrix		Water	Water	Water	Water	DI Water
Sample Source		Residential Well	Residential Well	Residential Well	Residential Well	Trip Blank
TCL VOC						
Dichlorodifluoromethane	NS	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
Chloromethane	NS	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
Vinyl chloride	2	0.090 U	0.090 U	0.090 U	0.090 U	0.090 U
Bromomethane	NS	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
Chloroethane	NS	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
Trichlorofluoromethane	NS	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
1,1-Dichloroethene	7	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NS	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
Acetone	NS	0.96 U	0.96 U	2.3 J	2.4 J	9.1
Carbon disulfide	NS	0.070 U	0.070 U	0.070 U	0.070 U	0.070 U
Methyl Acetate	NS	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
Methylene chloride	NS	0.090 U	0.090 U	0.090 U	0.090 U	0.44 J
trans-1,2-Dichloroethene	NS	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Methyl tert-butyl Ether	NS	0.17 J	0.16 J	0.28 J	0.080 U	0.080 U
1,1-Dichloroethane	NS	0.090 U	0.090 U	0.090 U	0.090 U	0.090 U
cis-1,2-Dichloroethene	70	4.1	3.9	3.5	0.78	0.100 U
2-Butanone	NS	0.88 U	0.88 U	0.88 U	0.88 U	0.88 U
Bromochloromethane	NS	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
Chloroform	*	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
1,1,1-Trichloroethane	200	0.090 U	0.090 U	0.090 U	0.090 U	0.090 U
Cyclohexane	NS	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U
Carbon tetrachloride	5	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
Benzene	5	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
1,2-Dichloroethane	5	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Trichloroethene	5	2.8	2.7	2.9	0.74	0.090 U
Methylcyclohexane	NS	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
1,2-Dichloropropane	*	0.080 U	0.080 U	0.080 U	0.08 U	0.080 U
Bromodichloromethane	80	0.090 U	0.090 U	0.090 U	0.090 U	0.090 U
cis-1,3-Dichloropropene	NS	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
4-Methyl-2-pentanone	NS	0.54 U	0.54 U	0.54 U	0.54 U	0.54 U
Toluene	1,000	0.090 U	0.090 U	0.090 U	0.090 U	0.63
trans-1,3-Dichloropropene	NS	0.070 U	0.070 U	0.070 U	0.070 U	0.070 U
1,1,2-Trichloroethane	5	0.090 U	0.090 U	0.090 U	0.090 U	0.090 U
Tetrachloroethene	5	1.5	1.5	4.5	0.28 J	0.080 U
2-Hexanone	*	0.81 U	0.81 U	0.81 U	0.81 U	0.81 U
Dibromochloromethane	80	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
1,2-Dibromoethane	0.05	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
Chlorobenzene	100	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U
Ethylbenzene	700	0.080 U	0.080 U	0.080 U	0.080 U	0.12 J
o-xylene	NS	0.100 U	0.100 U	0.100 U	0.100 U	0.13 J
m,p-xylene	NS	0.100 U	0.100 U	0.100 U	0.100 U	0.16 J
Styrene	100	0.100 U	0.100 U	0.100 U	0.100 U	0.55
Bromoform	*	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U
Isopropylbenzene	NS	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
1,1,2,2-Tetrachloroethane	NS	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
1,3-Dichlorobenzene	NS	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
1,4-Dichlorobenzene	NS	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,2-Dichlorobenzene	600	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
1,2-Dibromo-3-chloropropane	0.2	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,2,4-trichlorobenzene	70	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U
1,2,3-Trichlorobenzene	NS	0.090 U	0.090 U	0.090 U	0.090 U	0.090 U

Notes:

RST 3 - Removal Support Team 3

TCL VOC - Target Compound List Volatile Organic Compound

U - Not Detected, J - Estimated Result, UJ - Estimated at the Detection Limit

DI - Deionized

¹U.S. Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCLs), revised March 2018

All data reported in micrograms per liter (µg/L).

*For the total of the four trihalomethanes, the EPA MCL is 80 µg/L

Results in bold font are detections

Table 6 – Validated Residential Well Water Analytical Results Summary Table – TCL VOCs
Tutu Wellsfield Site
St. Thomas, U.S. Virgin Island
October 2019

