RECORD OF DECISION

Operable Unit 2
Tutu Wellfield Superfund Site
St. Thomas, U.S. Virgin Islands

United States Environmental Protection Agency
Region 2
New York, New York
September 2021

550186

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The Responsiveness Summary is provided as a separate attachment to this Record of Decision.

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PART 1 DECLARATION

SITE NAME AND LOCATION

Tutu Wellfield Superfund Site
St. Thomas, U.S. Virgin Islands
Superfund Site Identification Number: VID982272569
Operable Unit: 02

STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) documents the U.S. Environmental Protection Agency's (EPA's) selection of a remedy for Operable Unit 2 (OU2) at the Tutu Wellfield Superfund Site (Site), in St. Thomas, U.S. Virgin Islands. The remedy is chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, also known as Superfund), as amended, 42 U.S.C. §§ 9601-9675, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300. This ROD and decision summary document the factual and legal basis for selecting this remedy to address OU2 at the Site. The attached index (see Appendix III) identifies the items that comprise the Administrative Record for this decision, upon which the selected remedy is based.

The United States Virgin Islands (USVI) Department of Planning and Natural Resources (DPNR) was consulted on the selected remedy in accordance with Section 121(f) of CERCLA, 42 U.S.C. § 9621(f), and concurs with the selected remedy (see Appendix IV).

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from the Site, if not addressed by the implementation of the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The Site has been divided into two operable units. In July 1996, a remedy was selected for Operable Unit 1 (OU1) to address site-wide groundwater contamination. The OU1 remedy was designed to address three distinct plumes of groundwater contamination, one upgradient plume consisting of chlorinated volatile organic compound (CVOC) contamination and two other plumes consisting of petroleum products from two downgradient service stations, as well as additional downgradient CVOC contamination from a secondary source that co-mingles with the upgradient CVOC plume.

The OU1 remedy consisted of extraction of contaminated groundwater, ex-situ treatment, discharge of the treated groundwater to a nearby stream, and institutional controls (ICs), and it has been operating since 2004. While it is effectively controlling migration of the petroleum and CVOC plumes, monitoring conducted since 2004 has shown that concentrations in the CVOC plume are not decreasing as quickly as anticipated. This suggests that the source of contamination is more extensive than originally understood and indicates the potential presence of dense, non-aqueous phase liquid in the upgradient primary source area. Therefore, in April 2015, EPA determined that it was necessary to initiate Operable Unit 2 (OU2) at the Site to further investigate potential contaminant source areas and to evaluate options to accelerate the cleanup of groundwater contamination at the Site.

This selected remedy is for OU2, as described in this document, and it addresses the groundwater source area located at what is referred to as the Curriculum Center property, which 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 migration of contamination from the source area, as well as discharge to Turpentine Run (to be determined during the remedial design);
- Instituting alternate pumping and dual-phase extraction /enhanced fluid recovery 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 institutional controls, including DPNR well use laws, to ensure that the remedy remains protective until RAOs are achieved for protection of human health over the long-term; and
- Development of a Site Management Plan to ensure proper management of the Site remedy post-construction that would include long-term groundwater monitoring, institutional controls, vapor intrusion restrictions and periodic reviews, as applicable.

The effectiveness of the selected remedy will be evaluated based upon the attainment of specific performance standards and remediation goals (e.g., reduction in CVOC concentrations, hydraulic control, etc.) during the five-year reviews. Should the selected remedy fail to attain these standards and goals or should its implementation prove ineffective, Alternative 2B, "Expand Existing Groundwater Extraction and Treatment System with AS/SVE", would be evaluated as a contingency remedy. Specifically, the contingency remedy will be implemented if:

- 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.

Should the selected remedy, with the contingency remedy, still prove to be ineffective, the need for a technical impracticability waiver would be evaluated, in consultation with EPA headquarters.

The estimated cost of the selected remedy is $13,828,982.

In an effort to enhance the environmental benefits of the selected remedy, consideration will be given, during the design, to technologies and practices that are sustainable, in accordance with EPA Region 2's Clean and Green Energy Policy.[1] This will include consideration of green remediation technologies and practices.

DECLARATION OF STATUTORY DETERMINATIONS

The selected remedy meets the requirements for remedial actions set forth in Section 121 of CERCLA, 42 U.S.C. § 9621, because it meets the following requirements: 1) it is protective of human health and the environment; 2) it meets a level or standard of control of the hazardous substances, pollutants, and contaminants that at least attains the legally applicable or relevant and appropriate requirements under federal and state laws unless a statutory waiver is justified; 3) it is cost-effective; and 4) it utilizes permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable. In addition, Section 121 of CERCLA, 42 U.S.C. § 9621, includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances as a principal element. The selected remedy satisfies the preference for treatment, as it will result in the extraction and ex-situ treatment of contaminated groundwater from the aquifer prior to discharge of the treated groundwater via reinjection back to the aquifer.

While this alternative would ultimately result in reduction of contaminant levels in groundwater such that levels would allow for unlimited use and unrestricted exposure, it is anticipated that it would take longer than five years to achieve these levels. As a result, in accordance with CERCLA, this selected remedy is to be reviewed at least once every five years until remediation goals are achieved and unrestricted use is achieved.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for this action.

- ✓ A discussion of the current nature and extent of contamination is included in the "Summary of Site Characteristics" section.
- ✓ Chemicals of concern and their respective concentrations may be found in the "Summary of Site Characteristics" section.
- ✓ Potential adverse effects associated with exposure to Site contaminants may be found in the "Summary of Site Risks" section.
- ✓ A discussion of groundwater remediation goals for chemicals of concern may be found in

1 See https://www.epa.gov/greenercleanups/epa-region-2-clean-and-green-policy.

the “Remedial Action Objectives” section and in Table 7, in Appendix II.

- ✓ A discussion of principle threat waste is contained in the “Principle Threat Wastes” section.
- ✓ Current and reasonably anticipated future land use assumptions are presented in the “Current and Potential Future Land and Resources Uses” section.
- ✓ Estimated capital, operation and maintenance, and total present-worth costs are discussed in the “Cost” subsection of the “Description of Remedial Alternatives” section.
- ✓ Key factors that led to selecting the remedy (i.e., how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) may be found in the “Comparative Analysis of Alternatives” and “Statutory Determinations” sections.

AUTHORIZING SIGNATURE

Evangelista, Pat Digitally signed by Evangelista, Pat Date: 2021.09.30 13:19:52 -04'00'

09/30/2021

Pat Evangelista
Director
Superfund and Emergency Management Division

Date

PART 2 DECISION SUMMARY

1. SITE NAME, LOCATION, AND DESCRIPTION

The Tutu Wellfield Site is located in St. Thomas, U.S. Virgin Islands (USVI). The selected remedy described herein addresses the source area portion of the Site, referred to as Operable Unit 2 (OU2), which includes an area of approximately 1.5 square miles of the Tutu Valley in the Anna's Retreat section of St. Thomas, east of the city of Charlotte-Amalie. A Site location map is provided as Figure 1, which can be found in Appendix I.

The Site has been divided into two operable units. In July 1996, a remedy was selected for what is now designated as Operable Unit 1 (OU1) to address site-wide groundwater contamination. The OU1 remedy was designed to address three distinct plumes of groundwater contamination, one consisting of chlorinated volatile organic compounds (CVOCs) and two others consisting of petroleum products from two service stations, as well as additional downgradient CVOC contamination from a secondary source that co-mingles with the upgradient CVOC plume at a downgradient location.

The OU1 remedy consisted of extraction of contaminated groundwater, ex-situ treatment, discharge of the treated groundwater to a nearby stream, and institutional controls (ICs), and has been operating since 2004. While it is effectively managing the CVOC plume, monitoring conducted since 2004 has shown that concentrations in the CVOC plume are not decreasing as quickly as anticipated. This suggests that the source of contamination is more extensive than originally understood and indicates the potential presence of dense, non-aqueous phase liquid (DNAPL) in the upgradient primary source area. Therefore, in April 2015, EPA determined that it was necessary to initiate an OU2 at the Site to further investigate potential contaminant source areas and to evaluate options to accelerate the cleanup of groundwater contamination at the Site.

OU2 focuses on the source area of groundwater contamination located at what is referred to as the Curriculum Center property, located at 386 Smith Bay Road (Highway 38) in St. Thomas. 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 parking areas are located on the north side of the building. The existing, northern groundwater treatment system that is part of the OU1 remedy at the Site is located on the north side of the building. The Curriculum Center building was condemned after sustaining extensive damage during Hurricanes Irma and Maria in 2017. Site and building conditions will be further evaluated during remedy design.

2. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Curriculum Center property is currently owned by USVI. The property was originally owned by LAGA Industries, Ltd. (LAGA), which began operation of a textile manufacturing facility at the property in 1969. In 1970, LAGA was sold to the Duplan Corporation, at which time Duplan reportedly began dry-cleaning operations at the property, using tetrachloroethene (PCE) as the dry-cleaning fluid. Duplan filed for bankruptcy in 1976 and ceased all operations at the property in late 1978. Panex Co. (a corporation formed by the former owners of LAGA) purchased the facility in Duplan's bankruptcy in 1979 and sold it to USVI in 1981. Information on operations at the property during Panex's ownership is not available. From 1982 to 2017, the building was used by USVI's Department of Education as a book repository/library, warehouse with cold storage, maintenance shop, and school district administrative offices.

Multiple investigations have been performed at the Curriculum Center property since 1982. The original remedial investigation (RI) identified three plumes, a plume of groundwater contaminated with CVOC and two other plumes of groundwater contaminated with gasoline components (the latter two referred to as the Texaco and Esso plumes) that co-mingle with the CVOC plume. In that report, EPA concluded that the CVOC plume originated at or near the Curriculum Center and extended beyond the former O'Henry Dry Cleaners building (a potential secondary source) and followed an eastward path towards a local stream that is named Turpentine Run.

In 1995, the CVOC plume extended approximately 1,600 feet to the southwest from the Curriculum Center to Four Winds Plaza and was approximately 500 feet wide. The highest concentrations of total CVOCs were observed in the shallow zone monitoring wells (less than 90 feet below grade surface (bgs)) near the northern source area at the Curriculum Center property. The CVOCs detected at Curriculum Center were 1,1 dichloroethene (1,1-DCE), *cis*-1,2-dichloroethene (*cis*1,2-DCE), *trans*-1,2-dichloroethene (*trans*-1,2-DCE), PCE, trichloroethene (TCE), and vinyl chloride (VC). The highest concentrations detected were 2,100 micrograms per liter (µg/l) of *cis*-1,2-DCE, 1,300 µg/l of VC, 360 µg/l of PCE, and 78 µg/l of TCE; all exceeded their respective Maximum Contaminant Levels (MCLs). In the RI, EPA concluded that the elevated concentrations of CVOCs in groundwater adjacent to and immediately downgradient of the Curriculum Center indicated a high probability that PCE, a primary component of the CVOC plume, was present as DNAPL in the saturated and/or unsaturated bedrock.

The 1996 OU1 remedy for the Site was to address the site-wide groundwater contamination, calling for extraction of contaminated groundwater, ex-situ treatment, surface discharge of the treated groundwater, and institutional controls (ICs).

Following completion of the OU1 remedial design (RD) in September 2001, EPA constructed Groundwater Treatment Facility Number 1 (GWTF #1) at the Curriculum Center property in an effort to achieve hydraulic control of the northern portion of the plume and remove CVOC mass from the saturated zone. A separate, second treatment facility, GWTF #2, is located downgradient of GWTF #1 and addresses downgradient central portions of the plume, north of the O'Henry Dry Cleaners (see Figure 2).

EPA completed construction of GWTF #1 in 2004, which initially consisted of three groundwater extraction wells, an equalization tank, and a transfer pumping system, bag filters, a low-profile air stripper, and an off-gas treatment system. Use of the off-gas treatment system was discontinued in April 2006 after CVOC concentrations dropped below the air pollution control permit equivalency limits. One granular activated carbon filter unit and one potassium permanganate unit remain at the Curriculum Center on standby for emergency use, if needed. Chemical feed systems were also included in the treatment system for sequestrant/biocide injection and pH adjustment.

The three groundwater extraction wells associated with GWTF #1 are RW-6, RW-7, and RW-9 (see Figure 3). Extraction wells RW-7 and RW-9 are screened to a depth in the shallow, more productive portion of the aquifer, with access to the groundwater at 30 to 80 feet bgs and 40 to 60 feet bgs, respectively. Extraction well RW-6 is screened in the deeper, less productive portion of the aquifer with an open interval from 80 to 130 ft bgs. Extraction well RW-7 is operated on a continuous basis. Extraction well RW-9 operates as required to maintain the target groundwater elevation and is typically operated during and following heavy rain events. Extraction well RW-6 is operated approximately one hour per week, at a flow rate of approximately two gallons per minute (gpm), until the extraction well pump shuts down as a result of a low water level in the well. Treated water is discharged to Turpentine Run on the adjoining property to the northwest.

Overall, the OU1 site-wide remedy was operated by EPA from 2004 to 2013. Operation and maintenance (O&M) of the treatment systems was transferred from EPA to the USVI government in April 2013. As part of the long-term response action for the Site, groundwater monitoring is routinely completed to assess progress. Groundwater monitoring was completed on a quarterly basis from system startup in 2004 until April 2007, and it has been conducted annually since 2007. Groundwater from a total of 30 monitoring and residential wells is analyzed for the presence of Site-related contamination as part of Site monitoring, and groundwater levels are measured on a monthly basis from 36 monitoring wells. Influent monitoring is performed monthly at two of the extraction wells (RW-6 and RW-7) using the GWTF #1 influent sampling port.

A soil vapor extraction (SVE) system was constructed in 2004 to remediate the unsaturated zone source of the CVOC groundwater contamination. The system included two SVE wells with discharge to the GWTF #1 off-gas treatment system. The system was shut down in April 2006 because of a significant decrease in influent concentrations and achievement of asymptotic conditions.

EPA's Environmental Response Team (ERT) performed two investigations to characterize the potential for vapor intrusion into the Curriculum Center building. The investigations were performed in December 2007 and December 2011. The extent of soil vapor with elevated concentrations of PCE and TCE did not change noticeably between the two sampling rounds. All but one sample exceeded the soil vapor action level for PCE. The area of the highest sub-slab concentrations was found in the warehouse area located in the central portion of the Curriculum Center building and extends into the adjoining maintenance and office areas. The extent of TCE concentrations that exceeded subslab screening levels coincides with the area of highest PCE concentrations, which also serves as evidence of source material underlying the Curriculum Center. Sampling revealed that indoor air was not impacted above levels of concern. A 2011 evaluation of the remediation system resulted in a conclusion that extraction well RW-7 was too far upgradient to effectively contain the Curriculum Center source area, and it was recommended that additional wells screened across the shallow and deep zones be considered.

Consistent with the law, EPA formally has reviewed the OU1 remedy every five years to assure it is meeting its remedial action objectives. Results of the second five-year review, completed in 2014, revealed that the OU1 remedy would not achieve its objective of restoring the aquifer to drinking water standards. Of particular concern to EPA was the potential presence of DNAPL as an ongoing source of groundwater contamination for the deep aquifer in the northern portion of the groundwater plume. The review resulted in a recommendation for the installation of additional wells to further evaluate the presence of DNAPL, an evaluation of groundwater monitoring results, and the development of a conceptual site model to determine a strategy for addressing the ongoing sources of CVOCs at the Curriculum Center.

3. HIGHLIGHTS OF COMMUNITY PARTICIPATION

On July 14, 2021, EPA re-released the 2018 proposed plan (Proposed Plan) to the public for comment setting forth EPA's preferred alternative for addressing the above-described potential source areas. Supporting documentation comprising the administrative record supporting the decision was made available to the public at the following information repositories: the EPA Virgin Islands Field Office in St. Thomas; the EPA Region 2 Office in New York City; and EPA's website for the Site at https://www.epa.gov/superfund/tutu-wellfield. This Proposed Plan was updated from a 2018 Proposed Plan that was first released by EPA for public comment on August 8, 2018.

A news release announcing the Proposed Plan, which included the dates of the public comment period, the availability of the pre-recorded Public meeting, and the availability of the above-referenced documents in the administrative record was issued to the publication, *The Source,* and posted on EPA's Region 2 website on July 14, 2021

The public comment period began on July 14, 2021with release of the Proposed Plan and closed on August 13, 2021. No comments were received during this period. A copy of the public notice published in *The Source* along with responses to the questions and comments received during the public comment period can be found in the attached Responsiveness Summary (See Appendix V). Comments were received during the initial comment period that was held from August 8, 2018 to September 7, 2018 when the proposed plan was initially released. These commenters were generally supportive of the proposed alternative, and the comments were related to the remedy details, public health concerns, the location of the treatment system components, and the schedule for implementation of the remedy. For completeness and full transparency, these comments and the responses developed in 2018 are included in the attached Responsiveness Summary (see Appendix V).

4. SCOPE AND ROLE OF RESPONSE ACTION

As mentioned above, the Site has been divided into two operable units. In what is now called the OU1 ROD, a remedy was selected in 1996 to address what was intended to be the entire Site as one operable unit. The 1996 remedy was designed to address three distinct plumes of groundwater contamination, one consisting of CVOCs and two others consisting of petroleum products from two service stations (the Texaco and Esso plumes). A secondary source of CVOC contamination originates from the O'Henry Dry Cleaners building and co-mingles with the primary CVOC plume downgradient of the primary plume source. The 1996 OU1 remedy called for extraction of contaminated groundwater, ex-situ treatment, discharge of the treated groundwater to a nearby stream, and the implementation of ICs (Figure 2).

The 1996 OU1 remedy has been constructed and operating since 2004 and is effectively controlling migration of the petroleum and CVOC plumes. However, monitoring conducted since 2004 has revealed that concentrations in the CVOC plume are not decreasing as quickly as anticipated, suggesting that an unidentified source might still be present in the northern part of the CVOC plume. Therefore, in April 2015, EPA determined the need to investigate additional potential contaminant source areas and to evaluate options to accelerate the cleanup of groundwater contamination at the Site. The process of re-evaluating the 1996 OU1 remedy at the primary CVOC source area (Curriculum Center) is referred to as OU2.

The primary objectives of the OU2 remedy are to accelerate the remediation of the source area groundwater contamination, restore groundwater quality to its most beneficial use (i.e., federal drinking water standards, or MCLs), and minimize any potential future health and environmental impacts.

5. SUMMARY OF SITE CHARACTERISTICS

5.1 Hydrogeology

The water table at the Site is located in bedrock, roughly 15-30 feet bgs. Based on previous investigations, the saturated zone of bedrock can be divided into two zones:

- An upper, more productive zone that extends from the water table (15 to 30 feet bgs) to a depth of 80 to 90 feet bgs;
- A lower, less productive zone that extends from 80 to 90 feet bgs to 200 feet bgs.

There are geologic deposits called andesitic tuff and/or andesitic breccia at the Site that have primary (matrix) and secondary (fracture) porosity. Advective groundwater flow occurs through the secondary porosity while the primary porosity can act as a potential storage zone of contaminants. Groundwater flow in the upper zone is relatively fast, and flow in the lower zone is relatively slow as a result of a low hydraulic conductivity. The degree and aperture of fracturing observed from 80 to 200 feet bgs suggests limited potential for contaminant migration in the lower, less productive zone.

The area around the Curriculum Center is in the Upper Turpentine Run surface drainage basin of the Tutu Valley. This basin covers approximately 2.3 square miles, trends roughly north-south, and is bounded by the steep slopes of the surrounding hills. Turpentine Run is a dry stream bed with intermittent storm water flow from surface runoff after heavy rains. Groundwater does not discharge to Turpentine Run within the OU2 study area. Treated water from GWTF #1 at the Curriculum Center is discharged to Turpentine Run at the adjoining property to the northwest. Turpentine Run is partially channelized (about 1,000 feet total, 750 feet upgradient and 250 feet side gradient of the Site) and runs through a culvert for approximately 3,000 feet within the Upper Turpentine Run surface drainage basin of the Tutu Valley.

5.2 Summary of the Focused Source Remedial Investigation

The Focused Source Remedial Investigation (FSRI) Report, dated March 2018, provides the analytical results of sampling conducted between April 2016 and June 2017, the purpose of which was to further investigate the source or sources of groundwater contamination in the northern portion of the Site, specifically in the area of the Curriculum Center property. The FSRI activities included a surface geophysical survey, rock matrix diffusion sampling and analysis, borehole geophysical investigation, packer testing and sampling, monitoring well installation, groundwater sampling and level monitoring, and DNAPL monitoring.

The investigation focused on six contaminants, based on the Site history, frequency of detection, and concentrations that exceeded remediation goals established in the OU1 remedy: PCE, TCE, 1,1 DCE, *cis*1,2-DCE, *trans*-1,2-DCE, and VC.

The following conclusions were made based on the FSRI results:

- The bedrock aquifer can be divided into two general zones, a shallow, more hydraulically conductive zone at depths less than 90 feet bgs, and a deep, less conductive zone between the approximate depths of 90 and 140 feet bgs. Water bearing fractures in the vicinity of the Curriculum Center property are consistent with regional trends. The degree and orientation of fracturing observed below 140 feet bgs suggests limited potential for vertical contaminant migration below this depth;

- DNAPL is present within the shallow and deep bedrock zones based on direct observation and the presence of high levels of dissolved phase contamination. Evidence also indicates that DNAPL may be present in multiple source areas, such as on the surface of bedrock either beneath the Curriculum Center building, at the suspected waste pit, or in the former drum storage area. DNAPL is present in a partially mobile state and will act as an ongoing source of dissolved phase contamination at the Curriculum Center property;

- Dissolved phase CVOC contamination consisting of PCE, TCE, *cis*-1,2-DCE and VC is present at the Curriculum Center property ranging in concentration from low µg/l to milligram per liter concentrations. The plume of contaminated groundwater is primarily located in the shallow bedrock zone on the northeast side of the Curriculum Center and migrates by advective transport to the southwest. Contaminants have also migrated to the east of the Curriculum Center along a deformation zone located along the north side of the building and into the deep zone at the southwest corner of the building most likely through high angle fractures. This is further evidence that source material is underlying Curriculum Center;

- Matrix diffusion data indicate that contamination of the rock matrix can be expected in areas where high levels of CVOCs are present in groundwater. Based on desktop calculations, CVOCs present in the rock matrix will continue to back-diffuse from the rock matrix and impact groundwater in the Curriculum Center area for an estimated 17-25 years after source removal. This remediation timeframe is lower than typically seen when matrix diffusion is occurring because the median rock porosity is relatively low at 3%, meaning remediation timeframes are not as limited by back diffusion because there is less mass being stored in the rock;

- The degree of reductive dechlorination varies throughout the Curriculum Center area. PCE degradation on the northwest side of Curriculum Center has resulted in high levels of TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and VC, while areas to north, east, and south show more limited levels down to no degradation;

- The influence of the existing extraction system is dependent on the fractures, fracture systems, and faults that intersect the extraction wells. Although the impact of pumping can be observed at distances of 50 feet or more, the capture zone of the existing extraction system does not extend the full width of the plume or far enough in a downgradient direction to contain potential source material in the drum disposal area or in the immediate area of monitoring well OU2-MW3 at the southwestern corner of the Curriculum Center; and

- Based on visual evidence and concentrations indicative of DNAPL, the presence of DNAPL has been confirmed in the fractured bedrock aquifer underlying the Curriculum Center property.

5.3 Supplemental Post-Hurricane Sampling Event

The Final Monitoring and Residential Well Sampling Report, dated January 2020, provides analytical results of sampling conducted in June and October 2019 to confirm groundwater quality conditions after the Tutu Wellfield groundwater treatment facilities were shut down on September 2, 2017 as a result of hurricanes Irma and Maria. The treatment facilities were offline because of power-related issues. EPA used Recovery funding to repair and replaced all the pumps and computer panels in 2020. The treatments plants are currently operating.

Analytical results confirmed the extent of chlorinated ethenes in groundwater both within the OU2 study area and the larger downgradient plume, although concentrations in samples from Curriculum Center wells were generally lower than those established in the FSRI. The plume extent, based on October 2019 results, is shown on Figure 2. The report also indicated that concentrations detected in residential wells were generally below MCLs, with the exception of TCE exceeding its MCL at one residential well, which is use for irrigation purposes only.

6. CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

Land Use

The land in Anna’s Retreat section of St. Thomas, where the Curriculum Center source area is located, is used for a variety of institutional and commercial uses.

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. GWTF #1 is located on the north side of the building. The Curriculum Center building was condemned after sustaining extensive damage during Hurricanes Irma and Maria in 2017 and currently is unoccupied. Site and building conditions will be re-evaluated during remedy design.

The Curriculum Center property is bordered to the east by a steep wooded hillside, approximately 30-foot high, and a Virgin Islands Housing Authority property. That property includes maintenance areas, offices, and a police station. An elementary school borders the property to the north. The property is bordered to the west by an automobile dealership (Metro Motors) and the Tutu fire station. Smith Bay Road (Highway 38) and a Seventh Day Adventist church and school border the property to the south. The surrounding properties to the north, east and south are generally higher in elevation than the Curriculum Center, while properties to the northwest, west and southwest are generally lower in elevation. Turpentine Run crosses the adjoining school and car dealership properties to the north and west of the Curriculum Center.

EPA does not have a basis to anticipate that the future land use at the Site will change.

Groundwater Use

Groundwater at the Curriculum Center and within the area influenced by the contaminant plume currently is not being used as a source of drinking water. The USVI does not have drinking water source-based quality standards for organics in groundwater, as drinking water is taken from rainwater cisterns or from pumped water supplies using desalinated seawater.

7. SUMMARY OF SITE RISKS

A baseline human health risk assessment was conducted as part of the FSRI to estimate the risks associated with exposure to contaminants based on current and likely future uses of the Site as commercial/industrial. Relevant information associated with the risk assessment is summarized below.

An ecological risk assessment was not performed for OU2, as the focus of this investigation was on groundwater, which does not discharge to surface water anywhere within the OU2 area. Ecological receptors are not expected to have contact with groundwater; therefore, exclusion of an ecological risk assessment is consistent with EPA guidance that states ecological risk related to groundwater is to be considered only if there is potential for impacts on ecological receptors. It is also consistent with the scope of the 1996 OU1 RI, which limited the evaluation of ecological risk to surface soil contamination at the Site.

7.1 Human Health Risk Assessment

EPA conducted a four-step baseline human health risk assessment (HHRA) as part of the FSRI to assess Site-related carcinogenic risks and noncarcinogenic health hazards in the absence of any remedial action. The four-step process is comprised of the following: Hazard Identification, Exposure Assessment, Toxicity Assessment, and Risk Characterization. In more detail, they are as follows:

- *Hazard Identification* – in this step EPA uses the analytical data collected to identify the contaminants of potential concern (COPCs) at the site for each medium, with consideration of a number of factors explained in more detail below. A Summary of the contaminants of potential concern and medium-specific Exposure Point Concentrations is provided in Appendix II, Table 1;
- *Exposure Assessment* – in this step, EPA estimates the magnitude of actual and/or potential human exposures,; the frequency and duration of these exposures; and the pathways (e.g., ingesting contaminated well-water) by which humans are potentially exposed. This information is included in Appendix II, Table 2;

- *Toxicity Assessment* – in this step, EPA determines the types of adverse health effects associated with chemical exposures and the relationship between magnitude of exposure (dose) and severity of adverse effects (response). Noncarcinogenic and carcinogenic toxicity data are presented in Appendix II - Tables 3 (noncarcinogenic) and 4 (carcinogenic), and;
- *Risk Characterization* – in this step, EPA summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site-related risks. The risk characterization also identifies contamination with concentrations which exceed acceptable levels, defined by the National Contingency Plan (NCP) as an excess lifetime cancer risk greater than $1 \times 10^{-6} – 1 \times 10^{-4}$ or a Hazard Index greater than 1; contaminants at these concentrations are considered chemicals of concern (COCs) and are typically those that will require remediation at the site. Also included in this section is a discussion of the uncertainties associated with these risks. Appendix II – Table 5 presents the noncarcinogenic Risk Characterization Summary for future construction workers, indoor and outdoor on-site workers and residents potentially exposed to COCs at the site. Appendix II - Table 6 presents the carcinogenic Risk Characterization Summary for these same receptors.