START V Sample Number	EPA MCL ¹	P0001-SMITH-1101007-01	P0002-STEEL-191007-01-01	P0002-STEEL-191007-02	P0003-DELEGARD-191007-01	P0004-TILLET-101005-01	TB-3-191007-01
Sample Date		10/7/2019	10/7/2019	10/7/2019	10/7/2019	10/5/2019	10/7/2019
Sample Matrix		Water	Water	Water	Water	Water	Trip Blank
Sample Source		Residential Well	Residential Well	Residential Well	Residential Well	Residential Well	Deionized Water
TCL VOC							
Dichlorodifluoromethane	NS	1.0	0.55	0.65	1.6	0.50 U	0.50 U
Chloromethane	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.12 J
Vinyl chloride	2	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Bromomethane	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Chloroethane	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Trichlorofluoromethane	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,1-Dichloroethene	7	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Acetone	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.3
Carbon disulfide	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Methyl Acetate	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Methylene chloride	5	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
trans-1,2-Dichloroethene	100	0.50 U	0.50 U	0.080 J	0.50 U	0.50 U	0.50 U
Methyl tert-butyl Ether	NS	0.19 J	0.27 J	0.31 J	0.50 U	0.50 U	0.50 U
1,1-Dichloroethane	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
cis-1,2-Dichloroethene	70	5.0	3.4	3.8	1.0	5.3	0.50 U
2-Butanone	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Bromochloromethane	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Chloroform	*80	0.72	0.50 U	0.66	0.77	0.50 U	0.50 U
1,1,1-Trichloroethane	200	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Cyclohexane	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Carbon tetrachloride	5	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Benzene	5	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,2-Dichloroethane	5	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Trichloroethene	5	3.3	3.0	3.4	0.87	2.3	0.50 U
Methylcyclohexane	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,2-Dichloropropane	5	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Bromodichloromethane	*80	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
cis-1,3-Dichloropropene	NS	0.50 U	0.50 U	0.50 U	0.5 U	0.50 U	0.50 U
4-Methyl-2-pentanone	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Toluene	1,000	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.45 J
trans-1,3-Dichloropropene	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,1,2-Trichloroethane	5	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Tetrachloroethene	5	1.7	4.1	4.8	0.36 J	20	0.50 U
2-Hexanone	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Dibromochloromethane	*80	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,2-Dibromoethane**	0.05	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Chlorobenzene	100	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Ethylbenzene	700	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.10 J
o-Xylene	² 1,000	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.10 J
m,p-Xylene	² 1,000	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.16 J
Styrene	100	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.19 J
Bromoform	*80	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Isopropylbenzene	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,1,2,2-Tetrachloroethane	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,3-Dichlorobenzene	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,4-Dichlorobenzene	75	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,2-Dichlorobenzene	600	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,2-Dibromo-3-chloropropane**	0.2	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,2,4-trichlorobenzene	70	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,2,3-Trichlorobenzene	NS	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U

Notes:

START V - Superfund Technical Assistance and Response Team

TCL VOC - Target Compound List Volatile Organic Compound.

U - Not Detected, J - Estimated Result, UJ - Estimated at the Detection Limit.

¹U.S. Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCLs) contained in the Drinking Water Standards and Health Advisories (DWSHA), revised March 2018.

All data reported in micrograms per liter (µg/L).

*For the total of the four trihalomethanes, the EPA MCL is 80 µg/L per year.

**Not detected at the Reporting Limit (RL).

²There is no specified federal MCL for m-, p-, and o-xylene, the MCL for total xylene has been utilized.

Results in bold font are detections.

Result equals or exceeds EPA MCL.

APPENDICES

APPENDIX A – REFERENCE LIST

1. US Environmental Protection Agency Record of Decision, Tutu Wellfield, August 5, 1996
2. Forensic Environmental Services, Inc. -Remedial Action Progress Reports - Esso Tutu Service Station - Various Dates
3. MACTEC Engineering and Consulting, Inc.-Remedial Action Progress Report - Chevron/Texaco Tutu Service Station - Various Dates
4. Second EPA Five Year Review Report, September 2014
5. Arrowhead Contracting, Inc.- Annual Remedial Action Progress Reports, September 2014 to August 2018
6. No Further Action (NFA) Report for the Puma Tutu Service Station, October 2016
7. Response to Comments No Further Action (NFA) Request Puma Tutu Service Station, April 2017
8. 2017 Annual Remedial Action Progress Report and Request to Cancel TPDES Permit No. VI0040703 Total Petroleum (former Esso) tutu Service Station, August 2017
9. Final Remedial Investigation Report for the Tutu Wells Superfund Site Operable Unit 2, March 2018
10. Final Focused Source Feasibility Study for the Tutu Wells Superfund Site Operable Unit 2, March 2018
11. Residential Wells Sampling Report for the Tutu Wellfield Site prepared by START V dated August 2019
12. Monitoring and Residential Wells Sampling Report for the Tutu Wellfield Site prepared by START V dated September 2022
13. Remedial Design Report for the Tutu Wellfield OU2 Remedial Design dated December 2023

APPENDIX B – SITE BACKGROUND

Investigation work began at the Tutu Wellfield Site in 1987 in response to complaints from local residents of an odor emanating from their groundwater supply wells. Subsequent groundwater sampling by the EPA's Technical Assistance Team revealed the presence of chlorinated volatile organic compounds (CVOCs) and benzene, toluene, ethylbenzene, and xylenes (BTEX) contaminants in the groundwater above Federal maximum contaminant levels (MCLs) for drinking water. Several of the wells in this area were large commercial wells used for public drinking water supply. The incident led the U.S. Virgin Islands Department of Planning and Natural Resources (DPNR) Commissioner to request EPA to assume the role of lead agency. EPA condemned the contaminated supply wells, made arrangements to provide an alternate drinking water supply to the affected residents and initiated investigations to identify the sources of the contamination. Several residences were identified as being impacted by the contaminated plume. They were the Mathias, Laplace, Harvey, Steele, Smith and Delegard residences.

The site was proposed for addition on the National Priorities List (NPL) in February 1992. Remedial investigation and feasibility study (RI/FS) activities were completed at the site from 1992 to 1995. The Tutu Wellfield site was added to the NPL on September 29, 1995.