7.1.1 Hazard Identification

In this step, COPCs in groundwater were identified based on such factors as toxicity, frequency of occurrence, fate and transport of the contaminants in the environment, concentrations, mobility, persistence, and bioaccumulation. These COPCs could potentially cause adverse health effects in exposed populations. The COPC screening in the HHRA identified 13 COPCs in groundwater.

7.1.2 Exposure Assessment

Consistent with Superfund policy and guidance, the baseline HHRA assumes no remediation or institutional controls would occur or be put in place to mitigate, remove, or protect against exposure to hazardous substance releases. Carcinogenic risks and noncarcinogenic hazard indices were calculated based on an estimate of the reasonable maximum exposure (RME) expected to occur under current and future conditions at the Site. The RME is defined as the highest exposure that is reasonably expected to occur at a site.

As stated above, the land use in Anna’s Retreat includes a variety of institutional and commercial purposes. It is anticipated that the future land use for this area will remain consistent with the current uses.

The potential exposure scenarios considered in the HHRA include drinking water ingestion, dermal contact and inhalation of groundwater by residents, drinking water ingestion, and dermal contact by indoor and outdoor workers, as well as incidental ingestion, contact with, and inhalation of groundwater by a construction worker while working in a trench.

7.1.3 Toxicity Assessment

In this step, the types of adverse health effects associated with contaminant exposures and the relationship between magnitude of exposure and severity of adverse health effects are determined. Potential health effects are contaminant-specific and may include the risk of developing cancer over a lifetime or other noncarcinogenic health effects, such as changes in the normal functions of organs within the body (e.g., changes in the effectiveness of the immune system). Some contaminants are capable of causing both carcinogenic and noncarcinogenic health effects.

Under current EPA guidelines, the likelihood of carcinogenic risks and noncarcinogenic hazards as a result of exposure to site chemicals are considered separately. Consistent with current EPA policy, it was assumed that the toxic effects of the Site-related chemicals would be additive. Thus, carcinogenic and noncarcinogenic risks associated with exposures to individual COPCs were summed to indicate the potential risks and hazards associated with mixtures of potential carcinogens and noncarcinogens, respectively.

Toxicity data for the human health risk assessment are provided in the Integrated Risk Information System database, the Provisional Peer Reviewed Toxicity Database, and/or any other source that is identified as an appropriate reference for toxicity values consistent with EPA's directive on toxicity values. This information is presented in Appendix II - Table 3 (noncarcinogenic toxicity data summary) and Appendix II - Table 4 (carcinogenic toxicity data summary).

7.1.4 Risk Characterization

Noncarcinogenic risks were assessed using a hazard index (HI) approach, based on a comparison of expected contaminant intakes and benchmark comparison levels of intake known as reference doses (RfDs) for contaminants in soil and water, and reference concentrations (RfCs) for those in air. These are estimates of daily exposure levels for humans (including sensitive individuals) that are thought to be safe over a lifetime of exposure. The estimated intake of chemicals identified in environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) is compared to the RfD or RfC to derive the hazard quotient (HQ) for the contaminant in the particular medium. The HI is obtained by adding the HQs for all compounds within a particular medium that impacts a particular receptor population.

The HQ for oral and dermal exposures is calculated as below. The HQ for inhalation exposures is calculated using a similar model that incorporates the RfC, rather than the RfD.

HQ = Intake/RfD

Where: HQ = hazard quotient
Intake = estimated intake for a chemical (mg/kg-day)

RfD = reference dose (mg/kg-day)

The intake and the RfD will represent the same exposure period (i.e., chronic, subchronic, or acute).

The HI is calculated by summing the HQs for all chemicals for likely exposure scenarios for a specific population. An HI greater than 1.0 indicates that the potential exists for noncarcinogenic health effects to occur as a result of site-related exposures, with the potential for health effects increasing as the HI increases. When the HI calculated for all chemicals for a specific population exceeds 1.0, separate HI values are then calculated for those chemicals that are known to act on the same target organ. These discrete HI values are then compared to the acceptable limit of 1.0 to evaluate the potential for noncarcinogenic health effects on a specific target organ. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

A summary of the noncarcinogenic hazards associated with these chemicals for each exposure pathway and receptor evaluated is contained in Appendix II, Table 5.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a carcinogen, using the cancer slope factor (SF) for oral and dermal exposures and the inhalation unit risk for inhalation exposures. Excess lifetime carcinogenic risk (ELCR) for oral and dermal exposures is calculated from the following equation, while the equation for inhalation exposures uses the inhalation unit risk, rather than the SF:

Risk = LADD x SF

Where: Risk = a unitless probability (1×10^{-6}) of an individual developing cancer
LADD = lifetime average daily dose averaged over 70 years (mg/kg-day)
SF = cancer slope factor, expressed as [1/(mg/kg-day)]

These risks are probabilities that are usually expressed in scientific notation (such as 1×10^{-4}). An ELCR of 1×10^{-4} indicates that one additional incidence of cancer may occur in a population of 10,000 people who are exposed under the conditions identified in the assessment. Again, as stated in the NCP, the acceptable risk range for site-related exposure is 1×10^{-4} to 1×10^{-6} (i.e., one additional incidence of a cancer may occur in a population of 10,000 to 1,000,000 who are exposed under the conditions).

The evaluation of potential carcinogenic risks and noncarcinogenic hazards to future on-site receptors from exposure to COPCs in environmental media indicates that there are several primary contaminants contributing to an ELCR or HI exceeding the acceptable levels, identified as COCs.

Exposure to these COCs (PCE, TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, vinyl chloride, and 1,1,2-trichloroethane (1,1,2-TCA)) may result in potential adverse health effects.

A summary of the carcinogenic risks associated with these COCs for each exposure pathway and receptor included in the HHRA is provided in Appendix II, Table 6.

7.1.5 Risk Characterization Conclusion

The evaluation for future, on-site workers indicates that VC, TCE, PCE and *cis*-1,2-DCE have been identified as COCs for groundwater exposure, based on an ELCR exceeding $1x10^{-4}$ or resulting in an HI greater than or equal to one.

1,1-DCE does not exceed the noncarcinogenic threshold, however, it exceeds its MCL, so it is included as a COC.

The ELCRs for a potential future resident's exposure to COPCs in groundwater are significantly above the threshold of $1x10^{-4}$ at $7x10^{-1}$, and they largely result from ingestion of VC, TCE, and PCE. This assumes the groundwater is used for potable purposes with no treatment. The vapor intrusion risk evaluation indicates that these same COCs could also result in excess risks to future residents from exposure to contaminated soil vapor should an occupied building be located on the Site.

These carcinogenic risks and noncarcinogenic health hazards indicate that there is significant, potential risk from direct exposure to groundwater for future residents and Site workers. The results of the HHRA indicate that the selected remedy is necessary to mitigate potential risks associated with existing contamination. A more detailed discussion of the exposure pathways and estimates of risk can be found in the February 2018 HHRA in the Administrative Record for this action.

7.1.6 Uncertainty in the Risk Assessment

There is inherent uncertainty in the methods, inputs, and conclusions of a HHRA, resulting from the risk assessment development process and the fact that the HHRA involves numerous assumptions and unknowns that contribute to the total uncertainty in the HHRA conclusions. EPA uses default and appropriate values that guard against underestimating risk, while also assuring the HHRA is scientifically plausible given existing uncertainties.

Uncertainties specific to this HHRA include assumptions regarding the potential exposure of specific receptors to certain environmental media and the use of "surrogate" exposures. For example, drinking water ingestion by construction workers was not evaluated; assumptions of workers' drinking water ingestion rates were used as a conservative surrogate. Use of certain default values can also impact the final conclusions. Other data, e.g., chemicals without screening levels and tentatively identified compounds having highly variable concentrations in groundwater, were included in the HHRA based on applicable guidance, but they cannot be fully incorporated in the final risk characterization, as those risks cannot be calculated. There are also a few instances of failing to meet quality assurance project plan performance criteria, as discussed in the Data Evaluation Report section of the HHRA. Upon review of these variances, it was determined these data were acceptable to be retained for use in the HHRA.

7. 2 Basis for Taking Action

Based on the results of the FSRI and the risk assessment analysis, EPA has determined that a response action is necessary and that the response action selected in this OU2 ROD will be protective of the public health, welfare, or the environment from actual or threatened releases of hazardous substances into the environment.

8. REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are specific goals to protect human health and the environment. These objectives are based on available information and remediation goals, such as applicable or relevant and appropriate requirements (ARARs), to-be-considered guidance, and site-specific, risk-based levels.

Based on matrix diffusion sampling and modeling conducted as part of the March 2018 feasibility study (FS) and as described in more detail in the next section, the restoration of the groundwater within a reasonable time frame may be possible notwithstanding the presence of DNAPL.
As such, the following RAOs have been established for the source areas and groundwater:

- 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.

The remediation goals for groundwater are identified in Appendix II, Table 7. In order to determine whether the mass of DNAPL in the bedrock aquifer is decreasing, dissolved phase contaminant concentrations at wells in the source area where concentrations have been detected above one percent of the solubility limit will be evaluated on an annual basis. Successful reduction of DNAPL will be indicated by the increasing presence of dissolved phase concentrations below one percent solubility (i.e., the decrease in concentrations to below one percent of the solubility limit).

Note that these RAOs are not intended to modify those RAOs identified in the 1996 OU1 ROD related to non-OU2 portions of the Site.

9. DESCRIPTION OF REMEDIAL ALTERNATIVES

Section 121(b)(1) of CERCLA, 42 U.S.C. § 9621(b)(1), mandates that remedial actions must be protective of human health and the environment, cost-effective, comply with ARARs, and utilize permanent solutions, alternative treatment technologies, and resource recovery alternatives to the maximum extent practicable. Section 121(b)(1) also establishes a preference for remedial actions that employ, as a principal element, treatment to reduce permanently and significantly the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants at a site. Section 121(d) of CERCLA further specifies that a remedial action must attain a level or standard of control of the hazardous substances, pollutants, and contaminants that at least attains ARARs under federal and territory laws, unless a waiver can be justified pursuant to Section 121(d)(4) of CERCLA, 42 U.S.C. § 9621(d)(4).

The objective of the focused source FS was to identify and evaluate remedial action alternatives for addressing the contamination associated with the source areas and to attain the RAOs. A total of four alternatives were developed in the FS. Alternative 2 also includes four enhancement options. More detailed descriptions of the remedial alternatives are provided in the FS Report, dated March 2018. Expansions to the existing remedy as well as new remedial alternatives were assessed in the FS.

9.1 Description of Common Elements among Remedial Alternatives

All of the alternatives, with the exception of the no action alternative, include the following common components.

Matrix diffusion modeling was performed to simulate the fate and transport of PCE in fractured bedrock in circumstances where matrix diffusion plays a role in attenuating the contaminant's life in the system after the source has been removed. Based on information from borings collected around the Curriculum Center building, results of the matrix diffusion modeling indicate concentrations at the property boundary are predicted to drop below the MCL within an estimated range of 17 - 25 years after complete source removal. If actual conditions under the building are different than the model, these conditions may impact the estimated timeframes.

Long-Term Monitoring:

Alternatives 2 through 4 include long-term monitoring to ensure that groundwater quality improves following implementation of these alternatives until such time as remediation goals are achieved.

Predesign Investigation:

Assumptions were made in the FS for areas that were not fully investigated during the FSRI, specifically, beneath the northern portion of the Curriculum Center building. Alternatives 2 through 4 will include pre-design investigations (PDI) to verify FS assumptions, address data gaps, and obtain design parameters for the completion of an RD at the Curriculum Center source areas.

Institutional Controls:

Alternatives 2 through 4 also include ICs that will rely on groundwater use restrictions in the form of local well use laws until RAOs are achieved so as to ensure the remedy is protective. Specifically, Title 12, Chapter 5 of the Virgin Islands Code regulates installation of all private wells in the Virgin Islands. Alternatives 2 through 4 also include vapor intrusion restrictions on new construction at the Curriculum Center portion of the Site.

Site Management Plan:

Alternatives 2 through 4 also include a site management plan (SMP) that will be developed to provide for the proper O&M of the Site remedy post-construction, and it would include long-term groundwater monitoring, institutional controls, and periodic reviews until remediation goals are achieved.

Five-Year Review:

Additionally, while not part of the remedial alternatives, Section 121(c) of CERCLA requires that a review of conditions be conducted no less often than once every five years if a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site. Therefore, for all alternatives (including Alternative 1), these five-year reviews will be conducted until such time as remediation goals are achieved because it is anticipated that it will take longer than five years to achieve remediation goals under all of the alternatives.

9.2 Description of the Remedial Alternatives

Alternative 1: No Action

Capital Cost:	$0
Annual O&M Costs:	$0
Present-Worth Cost:	$0
Construction Time:	Not Applicable

The NCP requires that a “No Action” alternative be developed and considered as a baseline for comparing other remedial alternatives. Under this alternative, no additional action would be implemented beyond the on-going remedy selected in the 1996 OU1 ROD. Existing ICs that were required under the 1996 ROD would remain in place.

Alternative 2: Expand Existing Groundwater Extraction and Ex-Situ Treatment (a.k.a. Pump and Treat)

Capital Cost:	$4,802,538
Annual O&M Costs:	$8,481,677
Present-Worth Cost:	$13,340,565
Duration Time:	*30* years

This remedial alternative consists of expanding the current groundwater treatment system (GWTF #1) with the addition of new extraction wells located downgradient from the Curriculum Center. The addition of downgradient wells will allow for more flexibility in containing the primary CVOC plume as it migrates downgradient from the Curriculum Center source area. Alternative 2 also includes upgrading the current GWTF #1 system capacity and adding alternate pumping and dual-phase extraction (DPE)/enhanced fluid recovery (EFR) to existing monitoring wells with high contaminant concentrations.

For the conceptual design, it is estimated that two additional extraction wells would be installed downgradient from the existing recovery wells to a target depth of 140 feet bgs. It is estimated that the existing treatment system capacity will be upgraded from 60 to 100 gpm and will operate in “flow control” mode rather than at the current “constant head” configuration. All existing treatment equipment will be replaced with newer, more efficient equipment to accommodate the additional flow. The above-ground conveyance system within the facility from each of the existing extraction wells will be upgraded on an as needed basis to accommodate the higher capacity. The current 1,000-gallon equalization tank will be replaced with a similar capacity tank that is designed for flow equalization in addition to DNAPL recovery. The DNAPL that is collected at the bottom of the recovery tank will be removed and disposed at a licensed waste disposal facility. Extracted groundwater will be treated with air stripping and discharged via the existing outfall to Turpentine Run.

Alternative 2 will include alternate pumping from those existing monitoring wells with high contaminant concentrations present. It is assumed that the source area wells will include wells identified as OU2-MW3, RD-9, OU2-MW6, OU2-MW2, IW-1, IW-2, and OU2-MD1. The precise well selection will be made during the RD phase. It is assumed that a small pump connected to a flexible, high density polyethylene pipe will be placed inside each of these monitoring wells, and groundwater will be pumped into the DNAPL recovery tank, treated through the existing treatment system as described above, and then discharged at the existing outfall. It is assumed that this will be done in sequence at each well for a total estimated duration of one week per event.

Alternative 2 will also include DPE/EFR from existing monitoring wells where high contaminant concentrations are present. The DPE/EFR system is a portable system that will extract groundwater from designated monitoring wells that are present in source areas at the Curriculum Center property. A pilot study will be conducted to obtain design parameters for the DPE/EFR systems. The well head of each extraction point/monitoring well will be sealed, and a DPE/EFR mobile system will be used to apply a high vacuum to each well in order to remove contaminated groundwater/DNAPL from source areas. The recovered contaminated groundwater will be treated through the existing pump and treat system and then discharged at the outfall. The DNAPL that is collected at the bottom of the recovery tank will be removed and disposed at a licensed waste disposal facility. At a minimum, the DPE/EFR system will include a vacuum blower, knockout tank, air filters and silencers, flow meters, transfer pump, and a control panel. It is assumed that DPE/EFR events will be twice a year at each well, for a period of five years. The precise frequency of the events will be refined during the RD.

Based on calculations, it is estimated that clean up time for the Curriculum Center source areas using groundwater pump and treat will be in excess of 30 years. For cost-estimating and planning purposes, an estimated remediation time frame of 30 years is used for developing costs associated with O&M activities. It is assumed that active remediation would be employed in the targeted treatment areas until the MCL for each of the COCs is attained within the targeted treatment area. The success of the remedy in meeting the RAOs will be periodically evaluated through the above-mentioned statutorily required 5-Year Reviews.

The conceptual design would be refined during the RD phase.

Alternative Enhancement 2A: Reinjection

Capital Cost:	$437,053
Annual O&M Costs:	$51,364 plus Alt 2
Present-Worth Cost:	$488,417
Duration Time:	*30* years

This enhancement for Alternative 2, the tasks and cost of which would be in addition to Alternative 2, includes enhancing the existing pump and treat system as described in Alternative 2 with reinjection of the treated groundwater at a location downgradient from the Curriculum Center in an effort to create a hydraulic barrier to further prevent off property migration of the contamination.

For the conceptual design, it is estimated that two injection wells would be installed downgradient of the existing and proposed extraction wells and along major fracture/weathered zone trends that have been identified during the FSRI.

For cost-estimating and planning purposes, an estimated remediation time frame of 30 years is used for developing costs associated with O&M activities. Alternative Enhancement 2A, using reinjection, will not reduce the remedial timeframe; however, reinjection of ground water downgradient will help maintain ground water at the same level as prior to the OU2 pumping for treatment.

Alternative Enhancement 2B: Air Sparging/Soil Vapor Extraction

Capital Cost:	$1,739,745
Annual O&M Costs:	$205,461 plus Alt 2
Present-Worth Cost:	$1,945,206
Duration Time:	*30 years with five years of AS/SVE*

This enhancement for Alternative 2 consists of enhancing the existing pump and treat system as described earlier in Alternative 2 with air sparging/soil vapor extraction (AS/SVE) in source areas, including the area beneath the northern portion of the Curriculum Center building, in order to help mobilize residual DNAPL within the zone influenced by AS and thereby reducing the remedial timeframe of the groundwater extraction and treatment system.

For the conceptual design, it is estimated that 25 SVE wells and 30 AS wells would be installed at the Curriculum Center property. It is estimated that each SVE well will be installed to a depth of approximately 15 feet bgs, and each AS well will be installed to a depth of approximately 140 feet bgs. For cost estimating purposes, granular activated carbon and potassium permanganate are assumed as the vapor phase treatment option for the enhancement to the treatment system.

For both cost-estimating and planning purposes, an initial five years of AS/SVE is proposed. Based on calculations, it is estimated that the cleanup time for the Curriculum Center source areas, after complete removal of source concentrations, will be within about 25 years of the initial five-year period. It is therefore assumed that the remedial system will be active for a period of 30 years.

Alternative Enhancement 2C: In Situ Chemical Oxidation

Capital Cost:	$99,364
Annual O&M Costs:	$117,110 plus Alt 2
Present-Worth Cost:	$216,474
Duration Time:	*30* year*s with five years of injections*

This enhancement for Alternative 2 consists of enhancing the existing pump and treat system as described earlier in Alternative 2 with in-situ chemical oxidation (ISCO) treatment at the potential source areas. This process involves introducing strong oxidizing agents through existing monitoring wells within the potential source areas via slow-release cylinders or a comparable delivery method. Operating the pump and treat system could potentially enhance the distribution of oxidants across the source zone and maintain hydraulic control of the dissolved-phase plume emanating from the source areas.

For the conceptual design, it is estimated that 64 cylinders will be deployed in a total of 12 monitoring wells in the potential source areas. It is estimated that the cylinders will be removed and replaced on a yearly basis.

For cost estimating purposes, an initial five years of ISCO treatment is proposed before evaluating if further source area treatment is necessary. Based on calculations, it is estimated that the cleanup time for the Curriculum Center source areas, after complete removal of source concentrations, will be within about 25 years of the initial five-year period. For cost estimating purposes, it is assumed that the pump and treat remedial system will be active for a period of 30 years in order to capture contaminated groundwater beyond the active treatment source areas.

Alternative Enhancement 2D: Surfactant Flushing

Capital Cost:	$1,265,756
Annual O&M Costs:	Same as Alt 2 (no additional O&M- full implementation in initial year)
Present-Worth Cost:	$1,265,756
Duration Time:	*26* years

This enhancement for Alternative 2 consists of enhancing the existing pump and treat system as described earlier in Alternative 2 with in-situ flushing of fractures with surfactants at the potential source areas as an enhancement.

For the conceptual design, it is estimated that two deep injection wells and five shallow injection wells will be installed in the potential source areas. Extraction wells are required to maintain hydraulic control, bring emulsified/dissolved DNAPL to the surface for treatment, and to clear the aquifer of surfactant solution.

As a result of challenges associated with surfactant flushing in a bedrock aquifer, it is assumed that surfactant flushing will be performed in source areas for one year. For cost estimating purposes, two rounds of injections are assumed. Based on calculations, it is estimated that clean up time for the Curriculum Center source areas, after complete removal of source concentrations, will be within about 25 years. For cost estimating purposes, it is assumed that the remedial system will be active for a period of 26 years in order to capture contaminated groundwater beyond the active treatment source areas.

Alternative 3: In-Situ Thermal Treatment and Pump and Treat

Capital Cost:	$89,628,605

Annual O&M Costs: $4,569,283
Present-Worth Cost: $94,309,778
Duration Time: *12* years

This remedial alternative includes in-situ thermal treatment to target DNAPL in potential source areas with downgradient pump and treat for hydraulic control.

This treatment proposed for the Curriculum Center property consists of in-situ bedrock heating as a means to provide significant mass reduction (>99%) of CVOCs and DNAPL in groundwater within the fractured bedrock of the potential source areas with a time frame of approximately two years. Heat causes the underground contaminants, DNAPL, and water to boil, creating in-situ steam and vapor. Contaminated vapor and steam are extracted using vacuum recovery wells and treated above ground. The heater wells will be co-located with the recovery wells. Each recovery well is connected to the conveyance pipe that routes the steam and vapors to the condenser. All conveyance piping and cable will be above grade.

For the conceptual design, it is estimated that 260 to 270 heater wells, co-located with 260 to 270 vacuum extraction points, would be used to treat groundwater within the area beneath the northern portion of the Curriculum Center building and the potential source areas. It is assumed that each heater well boring will be installed from 1 to 140 feet bgs within the bedrock. The average distance between heater wells will be approximately 17 feet. It is estimated that 15 temperature monitoring points will be installed to monitor the subsurface temperature data continuously.

Alternative 3 includes the addition of two new extraction wells downgradient of the Curriculum Center to provide hydraulic control during in-situ thermal treatment at the source areas. Alternative 3 also includes upgrading the current treatment system (GWTF #1) to a capacity of 100 gpm. It is estimated that operating the treatment system at a total flow rate of 100 gpm will establish hydraulic control and capture the deep bedrock groundwater in the vicinity of the Curriculum Center source areas. This hydraulic containment will limit or prevent the downgradient migration of contaminants from the Curriculum Center property.

All existing treatment equipment will be replaced with newer, more efficient equipment to accommodate the additional flow as described in detail in Alternative 2, above.

It is anticipated that the duration of operating the active thermal treatment system will be on the order of two years. During this time, the pump and treat system will remain operational in order to maintain hydraulic control of the downgradient dissolved plume. It is estimated that contamination outside of the thermal treatment area will take 10 years to reach the perimeter pump and treat system. For cost estimating purposes, it is assumed that the enhanced groundwater treatment system will be active for a period of 12 years in order to capture contaminated groundwater beyond the active treatment source areas.

The conceptual design would require further evaluation during the remedial design phase.

Alternative 4: In-Situ Steam Injection and Pump and Treat

Capital Cost:	$25,568,569
Annual O&M Costs:	$8,539,451
Present-Worth Cost:	$34,171,200
Duration Time:	*27* years

This remedial alternative consists of steam injection at the potential source areas to mobilize the DNAPL in bedrock fractures and to cause destruction of contaminants in potential source areas. Mobilized DNAPL will be captured by the pump and treat system at the Curriculum Center property and properly disposed of.

Under the conceptual design, 60 steam injection wells and 30 multi-phase extraction wells would be installed across the source area. This configuration is intended to facilitate outward, horizontal advancement of the steam front from the steam injection wells toward the dual-phased extraction wells. The injection wells would be screened across the low-productive zone of the aquifer (approximately 80 to 140 feet bgs). The pressure of steam injection would also mobilize, and transport contaminants vertically based upon the higher permeability of the overlying shallow zone and the enhanced upward gradient imposed on the aquifer by shallow-zone remedial pumping associated with the pump and treat system. It is estimated that 10 temperature monitoring points would be installed to monitor the subsurface temperature data continuously.

Alternative 4 includes the addition of two new extraction wells downgradient from the Curriculum Center to maintain hydraulic control during steam injections at the source areas. Alternative 4 also includes upgrading the current system to a capacity of 100 gpm. It is estimated that operating the system at a total flow rate of 100 gpm will establish hydraulic control and capture the deep bedrock groundwater at the Curriculum Center source areas. This hydraulic containment will limit or prevent the downgradient migration of contaminants from the Curriculum Center property.

All existing treatment equipment will be replaced with newer, more efficient equipment to accommodate the additional flow as described in detail in Alternative 2, above.

It is anticipated that the duration of operating the steam injection system will be on the order of two years. During this time, the pump and treat system will remain operational in order to maintain hydraulic control of the downgradient dissolved plume. Based on calculations, it is estimated that clean up time in the Curriculum Center area after complete removal of source area concentrations will be within about 25 years. For cost estimating purposes, it is assumed that the enhanced groundwater treatment system will be active for a period of 27 years in order to capture contaminated groundwater beyond the active treatment source areas.

10. COMPARATIVE ANALYSIS OF ALTERNATIVES

In selecting a remedy for a site, EPA considers the factors set forth in Section 121 of CERCLA, 42 U.S.C. § 9621, and conducts a detailed analysis of the viable remedial alternatives in accordance with the NCP, 40 C.F.R Section 300.430(e)(9), EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies*, OSWER Directive 9355.3-01, and EPA's *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents*, OSWER 9200.1-23.P. The detailed analysis consists of an assessment of the individual alternatives set forth in the FS against each of the nine evaluation criteria set forth at Section 300.430(e)(9)(iii) of the NCP and a comparative analysis focusing upon the relative performance of each alternative against those criteria.

A comparative analysis of these alternatives, based upon the nine evaluation criteria noted below, follows.

Threshold Criteria *- The first two remedy selection criteria are known as "threshold criteria" because they are the minimum requirements that each response measure must meet in order to be eligible for selection as a remedy.*

10.1 Overall Protection of Human Health and the Environment

"Overall Protection of Human Health and the Environment" is a determinations of whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.

Overall Protection of Human Health and the Environment

Alternative 1 (No Action) would not meet the RAOs and would not be protective of human health and the environment because no action would be taken. Alternatives 2 through 4 are the active remedies that address groundwater contamination, minimize the migration of contaminated groundwater, and restore groundwater quality over the long-term.

Under Alternative 2, the pump and treat system will capture and treat the contaminants at and downgradient from the potential source areas. Expanding the pump and treat system by installing additional extraction wells downgradient from the Curriculum Center will prevent groundwater from migrating further downgradient and reduce the contaminant concentrations in the area, helping to restore groundwater more quickly. The four enhancements to Alternative 2 will improve the performance of this alternative and the protection of human health and the environment. The most desirable of the enhancements is 2A, Reinjection, because it uses treated water to reduce impacts to human health and the environment.

Alternatives 3 and 4 will prevent impact to groundwater because these alternatives will remove the DNAPL and dissolved CVOC contamination from the bedrock aquifer and prevent further migration of CVOC contamination to groundwater by operating newly installed downgradient extraction wells.