The results of the remedial investigations identified four sources of groundwater CVOCs and/or BTEX contamination. The sources are briefly described below:

- Curriculum Center – The northern-most (upgradient) source of CVOC groundwater contamination is located on the Curriculum Center property, which is currently owned and operated by the USVI Department of Education. The Curriculum Center building and property were previously occupied by LAGA Industries, Ltd., who owned and operated a textile manufacturing plant at this location from 1971 to 1978. The plant included an industrial size dry cleaning process that utilized tetrachloroethene (PCE) as the dry cleaning solvent. The RI work revealed the presence of CVOC contaminants in the soil and groundwater at the Curriculum Center property. The portion of the CVOC plume extending downgradient from the Curriculum Center to O'Henry Dry Cleaners, Inc., (O'Henry) is herein referred to as the Northern Plume.
- Texaco Service Station – RI work revealed the presence of BTEX and petroleum hydrocarbon contaminants in the soil and groundwater at the operating Texaco Caribbean, Inc., (Texaco) service station, which is located immediately downgradient (southwest) of the Curriculum Center building. Historically, the facility also included an automotive service station. This is located within the Northern Plume.
- Esso Service Station – RI work revealed the presence of CVOC, BTEX, and petroleum hydrocarbon contaminants in the soil and groundwater at the operating Esso Standard Oil, U.S.A., Inc., (Esso) service station, which is located downgradient (southwest) of Texaco. Historically, the facility also included an automotive service station. This is located within the Northern Plume.
- O'Henry Dry Cleaners – RI work revealed the presence of CVOC contaminants in soil and potentially in groundwater at O'Henry, an operating dry cleaning facility, which is located downgradient (south) of Esso. The portion of the CVOC plume extending south of O'Henry is herein referred to as the Southern Plume.

Additionally, BTEX-impacted soil was encountered at the Ramsey Motors property, located just to the north of the Texaco Service Station and at the Western Auto facility, which is located within the Four Winds Plaza shopping facility, west of the Esso Service Station.

Summary of Site Groundwater Contamination

The Northern Plume originates at the Curriculum Center property, which is located near the intersection of Routes 38 and 384 within the upper northeast reaches of the Turpentine Run Basin Aquifer. The Northern Plume extends site-wide to the lower reaches of the Tutu Valley and is historically believed to have co-mingled with the Southern Plume. Based upon the measured and observed convergent nature of groundwater flow within the Tutu valley, lateral dispersion of contaminants in this zone appears to be limited to a narrow strip along controlling faults and fractures. Vertically, the hydrogeology and contaminant distribution near the Curriculum Center can broadly be subdivided into:

- An upper, more productive zone, extending from the water table (15 to 30 feet below ground surface [bgs]) to a depth of approximately 80 feet.
- A lower, less productive zone, extending from approximately 80 to 140 feet bgs.

Contaminant transport is believed to be controlled by advection, with a discrete plume (with concentrations in excess of 1,000 micrograms per liter [ug/L] CVOCs) extending from north of the Curriculum Center to just north of the Texaco service station (approximately 500 feet downgradient of the center). The Northern Plume is also co-mingled with BTEX plumes that originate from the Texaco and Esso Service Stations. Anaerobic biodegradation of CVOC contaminants may be currently occurring in these sources, based upon the presence of dechlorination products such as trichloroethylene (TCE) and 1,2-dichloroethylene (1,2-DCE).

RI results indicated that a shallow BTEX plume located near the Texaco Tutu Service Station was approximately 400 feet long from north to south and approximately 200 feet wide from east to west. In the deep zone, it was approximately 300 feet by 130 feet in areal extent. The plume was elongated in the direction of shallow groundwater flow and appeared to have migrated past the Tillett Supply Well. The maximum concentrations of benzene, ethylbenzene, and xylenes were 21,000 µg/L, 3,700 µg/l and 18,000 µg/L, respectively. The shallow BTEX plume located near the Esso Service Station measured approximately 250 feet by 175 feet. The maximum concentrations of benzene, ethylbenzene, and xylenes detected at this location were 10,000 µg/L, 4,100 µg/L and 22,000 µg/L. Direct observations of floating product and sheens in some monitoring wells at the Esso and Texaco Service Stations confirmed the presence of light non-aqueous phase liquid (LNAPL).

The Southern Plume originates near the O'Henry facility and in this area there is a noticeable and measurable change in regional groundwater flow direction, from south to southeast. This change is believed to be controlled by regional fault and fracture zones along Turpentine Run, which "channel" groundwater flow toward the lower reaches of Turpentine Run and ultimately the Mangrove Lagoon. The Southern Plume CVOC contamination, therefore, travels within a relatively narrow zone along the southeast-northwest trending Turpentine Run.

Summary of Site Soil Contamination

During the RI, surface and subsurface soil samples were collected from borings and monitoring well boreholes. Soil quality data was collected from 15 properties in the project study area to identify impacted soil. Three properties were identified as having significant CVOC impact to soil, based on

exceedance of EPA's site-specific soil screening levels (SSLs) for impact to groundwater. At the Curriculum Center, contamination was detected at the north-central side of the main building in the vicinity of the former discharge pipe and presumed former waste pit, with PCE concentration up to 1,800 micrograms per kilogram ($\mu\text{g/kg}$) and TCE concentrations up to 130 $\mu\text{g/kg}$. The CVOC 1,1,1-trichloroethane (1,1,1-TCA), was also detected above the EPA's SSLs. The elevated concentrations of CVOCs in groundwater adjacent to and immediately downgradient of the Curriculum Center indicate a high probability that pure product is present in the unsaturated zone as dense non-aqueous phase liquid (DNAPL) at the Curriculum Center. At the Esso Tutu Service Station, PCE, TCE, 1,1,1-TCA, 1,2-DCE, and 1,1-dichloroethane (DCA) were detected above EPA's SSLs at the western portion of the property, near the north oil/water separator at concentrations up to 3,200 $\mu\text{g/kg}$. PCE was found in the vicinity of the O'Henry Dry Cleaners above EPA's SSLs in the southwestern portion of the property at concentrations up to 440,000 $\mu\text{g/kg}$. There is a potential for DNAPL to be present in the subsurface soil in the vicinity of the O'Henry dry cleaners due to significant concentrations of PCE detected in adjacent wells.

The site-specific SSLs for BTEX compounds were exceeded at five properties. At the northeast corner of the Curriculum Center, in an area where a sink from the paint shop drain discharged to the ground, BTEX compounds exceeded EPA's SSLs with benzene concentrations up to 2,700 $\mu\text{g/kg}$ and toluene concentrations up to 500,000 $\mu\text{g/kg}$. Benzene and ethylbenzene were detected in the vicinity of the underground storage tank (UST) at the Ramsay Motors property at levels above the EPA SSLs with maximum benzene concentrations of 17 $\mu\text{g/kg}$ and maximum ethylbenzene concentrations of 290 $\mu\text{g/kg}$. At the Texaco Service Station, BTEX compounds were found in the vicinity of the former USTs and at the oil/water separator at concentrations exceeding EPA's SSLs. Results ranged from 69 $\mu\text{g/kg}$ for benzene to 630 $\mu\text{g/kg}$ for ethylbenzene. At the Western Auto facility, all individual BTEX constituents exceeded EPA's SSLs, with maximum results for toluene and ethylbenzene at 16 $\mu\text{g/kg}$ for each and xylene at 34,000 $\mu\text{g/kg}$. A shallow gravel layer underlying the pavement in this area also contained visible stained oil. The impacted soil was located adjacent to an underground storage tank, which was removed in August 1994. At the Esso Tutu Service Station, BTEX compounds exceeded EPA's SSLs near the gasoline pump island, the north oil/water separator, and the former UST excavation. Individual BTEX concentrations above EPA's SSLs ranged from 26 $\mu\text{g/kg}$ of ethylbenzene to 540,000 $\mu\text{g/kg}$ of xylenes.

At the Tillett Gardens property, no CVOCs or BTEX constituents were detected above screening levels in the site soil. However, elevated concentrations (120,000 $\mu\text{g/kg}$) of the polychlorinated biphenyl (PCB) Aroclor 1242 were detected in one surface sample in 1988. Because this sample concentration resulted in unacceptable risks to human health from direct exposure, EPA collected confirmatory samples from the affected area in August 1995 to delineate the extent of impacted soil. PCBs were not detected in any of the confirmatory samples, indicating that PCBs are no longer a concern at this property.

APPENDIX C – CHRONOLOGY OF SITE EVENTS

Event	Date
Investigation at the Site begins pursuant to complaints from local residents of an odor emanating from groundwater supply wells	1987
Unilateral Administrative Orders (UAO) issued to Texaco, Esso, and O'Henry Dry Cleaners to implement a well-water monitoring program, provide potable water to affected residents, and coordinate design plans to connect affected residents to public water supply	1988 - 1990
Hazard Ranking System package prepared, and Site is proposed for addition to the NPL	February 1992
PA issues Administrative Order of Consent (AOC) to Texaco and Esso to implement an RI/FS	February 1 1992
Various RI/FS activities	1992 - 1995
Western Auto removes underground storage tank and paves the area with a concrete cap	August 1994
EPA issues Consent Order to O'Henry for soil cleanup. Pursuant to the Order O'Henry performs soil removal.	March 1995
Site is added to the NPL	September 1995
ROD signed	August 1996
Construction completed for the Texaco Service Station groundwater and soil treatment system and Vitelco groundwater treatment system. Texaco Service Station system is placed into operation.	1998
EPA issues UAOs to Texaco, Esso, and Western Auto /Four Winds Plaza for RDs/RAs to address site contamination	May 1998
Pre-design investigation performed for Curriculum Center soil and site-wide groundwater	August 1998 November 1999
Esso groundwater and soil treatment system construction completed and system is placed into operation	1999
Pre-design investigation performed at Western Auto/Four Winds Plaza	January- February 1999
EPA issues UAO to O'Henry for RDs/RAs to address site contamination	May 1999
O'Henry Dry Cleaners performs pre-design soil delineation investigation	November 1999
EPA approves No Further Action recommendation regarding ROD specified soil contamination for Western Auto Mart/Four Winds Plaza	January 2000
EPA approves No Further Action recommendation for O'Henry Dry Cleaners	July 2001
EPA completes the design for the Curriculum Center groundwater treatment and SVE, and side-wide groundwater treatment	September 2001
Soil excavation of contaminated soil at Esso Service Station and treatment of soil in bio-cells. Construction of Esso "Hot-Spot" remediation system.	2001 - 2002
Operation of Esso Service Station "Hot-Spot" remediation system	2002 - 2005
Texaco Service Station groundwater and SVE systems shutdown after a pulsing period is conducted	July 2003
MNA activities for Texaco Service Station	July 2003 – present