Until RAOs are met, protectiveness under Alternatives 2 through 4 requires a combination of actively reducing contaminant concentrations in groundwater and limiting exposure to residual contaminants through existing ICs prohibition groundwater use. ICs are anticipated to include existing governmental controls in the form of DPNR well use regulations. In addition, Alternatives 2 through 4 include vapor intrusion restrictions on new construction.

10.2 Compliance with ARARs, to be Considered, and other Guidance

Compliance with ARARs, to be Considered (TBCs), and other Guidance refers to the extent to which a remedial action attains legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations, unless such applicable or relevant and appropriate requirements are waived under CERCLA Section 121(d)(4).

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other federal and state environmental statutes or provides a basis for invoking a waiver.

A complete list of ARARs can be found in Appendix II – Tables 9, 10 and 11.

EPA has promulgated MCLs (40 CFR Part 141), which are enforceable standards for various drinking water contaminants (and are chemical-specific ARARs). The USVI does not have drinking water source-based quality standards for organics in groundwater, as drinking water is taken from rainwater cisterns or from pumped water supply using desalinated seawater. In the absence of any USVI regulations for CVOCs in groundwater, compliance with the federal standard is required.

Alternative 1 would not comply with ARARs as groundwater would not be restored.

Alternative 2, including Enhancements 2A – 2D, would achieve chemical-specific ARARs through extraction and *ex-situ* treatment of contaminated groundwater. Alternative 3 could achieve chemical-specific ARARs through *in-situ* thermal treatment. Alternative 4 would achieve chemical-specific ARARs through *in-situ* steam injections; however, Alternative 4's effectiveness would need to be verified in the field because it relies on its ability to contact, heat, and physically displace contaminants.

For Alternatives 2 to 4, action-specific ARARs would be met through compliance with Site-specific health and safety requirements, off-gas treatment requirements, if applicable, and water discharge criteria when applicable. There are no location-specific ARARs associated with the Site.

It is estimated that the RAOs would be achieved in 30 years with Alternative 2, including 2A-through 2D, 12 years with Alternative 3, and 27 years with Alternative 4. Active remediation under Alternatives 2 through 4 would be employed in the targeted treatment areas until the MCL for each of the COCs is attained within the targeted treatment area.

Primary Balancing Criteria *- The next five remedy selection criteria, numbers 3 through 7, are known as "primary balancing criteria." These five criteria are factors with which tradeoffs between response measures are assessed so that the best option will be chosen, given site-specific data and conditions.*

10.3 Long-Term Effectiveness and Permanence

"Long-term Effectiveness and Permanence" refers to the ability of an alternative to maintain protection of human health and the environment over time.

Alternative 1 would not provide long-term effectiveness and permanence because the source of the groundwater contamination would not be addressed. Alternatives 2 through 4 are considered effective technologies for treatment and/or containment of contaminated groundwater, if designed and constructed properly.

Alternatives 2, including Enhancements 2A – 2D, through 4 would provide long-term effectiveness and permanence by using in-situ treatment processes to reduce the contaminant mass in the treatment area. Alternatives 2 through 4 would also provide hydraulic control to prevent off-property migration of the contaminated plume at the Curriculum Center property. If assumptions of the conditions under the building prove to be incorrect, this will impact the remediation timeframes.

The approach outlined in Alternative 2 has been proven to be an effective technology in reducing the concentrations of VOC contaminated groundwater. Extraction and treatment of contaminated groundwater will limit downgradient migration of the contaminants and reduce groundwater concentrations. Alternative 2 on its own might be ineffective at removing DNAPL from the low-yielding fractured bedrock. Enhancements associated with Alternative 2 will likely be effective in reducing source area concentrations and mobilizing the DNAPL, if implemented in conjunction with the pump and treat system.

Among Alternatives 2 through 4, Alternative 3's use of *in-situ* thermal treatment would provide the highest mass reduction of groundwater contamination at the potential source area in the shortest period, followed by Alternative 4 using steam injections.

Alternative 4, *in-situ* steam injections, has the potential to significantly reduce contaminant concentrations in the treatment zones but has only limited application in the field for bedrock conditions. Properly designing the injection and the recovery system will be critical to the success of this alternative and to ensure that the system does not drive the contamination deeper into the subsurface.

10.4 Reduction in Toxicity, Mobility, or Volume Through Treatment

"Reduction in Toxicity, Mobility, or Volume of Contaminants through Treatment" refers to an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.

Alternative 1, no action, does not address the contamination, so there would be no reduction in toxicity, mobility, or volume of the contaminants through any treatment, and the alternative does not include long-term monitoring of groundwater conditions.

Alternatives 2 (including Enhancements 2A – 2D), 3, and 4 would provide reduction of toxicity, mobility, and volume through treatment and removal of contaminants. Alternative 3, using *in-situ* thermal remediation, would be the most effective in reducing toxicity and volume of contamination in groundwater through thermal treatment and faster destruction of contaminants in the impacted area, followed by Alternative 4, the use of in-situ steam injections, and finally Alternative 2, using pump and treat technology. Out of the Alternative 2 enhancements, the In Situ chemical Oxidation will provide the highest reduction in volume.

10.5 Short-Term Impact and Effectiveness

"Short-term Effectiveness" refers to the length of time needed to implement an alternative and the risks that the alternative poses to workers, residents, and the environment during implementation.

Alternative 1 would not have short-term impacts because no action would be implemented.

There would be significant short-term impacts to the local community and workers for Alternatives 2 through 4 as a result of the active remedial actions undertaken and the associated construction, operation, and/or treatment activities. Efforts could be made to minimize noise and impact from construction activities related to the operations at the Curriculum Center property, as applicable. Currently, the building is closed because of damage from the 2017 hurricanes. The future of the building and the previous operations therein is unknown.

Coordination and access would be required from USVI for staging or remedial action purposes. Noise and community air monitoring plans would be developed during the design and discussed with owners and local authorities. Engineering controls and appropriate personnel protective equipment would be used to protect the community and workers for Alternatives 2 through 4.

It is estimated that construction for each of the Alternatives 2 to 4 would be over a period of 1 year. Alternative 2 will be less intrusive because it will be partially using existing infrastructure, followed by increasingly more intrusive work for Alternatives 4 and 3, respectively.

10.6 Implementability

"Implementability" refers to the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Alternative 1, no action, would be the easiest of all the alternatives to implement. Alternatives 2 through 4 are all implementable, although each presents different challenges.

Services, materials, and experienced vendors are not readily available in the USVI. Shipping materials to the USVI from the United States would be required for a majority of the equipment needed for Alternatives 2 through 4 because local supplies of these materials are scarce. Pilot studies could be implemented to obtain Site-specific design parameters for Alternatives 2 through 4. A permit equivalent would be developed for in-situ treatment technologies for subsurface discharges and/or to discharge treated vapor to the atmosphere under the relevant Alternatives.

The success rate of Alternatives 2 through 4 depends on Site-specific conditions. Based on the conditions at this Site, with high levels of contamination and DNAPL in bedrock fractures, Alternative 3, using in-situ thermal remediation, will technically have the highest success rate followed by Alternative 4, using in-situ steam injections, and then Alternative 2, using an expanded pump and treat system (Alternatives 3 and 4 also employ the expanded pump and treat system). However, the power consumption for Alternative 3 is very high, and there is an uncertainty at this time if the current local power grid system can provide the required power since sustaining severe damage from Hurricanes Irma and Maria in 2017.

Of the three active remediation alternatives, Alternative 2 would be the most straightforward alternative to construct because this technology has already been implemented under the 1996 OU1 ROD as part of the Site-wide remedy, and it would result in less disruption to the existing, operating system.

Alternative 4 would be the most difficult to implement because delivery of steam to the source material through small aperture fractures can be problematic. Properly designing the injection and recovery system in Alternative 4 would be critical to ensure that the system does not drive the contamination deeper into the subsurface. The construction activities for Alternative 3 would result in the greatest disruption because this alternative estimates the installation of a significant number of wells and extraction points (260 – 270 of each) compared to the two new extraction wells and two injection wells in Alternative 2.

10.7 Cost

"Cost" includes estimating capital and annual operation and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent. This is a standard EPA assumption in accordance with EPA guidance.

The estimated capital cost, O&M, and present worth cost are discussed in detail in the March 2018 FS Report. For cost estimating and planning purposes, a 30-year time frame was used for O&M and long-term monitoring under Alternative 2, including enhancement options 2A – 2C, 26 years for enhancement option 2D, 12-years for Alternative 3, and 27-years for Alternative 4. Based on calculations, for the enhancement The cost estimates are based on the available information. Alternative 1 (No Action) has no cost because no activities would be implemented. The highest present value cost is Alternative 3 at $94.31 million. Of the three alternatives with active remedial components, Alternative 2 (with any of the four enhancements) is the least expensive with cost range from $13.34 to $ 15.29 million.

The estimated capital, O&M, and present-value costs for each of the alternatives are as follows:

Alternative	Capital Cost ($)	Annual O&M Cost ($)	Present Value Cost ($)
1.No Action	0	0	0
2. Pump & Treat	**4,802,538**	**8,481,677**	**13,340,565**
2A. Reinjection	**437,053**	**51,364**	**488,417**
2B. AS/SVE	1,739,745	205,461	1,945,206
2C. ISCO	99,364	117,110	216,474
2D. Surfactant Flushing	1,265,756	Same as Alt 2	1,265,756
3. *In-situ* Thermal and Pump & Treat	89,628,605	4,569,283	94,309,778
4. *In-situ* Steam and Pump & Treat	25,568,569	8,539,451	34,171,200

Note: The selected remedy is shown in bold.

Modifying Criteria *- The final two remedy selection criteria, numbers 8 and 9, are called "modifying criteria" because new information or comments from the state or the community on the Proposed Plan may modify the preferred response measure or cause another response measure to be considered.*

10.8 State/Support Agency Acceptance

"State/Support Agency Acceptance" refers to whether the State and/or Support Agency agrees with the EPA's analyses and recommendations.

DPNR, on behalf of USVI, concurs with the selected remedy. A letter of concurrence is attached in Appendix IV.

10.9 Community Acceptance

"Community Acceptance" refers to whether the local community agrees with the EPA's analyses and selected remedy. Comments received on the Proposed Plan are an important indicator of community acceptance.

EPA solicited input from the community on the remedial alternatives proposed for OU2 at the Site. The public comment period was held from July 14, 2021 to August 13, 2021. No comments were received. However, comments were received during the initial comment period held in 2018 when the initial proposed plan was released. Responses to the questions and comments received during that public comment period are included in the Responsiveness Summary (See Appendix V).

11. PRINCIPAL THREAT WASTES

The NCP establishes an expectation that the EPA will use treatment to address the principal threats posed by a site whenever practicable (NCP Section 300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for the migration of contamination to groundwater, surface water, or air, or act as a source for direct exposure. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment in the event exposure should occur. The decision to treat these wastes is made on a site-specific basis through a detailed analysis of alternatives, using the remedy selection criteria that are described above. The manner in which principal threat wastes are addressed provides a basis for making a statutory finding that the remedy employs treatment as a principal element.

Contaminated groundwater is generally not considered to be source material; however, DNAPL in groundwater may be viewed as potential source material. Based on the FSRI results, DNAPL was found and may be present in multiple source areas at the Curriculum Center. Each of the alternatives evaluated, other than no action, will address the principal threat waste, either by directly reducing the mass through the use of DPE/EFR and/or by mobilizing the DNAPL for subsequent extraction and treatment. In addition, since each of the active alternatives evaluated includes treatment as a significant component of the remedy, the statutory preference for remedies that employ treatment as a principal element is satisfied.

12. SELECTED REMEDY

12.1 Description and Rationale of the Selected Remedy

Based upon the requirements of CERCLA, the results of the FSRI, the detailed analysis of the alternatives in the FS, and Territory and public comments, EPA has determined that Alternative 2 (Expand Existing Groundwater Extraction and Ex-Situ Treatment (Pump and Treat)) with the enhancement of Alternative 2A (Reinjection) best satisfies the requirements of Section 121 of CERCLA, 42 U.S.C. § 9621, and provides the best balance of tradeoffs among the remedial alternatives with respect to the NCP's nine evaluation criteria, as set forth in Section 300.430(e)(9) of the NCP.

Alternative 2, as enhanced by Alternative 2A, has the following key components:

- Expansion of the existing pump and treat system to include downgradient extraction wells;
- Upgrading of the existing OU1 pump and treat system to accommodate 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 off-site migration of contamination, as well as discharge to Turpentine Run (to be determined during the remedial design);
- Alternate pumping and DPE/EFR from existing monitoring wells with high contaminant concentrations;
- Implementation of long-term monitoring to track and monitor changes in groundwater contamination to ensure the RAOs are attained;
- Retention of existing institutional controls, including DPNR well use laws, to ensure that the remedy remains protective until RAOs are achieved for protection of human health over the long-term; and
- Development of a Site Management Plan to ensure proper management of the Site remedy post-construction that would include long-term groundwater monitoring, institutional controls, vapor intrusion restrictions and five year periodic reviews, as applicable.

The effectiveness of the OU2 selected remedy will be evaluated based upon the attainment of specific performance standards and remediation goals during the five-year reviews (e.g., reduction in CVOC concentrations, hydraulic control, etc.). Should the selected remedy fail to attain these standards and goals or should its implementation prove ineffective, Alternative 2B, "Expand Existing Groundwater Extraction and Treatment System with AS/SVE," would be evaluated as a contingency remedy. Specifically, the contingency remedy will be implemented if:

- 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.

Should the selected remedy, with the contingency remedy, still prove to be ineffective, the need for a technical impracticability waiver would be evaluated, in consultation with EPA headquarters.

The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. DNAPL in groundwater may be viewed as source material. Principal threat waste will be addressed by designing active remediation elements to achieve the remediation goals by establishing containment, decreasing DNAPL mass in the bedrock aquifer, as measured by the presence of COCs above one percent of their solubility limits, and restoring groundwater. The enhanced extraction and treatment system would operate until remediation goals are attained.

Figure 3 provides the conceptual locations of the new extraction and injection wells and the existing treatment plant. The exact number and placement of extraction wells and injection wells would be determined during the remedial design, and a predesign investigation will be needed to help support development of the remedial design.

A long-term groundwater monitoring program would be implemented to track and monitor changes in the groundwater contamination during O&M to ensure the RAOs are attained. The results from the long-term monitoring program would be used to evaluate the migration and changes in CVOC contaminants over time.

Existing ICs will ensure that the remedy remains protective for protection of human health over the long-term until RAOs are achieved. Institutional controls for groundwater use would consist of DPNR well use laws. In addition, Alternatives 2 through 4 include vapor intrusion restrictions on new construction.

An SMP would also be developed and would provide for the proper management of the Site remedy post-construction, and it would include long-term groundwater monitoring, institutional controls, and periodic reviews until such time as clean up levels are attained.

The estimated present worth cost for the selected remedy is $13,828,982 based on 7% rate of return. Further detail of the cost is presented in Appendix A of the FS Report. This is an engineering cost estimate that is expected to be within the range of plus 50 percent to minus 30 percent of the actual project cost.

While this alternative would ultimately result in reduction of contaminant levels in groundwater such that levels would allow for unlimited use and unrestricted exposure, it is anticipated that it would take longer than 30 years to achieve these levels. As a result, in accordance with Section 121(c) of CERCLA, the performance of the remedy in meeting the RAOs will be reviewed at least once every five years after initiation of the remedy until remediation goals are achieved.

Alternative 1 (no Action) was not selected because it is not protective of human health and the environment. Alternative 2, extraction and treatment, is a proven technology which has demonstrated effectiveness at reducing contaminant mass and providing containment to achieve remediation goals for VOC-contaminated groundwater. Alternative 2 also partially uses existing infrastructure (existing extraction wells, monitoring wells, existing pipe when possible, existing utilities), minimizes impact to the community, and, by using enhancement 2A, reutilizes the treated water Alternatives 3 and 4 require significantly higher infrastructure (Alternative 3 requires 260-270 wells and Alternative 4 requires 90 wells) which could cause implementability issues considering the difficult bedrock drilling conditions at the Site. Alternatives 3 and 4 will also require power services that may not be available at the Site necessitating the use of temporary power generation stations further impacting the community. In addition, the cost of Alternative 3 ($94 million) and Alternative 4 ($34 million) are significantly greater than Alternative 2 with enhancement 2A, which has a total cost of $13,828,982.

Based upon the information currently available, EPA believes that the selected remedy meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing criteria. EPA has determined that the selected remedy satisfies the following statutory requirements of Section 121(b) of CERCLA: 1) the remedy is protective of human health and the environment; 2) it complies with ARARs; 3) it is cost effective; 4) it utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and 5) it satisfies the preference for treatment. Long-term monitoring will be performed to assure the protectiveness of the remedy. With respect to the two modifying criteria of the nine criteria, Territory and community acceptance, DPNR concurs with the selected remedy, and no adverse comments were received.

13 STATUTORY DETERMINATIONS

DPNR concurs that the selected remedy complies with the CERCLA and NCP provisions for remedy selection and meets the threshold criteria and provides the best balance of tradeoffs among the alternatives with respect to the balancing and modifying criteria. These provisions require the selection of remedies that are protective of human health and the environment, comply with ARARs (or justify a waiver from such requirements), are cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the toxicity, mobility, or volume of hazardous substances as a principal element (or justifies not satisfying the preference). The following sections discuss how the selected remedy meets these statutory requirements.

13.1 Protection of Human Health and the Environment

The selected remedy will protect human health and the environment because it will, over the long-term, restore groundwater at the Site to drinking water standards. Institutional controls will also assist in protecting human health over both the short- and long-term by helping to control and limit exposure to hazardous substances until RAOs are achieved.

13.2 Compliance with ARARs

The selected remedy is expected to achieve federal MCLs for the COCs in the groundwater. The COCs and the relevant MCLs are as provided in Table 7, which can be found in Appendix II.

A full list of the ARARs, TBCs, and other guidance related to implementation of the selected remedy is presented in Tables 9, 10, and 11, which can be found in Appendix II.

13.3 Cost Effectiveness

A cost-effective remedy is one whose costs are proportional to its overall effectiveness (40 C.F.R.

§ 300.430(f)(1)(ii)(D)). Overall effectiveness is based on the evaluations of long-term effectiveness and permanence, reduction in toxicity, mobility, and volume through treatment, and short-term effectiveness. Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness.

Each of the alternatives underwent a detailed cost analysis. In that analysis, capital and annual O&M costs were estimated and used to develop present-worth costs. In the present-worth cost analysis, annual O&M costs were calculated for the estimated life of each alternative. The total estimated present worth cost for implementing the selected remedy is $13,828,982.

Based on the comparison of overall effectiveness to cost, the selected remedy meets the statutory requirement that Superfund remedies are cost effective (40 C.F.R. § 300.430(f)(1)(ii)(D)) and is the least-cost action which will achieve groundwater standards within a reasonable time frame. A 30-year timeframe was used for planning and estimating purposes to remediate groundwater, although remediation timeframes could exceed this estimate.

13.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to Maximum Extent Practicable

The selected remedy complies with the statutory mandate to utilize permanent solutions, alternative treatment technologies, and resource recovery alternatives to the maximum extent practicable because it represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner for the Site. The selected remedy satisfies the criteria for long-term effectiveness and permanence by permanently reducing the mass of contaminants in the groundwater at the Site, thereby reducing the toxicity, mobility, and volume of contamination.

13.5 Preference for Treatment as a Principal Element

Using ex-situ groundwater extraction and treatment technology, the selected remedy satisfies the statutory preference for remedies that employ treatment as a principal element.

13.6 Five-Year Review Requirements

While this remedy would ultimately result in reduction of contaminant levels in groundwater such that levels would allow for unlimited use and unrestricted exposure, it is anticipated that it would take longer than 30 years to achieve these levels. As a result, in accordance with CERCLA, the success of the remedy in meeting the RAOs will be reviewed at least once every five years until remediation goals are achieved.

14 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for OU2 of the Site was re-released on July 14, 2021. The Proposed Plan identified Alternative 2, with enhancement Alternative 2A, as the preferred alternative for remediating the contaminated groundwater.

EPA considered and reviewed all written comments (including electronic formats, such as e-mail) received during both the 2018 and 2021 public comment periods, and has determined that no significant changes to the remedy, as originally identified in the Proposed Plan, are necessary or appropriate.

Appendix I

FIGURES

Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: US National Park Service

HDR

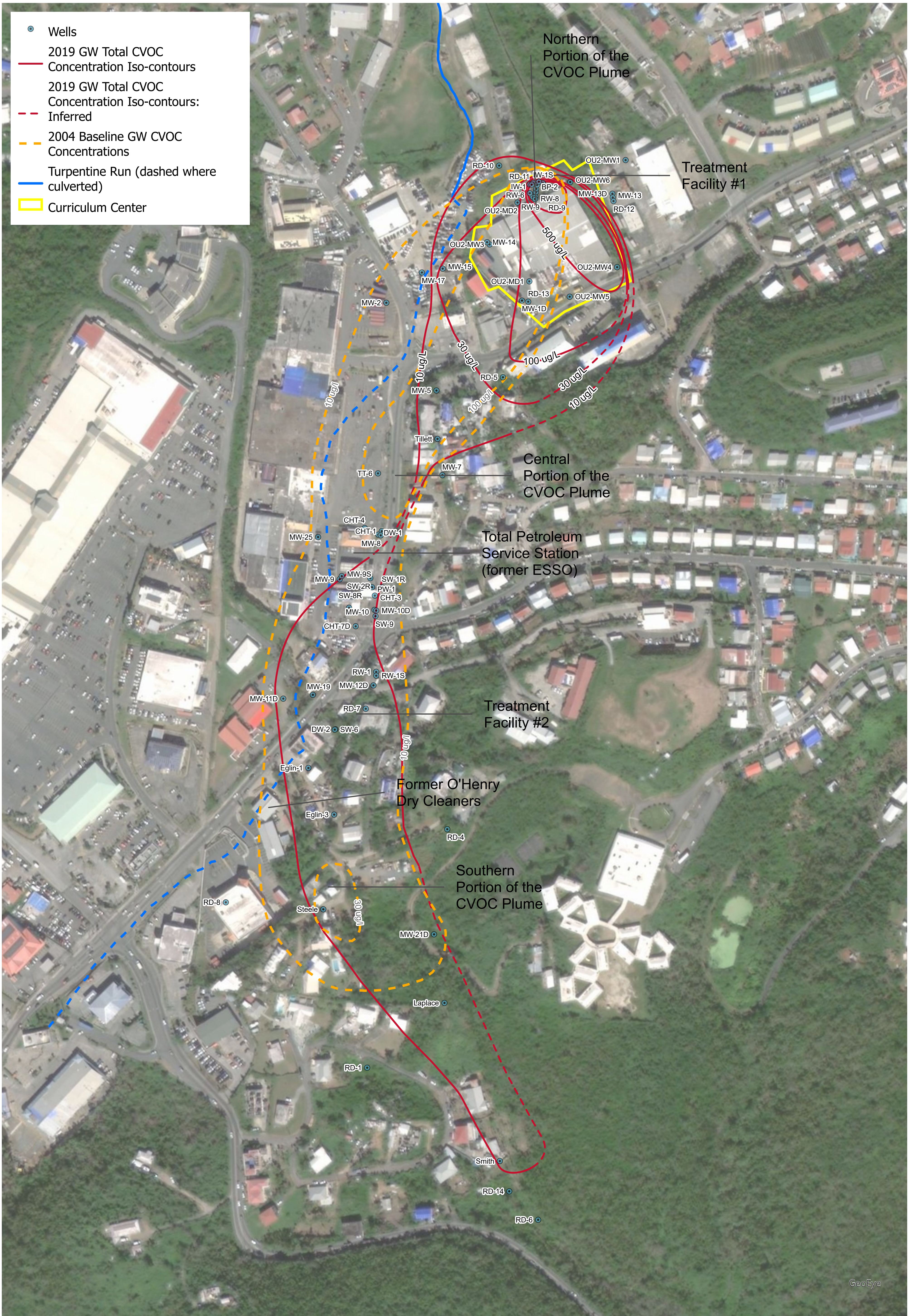
EPA United States Environmental Protection Agency

SITE LOCATION MAP

ST. THOMAS, U.S. VIRGIN ISLANDS

FIGURE 1

PATH: \\MAHPI-FILE01\ACTIVEPROJECTS\443005\CON0036696\0000000000254794\7.0_GIS_MODELS\7.2_WORK_IN_PROGRESS\MAP_DOCS\DRAFT\FIGURE 1-1.MXD - USER: CWEAVER - DATE: 10/12/2017



United States Environmental Protection Agency

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TUTU WELLS SUPERFUND SITE VICINITY MAP

ST. THOMAS, U.S. VIRGIN ISLANDS

FIGURE 2

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HDR | EPA United States Environmental Protection Agency

ALTERNATIVE 2A - EXPANSION OF PUMP AND TREAT SYSTEM AND REINJECTION

TUTU OU2, ST. THOMAS, U.S. VIRGIN ISLANDS

FIGURE 3

Appendix II

TABLES

Table 1

Summary of Constituents of Concern and Medium-Specific Exposure Point Concentrations

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Constituent of Potential Concern	Concentration Detected		Frequency of Detection	EPC	Statistical Measure
		Minimum	Maximum			
Groundwater	1,1,2-Trichloroethane	1.3	1.6	2 / 26	0.695	95% KM (t) UCL
	1,1-Dichloroethene	0.74	400	6 / 26	56.8	95% KM (t) UCL
	1,2,4-Trichlorobenzene	1	4.1	4 / 26	1.215	95% KM (t) UCL
	1,2-Dichloroethane	0.65	0.8	2 / 26	0.547	95% KM (t) UCL
	1,3-Dichlorobenzene	0.6	0.74	3 / 26	0.541	95% KM (t) UCL
	1,4-Dichlorobenzene	0.53	2.8	5 / 26	0.884	95% KM (t) UCL
	Bromodichloromethane	1.2	2.7	2 / 26	1.142	95% KM (Chebyshev) UCL
	Chlorobenzene	1.9	48	5 / 26	7.994	95% KM (t) UCL
	cis-1,2-Dichloroethylene	0.67	160,000	24 / 26	71118	99% KM (Chebyshev) UCL
	Tetrachloroethylene	0.97	92,000	26 / 26	40294	99% Chebyshev (Mean, Sd) UCL
	trans-1,2-Dichloroethylene	0.68	2,300	16 / 26	1502	99% KM (Chebyshev) UCL
	Trichloroethylene	0.51	29,000	22 / 26	12672	99% KM (Chebyshev) UCL
	Vinyl chloride	2.2	38,000	16 / 26	18727	99% KM (Chebyshev) UCL

Abbreviations and Notes:
KM = Kaplan Meier
UCL = Upper confidence limit
Concentrations are presented in units of micrograms per liter (ug/L).
This table presents the constituents of potential concern (COPCs) and exposure point concentrations (EPCs) in groundwater that were evaluated in the Human Health Risk Assessment (HHRA).

Table 2

Selection of Exposure Scenarios

Scenario Timeframe	Medium / Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Evaluation
Future	Groundwater	Tapwater	On-Site Worker	Adult	Ingestion	Quantitative
					Dermal	
		Indoor Air			Inhalation	Qualitative
Future	Groundwater	Trench Water	On-Site Construction Worker	Adult	Ingestion	Quantitative
					Dermal	
		Trench Air			Inhalation	
Future	Groundwater	Tapwater	Resident	Adult	Ingestion	Quantitative
					Dermal	
		Shower Vapors			Inhalation	
		Indoor Air			Inhalation	Qualitative
	Groundwater	Tapwater		Child (0-6 years)	Ingestion	Quantitative
					Dermal	
		Shower Vapors			Inhalation	
		Indoor Air			Inhalation	Qualitative

Note:
This table describes the exposure pathways that were evaluated in the HHRA. Exposure media, exposure points and characteristics of receptor populations are identified.