Site construction completed for Curriculum Center soil and site- wide groundwater. System is placed into operation.	March 2004
Operation, maintenance, and monitoring activities for Curriculum Center SVE and off-gas systems	March 2004 – March 2004
Operation, maintenance , and monitoring activities performed for site-wide groundwater	March 2004 -April 2013
MNA activities for Esso Service Station	2005 - present
Removal and replacement of three underground storage tanks and associated fuel lines performed at the Texaco Service Station	December 2006
Enhanced bioremediation application performed at the Texaco Service Station	January 2007
First Five Year Review report	April 2009
EPA transfer LTRA to Virgin Islands Government	April 2013
Second Five Year Review report	September 2014
OU2 Focused Source Area Remedial Investigation fieldwork	April 2016 – June 2017
OU2 Focused Source Area Remedial Investigation Report/Feasibility Study	March 2018
Residential Wells Sampling report prepared by START V	August 2019
Third Five Year Review Report	September 2019
OU2 Pre-Design Investigation	December 2022 – May 2023
OU2 Remedial Design Completed	December 2023

APPENDIX D – EVALUATION OF CLIMATE CHANGE RESILIENCY

Introduction

EPA issued a *Policy Statement on Climate Change Adaptation* in 2011 to integrate climate adaptation into the Agency's programs, policies, rules and operations. EPA Region 2 completed an *Integration Adaption Plan* in 2014, which determined that potential climate change impacts would be evaluated in the Five-Year Reviews (FYR) of National Priorities List (NPL) sites. In 2021, Region 2 issued regional practices for evaluating the impact of Climate Change and screening sites for climate vulnerabilities.

Potential impacts of Climate Change on the Tutu Wellfield Superfund Site were evaluated for this five year review based on EPA's *Guidance for Incorporating Climate Change Considerations into Five Year Reviews Version 2*, dated July 26, 2022. This document provides direction and tools to be utilized in assessing the climate resilience of Superfund Sites.

Potential vulnerabilities that are likely to affect contaminated sites are identified in the guidance. The Tutu Wellfield Site falls under the category of Ex-Situ Groundwater Treatment, which is considered to be vulnerable to sea level change, flooding and drought conditions. The guidance goes on to provide tools to evaluate climate data and indicators including:

- *The Climate Explorer* (temperature/precipitation/drought),
- *Risk Factor* (inland flooding),
- *NOAA Sea Level Rise Viewer* (sea level rise) and
- *USGS National Landslide Inventory* (landslides).

The tools provide limited data on the Tutu Wellfield area because it is located in St. Thomas, USVI and not within the mainland United States. When data were available, they were based on nearby locations such as Charlotte Amalie, which is at a lower elevation adjacent to the ocean, or Puerto Rico. Climate change vulnerability mapping was not available from *The Climate Explorer*, mapping of inland flood prone areas was not available from the *Risk Factor* and site-specific landslide data were not available from the *USGS National Landslide Inventory*. However, the tools did provide sufficient data to evaluate Climate Change vulnerability for the Site and FEMA flood hazard mapping shows current flood zones in the site area.

Climate Change Vulnerability Assessment

The Climate Explorer indicates that precipitation, and the number of days that exceed or fall below the average, are expected to remain relatively consistent well into the future and drop, slightly, in 50 to 60 years (**Figure 1**). The mean, maximum and minimum temperature is expected to steadily increase in the future (**Figure 2**). However, the area is moderated by sea breezes and average temperatures are not expected to exceed 90° F on a regular basis until 2070 (**Figure 3**). As noted on the figures, the temperature data are for northeastern Puerto Rico, although it is expected that conditions will be similar at the Tutu Wellfield Site. St. Thomas is in a hurricane prone area. Increased air and ocean temperatures can be expected to increase the severity of hurricanes in the future.

The potential impact of local flooding was evaluated using a combination of FEMA flood hazard mapping and the *Risk Factor* (formerly *Flood Factor*) tool because local mapping at St. Thomas was not provided in the tool. As shown on **Figure 4**, Treatment Facility #1 is located adjacent to a FEMA flood zone, and Treatment Facility #2 is located just within a flood zone. Neither facility has experienced

flooding in 19 years of operation. Although flooding potential will continue to exist, the *Risk Factor* indicates that the risk of major flooding in the future related to Climate Change is expected to be less; consistent with anticipated rainfall trends. This projection is also for Puerto Rico, but is expected to apply to the Tutu Wellfield area as well.

The *Sea Level Rise* tool did provide data specific to St. Thomas. As shown on **Figures 5, 6 and 7**, the Tutu Wellfield site is not currently, and is not expected to be, vulnerable to Climate Change-related sea level rise. The ground surface elevation of the site is approximately 200 feet above mean sea level. The site is mapped as an upland area (**Figure 6**) and the impacts of flooding related to seal level rise are only expected at the island perimeter where elevations are a few feet above sea level (**Figure 5**). The tool indicates that the Tutu Wellfield site is not in an area considered vulnerable to sea level rise (**Figure 7**).

The *USGS National Landslide Inventory* did not provide mapping for St. Thomas as previously mentioned. Although the site is at the base of a steep slope, the landslide potential is expected to be low because there is only a thin veneer of soil overlying bedrock in the area. Recent category 5 hurricanes Irma and Maria resulted in soil transport into the nearby Turpentine Run floodplain but did not impact the groundwater extraction system or the treatment plant area.