Table 3A

Noncancer Toxicity Data Summary - Oral / Dermal Pathways

COPC	Chronic / Subchronic	Oral Reference Dose (RfD)		Oral Absorption Efficiency for Dermal	Absorbed RfD for Dermal		Primary Target Organ	Combined Uncertainty / Modifying Factors	Source	Source Date
		Value	Units		Value	Units				
1,1,2-Trichloroethane	Chronic	0.004	mg/kg-day	1	0.004	mg/kg-day	Lymphatic	1000 / 1	IRIS	9/26/1988
1,1-Dichloroethene	Chronic	0.05	mg/kg-day	1	0.05	mg/kg-day	Hepatic	100 / 1	IRIS	8/13/2002
1,2,4-Trichlorobenzene	Chronic	0.01	mg/kg-day	1	0.01	mg/kg-day	Endocrine	1000 / 1	IRIS	5/1/1992
1,2-Dichloroethane	Chronic	0.006	mg/kg-day	1	0.006	mg/kg-day	Renal	10000	PPRTV Appendix	10/1/2010
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	Subchronic	0.07	mg/kg-day	1	0.07	mg/kg-day	Hepatic	100	ATSDR	7/1/2006
Bromodichloromethane	Chronic	0.02	mg/kg-day	1	0.02	mg/kg-day	Renal	1000 / 1	IRIS	9/30/1987
Chlorobenzene	Subchronic	0.02	mg/kg-day	1	0.02	mg/kg-day	Hepatic	1000	IRIS	7/1/1993
cis-1,2-Dichloroethylene	Chronic	0.002	mg/kg-day	1	0.002	mg/kg-day	Renal	3000	IRIS	9/30/2010
Tetrachloroethylene	Chronic	0.006	mg/kg-day	1	0.006	mg/kg-day	Nervous, Hepatic, Renal	1000	IRIS	2/10/2012
trans-1,2-Dichloroethylene	Subchronic	0.02	mg/kg-day	1	0.02	mg/kg-day	Lymphatic	3000	IRIS	9/30/2010
Trichloroethylene	Chronic	0.0005	mg/kg-day	1	0.0005	mg/kg-day	Developmental, Hepatic, Renal, Nervous, Lymphatic, Reproductive	100,1000,10, multiple studies	IRIS	9/28/2011
Vinyl chloride	Chronic	0.003	mg/kg-day	1	0.003	mg/kg-day	Hepatic	30	IRIS	8/7/2000

Abbreviations and Notes:

ATSDR = Agency for Toxic Substances & Disease Registry
COPC = Constituents of potential concern
IRIS = Integrated Risk Information System
NA = Not available
PPRTV = Provisional Peer-Reviewed Toxicity Values
This table provides the noncancer toxicity information for the oral and dermal exposure pathways. The dermal toxicity values are derived using oral toxicity values. Chronic toxicity values are applied where available.

Table 3B

Noncancer Toxicity Data - Inhalation Pathway

COPC	Chronic / Subchronic	Inhalation Reference Concentration (RfC)		Primary Target Organ	Combined Uncertainty / Modifying Factors	Source	Source Date
		Value	Units				
1,1,2-Trichloroethane	Subchronic	0.0002	mg/m^3	Hepatic	3000	PPRTV	4/1/2011
1,1-Dichloroethene	Chronic	0.2	mg/m^3	Hepatic	30 / 1	IRIS	8/13/2002
1,2,4-Trichlorobenzene	Chronic	0.002	mg/m^3	Endocrine	3000	PPRTV	6/16/2009
1,2-Dichloroethane	Chronic	0.007	mg/m^3	Nervous	300	PPRTV	10/1/2010
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	Subchronic	0.8	mg/m^3	Hepatic	100 / 1	IRIS	11/1/1996
Bromodichloromethane	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	Chronic	0.05	mg/m^3	Hepatic, Renal	1000	PPRTV	10/12/2006
cis-1,2-Dichloroethylene	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	Chronic	0.04	mg/m^3	Nervous, Hepatic, Renal	1000	IRIS	2/10/2012
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA	NA	NA
Trichloroethylene	Chronic	0.002	mg/m^3	Developmental, Hepatic, Renal, Nervous, Lymphatic, Reproductive	100,10, multiple studies	IRIS	9/28/2011
Vinyl chloride	Chronic	0.1	mg/m^3	Hepatic	30	IRIS	8/7/2000

Abbreviations and Notes:

COPC = Constituents of potential concern

IRIS = Integrated Risk Information System

NA = Not available

PPRTV = Provisional Peer-Reviewed Toxicity Values

This table provides the noncancer toxicity information for the inhalation exposure pathway. Chronic toxicity values are applied where available.

Table 4A

Cancer Toxicity Data - Oral / Dermal Pathways

COPC	Mutagenic	Oral Slope Factor (CSFo)		Oral Absorption Efficiency for Dermal	Absorbed CSFd for Dermal		Weight of Evidence / Cancer Guidelines Description	Source	Source Date
		Value	Units		Value	Units			
1,1,2-Trichloroethane	No	0.057	$(mg/kg\text{-}day)^{-1}$	1	0.057	$(mg/kg\text{-}day)^{-1}$	C / Possible human carcinogen	IRIS	3/31/1987
1,1-Dichloroethene	No	NA	NA	NA	NA	NA	Data are inadequate for assessment	IRIS	8/13/2002
1,2,4-Trichlorobenzene	No	0.029	$(mg/kg\text{-}day)^{-1}$	1	0.029	$(mg/kg\text{-}day)^{-1}$	D (IRIS) / Likely to be carcinogenic to humans (PPRTV)	PPRTV	6/16/2009
1,2-Dichloroethane	No	0.091	$(mg/kg\text{-}day)^{-1}$	1	0.091	$(mg/kg\text{-}day)^{-1}$	B2 / Probable human carcinogen	IRIS	3/31/1987
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	No	0.0054	$(mg/kg\text{-}day)^{-1}$	1	0.0054	$(mg/kg\text{-}day)^{-1}$	B2 / Probable human carcinogen	CAL EPA	2/1/1997
Bromodichloromethane	No	0.062	$(mg/kg\text{-}day)^{-1}$	1	0.062	$(mg/kg\text{-}day)^{-1}$	B2 / Probable human carcinogen	IRIS	2/1/1993
Chlorobenzene	No	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethylene	No	NA	NA	NA	NA	NA	Data are inadequate for assessment	IRIS	9/30/2010
Tetrachloroethylene	No	0.0021	$(mg/kg\text{-}day)^{-1}$	1	0.0021	$(mg/kg\text{-}day)^{-1}$	Likely to be carcinogenic in humans	IRIS	2/10/2012
trans-1,2-Dichloroethylene	No	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethylene	Yes	0.046	$(mg/kg\text{-}day)^{-1}$	1	0.046	$(mg/kg\text{-}day)^{-1}$	Carcinogenic to humans	IRIS	9/28/2011
Vinyl chloride	Yes	0.72	$(mg/kg\text{-}day)^{-1}$	1	0.72	$(mg/kg\text{-}day)^{-1}$	Known/likely human carcinogen	IRIS	8/7/2000

Abbreviations and Notes:
CAL EPA = California Environmental Protection Agency
COPC = Constituents of potential concern
IRIS = Integrated Risk Information System
NA = Not available
PPRTV = Provisional Peer-Reviewed Toxicity Values
This table provides the cancer toxicity information for the oral and dermal exposure pathways. The dermal toxicity values are derived using oral toxicity values.

Table 4B

Cancer Toxicity Data - Inhalation Pathway

COPC	Mutagenic	Inhalation Unit Risk (IUR)		Weight of Evidence / Cancer Guidelines Description	Source	Source Date
		Value	Units			
1,1,2-Trichloroethane	No	0.000016	$(ug/m3)^{-1}$	C / Possible human carcinogen	IRIS	3/31/1987
1,1-Dichloroethene	No	NA	NA	Suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential	IRIS	8/13/2002
1,2,4-Trichlorobenzene	No	NA	NA			
1,2-Dichloroethane	No	0.000026	$(ug/m3)^{-1}$	B2 / Probable human carcinogen	IRIS	3/31/1987
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	No	0.000011	$(ug/m3)^{-1}$	B2 / Probable human carcinogen	CAL EPA	2/1/1997
Bromodichloromethane	No	0.000037	$(ug/m3)^{-1}$	Carcinogenic - no class listed	CAL EPA	1/1/1990
Chlorobenzene	No	NA	NA	NA	NA	NA
cis-1,2-Dichloroethylene	No	NA	NA	Data are inadequate for assessment	IRIS	9/30/2010
Tetrachloroethylene	No	0.00000026	$(ug/m3)^{-1}$	Likely to be carcinogenic in humans	IRIS	2/10/2012
trans-1,2-Dichloroethylene	No	NA	NA	NA	NA	NA
Trichloroethylene	Yes	0.0000041	$(ug/m3)^{-1}$	Carcinogenic to humans	IRIS	9/28/2011
Vinyl chloride	Yes	0.0000044	$(ug/m3)^{-1}$	Known/likely human carcinogen	IRIS	8/7/2000

Abbreviations and Notes:
CAL EPA = California Environmental Protection Agency
COPC = Constituents of potential concern
IRIS = Integrated Risk Information System
NA = Not available
This table provides the cancer toxicity information for the inhalation exposure pathway.

Table 5A

Risk Characterization Summary - Noncarcinogens for a Construction Worker

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	COPC	Noncancer Hazard Quotients					
				Primary Target Organ (Ingestion / Dermal)	Ingestion	Dermal	Target Organ (Inhalation)	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Trench Water	1,1,2-Trichloroethane	Lymphatic	3.0E-05	1.4E-04	Hepatic	2.5E+00	2.5E+00
			1,1-Dichloroethene	Hepatic	1.9E-04	1.8E-03	Hepatic	2.5E-01	2.5E-01
			1,2,4-Trichlorobenzene	Endocrine	2.1E-05	1.5E-03	Endocrine	3.8E-01	3.8E-01
			1,2-Dichloroethane	Renal	1.6E-05	5.4E-05	Nervous	6.4E-02	6.4E-02
			1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA
			1,4-Dichlorobenzene	Hepatic	2.2E-06	8.6E-05	Hepatic	7.7E-04	8.6E-04
			Bromodichloromethane	Renal	9.8E-06	3.9E-05	NA	NA	4.9E-05
			Chlorobenzene	Hepatic	6.8E-05	1.6E-03	Hepatic, Renal	1.3E-01	1.3E-01
			cis-1,2-Dichloroethylene	Renal	6.1E+00	5.4E+01	NA	NA	6.0E+01
			Tetrachloroethylene	Nervous, Hepatic, Renal	1.1E+00	3.7E+01	Nervous, Hepatic, Renal	6.7E+02	7.1E+02
			trans-1,2-Dichloroethylene	Lymphatic	1.3E-02	1.1E-01	NA	NA	1.3E-01
			Trichloroethylene	Developmental, Hepatic, Renal, Nervous, Lymphatic, Reproductive	4.3E+00	4.4E+01	Developmental, Hepatic, Renal, Nervous, Lymphatic, Reproductive	4.7E+03	4.8E+03
			Vinyl chloride	Hepatic	1.1E+00	6.9E+00	Hepatic	2.0E+02	2.1E+02
								Hazard Index Total:	**5.8E+03**

Abbreviations and Notes:
COPC = Constituents of potential concern
NA = Not available
This table presents hazard quotients (HQs) for each route of exposure and the hazard index (HI, sum of hazard quotients) for exposure of a construction worker to COPCs in groundwater. The Risk Assessment Guidance for Superfund states that a HI greater than 1 indicates the potential for adverse noncancer effects.

Table 5B

Risk Characterization Summary - Noncarcinogens for a Worker

Scenario Timeframe: Future
Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	COPC	Noncancer Hazard Quotients			
				Primary Target Organ (Ingestion / Dermal)	Ingestion	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tapwater	1,1,2-Trichloroethane	Lymphatic	1.9E-03	5.6E-05	1.9E-03
			1,1-Dichloroethene	Hepatic	1.2E-02	6.9E-04	1.3E-02
			1,2,4-Trichlorobenzene	Endocrine	1.3E-03	7.5E-04	2.0E-03
			1,2-Dichloroethane	Renal	9.8E-04	2.0E-05	1.0E-03
			1,3-Dichlorobenzene	NA	NA	NA	NA
			1,4-Dichlorobenzene	Hepatic	1.4E-04	4.0E-05	1.8E-04
			Bromodichloromethane	Renal	6.1E-04	1.8E-05	6.3E-04
			Chlorobenzene	Hepatic	4.3E-03	6.3E-04	4.9E-03
			cis-1,2-Dichloroethylene	Renal	3.8E+02	2.0E+01	4.0E+02
			Tetrachloroethylene	Nervous, Hepatic, Renal	7.2E+01	1.8E+01	9.0E+01
			trans-1,2-Dichloroethylene	Lymphatic	8.0E-01	4.3E-02	8.5E-01
			Trichloroethylene	Developmental, Hepatic, Renal, Nervous, Lymphatic, Reproductive	2.7E+02	1.9E+01	2.9E+02
			Vinyl chloride	Hepatic	6.7E+01	2.3E+00	6.9E+01
						Hazard Index Total:	**8.5E+02**

Abbreviations and Notes:
COPC = Constituents of potential concern
NA = Not available
This table presents hazard quotients (HQs) for each route of exposure and the hazard index (HI, sum of hazard quotients) for exposure of a worker to COPCs in groundwater. The Risk Assessment Guidance for Superfund states that a HI greater than 1 indicates the potential for adverse noncancer effects.

Table 5C

Risk Characterization Summary - Noncarcinogens for a Resident

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	COPC	Noncancer Hazard Quotients					
				Primary Target Organ (Ingestion / Dermal)	Ingestion	Dermal	Target Organ (Inhalation)	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Tapwater	1,1,2-Trichloroethane	Lymphatic	5.2E-03	3.7E-04	Hepatic	1.7E+00	1.7E+00
			1,1-Dichloroethene	Hepatic	3.4E-02	4.4E-03	Hepatic	1.4E-01	1.8E-01
			1,2,4-Trichlorobenzene	Endocrine	3.6E-03	4.9E-03	Endocrine	3.0E-01	3.0E-01
			1,2-Dichloroethane	Renal	2.7E-03	1.3E-04	Nervous	3.8E-02	4.1E-02
			1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA
			1,4-Dichlorobenzene	Hepatic	3.8E-04	2.6E-04	Hepatic	5.4E-04	1.2E-03
			Bromodichloromethane	Renal	1.7E-03	1.2E-04	NA	NA	1.8E-03
			Chlorobenzene	Hepatic	1.2E-02	4.1E-03	Hepatic, Renal	7.8E-02	9.4E-02
			cis-1,2-Dichloroethylene	Renal	1.1E+03	1.3E+02	NA	NA	1.2E+03
			Tetrachloroethylene	Nervous, Hepatic, Renal	2.0E+02	1.2E+02	Nervous, Hepatic, Renal	4.9E+02	8.1E+02
			trans-1,2-Dichloroethylene	Lymphatic	2.3E+00	2.7E-01	NA	NA	2.5E+00
			Trichloroethylene	Developmental, Hepatic, Renal, Nervous, Lymphatic, Reproductive	7.6E+02	1.2E+02	Developmental, Hepatic, Renal, Nervous, Lymphatic, Reproductive	3.1E+03	4.0E+03
			Vinyl chloride	Hepatic	1.9E+02	1.4E+01	Hepatic	9.1E+01	2.9E+02
								Hazard Index Total:	**6.3E+03**

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child (0-6 yrs)

Medium	Exposure Medium	Exposure Point	COPC	Noncancer Hazard Quotients					
				Primary Target Organ (Ingestion / Dermal)	Ingestion	Dermal	Target Organ (Inhalation)	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Tapwater	1,1,2-Trichloroethane	Lymphatic	8.7E-03	5.5E-04	Hepatic	1.4E+00	1.4E+00
			1,1-Dichloroethene	Hepatic	5.7E-02	6.7E-03	Hepatic	1.2E-01	1.8E-01
			1,2,4-Trichlorobenzene	Endocrine	6.1E-03	7.4E-03	Endocrine	2.5E-01	2.6E-01
			1,2-Dichloroethane	Renal	4.5E-03	1.9E-04	Nervous	3.2E-02	3.7E-02
			1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA
			1,4-Dichlorobenzene	Hepatic	6.3E-04	4.0E-04	Hepatic	4.6E-04	1.5E-03
			Bromodichloromethane	Renal	2.8E-03	1.8E-04	NA	NA	3.0E-03
			Chlorobenzene	Hepatic	2.0E-02	6.2E-03	Hepatic, Renal	6.6E-02	9.2E-02
			cis-1,2-Dichloroethylene	Renal	1.8E+03	2.0E+02	NA	NA	2.0E+03
			Tetrachloroethylene	Nervous, Hepatic, Renal	3.3E+02	1.8E+02	Nervous, Hepatic, Renal	4.2E+02	9.3E+02
			trans-1,2-Dichloroethylene	Lymphatic	3.7E+00	4.1E-01	NA	NA	4.2E+00
			Trichloroethylene	Developmental, Hepatic, Renal, Nervous, Lymphatic, Reproductive	1.3E+03	1.8E+02	Developmental, Hepatic, Renal, Nervous, Lymphatic, Reproductive	2.6E+03	4.1E+03
			Vinyl chloride	Hepatic	3.1E+02	2.1E+01	Hepatic	7.7E+01	4.1E+02
								Hazard Index Total:	**7.4E+03**

Abbreviations and Notes:
COPC = Constituents of potential concern
NA = Not available
This table presents hazard quotients (HQs) for each route of exposure and the hazard index (HI, sum of hazard quotients) for exposure of a resident adult and child to COPCs in groundwater. The Risk Assessment Guidance for Superfund states that a HI greater than 1 indicates the potential for adverse noncancer effects.

Table 6A

Risk Characterization Summary - Carcinogens for a Construction Worker

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	COPC	Cancer Risks			
				Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Trench Water	1,1,2-Trichloroethane	9.7E-11	4.4E-10	1.1E-07	1.1E-07
			1,1-Dichloroethene	NA	NA	NA	NA
			1,2,4-Trichlorobenzene	8.6E-11	6.3E-09	NA	6.4E-09
			1,2-Dichloroethane	1.2E-10	4.2E-10	1.7E-07	1.7E-07
			1,3-Dichlorobenzene	NA	NA	NA	NA
			1,4-Dichlorobenzene	1.2E-11	4.7E-10	9.7E-08	9.7E-08
			Bromodichloromethane	1.7E-10	7.0E-10	3.9E-07	3.9E-07
			Chlorobenzene	NA	NA	NA	NA
			cis-1,2-Dichloroethylene	NA	NA	NA	NA
			Tetrachloroethylene	2.1E-07	6.7E-06	1.0E-04	1.1E-04
			trans-1,2-Dichloroethylene	NA	NA	NA	NA
			Trichloroethylene	1.4E-06	1.5E-05	5.5E-04	5.7E-04
			Vinyl chloride	3.3E-05	2.1E-04	1.3E-03	1.5E-03
						Cumulative Cancer Risk:	**2.2E-03**

Abbreviations and Notes:
COPC = Constituents of potential concern
NA = Not available
The table presents excess cancer risks for each route of exposure and the cumulative cancer risk for exposure of a construction worker to COPCs in groundwater.

Table 6B

Risk Characterization Summary - Carcinogens for a Worker

Scenario Timeframe: Future
Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	COPC	Cancer Risks		
				Ingestion	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tapwater	1,1,2-Trichloroethane	1.5E-07	4.6E-09	1.6E-07
			1,1-Dichloroethene	NA	NA	NA
			1,2,4-Trichlorobenzene	1.3E-07	7.7E-08	2.1E-07
			1,2-Dichloroethane	1.9E-07	3.9E-09	1.9E-07
			1,3-Dichlorobenzene	NA	NA	NA
			1,4-Dichlorobenzene	1.8E-08	5.4E-09	2.4E-08
			Bromodichloromethane	2.7E-07	7.9E-09	2.8E-07
			Chlorobenzene	NA	NA	NA
			cis-1,2-Dichloroethylene	NA	NA	NA
			Tetrachloroethylene	3.2E-04	8.0E-05	4.0E-04
			trans-1,2-Dichloroethylene	NA	NA	NA
			Trichloroethylene	2.2E-03	1.5E-04	2.4E-03
			Vinyl chloride	5.2E-02	1.8E-03	5.3E-02
				Cumulative Cancer Risk:		**5.6E-02**

Abbreviations and Notes:
COPC = Constituents of potential concern
NA = Not available

The table presents excess cancer risks for each route of exposure and the cumulative cancer risk for exposure of a worker to COPCs in groundwater.

Table 6C

Risk Characterization Summary - Carcinogens for a Resident

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult and Child (0-6 yrs)

Medium	Exposure Medium	Exposure Point	COPC	Cancer Risks			
				Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Tapwater	1,1,2-Trichloroethane	6.1E-07	3.8E-08	1.9E-06	2.6E-06
			1,1-Dichloroethene	NA	NA	NA	NA
			1,2,4-Trichlorobenzene	5.4E-07	6.5E-07	NA	1.2E-06
			1,2-Dichloroethane	7.7E-07	3.2E-08	2.5E-06	3.3E-06
			1,3-Dichlorobenzene	NA	NA	NA	NA
			1,4-Dichlorobenzene	7.4E-08	4.5E-08	1.7E-06	1.8E-06
			Bromodichloromethane	1.1E-06	6.6E-08	7.4E-06	8.5E-06
			Chlorobenzene	NA	NA	NA	NA
			cis-1,2-Dichloroethylene	NA	NA	NA	NA
			Tetrachloroethylene	1.3E-03	6.7E-04	1.8E-03	3.8E-03
			trans-1,2-Dichloroethylene	NA	NA	NA	NA
			Trichloroethylene	1.4E-02	1.8E-03	2.5E-02	4.1E-02
			Vinyl chloride	9.1E-01	6.1E-02	1.7E-02	9.9E-01
						Cumulative Cancer Risk:	**1.0E+00**

Abbreviations and Notes:
COPC = Constituents of potential concern
NA = Not available
The table presents excess cancer risks for each route of exposure and the cumulative cancer risk for exposure of a resident to COPCs in groundwater. Cancer risk is expressed as a unitless probability of an individual in a population developing cancer over a lifetime; therefore, the chemical-specific risk cannot be greater than 1.

Table 7
Cleanup Levels for Groundwater

Contaminants of Concern	EPA National Primary Drinking Water Standards[1] MCLs (µg/l)	Remediation Goals[2] (µg/l)	Maximum Detected Concentrations[3] (µg/l)
Tetrachloroethene	5	5	92,000
Trichloroethene	5	5	29,000
1,1-Dichloroethene	7	7	400
cis-1,2-Dichloroethene	70	70	160,000
trans-1,2-Dichlorothene	100	100	2,300
Vinyl Chloride	2	2	38,000
1,1,2-Trichloroethane**	5	5	1.60

Note:

1. EPA National Primary Drinking Water Standards (web page), http://www.epa.gov/safewater/consumer/pdf/mcl.pdf.
2. In the absence of local guidance values and regulations, EPA MCLs will be the remediation goals.
3. The maximum concentrations detected during the focused source remedial investigation by HDR in 2016-2017.

**- included in this table based on HHRA (HDR 2018); calculated cancer risks for these constituents are in the 1 x10-6 range, contributing to a cumulative ELCR greater than 1 x10-4. 1,1,2-trichloroethane also contributes to noncancer hazards greater than one for the liver as a target organ.

Acronyms:
EPA - United States Environmental Protection Agency
MCLs - Maximum Contaminant Levels
µg/l - microgram per liter
HHRA- Human Health Risk Assessment

Table 8 - Cost Estimate Summary for the Selected Remedy - Alternative 2

Alternative 2
Expand Existing Pump and Treat System

COST ESTIMATE SUMMARY

Site: Tutu Wells Superfund Site Operable Unit 2
Location: St. Thomas, USVI
Phase: Feasibility Study (-30% - +50%)
Base Year: 2021
Date: January 15, 2021

Description: Alternative 2 consists of:
i.) Expansion of existing system with addition of new extraction wells downgradient; ii) Operate at higher capacity with combination of extraction wells;
iii) Replace all existing treatment equipment and conveyance piping, upgrade existing PLC system, and replace EQ tank for DNAPL separator;
iv) Alternate pumping from existing monitoring wells with high contaminant concentrations; and
v) Dual phase extraction/EFR from source area wells

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Site Survey and Utility Clearance**					
1.1	Survey	1	LS	$ 15,000	$ 15,000	
1.2	Utility Clearance	1	LS	$ 15,000	$ 15,000	
	Sub-Total				**$ 30,000**	
2	**Pre-Design Investigation**					
2.1	Investigation Work Plan	1	LS	$ 100,000	$ 100,000	Sampling Plan, QAPP, HASP
2.2	Mobilization/ Demobilization	1	LS	$ 100,000	$ 100,000	Mobilize all equipment and personnel to USVI
2.3	Site Preparation	1	LS	$ 18,500	$ 18,500	Clearing/ Grubbing drilling locations
2.4	Permits	1	LS	$ 10,000	$ 10,000	Local Permits
2.5	Bedrock Drilling	700	LF	$ 75	$ 52,500	Five, 2-inch diameter MWs installed to 140 ft bgs.
2.6	Grouting Open Boreholes	100	LF	$ 20	$ 2,000	Back grouting boreholes as necessary. Assume 20 ft/ MW
2.7	Flush-mount curb box with inner locking cap	5	EA	$ 300	$ 1,500	For monitoring wells
2.8	Monitoring Well Redevelopment	40	hr	$ 350	$ 14,000	Assume 8 hrs per MW
2.9	Groundwater Sampling and Data Evaluation	1	LS	$ 50,000	$ 50,000	Assume 30 wells for baseline
2.10	Surface Repair	1	LS	$ 6,000	$ 6,000	
2.11	Water Level Measurements	1	LS	$ 1,500	$ 1,500	
2.12	Hydrogeologic Assessment - Pumping Test	1	LS	$ 100,000	$ 100,000	
2.13	Extraction Well Redevelopment	1	LS	$ 100,000	$ 100,000	
2.14	Hydrogeologic Evaluation	1	LS	$ 75,000	$ 75,000	
2.15	IDW Characterization and Disposal	1	LS	$ 30,000	$ 30,000	Sleeves, decon water, misc. used items, groundwater waste from well installation and redevelopment.
2.16	PDI Report	1	LS	$ 50,000	$ 50,000	
	Sub-Total				**$ 711,000**	
3	**Site Mobilization/Demobilization**					
3.1	Remedial Action Work plan/Permitting	1	LS	$ 100,000	$ 100,000	Permit equivalents, access agreements, RAWP, Construction HASP, Subcontractor procurement
3.2	Submittals/Implementation Plans	1	LS	$ 100,000	$ 100,000	Remedial Design reports
3.3	Post Construction Submittals	1	LS	$ 75,000	$ 75,000	Bi-weekly reports, monthly progress reports
3.4	Decontamination Station	1	LS	$ 5,000	$ 5,000	
	Sub-Total				**$ 280,000**	
4	**Health and Safety**					
4.1	PPE and Field Supplies	1	LS	$ 5,000	$ 5,000	
	Sub-Total				**$ 5,000**	
5	**Site Preparation**					
5.1	Temporary Security Fence	1,000	LF	$ 30	$ 30,000	
	Sub-Total				**$ 30,000**	
6	**Treatment Plant Upgrades**					
6.1	Demolition and Replacement of Existing Equipment	1	LS	$ 1,000,000	$ 1,000,000	Includes the demolition and replacement of treatment equipment such as EW pumps, transfer pumps, air stripper, air stripper blower, bag filters, EQ tank for DNAPL recovery tank, piping, PLC, chemical feed metering pumps and tank, heat exchanger, 2 GAC vessels, 2 permanganate vessels. Also includes cost for alternate pumping labor and equipment.
	Sub-Total				**$ 1,000,000**	