Conclusions

Based on an assessment of Climate Change vulnerability, the Tutu Wellfield site and performance of the remedy is currently not at risk due to the expected effects of climate change in the region and near the site. However, the Site will continue to be at risk from inland flooding, high winds and power outages from hurricanes and tropical storms, as was experienced during hurricanes Irma and Maria. The current systems have been constructed with resilience measures for these weather events. All equipment is housed in concrete structures to guard against flooding and heavy winds. Wells are sealed in heavy duty vaults, and the systems are shut down when there is an approaching storm to protect electrical systems from power surges or outages.

Figure 1

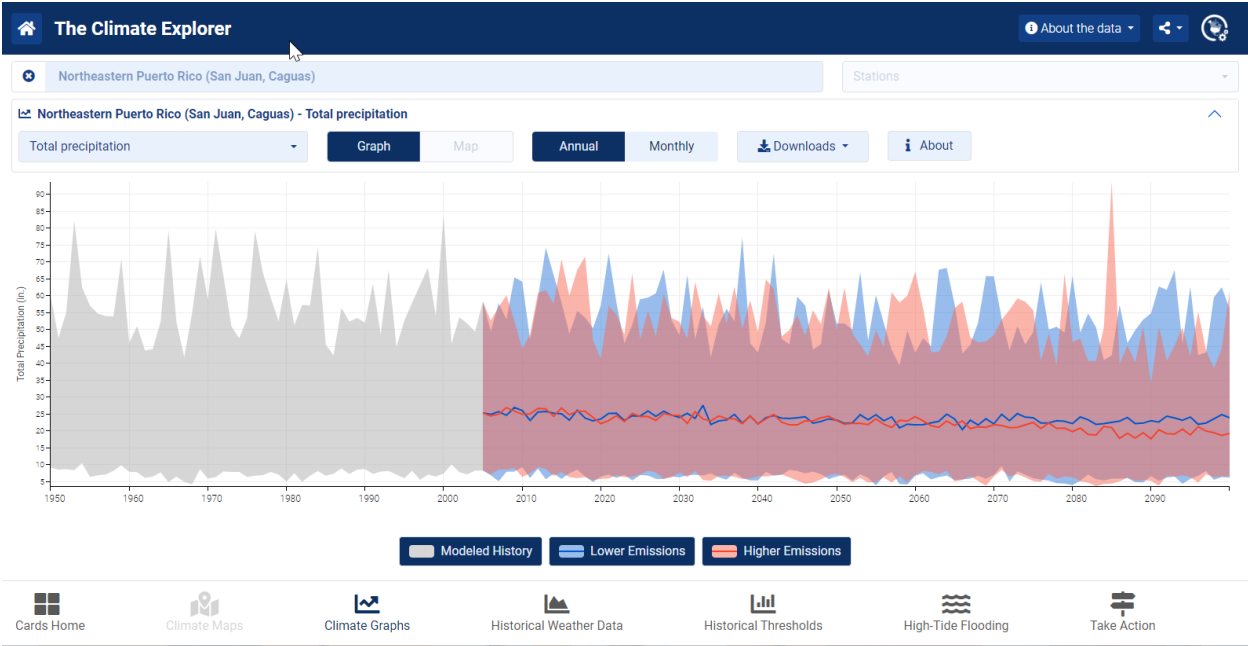


Figure 2

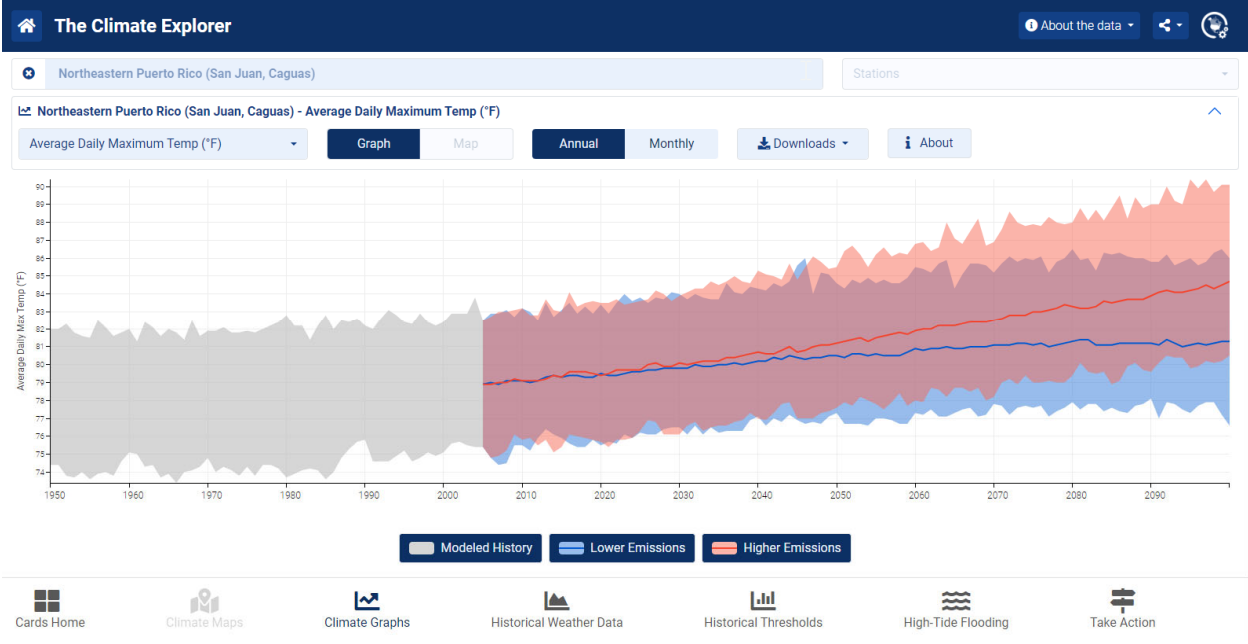


Figure 3



Figure 4a

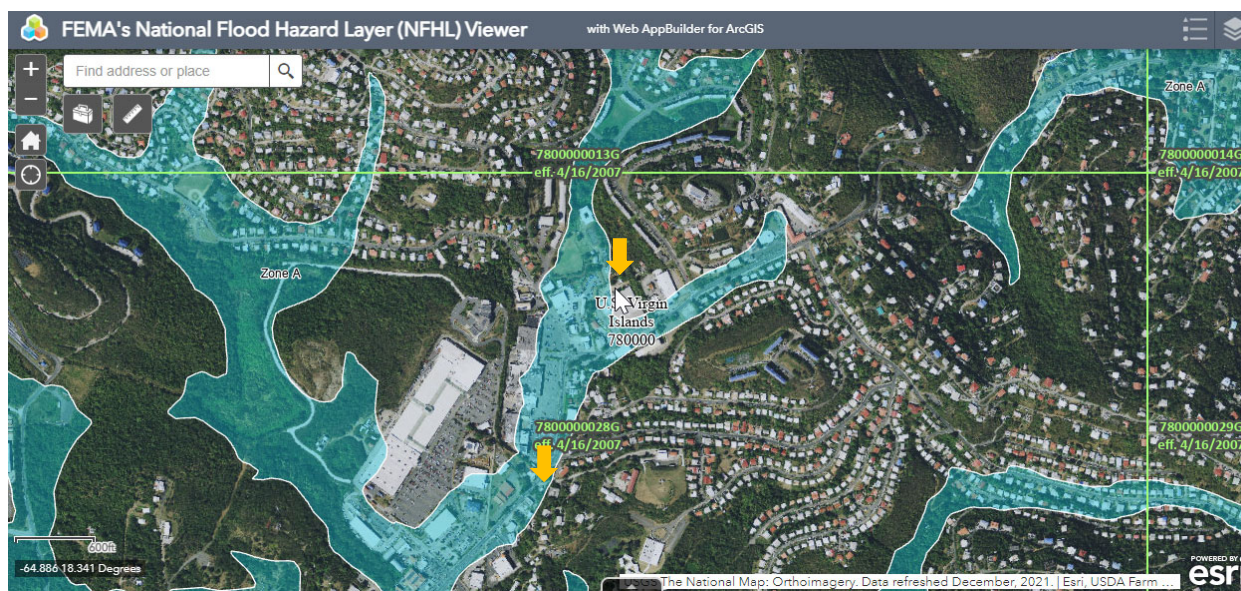


Figure 4b



CURRENT & FUTURE RISK

Anticipating Changes in Flood Risk for Puerto Rico

Deeper floods from major events, like hurricanes, are less likely to occur, but affect more properties than more shallow flood events, like heavy rains.