Table 8 - Cost Estimate Summary for the Selected Remedy - Alternative 2

Alternative 2
Expand Existing Pump and Treat System

COST ESTIMATE SUMMARY

Site: Tutu Wells Superfund Site Operable Unit 2
Location: St. Thomas, USVI
Phase: Feasibility Study (-30% - +50%)
Base Year: 2021
Date: January 15, 2021

Description: Alternative 2 consists of:
i.) Expansion of existing system with addition of new extraction wells downgradient; ii) Operate at higher capacity with combination of extraction wells;
iii) Replace all existing treatment equipment and conveyance piping, upgrade existing PLC system, and replace EQ tank for DNAPL separator;
iv) Alternate pumping from existing monitoring wells with high contaminant concentrations; and
v) Dual phase extraction/EFR from source area wells

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
7	**New Extraction Well Drilling**					
7.1	Mobilization/ Demobilization	1	LS	$ 50,000	$ 50,000	
7.2	Per Diem (Per working crew day)	20	Crew-day	$ 750	$ 15,000	Estimate 10 days per well
7.3	Standby	8	HR	$ 450	$ 3,600	
7.4	Grouting Open Boreholes	100	LF	$ 20	$ 2,000	
7.5	Bedrock Drilling	280	LF	$ 75	$ 21,000	Assume each well is 140 ft bgs
7.6	Steel Casing	100	LF	$ 50	$ 5,000	Assume casing goes to 50 ft bgs for each well
7.7	Extraction Well Vault	2	EA	$ 5,000	$ 10,000	
7.8	Borehole/ Well Development	20	HR	$ 375	$ 7,500	
7.9	Dual Packer Testing	16	HR	$ 525	$ 8,400	
7.10	Site Access, Set-up, Breakdown and Restoration	1	LS	$ 20,000	$ 20,000	
7.11	Drums	100	EA	$ 150	$ 15,000	
7.12	Manage IDW	20	HR	$ 350	$ 7,000	
7.13	Decon	20	HR	$ 250	$ 5,000	
	Sub-Total				**$ 169,500**	
8	**Conveyance Piping**					
8.1	Mobilization	1	LS	$ 30,000	$ 30,000	
8.2	Soil Erosion and Sediment Control	1,000	LF	$ 5	$ 5,000	
8.3	Trenching	593	CY	$ 50	$ 29,630	
8.4	Pipe (HDPE double walled)	1,000	LF	$ 30	$ 30,000	Piping from the extraction wells to the treatment plant.
8.5	Utility Marking Tape	1,000	LF	$ 0.30	$ 300	
8.6	Bedding	593	CY	$ 20	$ 11,852	
8.7	Backfill and Compaction	4,000	SF	$ 5	$ 20,000	
8.8	Vaults and Junctions	4	EA	$ 6,500	$ 26,000	Assume 2 vaults and 2 cleanouts
	Sub-Total				**$ 152,781**	
9	**DPE/EFR Events**					
9.1	Pilot Study	1	LS	$ 50,000	$ 50,000	includes reporting
9.2	15-mil geomembrane liner with soil cover	60,000	SF	$ 1.00	$ 60,000	Vendor estimate
9.3	EFR Events at Source Area Wells	10	Each	$ 60,000	$ 600,000	Assume twice a year for 5 years
9.4	Vapor and Liquid sampling	140	Each	$ 1,500	$ 18,000	Assume a vapor and liquid sample at each EFR well (7) twice a year for 5 years
	Sub-Total				**$ 728,000**	
10	**Reporting and Institutional Controls**					
10.1	Remedial Action Report	1	LS	$ 50,000	$ 50,000	
10.2	Institutional Controls & Site Management Plan	1	LS	$ 20,000	$ 20,000	
	Sub-Total				**$ 70,000**	
	Sub-Total				**$ 3,176,281**	Sub-Total All Construction Costs.
	Contingency	20%			$ 635,256	10% scope + 10% bid
	Sub-Total				**$ 3,811,538**	
	Project Management	6%			$ 228,692	
	Remedial Design	12%			$ 457,385	
	Construction Management	8%			$ 304,923	
	TOTAL CAPITAL COST				**$ 4,802,538**	

Table 8 - Cost Estimate Summary for the Selected Remedy - Alternative 2

Alternative 2
Expand Existing Pump and Treat System

COST ESTIMATE SUMMARY

Site: Tutu Wells Superfund Site Operable Unit 2
Location: St. Thomas, USVI
Phase: Feasibility Study (-30% - +50%)
Base Year: 2021
Date: January 15, 2021

Description: Alternative 2 consists of:
i.) Expansion of existing system with addition of new extraction wells downgradient; ii) Operate at higher capacity with combination of extraction wells;
iii) Replace all existing treatment equipment and conveyance piping, upgrade existing PLC system, and replace EQ tank for DNAPL separator;
iv) Alternate pumping from existing monitoring wells with high contaminant concentrations; and
v) Dual phase extraction/EFR from source area wells

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes

ANNUAL O&M COST

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Operations Costs - Year 1 to 30**	1 to 30					Every year through year 30.
1.1	Electrical Usage		150,000	KW-Hr	$ 0.47	$ 69,810	P&T system operates for 30 years
1.2	Vapor Carbon Usage		10,000	LB	$ 4.00	$ 40,000	Change out both units once per year, estimate 5,000 lbs ea
1.3	Vapor Carbon Disposal		10,000	lb	$ 1.00	$ 10,000	
1.4	Potassium Permanganate Usage		14,000	LB	$ 4.00	$ 56,000	
1.5	Potassium Permanganate Disposal		1	EA	$ 3,000.00	$ 3,000	
1.6	Weekly Inspections		52	EA	$ 600.00	$ 31,200	1x per week
1.7	Effluent Sampling		12	EA	$ 1,500	$ 18,000	Monthly Influent, Effluent Air Sampling and between GAC vessels for VOCs; includes labor
1.8	DNAPL Shipping and Disposal		3	EA	$ 12,500	$ 37,500	Assume 3, 55 gallon drums of DNAPL are generated annually and need to be disposed offsite.
1.9	Reporting		12	Month	$ 5,000	$ 60,000	Monthly
	Sub-Total					**$ 325,510**	
	Contingency		15%			$ 48,827	
	ANNUAL OPERATIONS COST (Year 1 to 30)					**$ 374,337**	
2	**LTM - Year 1 to 30**	1 to 30					Every year through year 30.
2.1	Groundwater Sampling		30	EA	$ 750	$ 22,500	30 wells annually; includes labor
2.2	Groundwater Sample Laboratory Analysis		36	EA	$ 550	$ 19,800	Total VOCs analysis + 20% QC samples.
2.3	Data Reduction, Evaluation and Reporting		1	EA	$ 20,000	$ 20,000	
2.4	Annual Report		1	EA	$ 24,000	$ 24,000	Includes periodic report
	Sub-Total					**$ 86,300**	
	Contingency		15%			$ 12,945	
	ANNUAL LTM COST (Year 1 to 30)					**$ 99,245**	
	Project Management					**$ 5,000**	
	Technical Support					**$ 5,000**	

Table 8 - Cost Estimate Summary for the Selected Remedy - Alternative 2

Alternative 2
Expand Existing Pump and Treat System

COST ESTIMATE SUMMARY

Site: Tutu Wells Superfund Site Operable Unit 2
Location: St. Thomas, USVI
Phase: Feasibility Study (-30% - +50%)
Base Year: 2021
Date: January 15, 2021

Description: Alternative 2 consists of:
i.) Expansion of existing system with addition of new extraction wells downgradient; ii) Operate at higher capacity with combination of extraction wells;
iii) Replace all existing treatment equipment and conveyance piping, upgrade existing PLC system, and replace EQ tank for DNAPL separator;
iv) Alternate pumping from existing monitoring wells with high contaminant concentrations; and
v) Dual phase extraction/EFR from source area wells

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes

PERIODIC COSTS

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Decommission System and Site Close Out**	30					At the end of Year 30
1.1	Decommission System		1	LS	$ 50,000	$ 50,000	
1.2	Monitoring Well Abandonment		30	EA	$ 1,500	$ 45,000	Drilling subcontractor, abandonment of monitoring wells
1.3	Final Closure Report		1	LS	$ 50,000	$ 50,000	
	Sub-Total					**$ 145,000**	
	Contingency		15%			$ 21,750	
	Project Management					$ 5,000	
	Technical Support					$ 5,000	
	PERIODIC COSTS (Year 30)					**$ 176,750**	

PRESENT VALUE ANALYSIS: Rate of Return: 7% Inflation Rate 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0		**$ 4,802,538**	
2	**Annual O&M Cost**				
2.1	Year 1 to 30	1 to 30	483,582	**$8,481,677**	Operations and LTM
3	**Periodic Costs**				
3.1	Year 30	30	176,750	$56,350	Decommission System and Site Close Out
	Sub-Total			**$ 56,350**	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 13,340,565**	

Table 8a - Cost Estimate Summary for the Selected Remedy - Alternative 2a

Alternative 2A
Reinjection

COST ESTIMATE SUMMARY

Site: Tutu Wells Superfund Site Operable Unit 2
Location: St. Thomas, USVI
Phase: Feasibility Study (-30% - +50%)
Base Year: 2021
Date: January 15, 2021

Description: Alternative 2A consists of :
i) Includes additional components and cost to Alternative 2 for reinjection of treated water downgradient via injection wells.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Injection Wells**					Drilling and Piping
1.1	Mobilization/ Demobilization	1	LS	$ 50,000	$ 50,000	
1.2	Per Diem (Per working crew day)	20	Crew-day	$ 750	$ 15,000	Assume 2 injection wells, estimate 10 days per well
1.3	Standby	8	HR	$ 450	$ 3,600	
1.4	Grouting Open Boreholes	40	LF	$ 20	$ 800	
1.5	Bedrock Drilling	280	LF	$ 75	$ 21,000	
1.6	Steel Casing	40	LF	$ 50	$ 2,000	Assume 10ft of casing per injection well
1.7	Injection Well Vault	2	EA	$ 5,000	$ 10,000	
1.8	Borehole/ Well Development	20	HR	$ 375	$ 7,500	Assume 10hr per well
1.9	Site Access, Set-up, Breakdown and Restoration	1	LS	$ 20,000	$ 20,000	
1.10	Drums	100	EA	$ 150	$ 15,000	
1.11	Manage IDW	20	HR	$ 350	$ 7,000	
1.12	Decon	20	HR	$ 250	$ 5,000	
1.13	Soil Erosion and Sediment Control	1,000	LF	$ 5	$ 5,000	Injection well water conveyance estimate
1.14	Trenching	593	CY	$ 50	$ 29,630	
1.15	Pipe (HDPE)	1,000	LF	$ 30	$ 30,000	Includes labor and material
1.17	Utility Marking Tape	1,000	LF	$ 0.30	$ 300	
1.18	Bedding	593	CY	$ 20	$ 11,852	
1.19	Backfill and Compaction	4,000	SF	$ 5	$ 20,000	
1.20	Asphalt/ concrete repair	1,000	SF	$ 5	$ 5,000	
1.21	Asphalt/ concrete disposal	35	Ton	$ 125	$ 4,375	
1.22	Vaults and Junctions	4	EA	$ 6,500	$ 26,000	Assume 2 vaults, 2 cleanouts
	Sub-Total				**$ 289,056**	
	Contingency	20%			$ 57,811	10% scope + 10% bid
	Sub-Total				**$ 346,868**	
	Project Management	6%			$ 20,812	
	Remedial Design	12%			$ 41,624	
	Construction Management	8%			$ 27,749	
	TOTAL CAPITAL COST				**$ 437,053**	

ANNUAL O&M COST

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Operations Costs - Year 1 to 30**	1 to 30					Every year through year 30.
1.1	Well Redevelopment		1	LS	$ 10,000	$ 10,000	Assumed once per year, 2 wells
	Sub-Total					**$ 10,000**	
	Contingency		15%			$ 1,500	
	ANNUAL OPERATIONS COST (Year 1 to 30)					**$ 11,500**	
2	**ANNUAL LTM COSTS ARE INCLUDED IN ALTERNATIVE 2**						

PERIODIC COSTS ARE INCLUDED IN ALTERNATIVE 2

PRESENT VALUE ANALYSIS: Rate of Return: 7% Inflation Rate 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0		**$ 437,053**	
2	**Annual O&M Cost**				
2.1	Year 1 to 30	1 to 30	11,500	**$ 51,364**	Operations only. LTM, Project Management and Tech support costs included in Alternative 2
3	**Periodic Costs**	30		-	Included in Alternative 2
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 488,417**	**In addition to costs under Alternative 2**

Table 9

Chemical-Specific ARARs, TBCs, and Other Guidance

Regulatory Level	ARAR Identification	Status	Requirement Synopsis	Comments
Federal	National Primary Drinking Water Standards (40 CFR 141)	Applicable	Establishes health-based standards for public drinking water systems. Also establishes drinking water quality goals set at levels at which no adverse health effects are anticipated, with an adequate margin of safety.	Drinking water standards maximum contaminant levels will be used to develop the remediation goals

Table 10
Location-Specific ARARs, TBCs, and Other Guidance

Regulatory Level	Authority/Source	Citation	Status	Requirement Synopsis	Comments
No Location-Specific ARARs, TBCs, and Other Guidance identified					

Table 11 Action-Specific ARARs, TBCs, and Other Guidance					
Regulatory Level	**Authority/Source**	**Citation**	**Status**	**Requirement Synopsis**	**Comments**
Federal	RCRA Identification and Listing of Hazardous Wastes	42 U.S.C. §6925; 40 CFR Part 261	Applicable for DNAPL	Describes methods for identifying hazardous wastes and lists known hazardous wastes.	This regulation is applicable to the identification of DNAPL hazardous wastes that are generated, treated, stored, or disposed during remedial activities.
Federal	RCRA Standards Applicable to Generators of Hazardous Wastes	42 U.S.C.§§ 6906, 6912, 6922-6925, 6937, and 6938; 40 CFR Part 262	Applicable for DNAPL	Describes standards applicable to generators of hazardous wastes.	Standards will be followed if any DNAPL hazardous wastes are generated.
Federal	RCRA- Standards for Owners/Operators of Treatment, Storage, and Disposal Facilities	42 U.S.C. §§6905, 6912(a), 6924, and 6925; 40 CFR Part 264	Relevant and Appropriate for DNAPL	This regulation lists general facility requirements including general waste analysis, security measures, inspections, and training requirements.	Facility will be designed, constructed, and operated in accordance with this requirement. All workers will be properly trained to handle DNAPL.
Federal	Hazardous Materials Transportation Regulations	49 CFR Parts 107, 171, 172, 177 to 179)	Relevant and Appropriate for DNAPL	This regulation outlines procedures for the packaging, labeling, manifesting, and transporting hazardous materials such as DNAPL.	Any company contracted to transport DNAPL material from the site will be required to comply with this regulation.
Federal	RCRA Standards Applicable to Transporters of Hazardous Waste	42 U.S.C.§§ 6906, 6912, 6922-6925, 6937, and 6938; 40 CFR Part 263	Relevant and Appropriate for DNAPL	Establishes the responsibility of off-site transporters of DNAPL in the handling, transportation and management of the waste. Requires manifesting, recordkeeping and immediate action in the event of a discharge.	Any company contracted to transport DNAPL material from the site will be required to comply with this regulation.
Federal	RCRA Land Disposal Restrictions	40 CFR 268	Applicable for DNAPL	This regulation identifies hazardous wastes restricted for disposal and provides treatment standards for disposal.	DNAPL will be treated to meet disposal requirements.
Territory	Division of Environmental Protection for waste storage, handling, and disposal and Virgin Islands Code	Title 19, Chapter 56	Applicable for DNAPL	This regulation identifies requirements for storage, handling, transportation, and disposal of hazardous wastes	This standard would apply to DNAPL generated from remediation activities performed at the site.
Federal	Clean Water Act Effluent Guidelines and Standards for the Point Source Category	40 CFR 414	Applicable	Establishes criteria for discharge quality of wastewater that contains organic chemicals, plastics and/or synthetic fibers	Need to meet requirements when discharging treated effluent
Federal	Clean Water Act (Federal Ambient Water Quality Criteria [FAWQC] and Guidance Values	40 CFR 131.36	Applicable	Establishes criteria for surface water quality based on toxicity to aquatic organisms and human health.	Need to meet requirements when discharging treated effluent
Federal	Safe Drinking Water Act – Underground Injection Control Program	40 CFR 144, 146	Applicable for treated groundwater reinjection	Establish performance standards, well requirements, and permitting requirements for groundwater re-injection wells	Project will evaluate the requirements for groundwater re-injection wells
Territory	Water Quality Standards for Waters of the Virgin Islands	Title 12, Chapter 7	Applicable	These provide water quality criteria for toxic pollutants applicable to all Territorial Waters	Need to meet requirements when discharging treated effluent
Federal	Clean Air Act (CAA)—National Ambient Air Quality Standards (NAAQs)	40 CFR 50	Relevant and Appropriate	These provide air quality standards for particulate matter, lead, NO2, SO2, CO, and volatile organic matter.	During treatment, air emissions from the air stripper will be properly controlled and monitored to comply with these standards.
Federal	Federal Directive – Control of Air Emissions from Superfund Air Strippers	OSWER Directive 9355.028	Applicable, if air strippers are used for groundwater treatment	These provide guidance on the use of controls for superfund site air strippers as well as other vapor extraction techniques in attainment and non-attainment areas for ozone.	The treatment system includes an air stripper and air emissions will be properly controlled and monitored to comply with these standards.
Territory	Virgin Islands Laws and Rules and Regulations on Air Pollution Control	Title 12, Chapter 9, Subchapters 201-204 and 206	Relevant and Appropriate	These provide guidance on regulations to control emissions of contaminants and particulates	This standard would apply to air emissions from the air stripper at the site.

Appendix III

ADMINISTRATIVE RECORD INDEX

ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

FINAL

07/07/2021

REGION ID: 02

Site Name: TUTU WELLFIELD
CERCLIS ID: VID982272569
OUID: 02
SSID: 021D
Action:

DocID:	Doc Date:	Title:	Image Count:	Doc Type:	Addressee Name/Organization:	Author Name/Organization:
503390	07/07/2021	ADMINISTRATIVE RECORD INDEX FOR OU2 FOR THE TUTU WELLFIELD SITE	3	Administrative Record Index		(US ENVIRONMENTAL PROTECTION AGENCY)
537591	09/30/2015	PROJECT SPECIFIC HEALTH AND SAFETY PLAN FOR THE TUTU WELLFIELD SITE	190	Work Plan	(US ENVIRONMENTAL PROTECTION AGENCY)	(HDR ENGINEERING INCORPORATED)
351489	10/01/2015	FINAL FOCUSED SOURCE REMEDIAL INVESTIGATION / FEASIBILITY STUDY WORK PLAN, VOLUME 1 OF 2 FOR THE TUTU WELLFIELD SITE	65	Work Plan	(US ENVIRONMENTAL PROTECTION AGENCY)	(HDR ENGINEERING INCORPORATED)
537592	10/01/2015	OPTIMIZED UNIFORM FEDERAL POLICY - QUALITY ASSURANCE PROJECT PLAN FOR THE TUTU WELLFIELD SITE	193	Work Plan	(US ENVIRONMENTAL PROTECTION AGENCY)	(HDR ENGINEERING INCORPORATED)
537593	01/01/2017	PHASE 1 ARCHAEOLOGICAL INVESTIGATION FOR THE TUTU WELLFIELD SITE	72	Report	(US ENVIRONMENTAL PROTECTION AGENCY)	(HDR ENGINEERING INCORPORATED)
537590	03/01/2017	COMMUNITY INVOLVEMENT PLAN FOR THE TUTU WELLFIELD SITE	28	Work Plan	(US ENVIRONMENTAL PROTECTION AGENCY)	(HDR ENGINEERING INCORPORATED)
537645	02/26/2018	HUMAN HEALTH RISK ASSESSMENT REPORT OU2 FOR THE TUTU WELLFIELD SITE	102	Report	(US ENVIRONMENTAL PROTECTION AGENCY)	(HDR ENGINEERING INCORPORATED)

550186

ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

FINAL

07/07/2021

REGION ID: 02

Site Name: TUTU WELLFIELD
CERCLIS ID: VID982272569
OUID: 02
SSID: 021D
Action:

DocID:	Doc Date:	Title:	Image Count:	Doc Type:	Addressee Name/Organization:	Author Name/Organization:
537668	03/06/2018	FINAL REMEDIAL INVESTIGATION REPORT OU2 FOR THE TUTU WELLFIELD SITE	125	Report	(US ENVIRONMENTAL PROTECTION AGENCY)	(HDR ENGINEERING INCORPORATED)
538174	03/13/2018	FOCUSED FEASIBILITY STUDY REPORT FOR OU2 FOR THE TUTU WELLFIELD SITE	187	Report	(US ENVIRONMENTAL PROTECTION AGENCY)	(HDR ARCHITECTURE AND ENGINEERING PC)|(HENNINGSON, DURHAM & RICHARDSON ARCHITECTURE AND ENGINEERING PC)
538310	08/03/2018	PROPOSED PLAN FOR OU2 FOR THE TUTU WELLFIELD SITE	19	Publication		(US ENVIRONMENTAL PROTECTION AGENCY)
616733	08/09/2019	RESIDENTIAL WELL SAMPLING REPORT FOR OU2 FOR THE TUTU WELLFIELD SITE	65	Report	(US ENVIRONMENTAL PROTECTION AGENCY)	(WESTON SOLUTIONS INCORPORATED)
616735	01/22/2020	FINAL MONITORING AND RESIDENTIAL WELL SAMPLING REPORT FOR OU2 FOR THE TUTU WELLFIELD SITE	474	Report	(US ENVIRONMENTAL PROTECTION AGENCY)	(WESTON SOLUTIONS INCORPORATED)
616737	02/01/2021	2021 REVISED FINAL FOCUSED SOURCE FEASIBILITY STUDY FOR OU2 FOR THE TUTU WELLFIELD SITE	188	Report	(US ENVIRONMENTAL PROTECTION AGENCY)	(HDR)
618370	06/10/2021	DEPARTMENT OF PLANNING AND NATURAL RESOURCES (DPNR) CONCUR WITH THE PROPOSED PLAN FOR OU2 FOR THE TUTU WELLFIELD SITE	1	Letter	EVANGELISTA,PAT (US ENVIRONMENTAL PROTECTION AGENCY)	(DEPARTMENT OF PLANNING AND NATURAL RESOURCES)

ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

FINAL

07/07/2021

REGION ID: 02

Site Name: TUTU WELLFIELD
CERCLIS ID: VID982272569
OUID: 02
SSID: 021D
Action:

DocID:	Doc Date:	Title:	Image Count:	Doc Type:	Addressee Name/Organization:	Author Name/Organization:
618371	07/01/2021	PROPOSED PLAN FOR OU2 FOR THE TUTU WELLFIELD SITE	1	Publication		(US ENVIRONMENTAL PROTECTION AGENCY)

Appendix IV

DPNR CONCURRENCE LETTER

GOVERNMENT OF THE UNITED STATES VIRGIN ISLANDS
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DEPARTMENT OF PLANNING AND NATURAL RESOURCES
4611 Tutu Park Mall
Suite 300
St. Thomas, U.S. Virgin Islands 00802

Office of the Commissioner Telephone: (340) 774-3320

September 21, 2021

Pat Evangelista, Director
Superfund Emergency Management Division
U.S. Environmental Protection Agency, Region 2
290 Broadway
New York, New York 10007-1866

Re: **Tutu Wellfield Superfund Site, St. Thomas, Virgin Islands**
Draft Record of Decision for Operable Unit 2

Dear Mr. Evangelista:

The Department of Planning and Natural Resources (DPNR) has reviewed the July 2021 Draft Record of Decision (ROD) for the Tutu Wellfield Site, Operable Unit (OU) 2. This ROD describes remedial alternatives that the Environmental Protection Agency (EPA) considered to address groundwater contamination associated with the Curriculum Center contaminant source areas.

Based upon an evaluation of the remedial alternatives, EPA proposes Alternative 2, Expand Existing Groundwater Extraction and Ex-Situ Treatment (Pump and Treat) with Alternative 2A, Reinjection, as the preferred remedial alternative. DPNR agrees with and concurs on the technical merits of the preferred remedial alternative for Operable Unit 2.

By concurring on the technical merits of the plan, DPNR is in no way obligating the Territory in any manner regarding any aspect of the future implementation of the selected remedy, including any future payment obligation related to the remedy.

Sincerely

Jean-Pierre L. Oriol
Commissioner

cc: Austin F. Callwood, Director, DEP

Appendix V

RESPONSIVENESS SUMMARY

INTRODUCTION

This Responsiveness Summary provides a summary of the significant comments submitted by the public on the U.S. Environmental Protection Agency's (EPA's) August 2018 and July 2021 Proposed Plans for the Tutu Wellfield Superfund Site (Site), Operable Unit 2 (OU2), and EPA's responses to those comments. All comments summarized in this Responsiveness Summary were considered by EPA in making a final decision on the remedy for OU2 at the Site.

This Responsiveness Summary is divided into the following sections:

I. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS
This section provides the history of community involvement and interests regarding the site; and

II. COMPREHENSIVE SUMMARY OF SIGNIFICANT QUESTIONS, COMMENTS, CONCERNS AND RESPONSES
This section contains summaries of written and oral comments received by EPA at the public meeting and during the public comment period, and EPA's responses to these comments.

The last section of this Responsiveness Summary includes attachments, which document public participation in the remedy selection process for this site. They are as follows:

Attachment A contains the Proposed Plans that were distributed to the public for review and comment;

Attachment B contains the public notices that appeared in prominent local newspapers, *The Virgin Islands Daily News* on August 8, 2018 and *The Source* on July 14, 2021;

Attachment C contains the transcripts of the public meeting held on August 23, 2018 at the Grace Gospel Chapel located at 148-320-321 & 322 Estate Anna's Retreat in St. Thomas and the pre-recorded public meeting held on July 14, 2021.

I. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS

The Proposed Plan for OU2 was originally released to the public on August 8, 2018, along with the Remedial Investigation, the Feasibility Study, and the Human Health Risk Assessment reports for OU2. These documents were made available to the public at information repositories maintained at EPA's Virgin Islands Office, located at the Tunick Building, 1336 Beltjen Road, Suite 102, in St. Thomas, Virgin Islands; the EPA Region 2 Office in New York City; and EPA's website for the Site at https://www.epa.gov/superfund/tutu-wellfield.

The Proposed Plan for OU2 was then re-released to the public on July 14, 2021, with updated cost information, as well as more recent sampling results. On August 8, 2018, EPA published a notice in *The Virgin Islands Daily News* to announce the start of the public comment period and the availability of the above-referenced documents. A news release, announcing the Proposed Plan, which included the public meeting date, time, and location, was issued to various media outlets and posted on EPA's Region 2 website on August 8, 2018. EPA held the public meeting on August 23, 2018 at the Grace Gospel Chapel, located at 148-320-321&322 Estate Anna's Retreat, St. Thomas, VI 00802, to inform officials and interested citizens about the Superfund process; to present the Proposed Plan for OU2 of the Site, including identifying and describing EPA's preferred remedial alternative; and to respond to questions and comments. The public meeting was attended by approximately 22 people, including residents, local business people, and state and local government officials.

On July 14, 2021, EPA published a notice in *The Source* to announce the start of the public comment period for the re-released Proposed Plan and the availability of the above-referenced documents. A news release announcing the Proposed Plan, which included the links to the Pre-recorded public meeting and documents available, was posted on EPA's Region 2 website on July 14, 2021.

Attachment A of this Responsiveness Summary includes both the 2018 and 2021 Proposed Plans. Attachment B contains a copy of the August 8, 2018 public notice published in the *Virgin Islands Daily News* and a copy of the July 14, 2021 public notice published in *The Source*. Attachment C includes the transcripts of the August 23, 2018 public meeting and the July 14, 2021 Pre-recorded Public meeting. Comments received during the first public comment period in 2018 are included in the Responsiveness Summary; no comments were received during the 2021 comment period.

II. COMPREHENSIVE SUMMARY OF SIGNIFICANT QUESTIONS, COMMENTS, CONCERNS AND RESPONSES

This section provides a summary of oral comments received from the public during the 2018 and 2021 public comment periods and EPA's responses. EPA did not receive any oral comments from the public during the 30-day public comment period for the re-released Proposed Plan that ran from July 14, 2021 to August 13, 2021. Several oral comments were received during the 30-day public comment period for the original Proposed Plan that ran from August 8, 2018 to September 7, 2018. A transcript of the public meeting held on August 8, 2018 is included in Attachment C to this Responsiveness Summary.

Based on the comments received, the public generally supports the selected remedy. The majority of the comments pertained to the Site cleanup and the unknown status of the Curriculum Center building. A summary of the comments, and EPA's responses prepared in 2018 and updated as necessary in 2021, is provided below:

Comment #1: A commenter inquired about the impact of Hurricanes Irma and Maria, which hit St. Thomas in September 2017, on the treatment facility. What damage did the hurricanes cause and did they create more work for EPA? Did the pump shut down, and what additional costs did EPA incur if the pumps went down?

Response to Comment #1: The operation of the pump and treat system was turned over to the Virgin Islands Government in April 2013. The building and equipment did not get damaged in the Hurricanes. However, the pumps and blowers ceased operating because of the power outage, and during the long outage, moisture in the equipment caused the equipment to rust.

<u>Updated Response</u>: In 2020, EPA repaired and replaced all the pumps and computer panels. The treatment plants are currently operating.

Comment #2: A commenter asked who will pay for the remedy.

Response to Comment #2: EPA explained that, by federal law, the remedy may be paid for using a combination of federal funding and some local funding. Also, funding could be provided by any additional potentially responsible parties identified if they have contributed to the contamination.

Comment #3: A commenter wanted to know if EPA is still looking for other parties that may have impacted the groundwater?

Response to Comment #3: The remedial investigation and feasibility study process is designed to determine the nature and extent of contamination at a site and set forth cleanup options. While identifying a source can result in identification of a responsible party, EPA has a separate process for making enforcement decisions regarding identifying and pursuing responsible parties who could be responsible for contaminating the aquifer. From a technical perspective, an additional source of contamination has been identified as being at the Curriculum Center, which is why a new cleanup option was proposed. However, additional responsible parties for that contamination have not been identified at this time.

Comment #4: A commenter wanted to know if some of the treated water from the plant is going to Smith Bay because, after Hurricanes Irma and Maria, the Smith Bay runoff on the hill was running for about six months. The commenter was concerned that the contaminated plume may be traveling somewhere else, rather than staying within the Tutu valley.

Response to Comment #4: The groundwater treatment system became non-operational right after the Hurricanes hit in September 2017, so no discharge from the system has been going to Smith Bay since that time. The contamination has remained underground, in the aquifer.

<u>Updated Response</u>: Additional sampling conducted in June and October 2019 confirmed that the contamination remained in ground water both within the OU2 study area and the larger downgradient plume. The report also indicated that concentrations detected in residential wells were generally below Federal Drinking Water Quality Standards. The only contaminant to exceed these standards was trichloroethylene (TCE) in a well used for irrigation purposes only. Since the treatment plants became operational, treated water is discharged to Turpentine Run.

Comment #5: A commenter wanted to know if any samples will be taken from the footprint of the Curriculum Center building because it has been destroyed by the Hurricane. Are there any plans to look at what is beneath the slab?

Response to Comment #5: The Curriculum Center building is condemned. No one is allowed to enter the building. If the building is demolished, EPA may be able to drill beneath the slab to confirm previous findings and associated assumptions.

Comment #6: A commenter wanted to know if there are plans to rebuild at the Curriculum Center and if EPA needs to be able to drill below the slab, would that be a 30-year process?

Response to Comment #6: If the building is demolished, EPA will probably conduct additional sampling where the footprint of the building was through a predesign investigation. This sampling would help confirm that the system is designed with an adequate capture zone for the contaminated groundwater. Whether the Curriculum Center is demolished or not, the plant will be upgraded, and improvements will be made. EPA knows there are high concentrations of volatile organic compounds in groundwater behind the building, including TCE which was found at a concentration of 160,000 parts per billion in sampling from 2018. Ideally, EPA wants to install wells within the building footprint as well. These design issues are not a 30-year process. The aspect of the cleanup that may take 30-years is related to the groundwater treatment. Groundwater pump and treat remedies take time, and water cannot be pumped from the aquifer at such a rate so as to cause saltwater intrusion, which would not be good for the aquifer or the treatment system.

Comment #7: A commenter wanted to know if the Superfund status of the site will have any impact on rebuilding an educational facility on the same property.

Response to Comment #7: The Superfund status should have no legal impact on rebuilding plans. It may have an impact on a developer's ability to obtain financing, but the property is owned by the Government of Virgin Islands. The property was originally owned by LAGA Industries, Inc., which operated a textile manufacturing company at the site starting in 1969in1969. In 1970, the property was sold to Duplan Corporation, which reportedly operated a dry-cleaning operation there until 1978. Panex Co. purchased the property in 1979 and sold it to the U.S. Virgin Islands in 1981. The building was then used by the Government of Virgin Islands' Department of Education from 1982 to 2017. It is the Department of Education's decision if they want to demolish the building and put up a new building.

Comment #8: Commenters wanted to know if the O'Henry Dry Cleaner has any relevance to this proposed project and if the plume was contained within the O'Henry area or did it move over and go down to Smith Bay.

Response to Comment #8: The O'Henry Dry Cleaner has been out of business for a long time. The first cleanup plan selected for the Site in 1996 addressed the O'Henry Dry Cleaner property and its related contamination. As part of that cleanup, in 2004, two treatment plants were constructed, one at the Curriculum Center and one downgradient near the O'Henry Dry Cleaner property. The plume near the O'Henry Dry Cleaner property is contained, and since 2004, EPA has seen decreases in concentrations.

Updated Response: An increase in concentrations downgradient of the O'Henry Dry Cleaner property were detected during EPA's October 2019 sampling event. This increase in concentrations is attributed to the shut down of the treatment systems since the 2017 hurricanes. Future monitoring will confirm that concentrations are declining now that the treatment systems are operating.

Comment #9: A commenter wanted to know if any testing was done in 2018 after the pumps became non-operational.

Response to Comment #9: The Department of Planning and Natural Resources (DPNR) tested in January 2018, and EPA received the report.

Updated Response: EPA collected additional samples in June and October 2019 to determine ground water quality conditions after the groundwater treatment system was shut down. The results confirmed that the groundwater contamination extended within the OU2 study area and the larger downgradient plume. The results also indicated that concentrations detected in residential wells were generally below MCLs. The only contaminant to exceed an MCL was TCE in a well used for irrigation purposes only.

Comment #10: A commenter wanted to know if there is a secondary source of contaminants at the southern plume.

Response to Comment #10: EPA explained that the secondary source is under the first operable unit. Through the operation of the two treatment plants, it is anticipated that the secondary source will eventually be addressed. DPNR is monitoring and operating the two plants.

Comment #11: A commenter wanted clarification regarding option two, which discusses treating dense non-aqueous phase liquid, or DNAPL. How long will the DNAPL be held onsite until it is properly disposed of and who is the licensed party that is responsible for removing the DNAPL?

Response to Comment #11: It has not been determined yet who is going to transport the DNAPL offsite for disposal and how long DNAPL will be stored onsite. It will not be stored at the Site long-term. It will be handled properly through licensed contractors and disposed of at a facility on the mainland United States that is regulated to handle such material.

Comment #12: Commenters asked if the capital cost includes the purchase of the property by EPA so that the property can be cleaned up.

Response to Comment #12: EPA will not purchase the Curriculum Center property from the Department of Education in order to remediate the Site. Thus, the capital cost does not reflect property acquisition and is just for upgrading the treatment plant.

Comment #13: A commenter asked if homes can be built on this Site and if vapor intrusion can occur through the soil or concrete.

Response to Comment #13: EPA explained that, based on vapor intrusion testing that has been conducted at the Site, vapor intrusion has not been identified as an issue at this Site. However, this pathway would need to be re-evaluated if new construction were to occur. The remedy for OU2 includes vapor intrusion restrictions on new construction.

Comment #14: A commenter asked that if the building were demolished and it was found that there is contamination under the slab that requires further remediation, what would EPA's recommendation be regarding whether to rebuild or not? The commenter was concerned that such new findings would dictate the determination of the future use of the property. The commenter also asked whether the building slab would need to be removed if the soil under the slab is contaminated?

Response to Comment #14: The future use of the property is not EPA's decision to make. Depending on what is found under the building, EPA may recommend that a vapor barrier be installed under a new building, if one were built, which is simply a synthetic layer beneath the foundation that does not allow the vapor to migrate into the building. Note that the soil was cleaned up previously as part of the OU1 remedy. Currently, there is groundwater contamination that could potentially be a source of vapor intrusion, but testing has indicated that it is not an issue at other portions of the Site. If necessary, however, this could be mitigated by a vapor barrier as well. Also note that sampling conducted in the late 1990's, during the predesign investigation, did not reveal any significant contamination under the concrete slab of the Curriculum Center.

Comment #15: A commenter asked if vapor intrusion affects employees outdoors, in open space such as where there is bare soil in the back of a property?

Response to Comment #15: EPA explained that vapor intrusion is an issue in an enclosed building where vapors can accumulate.

Comment #16: A commenter asked if the nature of the bedrock complicates the reinjection process that is proposed under alternative 2A? During the previous geophysical surveys conducted, was EPA able to drill below the surface of the slab at all, or will this be part of some additional testing?

Response to Comment #16: Yes, it does complicate matters. The predesign investigation will clarify assumptions relating to reinjection well installation. If we do not encounter any major fractures that would allow adequate reinjection of the water, and there are only hairline fractures which retard water flow, the reinjection of treated groundwater will not be successful. If the Curriculum Center building is removed, additional investigations similar to those conducted in the past can be performed to help determine what is under the building.

Comment #17: A commenter asked if the watershed for Turpentine Run has been impacted by contamination, and whether this has any effect on the farmers and farm animals. Has EPA looked at this?

Response to Comment #17: EPA completed detailed risk assessments for OU1 to evaluate human health and ecological risks, and included the fact that Turpentine Run discharges to the mangrove lagoon. The ecological risk assessment found no unacceptable risk to ecological receptors from the Site. EPA's focus is on human health risks posed by people ingesting the groundwater.

Comment #18: A commenter asked when the 30-year period for cleanup starts.

Response to Comment #18: EPA explained that the 30-year period will commence for this new cleanup plan as soon as construction is completed and operation and maintenance of the treatment system begins. The first year of operation represents the start of the 30-year timeline.

PART 2. Written Comments

This section provides a summary of written comments received from the public during the 2018 and 2021 public comment periods and EPA's responses. EPA did not receive any written comments from the public during the 30-day public comment period for the re-released Proposed Plan that ran from July 14, 2021 to August 13, 2021. Written comments were received during the 30-day public comment period for the original Proposed Plan that ran from August 8, 2018 to September 7, 2018. The written comments received are included in this Responsiveness Summary.

The written comments received during the 2018 public comment period pertained primarily to renewable energy concerns. A summary of the comments, and EPA's responses prepared in 2018, is provided below:

Comment #19: A commenter asked if the treated groundwater can be used for farming.

Response to Comment #19: For the first operable unit, DPNR opted not to treat the water to drinking water standards but to treat it and discharge it to Turpentine Run instead. However, it could be treated for drinking water or farm use. Under this OU2 alternative, the treated water will be reinjected back to the aquifer to act as a hydraulic barrier to further migration of contamination from the source area, as well as discharge to Turpentine Run (with the details to be determined during the remedial design).

Comment #20: A commenter wanted to know if hydroelectric pump battery storage could be used for the contaminated water in the Tutu area using higher ground. The commenter suggested that this would help the VI store renewable energy supplies and make use of the treated groundwater to generate electricity.

Response to Comment #20: EPA will evaluate this option during the remedial design.

ATTACHMENT A

PROPOSED PLAN

Tutu Wellfield Superfund Site

St. Thomas, U.S. Virgin Islands

July 2021

EPA ANNOUNCES PROPOSED PLAN

This Proposed Plan describes remedial alternatives that the United States Environmental Protection Agency (EPA) considered to address groundwater contamination associated with the contaminant source areas at the Tutu Wellfield Superfund Site located in St. Thomas, U.S. Virgin Islands. This Plan also identifies EPA's preferred alternative described below (Preferred Alternative) and provides the rationale for this preference.

This Proposed Plan includes summaries of cleanup alternatives evaluated to address more effectively contaminant source areas referred to as Operable Unit 2 (OU2) and accelerate the cleanup of groundwater contamination at the site. As described herein, EPA, in consultation with the United States Virgin Islands (USVI) Department of Planning and Natural Resources (DPNR), will select a remedy to address more effectively source area ground water after reviewing and considering all information submitted during the 30-day public comment period. EPA, in consultation with DPNR, may modify the Preferred Alternative or select another response action, including possibly an alternative presented in this Proposed Plan, based on new information or public comments. Therefore, the public is encouraged to review and comment on all the alternatives presented in this Proposed Plan.

EPA is re-issuing this Proposed Plan as part of its public participation responsibilities in accordance with Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA, also known as Superfund), 42 U.S.C. §117(a) , and Sections 300.430(f) and 300.435(c) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This Proposed Plan was released in 2018 for public comments. EPA has revised this Proposed Plan with updated cost estimates of the remedial alternatives. Additional information can be found in greater detail in the Focused Source Remedial Investigation (FSRI) and Feasibility Study (FS) reports as well as other related documents contained in the publicly available Administrative Record for this decision. EPA encourages the public to review these documents to gain a more comprehensive understanding of the site and Superfund activities that have been conducted.

MARK YOUR CALENDAR

Public Comment Period:
EPA will accept written comments on the Proposed Plan from July 14, 2021 to August 13, 2021. Written comments must be postmarked or emailed no later than August 13, 2021, to:

Caroline Kwan
Remedial Project Manager
U.S. Environmental Protection Agency
290 Broadway, 18th Floor
New York, NY 10007
Email: kwan.caroline@epa.gov

Pre-Recorded Public Meeting:
A pre-recorded presentation via YouTube is included in the EPA's webpage listed below. The Pre-Recorded Public meeting explains the re-issued Proposed Plan and cost updates.

Donette Samuel
Community Involvement Coordinator
U.S. Environmental Protection Agency
Email: samuel.donette@epa.gov
Phone: 212-637-3750

You may also access the original and the re-issued Proposed Plans and pre-recorded presentation at www.epa.gov/superfund/tutu-wellfield.

A prior remedy for the site, selected in 1996 and memorialized in a document called a record of decision (ROD), consists of extraction of contaminated ground water, ex-situ treatment, discharge of the treated ground water to a nearby stream, and institutional controls (ICs). Construction of the 1996 remedy was completed in 2004 and began operation at that time. As required by law, operation and maintenance (O&M) of the treatment system was transferred from EPA to the USVI government in April 2013, and the USVI O&M obligation continues. The 1996 remedy is designed to address the initial operable unit (OU) at the site, or OU1. The Preferred Alternative identified in this Proposed Plan is to address a second OU, or OU2, and it would include an expansion and upgrade of the existing pump and treat system, reinjection of ground water to create a hydraulic barrier downgradient of the source area, long-term monitoring, and the implementation of ICs.

COMMUNITY ROLE IN SELECTION PROCESS

A prior proposed plan was published in August 2018, to address OU2. This Proposed Plan is being re-issued to inform the public of EPA's Proposed Alternative and to re-solicit public comments pertaining to all of the remedial alternatives evaluated, including the Preferred Alternative, because, among other things, the lapse of time and the fact that this Proposed Plan has been updated, such as to include up-to-date estimates of the remedial alternatives' costs. A final decision regarding a selection of a remedy will be made after EPA has taken into consideration all public comments. As stated above, EPA is soliciting public comments on all of the alternatives considered in the Proposed Plan because EPA may ultimately select a remedy other than the Preferred Alternative.

A public meeting will be held during the public comment period to present this Proposed Plan and information regarding the investigations of ground water at the site, including the conclusions of studies performed to assess treatment options, as well as the FS, so as to elaborate further on the reasons for proposing the Preferred Alternative. The public meeting will include a presentation by EPA of the Preferred Alternative and other cleanup options and an opportunity to receive comments from the public. Information on the public meeting and how to submit written comments can be found in the "Mark Your Calendar" text box on Page 1.

Comments received at the public meeting, as well as written comments received during the comment period, will be addressed and documented in the Responsiveness Summary section of a forthcoming ROD for OU2. The ROD is the document that memorializes the alternative that has been selected as a remedy and the basis for the selection of the remedy.

SCOPE AND ROLE OF ACTION

As mentioned above, the site has been divided into two OUs. The 1996 remedy was selected to address the entire site as one operable unit (now known as OU1). The remedy was designed to address three distinct plumes of groundwater contamination, one consisting of chlorinated volatile organic compounds (CVOCs) and two others consisting of petroleum products from two service stations (the Texaco and Esso plumes). A secondary source of CVOC contamination originates from the O'Henry Dry Cleaners building and mixes with the primary CVOC plume downgradient of the primary source. The 1996 remedy called for extraction of contaminated ground water, ex-situ treatment, discharge of the treated ground water to a nearby stream, and the implementation of ICs (see Figure 1).

The 1996 remedy has been constructed and operating since 2004 and is effectively managing the Texaco and Esso plumes. However, monitoring conducted since 2004 has shown that concentrations in the CVOC plume are not decreasing as quickly as anticipated, suggesting that an unidentified source may still be present in the northern part of the plume. Therefore, in April 2015 EPA created OU2 to investigate potential contaminant source areas further and to evaluate options to accelerate the cleanup of groundwater contamination at OU2 of the site.

The primary objectives of an OU2 remedy are to accelerate the remediation of the source area groundwater contamination, restore groundwater quality to its most beneficial use (i.e., federal drinking water standards), and minimize any potential future health and environmental impacts.

SITE BACKGROUND

Site Description

The site is located in east-central St. Thomas in the USVI, and it consists of contaminated groundwater plumes covering an area approximately 108 acres in size. This Proposed Plan focuses on the source area of the CVOC plume, which is centered on the USVI Department of Education (VIDE) Curriculum Center property in the Anna's Retreat section of St. Thomas, east of the city of Charlotte-Amalie. A site location map is provided as Figure 1.

The Curriculum Center property is located at 386 Smith Bay Road (Highway 38). The 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 existing northern groundwater treatment system is located on the north side of the building. The Curriculum Center building was condemned after sustaining extensive damage during Hurricane Irma/Maria in 2017. Future prospect of the building is being evaluated by local Authorities and impact of the Site and building conditions on the remedy implementation will be evaluated during remedy design.

Site History

The Curriculum Center property is currently owned by VIDE. The property was originally owned by LAGA Industries, Ltd. (LAGA), which began operation of a textile manufacturing facility at the property in 1969. In 1970, LAGA was sold to the Duplan Corporation at which time

Duplan reportedly began dry cleaning operations at the property using tetrachloroethene (PCE) as the dry-cleaning fluid. PCE is part of the CVOC group of chemicals. Duplan filed for bankruptcy in 1976 and ceased all operations at the property in late 1978. Panex Co. (a corporation formed by the former owners of LAGA) purchased the facility from Duplan's bankruptcy trustee in 1979 and sold it to VIDE in 1981. Information on property operations during Panex's ownership was not available. From 1982 to 2017, the building was used by VIDE as a book repository/library, warehouse with cold storage, maintenance shop, and school district administrative offices.

Remedial Investigation/Action Summary

Multiple investigations have been performed at the Curriculum Center property since 1982. The original RI that focused on the entire site identified a plume of ground water contaminated with CVOCs and two plumes of ground water contaminated with gasoline components (the Texaco and Esso plumes) that co-mingled with the CVOC plume. EPA concluded that the CVOC plume originated at or near the Curriculum Center property, extended beyond the former O'Henry Dry Cleaners building (a potential secondary source), and followed an eastward path toward Turpentine Run.

In 1995, the CVOC plume extended approximately 1,600 feet to the southwest from the Curriculum Center to Four Winds Plaza and was approximately 500 feet wide. The highest concentrations of total CVOCs were observed in the shallow zone (less than 90 feet below grade surface (bgs)) monitoring wells near the northern source area at Curriculum Center property. The CVOCs detected at Curriculum Center were dichloroethene (DCE), PCE, trichloroethene (TCE), and vinyl chloride (VC). The highest concentrations detected were 2,100 micrograms per liter (µg/l) of cis-1,2-DCE, 1,300 µg/l of VC, 360 µg/l of PCE, and 78 µg/l of TCE; all exceeded their respective Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act. In the RI, EPA concluded that the elevated concentrations of CVOCs in ground water adjacent to and immediately downgradient of the Curriculum Center indicated a high probability that PCE, a primary component of the CVOC plume, was present as dense non-aqueous phase liquid (DNAPL) in the saturated and/or unsaturated bedrock.

The 1996 remedy for the site was to address the site-wide ground water contamination, calling for extraction of contaminated ground water, ex-situ treatment, surface discharge of the treated ground water, and ICs.

Following completion of the remedial design (RD) in September 2001, EPA constructed a groundwater treatment facility (GWTF #1) at the Curriculum Center property, the operation of which was to achieve hydraulic control of the northern portion of the plume and remove CVOC mass from the saturated zone. A second treatment facility, GWTF #2, was constructed and is located downgradient of GWTF #1, and its operation is to address downgradient central portions of the plume, north of the O'Henry drycleaner (Figure 2).

EPA completed construction of GWTF #1 in 2004, which initially consisted of three groundwater extraction wells, an equalization tank and transfer pumping system, bag filters, a low-profile air stripper, and an off-gas treatment system. Use of the off-gas treatment system was discontinued in April 2006 after CVOC concentrations dropped below the air pollution control permit equivalency limits. One granular activated carbon filter unit and one potassium permanganate unit remain at the Curriculum Center on standby for emergency use. Chemical feed systems were also included for sequesterant/biocide injection and pH adjustment.

The three groundwater extraction wells associated with GWTF #1 are RW-6, RW-7, and RW-9. Extraction wells RW-7 and RW-9 are completed in the shallow, more productive portion of the aquifer, with access to the ground water at 30 to 80 feet bgs and 40 to 60 feet bgs, respectively. Extraction well RW-6 is completed in the deeper, less productive portion of the aquifer with access from 80 to 130 feet bgs. Extraction well RW-7 is operated on a continuous basis. Extraction well RW-9 operates as required to maintain the target groundwater elevation and is typically operated during and following heavy rain events. Extraction well RW-6 is operated approximately one hour per week, at a flow rate of approximately two gallons per minute (gpm), until the extraction well pump shuts down as a result of a low water level in the well. Treated water is discharged to Turpentine Run on the adjoining property to the northwest.

Overall, the components of the 1996 remedy were operated by EPA from 2004 to 2013. Operation and maintenance of the treatment systems was transferred from EPA to the USVI government in April 2013. As part of the long-term response action for the site, groundwater monitoring is routinely performed to assess progress. Groundwater monitoring was performed on a quarterly basis from system startup in 2004 until April 2007, and it has been conducted annually since 2007. Ground water from a total of 30 monitoring and residential wells is analyzed for the presence of site-related contamination as part of site monitoring, and groundwater levels are measured on a monthly basis from 36 monitoring wells. Influent monitoring is performed monthly at two of the extraction wells (RW-6 and RW-7) using the GWTF #1 influent sampling port.

An SVE system was constructed in 2004 to remediate the unsaturated zone source of the CVOC groundwater contamination. The system included two SVE wells with discharge to the GWTF off-gas treatment system. The system was shut down in April 2006 because of a significant decrease in influent concentrations and achievement of asymptotic conditions.

EPA's Environmental Response Team (ERT) performed two investigations to characterize the potential for vapor intrusion into the Curriculum Center building. The investigations were performed in December 2007 and December 2011. The extent of soil vapor with elevated concentrations of PCE and TCE did not change noticeably between the two sampling rounds. All but one sample exceeded the soil vapor action level for PCE. The area of the highest sub-slab concentrations was found in the warehouse area located in the central portion of the Curriculum Center building and extends into the adjoining maintenance and office areas. The extent of TCE concentrations that exceeded action levels in soil vapor falls within the area of highest PCE concentrations.

A 2011 evaluation of the GWTF #1 system resulted in a conclusion that extraction well RW-7 was too far upgradient to effectively contain the Curriculum Center source area, and it was recommended that a new containment system with additional wells screened across the shallow and deep zones be considered.

Consistent with the law, EPA formally reviews certain remedies every five years to assure that they meet their respective remedial action objectives. The 1996 remedy is one such remedy, and results of the second five-year review, completed in 2014, revealed that the existing remedy would not achieve its objective of restoring the aquifer to drinking water standards. Of particular concern to EPA was the potential presence of DNAPL as an ongoing source of groundwater contamination to the deep aquifer in the northern portion of the groundwater plume. The review resulted in a recommendation for the installation of additional wells to further evaluate the presence of DNAPL, the evaluation of groundwater monitoring results, and the development of a conceptual site model (CSM) to determine a strategy for addressing the ongoing sources of CVOCs at the Curriculum Center property. The review further revealed that vapor intrusion concerns had been determined to unwarranted because sampling in 2007 confirmed that, although the sub-slab results exceeded screening values, the indoor air concentrations were negligible and well below risk-based concentrations.

RESULTS OF THE FOCUSED SOURCE REMEDIAL INVESTIGATION (FSRI)

The FSRI Report, dated March 2018, provides the analytical results of sampling conducted between April 2016 and June 2017, the purpose of which being to further investigate the source or sources of groundwater contamination in the northern portion of the site, and more specifically, in the area of the Curriculum Center. The FSRI activities included a surface geophysical survey, rock matrix diffusion sampling and analysis, a borehole geophysical investigation, packer testing and sampling, monitoring well installation, ground water sampling, ground water level monitoring, and DNAPL monitoring.

The investigation focused on six contaminants, based on the site history, frequency of detection, and concentrations that had previously exceeded cleanup standards: PCE, TCE, 1,1-DCE, *cis*-1,2 DCE, *trans*-1,2 DCE, and VC.

The following conclusions were made based on the FSRI results:

- The bedrock aquifer can be divided into two general zones: a shallow, more hydraulically conductive zone at depths less than 90 feet bgs and a deep, less conductive zone between the approximate depths of 90 and 140 feet bgs. Water bearing fractures in the vicinity of the Curriculum Center property are consistent with regional trends. The degree and orientation of fracturing observed below 140 feet bgs suggest limited potential for vertical contaminant migration below this depth.

- DNAPL is present within the shallow and deep bedrock zones based on direct observation and the presence of high levels of dissolved phase contamination. Evidence also indicates that DNAPL may be present in the following multiple source areas; on the surface of bedrock either beneath the Curriculum Center building, at the suspected waste pit, and/or in the former drum storage area. DNAPL is present in a partially mobile state, and it has been concluded that it will act as an ongoing source of dissolved phase contamination at the Curriculum Center property.

- Dissolved phase CVOC contamination consisting of PCE, TCE, *cis*-1,2-DCE and VC is present at the Curriculum Center property ranging in concentration from low µg/l to milligram per liter (mg/l) concentrations. The plume of contaminated ground water is primarily located in the shallow bedrock zone on the northwest side of the Curriculum Center and migrates to the southwest. Contaminants have also migrated to the east of the

Curriculum Center and into the deep zone at the southwest corner of the building.

Matrix diffusion data indicate that contamination of the rock matrix can be expected in areas where high levels of contaminants of concern (COCs) are present in ground water. Contaminants present in the rock matrix will continue to back-diffuse from the rock matrix and impact ground water in the Curriculum Center area for an estimated 17-25 years after source removal.