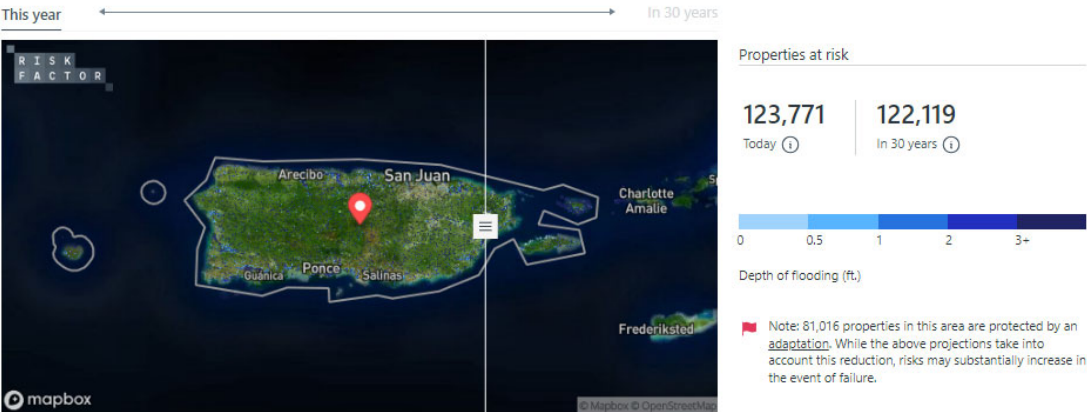


Figure 5

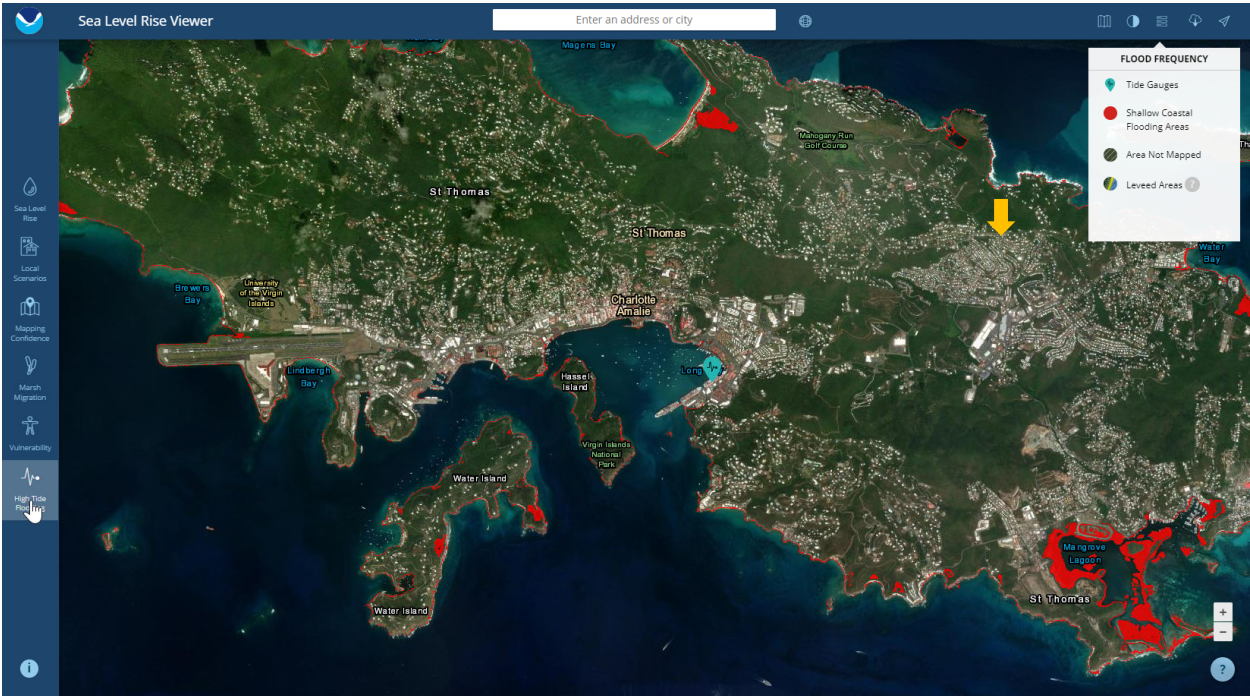


Figure 6

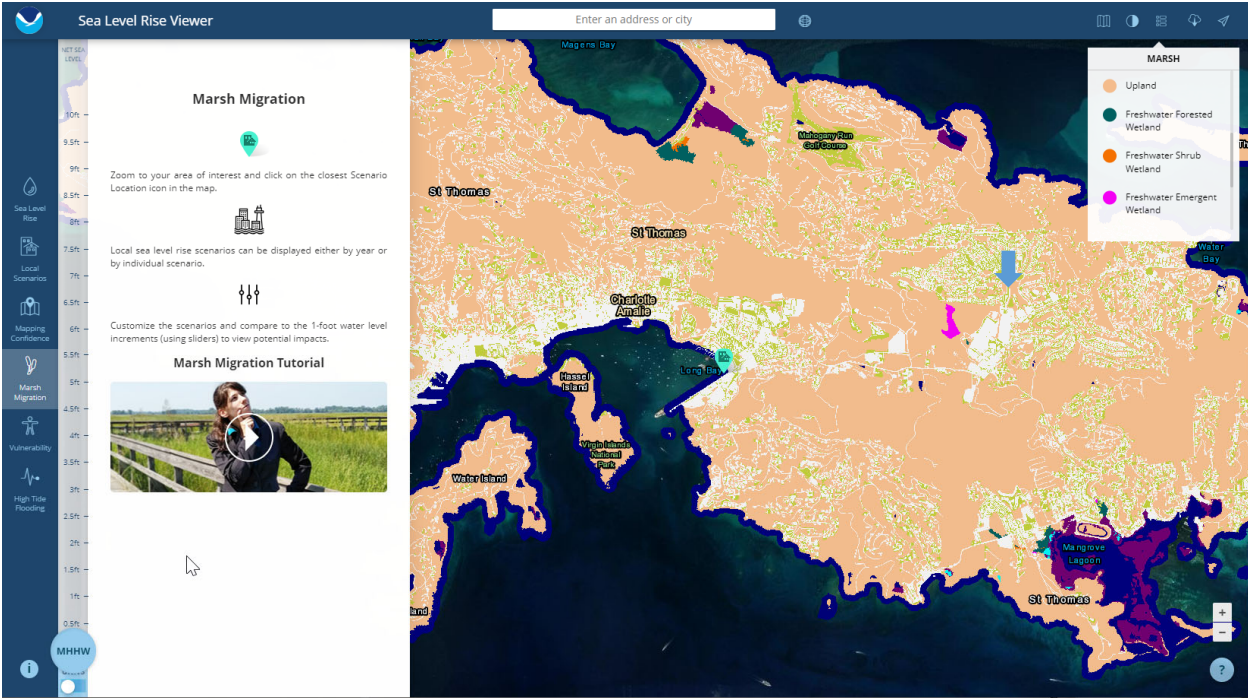


Figure 7