- The degree of reductive dechlorination varies throughout the Curriculum Center area. PCE degradation on the northwest side of Curriculum Center has resulted in high levels of TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and VC, while areas to north, east, and south show more limited to no degradation; and

- The influence of the existing extraction system is dependent on the fractures, fracture systems, and faults that intersect the extraction wells. Although the impact of pumping can be observed at distances of 50 feet or more, the capture zone of the existing extraction system does not extend the full width of the plume or far enough in a downgradient direction to contain potential source material in the drum disposal area or in the immediate area of monitoring well OU2-MW3 at the southwestern corner of the Curriculum Center.

Based on visual evidence and concentrations indicative of DNAPL, the presence of DNAPL has been confirmed in the fractured bedrock aquifer underlying the Curriculum Center property.

SUPPLEMENTAL-POST-HURRICANE SAMPLING EVENT

The Final Monitoring and Residential Well Sampling Report, dated January 2020, provides analytical results of sampling conducted in June and October 2019 to determine ground water quality conditions after the GWTF #1 and #2 were shut down on September 2, 2017 as a result of hurricanes Irma and Maria. The treatment facilities remained offline because of power-related issues and damage from the storms.

Analytical results confirmed the extent of chlorinated ethenes in ground water both within the OU2 study area and the larger downgradient plume, although concentrations in samples from Curriculum Center wells were generally lower than those established in the FSRI. The plume extent, based on October 2019 results, is shown in Figure 2. The report also indicated that concentrations detected in residential wells were generally below MCLs. The only contaminant to exceed an MCL was TCE in a well used only for irrigation purposes.

Principal Threat Waste

Principal threat wastes are considered source materials, i.e., materials that include or contain hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water, or as a source for direct exposure. Contaminated ground water is generally not considered to be source material; however, the presence of DNAPL in the subsurface may be viewed as source material. Please refer to the text box entitled, “What is a Principal Threat” for more information on the principal threat concept.

SUMMARY OF SITE RISKS

A baseline human health risk assessment was conducted as part of the FSRI to estimate the risks associated with exposure to contaminants based on current and likely future commercial/industrial uses of the site. Relevant information associated with this risk assessment is summarized below.

An ecological risk assessment was not performed for OU2 because the focus of this investigation was ground water, which does not discharge to surface water anywhere within the OU2 area. Ecological receptors are not expected to have contact with ground water; therefore, exclusion of an ecological risk assessment is consistent with EPA guidance that states ecological risk related to ground water is to be considered only if there is potential for impacts on ecological receptors. It is also consistent with the scope of the 1996 RI, which limited the evaluation of ecological risk to surface soil contamination at the site.

Human Health Risk Assessment

EPA conducted a four-step baseline human health risk assessment (HHRA) as part of the FSRI to assess site-related cancer risks and non-cancer health hazards in the absence of any remedial action. The four-step process is comprised of: Hazard Identification, Exposure Assessment, Toxicity Assessment, and Risk Characterization (refer to the text box, "What is Risk and How is it Calculated").

The HHRA began with selecting chemicals of potential concern (COPCs) in ground water that could potentially cause adverse health effects in exposed populations. The COPC screening as part of the HHRA identified 13 COPCs. The potential exposure scenarios considered in the HHRA include drinking water ingestion, dermal contact with and inhalation of ground water by residents, drinking water ingestion and dermal contact by indoor and outdoor workers, as well as incidental ingestion, contact and inhalation with ground water by a construction worker in a trench.

The evaluation of potential cancer risks and noncancer hazards to future, on-site receptors from exposure to COPCs in environmental media indicates that there are several primary COPCs, now identified as COCs, whose concentrations in environmental media contribute to the hazard and risk estimates, and exposure to these COCs may result in potential adverse health effects.

The evaluation for future, on-site workers indicates that VC, TCE, PCE, and cis-1,2-DCE have been identified as COCs for groundwater exposure, based on an excess lifetime cancer risk exceeding $1x10^{-4}$ or resulting in a hazard index (HI) greater than or equal to one.

PCE and TCE volatilizing into buildings are also of potential concern to workers based on ground water, indoor air, and sub-slab soil gas data. Volatilizing of VC into buildings may be of potential concern based on groundwater concentrations; however, VC was below detection limits in the sub-slab soil gas and indoor air during two sampling events in 2007 and 2011. Note that the Curriculum Center building has been condemned as a result of damage during hurricanes Irma and Maria. Future use of the building is currently unknown.

1,1-DCE does not exceed the noncancer threshold, however, it exceeds its MCL, so it is included as a COC.

The excess lifetime cancer risk for a potential future resident's exposure to COPCs in ground water are significantly above the threshold of $1x10^{-4}$. They were detected at $7x10^{-1}$, and the risk largely result from ingestion of VC, TCE and PCE. This assumes the ground water is used for potable purposes with no treatment, as is required to be assumed in a baseline HHRA. The vapor intrusion risk evaluation indicates that these same COCs could also result in excess risks to future residents from exposure to contaminated soil vapor should an occupied building be located on the site.

WHAT IS A "PRINCIPAL THREAT"?

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water, or air, or acts as a source for direct exposure. Contaminated ground water generally is not considered to be a source material; however, Non-Aqueous Phase Liquids (NAPLs) in ground water may be viewed as source material. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. The decision to treat these wastes is made on a site-specific basis through a detailed analysis of the alternatives using the nine remedy selection criteria. This analysis provides a basis for making a statutory finding that the remedy employs treatment as a principal element.

WHAT IS RISK AND HOW IS IT CALCULATED?

A Superfund baseline human health risk assessment is an analysis of the potential adverse health effects caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these releases under current - and anticipated future - land uses. A four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios.

Hazard Identification: In this step, the chemicals of potential concern (COPCs) at the site in various media (*i.e.*, soil, ground water, surface water, and air) are identified based on such factors as toxicity, frequency of occurrence, and fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence, and bioaccumulation.

Exposure Assessment: In this step, the different exposure pathways through which people might be exposed to the contaminants identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of and dermal contact with contaminated soil and ingestion of and dermal contact with contaminated ground water. Factors relating to the exposure assessment include, but are not limited to, the concentrations in specific media that people might be exposed to and the frequency and duration of that exposure. Using these factors, a "reasonable maximum exposure" scenario that portrays the highest level of human exposure that could reasonably be expected to occur is calculated.

Toxicity Assessment: In this step, the types of adverse health effects associated with chemical exposures and the relationship between magnitude of exposure and severity of adverse effects are determined. Potential health effects are chemical-specific and may include the risk of developing cancer over a lifetime or other non-cancer health hazards, such as changes in the normal functions of organs within the body (*e.g.*, changes in the effectiveness of the immune system). Some chemicals are capable of causing both cancer and non-cancer health hazards.

Risk Characterization: This step summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site risks for all COPCs. Exposures are evaluated based on the potential risk of developing cancer and the potential for non-cancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 1×10^{-4} cancer risk means a "one-in-ten-thousand excess cancer risk"; or one additional cancer may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions identified in the Exposure Assessment. Current Superfund regulations for exposures identify the range for determining whether remedial action is necessary as an individual excess lifetime cancer risk of 1×10^{-4} to 1×10^{-6}, corresponding to a one-in-ten-thousand to a one-in-a-million excess cancer risk. For non-cancer health effects, a "hazard index" (HI) is calculated. The key concept for a non-cancer HI is that a "threshold" (measured as an HI of less than or equal to 1) exists below which non-cancer health hazards are not expected to occur. The goal of protection is 1×10^{-6} for cancer risk and an HI of 1 for a noncancer health hazard. Chemicals that exceed a 1×10^{-4} cancer risk or an HI of 1 are typically those that will require remedial action at a site and are referred to as chemicals of concern, or COCs, in the final remedial decision document or Record of Decision.

These cancer risks and noncancer health hazards indicate that there is significant, potential risk from direct exposure to ground water for future residents and site workers. The results of the HHRA indicate the proposed alternative will be necessary to mitigate potential risks associated with existing contamination. A more detailed discussion of the exposure pathways and estimates of risk can be found in the February 2018 HHRA, which is included in the Administrative Record of this action. Refer Table 1, Risk Summary.

Table 1: Risk Summary – Future Scenario

COC	Construction Worker		Worker		Resident		
	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Adult Noncancer Hazard	Child Noncancer Hazard
PCE	1.07E-04	7.10E+02	4.03E-04	8.96E+01	3.80E-03	8.08E+02	9.25E+02
TCE	5.71E-04	4.78E+03	2.38E-03	2.90E+02	4.06E-02	3.97E+03	4.06E+03
1,1-DCE***	N/A	2.50E-01	N/A	1.28E-02	N/A	1.77E-01	1.80E-01
cis-1,2-DCE***	N/A	6.05E+01	N/A	4.01E+02	N/A	1.20E+03	1.97E+03
trans-1,2-DCE***	N/A	1.28E-01	N/A	8.47E-01	N/A	2.52E+00	4.16E+00
VC	1.53E-03	2.11E+02	5.33E-02	6.91E+01	9.88E-01	2.93E+02	4.09E+02
1,1,2-Trichloroethane	1.13E-07	2.45E+00	1.56E-07	1.92E-03	2.59E-06	1.70E+00	1.44E+00
Total Risk and HQ	2.20E-03	5.77E+03	5.48E-02	8.50E+02	7.18E-01	6.27E+03	7.37E+03

Notes:
*** N/A = Not available. No cancer toxicity values are available for these COCs; no risks have been calculated.
Total cancer risks and HQs include all constituents evaluated in the HHRA.

Conclusion

The results of the HHRA indicate that the contaminated groundwater presents an unacceptable exposure risk. It is the EPA's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan or on the superfund records website https://www.epa.gov/superfund/tutu-wellfield, is necessary to protect public health or welfare or the environment from actual or threatened releases of pollutants or contaminants from this site that may present an imminent and substantial endangerment to public health or welfare.

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are specific goals to protect human health and the environment. These objectives are based on available information and standards such as applicable or relevant and appropriate requirements (ARARs), to-be-considered guidance, and site-specific, risk-based levels.

Based on matrix diffusion modeling conducted as part of the FS and described in more detail in the next section, the restoration of the ground water within a reasonable time frame may be possible notwithstanding the presence of DNAPL.

As such, the following RAOs have been established for the source areas and ground water:

- Reduce DNAPL mass in the bedrock aquifer to the maximum extent practicable;
- Restore ground water to concentrations of site-related contaminants to at or 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 above levels that pose an unacceptable risk for commercial/industrial use and future residential use.

The preliminary remedial goal (PRGs) for ground water are identified in Table 2.

Table 2: PRGs for Groundwater

COC	MCLs (µg/L)	PRG (µg/L)
PCE	5	5
TCE	5	5
1,1-DCE	7	7
cis-1,2-DCE	70	70
trans-1,2-DCE	100	100
VC	2	2
1,1,2-Trichloroethane	5	5

http://www.epa.gov/safewater/consumer/pdf/mcl.pdf.

SUMMARY OF REMEDIAL ALTERNATIVES

Section 121(b)(1) of CERCLA, 42 U.S.C. § 9621(b)(1), mandates that remedial actions must be protective of human health and the environment, cost-effective, comply with ARARs, and utilize permanent solutions, alternative treatment technologies, and resource recovery alternatives to the maximum extent practicable. Section 121(b)(1) of CERCLA also establishes a preference for remedial actions that employ, as a principal element, treatment to reduce permanently and significantly the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants at a site. Section 121(d) of CERCLA, 42

U.S.C. § 9621(d), further specifies that a remedial action must attain a level or standard of control of the hazardous substances, pollutants, and contaminants that at least attains ARARs under federal and territory laws, unless a waiver can be justified pursuant to Section 121(d)(4) of CERCLA, 42 U.S.C. § 9621(d)(4).

The objective of the FS was to identify and evaluate remedial action alternatives for addressing the contamination associated with the source areas and to meet the RAOs. A total of four alternatives were developed in the FS. Alternative 2 also includes four enhancement options. Detailed descriptions of the remedial alternatives are provided in the FS Report, dated March 2018. Expansions to the existing remedy as well as new remedial alternatives were assessed in the FS.

Common Elements

All of the alternatives, with the exception of the no action alternative, include common components.

Matrix diffusion modeling was performed to simulate the fate and transport of PCE in fractured bedrock where matrix diffusion plays a role in attenuating the contaminant's life in the system after the source has been removed. Results of the matrix diffusion modeling indicate concentrations at the property boundary are predicted to drop below the MCL within an estimated range of 17 - 25 years after complete source removal.

Alternatives 2 through 4 include long-term monitoring to ensure that groundwater quality improves following implementation of these alternatives until such time as clean up levels are achieved.

Assumptions were made in the FS for areas that were not fully investigated during the FSRI, specifically, beneath the northern portion of the Curriculum Center building. Alternatives 2 through 4 will include a pre-design investigations (PDI) to verify FS assumptions, to address data gaps and to obtain design parameters for the completion of an RD at the Curriculum Center source areas. The timeframes for remediation presented below include the time for PDIs, remedial design, contract procurements and the actual time required to construct and implement the action.

Alternatives 2 through 4 also include ICs that will rely on ground water use restrictions in the form of local well use laws until RAOs are achieved to ensure the remedy remains protective. Specifically, Title 12, Chapter 5 of Virgin Islands Code regulates installation of any well other than a public water supply well in the Virgin Islands. ICs will include vapor intrusion restrictions for any new construction at the site.

A site management plan would be developed to provide for the proper O&M of the site remedy post-construction, and it would include long-term groundwater monitoring, institutional controls, and periodic reviews until clean up levels are achieved.

Additionally, it should be noted that because it will take longer than five years to achieve cleanup levels under all of the active alternatives, CERCLA requires that a review of conditions at the site be conducted no less often than once every five years until such time as cleanup levels are achieved. While this requirement is independent of Alternatives 2 through 4, the site will be subject to these five-year reviews, as required by CERCLA 121(c) and the NCP [40 C.F.F.§300.430(f)(4)(ii)].

Alternative 1: No Action

The NCP requires that a "No Action" alternative be developed and considered as a baseline for comparing other remedial alternatives. Under this alternative, no additional action would be implemented beyond the remedy selected in the 1996 remedy. Existing ICs that were required under the 1996 remedy would remain in place.

Capital Cost:	$0
O&M Costs:	$0
Present-Worth Cost:	$0
Time frame:	Not Applicable

Alternative 2: Expand and Optimize Existing Groundwater Extraction and Ex-Situ Treatment (Pump and Treat)

Capital Cost:	$4,802,538
Present -Worth O&M Costs:	$8,481,677
Present-Worth Cost:	$13,340,565
Time frame:	*30* years

This remedial alternative consists of expanding the current groundwater treatment system (GWTF #1) with the addition of new extraction wells downgradient of the Curriculum Center. The addition of downgradient wells will allow for more flexibility in containing the plume as it migrates from the source area. Alternative 2 also includes upgrading the GWTF #1 current system capacity and adding alternate pumping and dual-phase extraction (DPE)/enhanced fluid recovery (EFR) from existing monitoring wells with high contaminant concentrations.

For the conceptual design, it is estimated that two additional extraction wells would be installed downgradient of the existing recovery wells to a target depth of 140 feet bgs. It is estimated that the existing GWTF#? system's capacity will be upgraded from 60 to 100 gpm and will operate in "flow control" mode rather than at the current "constant head" configuration, and all existing treatment equipment will be replaced with newer, more efficient equipment to accommodate the additional flow. The above-ground conveyance system within the facility from each of the existing extraction wells will be upgraded on an as needed basis to accommodate the higher capacity. The current 1,000-gallon equalization tank will be replaced with a similar capacity tank that is designed for flow equalization in addition to DNAPL recovery. The DNAPL that is collected at the bottom of the recovery tank will be removed and disposed at a licensed waste disposal facility. Extracted ground water will be treated with air stripping and discharged via the existing outfall to Turpentine Run.

Alternative 2 will include alternate pumping from existing monitoring wells with high contaminant concentrations. It is assumed that the source area wells will include wells identified as OU2-MW3, RD-9, OU2-MW6, OU2-MW2, IW-1, IW-2, and OU2-MD1. The well selection will be made during the RD phase. It is assumed that a small pump connected to a flexible pipe will be placed inside each of these monitoring wells, and ground water will be pumped into the DNAPL recovery tank, treated through the existing treatment system as described above, and then discharged at the existing outfall. It was assumed that this will be done in sequence at each well for a total estimated duration of one week per event.

As mentioned above, Alternative 2 will also include DPE/EFR from existing monitoring wells where high contaminant concentrations are present. The DPE/EFR is a portable system that will extract ground water from designated monitoring wells that are present in source areas at the Curriculum Center property. A pilot study will be conducted to obtain design parameters for the DPE/EFR. The well head of each extraction point/monitoring well will be sealed, and a DPE/EFR mobile system will be used to apply a high vacuum to each well in order to remove contaminated ground water/DNAPL from source areas. The recovered contaminated ground water will be treated through the existing pump and treat system and then discharged at the outfall. The DNAPL that is collected at the bottom of the recovery tank will be removed and disposed at a licensed waste disposal facility. At a minimum, the DPE/EFR system will include a vacuum blower, knockout tank, air filters and silencers, flow meters, transfer pump, and a control panel. It is assumed that DPE/EFR events will be twice a year at each well, for a period of five years. The frequency of the events will be refined during the RD.

Based on calculations, it is estimated that clean up time for the Curriculum Center source areas using groundwater pump and treat will be in excess of 30 years. For cost-estimating and planning purposes, an estimated remediation time frame of 30 years is used for developing costs associated with O&M activities. It is assumed that active remediation would be employed in the targeted treatment areas until the MCL for each of the COCs is attained within the targeted treatment area. As outlined in the 1996 ROD, natural processes would be relied upon to achieve the MCLs for areas outside the capture zone and not targeted for active remediation. The success of the remedy in meeting the RAOs will be evaluated through the above-mentioned statutorily required five-year reviews.

The conceptual design would be refined during the RD phase if this alternative is selected.

Alternative Enhancement 2A: Reinjection

Capital Cost:	$437,053
Present-Worth O&M Costs:	$51,364 plus Alt 2
Present-Worth Cost:	$488,417
Time frame:	*30* years

This enhancement for Alternative 2, the cost of which would be in addition to Alternative 2, includes enhancing the existing pump and treat system as described in Alternative 2 with reinjection of the treated ground water downgradient of the Curriculum Center in an effort to act as a hydraulic barrier to prevent further off property migration of the contamination.

For the conceptual design, it is estimated that two injection wells would be installed downgradient of the existing and proposed extraction wells and along major fracture/weathered zone trends identified during the FSRI.

For cost-estimating and planning purposes, an estimated remediation time frame of 30 years is used for developing costs associated with O&M activities.

Alternative Enhancement 2B: Air Sparging/Soil Vapor Extraction

Capital Cost:	$1,739,745
Present-Worth O&M Costs:	$205,461 plus Alt 2
Present-Worth Cost:	$1,945,206
Time frame:	*30* years

This enhancement for Alternative 2 consists of enhancing the existing pump and treat system as described above in Alternative 2 with air sparging/soil vapor extraction (AS/SVE) in source areas, including the area beneath the northern portion of the building, in order to help mobilize residual DNAPL within the zone influenced by air sparging and thereby reducing the remedial timeframe of the groundwater extraction and treatment system.

For the conceptual design, it is estimated that 25 SVE wells and 30 AS wells would be installed at the Curriculum Center property. It is estimated that each SVE well will be installed to a depth of approximately 15 feet bgs, and each

AS well will be installed to a depth of approximately 140 feet bgs. For cost estimating purposes, granular activated carbon and potassium permanganate is assumed as the vapor phase treatment option for the enhancement to the treatment system.

For both cost-estimating and planning purposes, an initial five years of AS/SVE is proposed. Based on calculations, it is estimated that the cleanup time for the Curriculum Center source area will be about 25 years after the source area residual DNAPL is removed by AS/SVE. It is therefore assumed that the remedial system will be active for a period of 30 years.

Alternative Enhancement 2C: In-Situ Chemical Oxidation

Capital Cost:	$99,364
Present-Worth O&M Costs:	*$*117,110 plus Alt 2
Present-Worth Cost:	$216,474
Time frame:	*30* years

This enhancement for Alternative 2 consists of enhancing the existing pump and treat system as described above in Alternative 2 with in-situ chemical oxidation (ISCO) treatment at the potential source areas as an enhancement. This process involves introducing strong oxidizing agents through existing monitoring wells within the potential source areas via slow-release cylinders or a comparable delivery method. Operating the pump and treat system could potentially enhance the distribution of oxidants across the source zone and maintain hydraulic control of the dissolved-phase plume emanating from the source areas.

For the conceptual design, it is estimated that 64 cylinders will be deployed in a total of 12 monitoring wells in the potential source areas. It is estimated that the cylinders will be removed and replaced on an annual basis.

For cost estimating purposes, an initial five years of ISCO treatment is proposed before evaluating if further source area treatment is necessary. Based on calculations, it is estimated that the cleanup time for the Curriculum Center source areas, after complete removal of source concentrations, will be about 25 years. For cost estimating purposes, it is assumed that the pump and treat remedial system will be active for a period of 30 years in order to capture contaminated ground water beyond the active treatment source areas.

Alternative Enhancement 2D: Surfactant Flushing

Capital Cost:	$1,265,756
Present-Worth O&M Costs:	Same as Alt 2
Present-Worth Cost:	$1,265,756
Time frame:	*26* years

This enhancement for Alternative 2 consists of enhancing the existing pump and treat system as described above in Alternative 2 with in-situ flushing of bedrock fractures with surfactants at the potential source areas as an enhancement.

For the conceptual design, it is estimated that two deep injection wells and five shallow injection wells will be installed in the potential source areas. Extraction wells are required to maintain hydraulic control, bring emulsified/dissolved DNAPL to the surface for treatment and to clear the aquifer of surfactant solution.

As a result of challenges associated with surfactant flushing in a bedrock aquifer, it is assumed that surfactant flushing will be performed in source areas for one year. For cost estimating purposes, two rounds of injections are assumed. Based on calculations, it is estimated that clean up time for the Curriculum Center source areas, after complete removal of source concentrations, will be within about 25 years. For cost estimating purposes, it is assumed that the remedial system will be active for a period of 26 years in order to capture contaminated ground water beyond the active treatment source areas.

Alternative 3: In-Situ Thermal Treatment and Pump and Treat

Capital Cost:	$89,628,605
Present-Worth O&M Costs:	*$*4,569,283
Present-Worth Cost:	$94,309,778
Time frame:	*12* years

This remedial alternative includes in-situ thermal treatment (ISTT) to target DNAPL in potential source areas with downgradient pump and treat for hydraulic control.

The ISTT proposed for the Curriculum Center property consists of in-situ bedrock heating as a means to provide significant mass reduction (>99%) of CVOCs and DNAPL in ground water within the fractured bedrock of the potential source areas with a time frame of approximately two years. Heat causes the underground contaminants, DNAPL, and water to boil, creating in-situ steam and vapor. Contaminated vapor and steam are extracted using vacuum recovery wells and treated above ground. The heater wells will be co-located with the recovery wells. Each recovery well is connected to the conveyance pipe that routes the steam and vapors to the condenser. All conveyance piping and cable will be above grade.

For the conceptual design, it is estimated that 260 to 270 heater wells, co-located with 260 to 270 vacuum extraction points, would be used to treat ground water within the area beneath the northern portion of the Curriculum Center building and the potential source areas. It is assumed that each heater well boring will be installed from 1 to 140 feet bgs within the bedrock. The average distance between heater wells will be approximately 17 feet. It is estimated that 15 temperature monitoring points will be installed to monitor the subsurface temperature data continuously.

Alternative 3 includes the addition of two new extraction wells downgradient of the Curriculum Center to provide hydraulic control during in-situ thermal treatment at the source areas. Alternative 3 also includes upgrading the current treatment system (GWTF #1) to a capacity of 100 gpm. It is estimated that operating the treatment system at a total flow rate of 100 gpm will establish hydraulic control and capture the deep bedrock ground water in the vicinity of the Curriculum Center source areas. This hydraulic containment will limit or prevent the downgradient migration of contaminants from the Curriculum Center property.

All existing treatment equipment will be replaced with newer, more efficient equipment to accommodate the additional flow as described in detail in Alternative 2, above.

It is anticipated that the duration of operating the active thermal treatment system will be on the order of two years. During this time, the pump and treat system will remain operational in order to maintain hydraulic control of the downgradient dissolved plume. It is estimated that contamination outside of the thermal treatment area will take 10 years to reach the perimeter pump and treat system. For cost estimating purposes, it is assumed that the enhanced groundwater treatment system will be active for a period of 12 years in order to capture contaminated ground water beyond the active treatment source areas.

The conceptual design would require further evaluation during the RD phase if this alternative is selected.

Alternative 4: In-Situ Steam Injection and Pump and Treat

Capital Cost:	$25,568,569
Present-Worth O&M Costs:	$8,539,451
Present-Worth Cost:	$34,171,200
Time frame:	*27* years

This remedial alternative consists of steam injection at the potential source areas to mobilize the DNAPL in bedrock fractures and to cause destruction of contaminants in potential source areas. Mobilized DNAPL will be captured by the pump and treat system at the Curriculum Center property (GWTF#1).

Under the conceptual design, sixty steam injection wells and thirty multi-phase extraction wells would be installed across the source area. This configuration is intended to facilitate outward, horizontal advancement of the steam front from the steam injection wells toward the dual-phased extraction wells. The injection wells would be screened across the low-productive zone of the aquifer (approximately 80 to 140 feet bgs). The pressure of steam injection would also mobilize and transport contaminants vertically based upon the higher permeability of the overlying shallow zone and the enhanced upward gradient imposed on the aquifer by shallow-zone remedial pumping associated with the pump and treat system. It is estimated that ten temperature monitoring points would be installed to monitor the subsurface temperature data continuously.

Alternative 4 includes the addition of two new extraction wells downgradient of the Curriculum Center to provide hydraulic control to maintain hydraulic control during steam injections at the source areas. Alternative 4 also includes upgrading the current system to a capacity of 100 gpm. It is estimated that operating the system at a total flow rate of 100 gpm will establish hydraulic control and capture the deep bedrock ground water at the Curriculum Center source areas. This hydraulic containment will limit or prevent the downgradient migration of contaminants from the Curriculum Center property.

All existing treatment equipment will be replaced with newer, more efficient equipment to accommodate the additional flow as described in detail in Alternative 2, above.

It is anticipated that the duration of operating the steam injection system will be on the order of two years. During this time, the pump and treat system will remain operational in order to maintain hydraulic control of the downgradient dissolved plume. Based on calculations, it is estimated that clean up time in the Curriculum Center area after complete removal of source area concentrations will be within about 25 years. For cost estimating purposes, it is assumed that the enhanced groundwater treatment system will be active for a period of 27 years in order to capture contaminated ground water beyond the active treatment source areas.

EVALUATION OF ALTERNATIVES

In evaluating the remedial alternatives, each alternative is assessed against the nine evaluation criteria set forth in the NCP, namely the following: overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; cost; and State and community acceptance. Refer to the text box for a more detailed description of these evaluation criteria.

This section of the Proposed Plan evaluates the relative performance of each alternative against the nine criteria, noting how each compares to the other options under consideration. A detailed analysis of alternatives can be found in EPA's FS Report supporting this decision, dated March 2018.

Overall Protection of Human Health and the Environment

Alternative 1 (No Action) would not meet the RAOs and would not be protective of human health and the environment because no action would be taken. Alternatives 2 through 4 are the active remedies that address ground water contamination, minimize the migration of contaminated ground water, and would restore ground water quality over the long-term.

Under Alternative 2, the pump and treat system will capture and treat the contaminants at and downgradient of the potential source areas. Expanding the pump and treat system by installing additional extraction wells downgradient of the Curriculum Center will prevent ground water from migrating further downgradient and reduce the contaminant concentrations in the area.

Alternatives 3 and 4 will prevent an impact to ground water because these alternatives will remove the DNAPL and dissolved CVOC contamination from the bedrock aquifer and will prevent further downward migration of CVOC contamination to ground water by operating newly installed downgradient extraction wells.

Until RAOs are met, protectiveness under Alternatives 2 through 4 requires a combination of actively reducing contaminant concentrations in ground water and limiting exposure to residual contaminants through existing ICs for ground water use. ICs are anticipated to include existing governmental controls in the form of DPNR well use regulations.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

EPA has promulgated MCLs (40 CFR Part 141), which are enforceable standards for various drinking water contaminants (and are chemical-specific ARARs). The USVI does not have drinking water source-based quality standards for organics in ground water, as drinking water is taken from rainwater cisterns or from pumped water supply using desalinated seawater. In the absence of any USVI regulations for CVOCs in ground water, compliance with the federal standard is required.

Alternative 1 would not comply with ARARs. Action-specific ARARs would not be attained under this alternative because no remedial action would be conducted under the no action alternative.

Alternative 2 would achieve chemical-specific ARARs through extraction and *ex-situ* treatment of contaminated ground water. Alternative 3 could achieve chemical-specific ARARs through *in-situ* thermal treatment. Alternative 4 would achieve chemical-specific ARARs through *in-situ* steam injections; however, Alternative 4's long-term effectiveness would need to be verified in the field because it relies on its ability to contact, heat, and physically displace contaminants.

For Alternatives 2 through 4, action-specific ARARs would be met through Site specific health and safety requirements, off-gas treatment requirements, if applicable, and water discharge criteria when applicable. There are no location specific ARARs associated with the site.

It is estimated that the RAOs would be achieved in 30 years with Alternative 2, 12 years with Alternative 3, and 27 years with Alternative 4. Active remediation under Alternatives 2 through 4 would be employed in the targeted treatment areas until the MCL for each of the COCs is attained within the targeted treatment area.

Long-Term Effectiveness and Permanence

Alternative 1 would not provide long-term effectiveness and permanence because groundwater contamination would not be addressed. Alternatives 2 through 4 are considered effective technologies for treatment and/or containment of contaminated ground water, if designed and constructed properly.

EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES

Overall Protectiveness of Human Health and the Environment considers whether and how an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) considers whether the alternative meets federal and state environmental statutes, regulations, and other requirements that pertain to the Site, or whether a waiver is justified.

Long-term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.

Reduction of Toxicity, Mobility, or Volume (TMV) of Contaminants through Treatment considers an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.

Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, the community, and the environment during implementation.

Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.

Cost considers estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

State/Support Agency Acceptance considers whether the State agrees with EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.

Community Acceptance considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

Alternatives 2 through 4 would provide long-term effectiveness and permanence by using in-situ treatment processes to reduce the contaminant mass in the treatment area. Alternatives 2 through 4 would also provide hydraulic control to prevent off-property migration of the contaminated plume at the Curriculum Center property.

Alternative 2's approach has been proven to be an effective technology in reducing the concentrations of VOC contaminated ground water. Extraction and treatment of contaminated ground water would limit downgradient migration of the contaminants and reduce groundwater contamination. Alternative 2 on its own might be ineffective at removing DNAPL from the low-yielding fractured bedrock. Enhancements associated with Alternative 2 will likely be effective in reducing source area concentrations and mobilizing the DNAPL if implemented in conjunction with the pump and treat system.

Among Alternatives 2 through 4, Alternative 3's use of *in-situ* thermal treatment would provide the highest mass reduction of groundwater contamination at the potential source areas in the shortest period, followed by Alternative 4's use of steam injections.

Alternative 4, *in-situ* steam injections, has the potential to significantly reduce contaminant concentrations in the treatment zones but has only limited application in the field for bedrock. Properly designing the injection and the recovery system will be critical to the success of this alternative and to ensure that the system does not drive the contamination deeper into the subsurface.

Alternatives 2 through 4 would control risk to human health through the implementation of ICs until clean up levels are achieved.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 1, no action, would not address the contamination through treatment, so there would be no reduction in toxicity, mobility, or volume of the contaminants, and the alternative does not include long-term monitoring of groundwater conditions.

Alternatives 2, 3, and 4 would provide reduction of toxicity, mobility, and volume through treatment and removal of contaminants. Alternative 3, using *in-situ* thermal remediation, would be the most effective in reducing toxicity and volume of contamination in ground water through treatment, followed by Alternative 4 using in-situ steam injections, and finally Alternative 2 using the pump and treat system.

Short-Term Impact and Effectiveness

Alternative 1 would not have short-term adverse impacts because no action would be implemented.

There would be significant short-term impacts to the local community and workers for Alternatives 2 through 4 as a result of the active remedial actions undertaken and associated with construction, operation, and/or treatment activities. Efforts could be made to minimize noise and impact from construction activities related to the operations at the Curriculum Center, if applicable. Currently, the building is closed because of damage from the 2017 hurricanes. The future of the building and previous operations is unknown.

Coordination with and access from DPNR and VIDE would be required for staging or remedial action purposes. Noise and community air monitoring plans would be developed during the design and discussed with owners and local authorities. Engineering controls and appropriate personnel protective equipment would be used to protect the community and workers during implementation of Alternatives 2 through 4.

It is estimated that construction for each of Alternatives 2 through 4 will be over a period of 1 year.

Implementability

Alternative 1, no action, would be the easiest of all the alternatives to implement because there would be no remedy to implement. Alternatives 2 through 4 are all implementable, although each present different challenges.

Services, materials, and experienced vendors to implement Alternatives 2 through 4 are readily available in the continental USA. Shipping equipment to the USVI from the United States would be required for a majority of the equipment needed for Alternatives 2 through 4 because local supplies of these materials are scarce. Pilot studies could be implemented to obtain site-specific design parameters for Alternatives 2 through 4. A permit equivalent would be developed for in-situ treatment technologies for subsurface discharges and/or discharge of treated vapor to the atmosphere under Alternatives 2 through 4.

The ultimate success rate of Alternatives 2 through 4 will depend upon site-specific conditions. Based on the conditions at this site, with high levels of contamination and DNAPL in bedrock fractures, Alternative 3, using in-situ thermal remediation, would have the highest projected success rate, followed by Alternative 4, which uses in-situ steam injections, followed in projected success by Alternative 2, using an expanded pump and treat system. Note that Alternatives 3 and 4 also would employ the expanded pump and treat system.

Of the three active remediation alternatives (Alternatives 2 through 4), Alternative 2 would be the easiest alternative to construct because this technology is already in use and has been implemented under the 1996 remedy, and thus it would result in less disruption to the existing, operating system.

Alternative 4 would be the most difficult alternative to implement because delivery of steam to the source material through small aperture fractures can be problematic. Properly designing the injection and recovery system proposed in Alternative 4 would be a critical component to ensuring that the system does not drive the contamination deeper into the subsurface. Alternative 3 may require an alternative power source because existing sources are insufficient, particularly when considering damage caused by the 2017 hurricanes.

The construction activities for Alternative 3 would also result in the greatest disruption because this alternative requires installation of a significant number of wells when compared to the two new extraction wells and two injection wells set forthin Alternative 2.

Alternatives 2 through 4 would require routine groundwater quality, performance, and administrative monitoring, including statutorily-mandated five-year CERCLA reviews, as discussed above.

Cost

The estimated capital cost, O&M, and present worth cost of the various Alternatives are discussed in detail in the February, 2021 FS Report. For cost estimating and planning purposes, a 30-year time frame was used for O&M and long-term monitoring under Alternative 2, a 12-year period was used for Alternative 3, and a 27-year period was used for Alternative 4. Based on calculations, for the enhancement Alternatives 2A through 2C, a 30-year timeframe was assumed, and a 26-year timeframe was used for Alternative 2D. The cost estimates are based on the available information. Alternative 1 (No Action) has no cost because no activities would be implemented. The highest present value cost is Alternative 3 at $94.31 million. Of the three alternatives with active remedial components, Alternative 2 is the least expensive at $13.34 million.

The estimated capital, O&M, and present-value costs for each of the alternatives are as follows (with the amounts indicated for 2A – 2D being additional amounts to be added to the Alternative 2 amount):

Alternative	**Capital Cost ($)**	**Present Worth O&M Cost ($)**	**Present Value Cost ($)**
1 No Action	0	0	0
2 Pump & Treat	4,802,538	8,481,677	13,340,565
2A Reinjection	437,053	51,364	488,417
2B AS/SVE	1,739,745	205,461	1,945,206
2C ISCO	99,364	117,110	216,474
2D Surfactant Flushing	1,265,756	Same as Alt 2	1,265,756
3 *In-situ* Thermal and Pump & Treat	89,628,605	4,569,283	94,309,778
4 *In-situ* Steam and Pump & Treat	25,568,569	8,539,451	34,171,200

Territorial Support Acceptance

DPNR supports the EPA's preferred remedial alternatives as stated in this Proposed Plan.

Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and all comments are reviewed. Comments received during the public comment period will be addressed in a responsiveness summary section of the OU2 ROD. The ROD is the document that will formalize the selection of the remedy for the site.

PREFERRED ALTERNATIVE

Based upon an evaluation of the remedial alternatives, EPA proposes Alternative 2, Expand Existing Groundwater Extraction and Ex-Situ Treatment (Pump and Treat) with Alternative 2A, Reinjection, as the preferred remedial alternative for the Curriculum Center source areas. Combined Alternatives 2 and 2A have the following key components:

- Expand the existing pump and treat system to include two downgradient extraction wells;
- Upgrade current pump and treat system to increase flow rate;
- Upgrade all treatment equipment to accommodate additional flow and improve efficiency;
- Reinject treated water;
- Alternate pumping from existing monitoring wells with high contaminant concentrations;
- Utilize dual-phase extraction from source area wells; and
- Monitor ground water long-term.

The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. DNAPL in ground water may be viewed as source material. Principal threat waste will be addressed by designing active remediation elements to achieve the cleanup levels by establishing containment, decreasing DNAPL mass in the bedrock aquifer, and restoring ground water. The enhanced extraction and treatment system would operate until remediation goals are attained. Figure 3 provides the conceptual locations of the new extraction and injection wells and the existing treatment plant. The exact number and placement of extraction and injection wells would be determined during the remedial design.

A contingency remedy to Alternative 2A, Reinjection will be Alternative 2B, Expand Existing Groundwater Extraction and Treatment System with AS/SVE.

The effectiveness of the preferred alternative would be evaluated based upon the attainment of specific performance standards and cleanup goals during post-remedy monitoring (e.g., reduction in CVOC concentrations, hydraulic control, etc.). Should the preferred alternative fail to attain these standards and goals in the estimated timeframe (e.g., if there is persistence of high CVOC concentrations) or should its implementation prove ineffective (e.g., there is ineffective hydraulic control as a result of the inability of the bedrock aquifer to accept the re-injected water which would create a hydraulic mound to support the hydraulic capture of the contaminant plume), Alternative 2B, "Expand Existing Groundwater Extraction and Treatment System with AS/SVE", would be evaluated as a contingency remedy. Should Alternative 2 with Alternative 2B prove to be ineffective, the need for a technical impracticability waiver could be evaluated. The ineffectiveness of Alternative 2 with Alternative 2B would imply the presence of DNAPL in the bedrock fractures beneath the Curriculum Center building that was not accessible during the remedial investigation. DNAPL presence in the aquifer beneath the Curriculum Center could have major impacts on the remediation approach and extend remediation timeframes thereby warranting technical impracticability evaluations.

A long-term groundwater monitoring program would be implemented to track and monitor changes in the ground water contamination to ensure the RAOs are attained. The results from the long-term monitoring program would be used to evaluate the migration and changes in VOC contaminants over time.

Existing ICs will ensure that the remedy remains protective until RAOs are achieved for protection of human health over the long term. Institutional controls for ground water use would consist of DPNR well use laws and, for new construction, vapor intrusion prevention.

A Site Management Plan would also be developed and would provide for the proper management of the site remedy post-construction, and it would include long-term groundwater monitoring, health and safety requirements, institutional controls, and periodic reviews until such time as clean up levels are attained.

The total, estimated, present worth cost for the proposed remedy is $13,828,982. Further detail of the cost is presented in Appendix A of the FS Report. This is an engineering cost estimate that is expected to be within the range of plus 50 percent to minus 30 percent of the actual project cost.

While it is anticipated that the proposed alternative would ultimately result in reduction of contaminant levels in ground water such that levels would allow for unlimited use and unrestricted exposure, it is estimated that it would take longer than 30 years to achieve these levels. Because levels of contaminants will remain at the site during this period, a statutorily mandated review of the remedy will be performed at least once every five years until remediation goals are achieved.

Alternative 2, extraction and treatment, is a proven technology that has demonstrated effectiveness at reducing contaminant mass and providing containment to achieve cleanup standards for VOC-contaminated ground water.

Based upon the information currently available, EPA believes that the preferred alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing criteria. EPA expects the preferred alternative to satisfy the following statutory requirements of Section 121(b) of CERCLA: (1) the proposed remedy is protective of human health and the environment; (2) it complies with ARARs; (3) it is cost effective; (4) it utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) it satisfies the preference for treatment. Long-term monitoring would be performed to assure the protectiveness of the remedy. With respect to the two modifying criteria of the nine criteria, territory acceptance and community acceptance, DPNR and community acceptance will be evaluated upon the close of the public comment period.

FOR FURTHER INFORMATION

The Administrative Record file, which contains copies of the Proposed Plan and supporting documentation are available at the following information repositories:

U.S. Environmental Protection Agency
Virgin Islands Field Office
Tunick Building, Suite 102
1336 Beltjen Road
St. Thomas, VI 00801
(340) 714-2333
Hours of operation:
Mon-Fri 9:00 am – 4:30 pm

USEPA – Region II
Superfund Records Center
290 Broadway, 18th Floor
New York, New York 10007-1866
(212) 637-4325
Hours: Monday – Friday: 9:00 am to 4:30 pm

In addition, the Administrative Record file is available on-line at:

https://www.epa.gov/superfund/tutu-wellfield

EPA United States Environmental Protection Agency

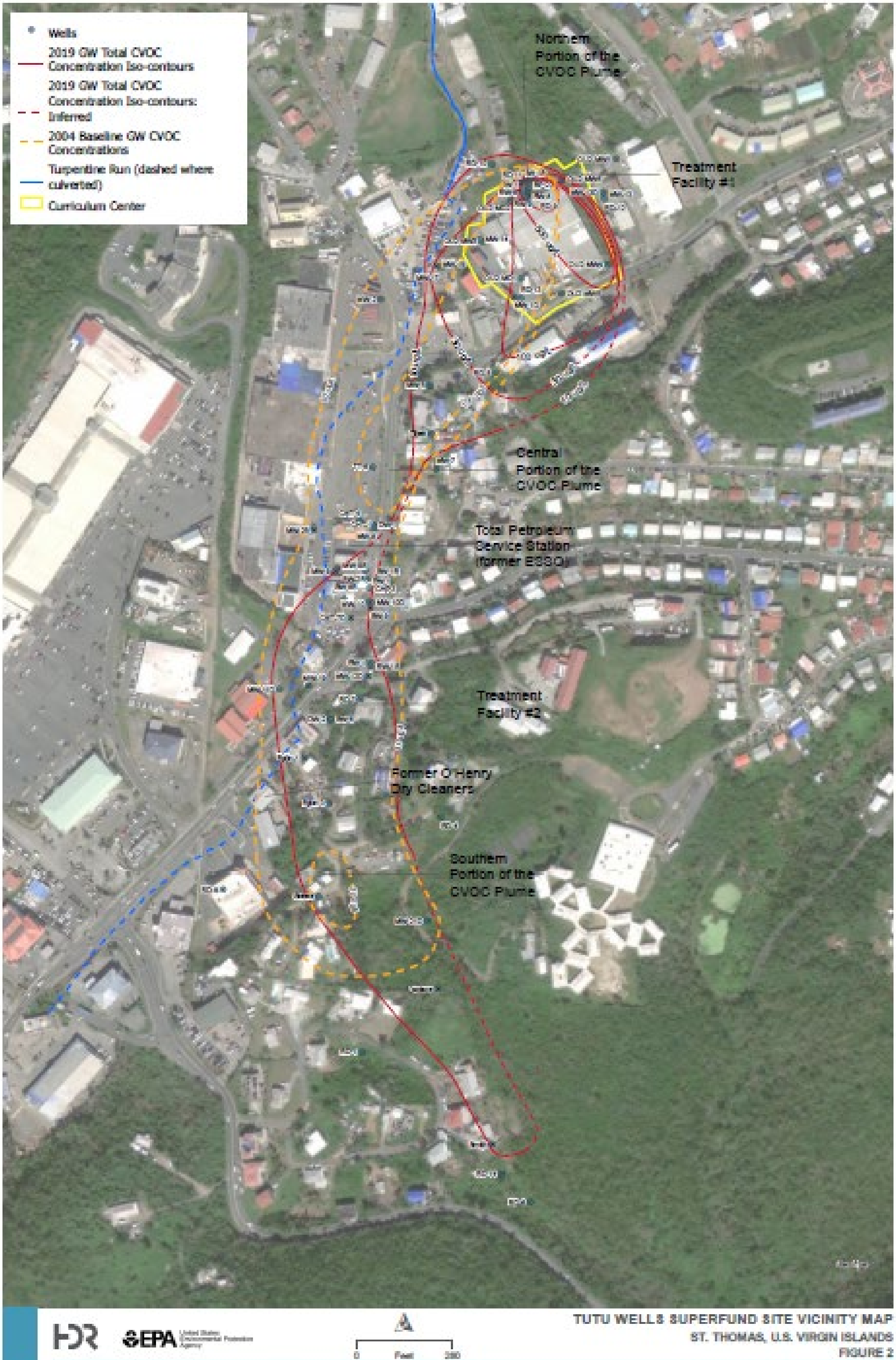
SITE LOCATION MAP

ST. THOMAS, U.S. VIRGIN ISLANDS

FIGURE 1

TUTU WELLS SUPERFUND SITE FOCUSED SOURCE RI/FS OU2

PATH: \\MAHPI-FILE01\ACTIVEPROJECTS\443005\CON0036696\0000000002547947.0_GIS_MODELS\7.2_WORK_IN_PROGRESS\MAP_DOCS\DRAFT\FIGURE 2-1.MXD - USER: CWEAVER - DATE: 10/12/2017



TUTU WELLS SUPERFUND SITE VICINITY MAP

ST. THOMAS, U.S. VIRGIN ISLANDS

FIGURE 2

EPA United States Environmental Protection Agency

ALTERNATIVE 2A - EXPANSION OF PUMP AND TREAT SYSTEM AND REINJECTION

TUTU OU2, ST. THOMAS, U.S. VIRGIN ISLANDS

FIGURE 3

Tutu Wellfield Superfund Site

St. Thomas, U.S. Virgin Islands

August 2018

EPA ANNOUNCES PROPOSED PLAN

This Proposed Plan describes remedial alternatives that the United States Environmental Protection Agency (EPA) considered to address groundwater contamination associated with the contaminant source areas at the Tutu Wellfield Superfund Site located in St. Thomas, U.S. Virgin Islands. This Plan also identifies EPA's Preferred Alternative and provides the rationale for this preference.

This Proposed Plan includes summaries of cleanup alternatives evaluated to more effectively address contaminant source areas and accelerate the cleanup of groundwater contamination at the site. As described herein, EPA, in consultation with the United States Virgin Islands (USVI) Department of Planning and Natural Resources (DPNR), will select the remedy for source area groundwater after reviewing and considering all information submitted during the 30-day public comment period. EPA, in consultation with DPNR, may modify the Preferred Alternative or select another response action presented in this Proposed Plan based on new information or public comments. Therefore, the public is encouraged to review and comment on all the alternatives presented in this Proposed Plan.

EPA is issuing this Proposed Plan as part of its public participation responsibilities in accordance with Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. §117(a) (CERCLA) (also known as Superfund), and Sections 300.430(f) and 300.435(c) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This Proposed Plan summarizes information that can be found in greater detail in the Remedial Investigation (RI) and Feasibility Study (FS) reports as well as other related documents contained in the publicly available Administrative Record for this decision. EPA encourages the public to review these documents to gain a more comprehensive understanding of the site and Superfund activities that have been conducted.

MARK YOUR CALENDAR

PUBLIC COMMENT PERIOD: August 8 - September 7, 2018
EPA will accept written comments on the Proposed Plan during the public comment period. Written comments should be addressed to:

Caroline Kwan
Remedial Project Manager
U.S. Environmental Protection Agency
290 Broadway, 20th Floor
New York, NY 10007
Email: kwan.caroline@epa.gov

Written comments must be postmarked or emailed no later than September 7, 2018.

PUBLIC MEETING: August 23, 2018 at 7:00 pm
EPA will hold a public meeting to explain the Proposed Plan and all of the alternatives presented in the Feasibility Study. Oral and written comments will also be accepted at the meeting. The meeting will be held at:

GRACE GOSPEL CHAPEL
148-320-321&322 Estate Anna's Retreat
St. Thomas, VI 00802

In addition, select documents from the administrative record are available on-line at:

https://www.epa.gov/superfund/tutu-wellfield

The current remedy for the site, selected in 1996 in a document called a Record of Decision (ROD), consists of extraction of contaminated groundwater, ex-situ treatment, discharge of the treated groundwater to a nearby stream, and institutional controls (ICs). Construction of the remedy selected in the 1996 ROD was completed in 2004 and began operation at that time. Operation and maintenance (O&M) of the treatment system was transferred from EPA to the USVI government in April 2013, and the USVI O&M obligation continues. The Preferred Alternative identified in this Proposed Plan would include expansion of the existing pump and treat system, reinjection of groundwater to create a hydraulic barrier downgradient of the source area, long-term monitoring, and the implementation of the already-required ICs.

COMMUNITY ROLE IN SELECTION PROCESS

This Proposed Plan is being issued to inform the public of EPA's proposed alternative and to solicit public comments pertaining to all of the remedial alternatives evaluated, including the Preferred Alternative. Changes to the Preferred Alternative, or a change to a preference for another alternative, may be made if public comments or additional data indicate that such a change would result in a more appropriate remedial action. The final decision regarding the selected remedy will be made after EPA has taken into consideration all public comments. As stated above, EPA is soliciting public comments on all of the alternatives considered in the Proposed Plan because EPA may ultimately select a remedy other than the Preferred Alternative. This Proposed Plan has been made available to the public for a public comment period that concludes on September 7, 2018.

A public meeting will be held during the public comment period to present the information regarding the investigations of groundwater at the site, including the conclusions of studies performed to assess treatment options, as well as the FS, so as to elaborate further on the reasons for proposing the Preferred Alternative. The public meeting will include a presentation by EPA of the Preferred Alternative and other cleanup options and an opportunity to receive comments from the public. Information on the public meeting and how to submit written comments can be found in the "Mark Your Calendar" text box on Page 1.

Comments received at the public meeting, as well as written comments received during the comment period, will be addressed and documented in the Responsiveness Summary section of the ROD. The ROD is the document that presents which alternative has been selected and the basis for the selection of the remedy.

SCOPE AND ROLE OF ACTION

The site has been divided into two operable units. The 1996 ROD selected a remedy to address the entire site as one operable unit (OU1). The remedy was designed to address three distinct plumes of groundwater contamination, one consisting of chlorinated volatile organic compounds (CVOCs) and two others consisting of petroleum products from two service stations (the Texaco and Esso plumes). A secondary source of CVOC contamination originates from the O'Henry Dry Cleaners building and mixes with the primary CVOC plume downgradient of the source. The 1996 remedy called for extraction of contaminated groundwater, ex-situ treatment, discharge of the treated groundwater to a nearby stream and the implementation of ICs (Figure 1).

The 1996 remedy has been constructed and operating since 2004 and is effectively managing the Texaco and Esso plumes. However, monitoring conducted since 2004 has shown that concentrations in the CVOC plume are not decreasing as quickly as anticipated, suggesting that an unidentified source may still be present in the northern part of the plume. Therefore, in April 2015 EPA created OU2 to further investigate potential contaminant source areas and to evaluate options to accelerate the cleanup of groundwater contamination at the site.

The primary objectives of the OU2 remedy are to accelerate the remediation of the source area groundwater contamination, restore groundwater quality to its most beneficial use (i.e., federal drinking water standards), and minimize any potential future health and environmental impacts.

SITE BACKGROUND

Site Description

The site is located in east-central St. Thomas in the USVI, and it consists of contaminated groundwater plumes covering an area approximately 108 acres in size. This Proposed Plan focuses on the source area of the CVOC plume, which is centered on the USVI Department of Education (VIDE) Curriculum Center property in the Anna's Retreat section of St. Thomas, east of the city of Charlotte-Amalie. A site location map is provided as Figure 1.

The Curriculum Center property is located at 386 Smith Bay Road (Highway 38). The 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 existing northern groundwater treatment system is located on the north side of the building. The Curriculum Center building was condemned after sustaining extensive damage during Hurricane Irma/Maria in 2017.

Site History

The Curriculum Center property is currently owned by VIDE. The property was originally owned by LAGA Industries, Ltd. (LAGA), which began operation of a textile manufacturing facility at the property in 1969. In 1970, LAGA was sold to the Duplan Corporation at which time Duplan reportedly began dry cleaning operations at the property using tetrachloroethene (PCE) as the dry cleaning fluid. PCE is part of the CVOC group of chemicals. Duplan filed for bankruptcy in 1976 and ceased all operations at the property in late 1978. Panex Co. (a corporation formed by the former owners of LAGA) purchased the facility from Duplan's bankruptcy trustee in 1979 and sold it to VIDE in 1981. Information on property operations during Panex's ownership was not available. From 1982 to 2017, the building was used by VIDE as a book repository/library, warehouse with cold storage, maintenance shop and school district administrative offices.

Remedial Investigation/Action Summary

Multiple investigations have been performed at the Curriculum Center property since 1982. The original RI that focused on the entire site identified a plume of groundwater contaminated with CVOCs and two plumes of groundwater contaminated with gasoline components (the Texaco and Esso plumes) that co-mingled with the CVOC plume. EPA concluded that the CVOC plume originated at or near the Curriculum Center property, extended beyond the former O'Henry Dry Cleaners building (a potential secondary source), and followed an eastward path towards Turpentine Run.

In 1995, the CVOC plume extended approximately 1,600 feet to the southwest from the Curriculum Center to Four Winds Plaza and was approximately 500 feet wide. The highest concentrations of total CVOCs were observed in the shallow zone (less than 90 feet below grade surface (bgs)) monitoring wells near the northern source area at Curriculum Center property. The CVOCs detected at Curriculum Center were DCE, PCE, TCE, and vinyl chloride (VC). The highest concentrations detected were 2,100 µg/l of cis-1,2-DCE, 1,300 µg/l of VC, 360 µg/l of PCE, and 78 µg/l of TCE; all exceeded their respective Maximum Contaminant Levels (MCLs). In the RI, EPA concluded that the elevated concentrations of CVOCs in groundwater adjacent to and immediately downgradient of the Curriculum Center indicated a high probability that PCE, a primary component of the CVOC plume, was present as dense non-aqueous phase liquid (DNAPL) in the saturated and/or unsaturated bedrock.

The 1996 remedy for the site was to address the site-wide groundwater contamination, calling for extraction of contaminated groundwater, ex-situ treatment, surface discharge of the treated groundwater, and ICs.

Following completion of the remedial design (RD) in September 2001, EPA constructed Groundwater Treatment Facility Number 1 (GWTF #1) at the Curriculum Center property to achieve hydraulic control of the northern portion of the plume and remove CVOC mass from the saturated zone. GWTF #2 is located downgradient of GWTF #1 and addresses downgradient central portions of the plume, north of the O'Henry drycleaner (Figure 2).

EPA completed construction of GWTF #1 in 2004 which initially consisted of three groundwater extraction wells, an equalization tank and transfer pumping system, bag filters, a low-profile air stripper and an off-gas treatment system. Use of the off-gas treatment system was discontinued in April 2006 after CVOC concentrations dropped below the air pollution control permit equivalency limits. One granular activated carbon filter unit and one potassium permanganate unit remain at the Curriculum Center on standby for emergency use. Chemical feed systems were also included for sequesterant/biocide injection and pH adjustment.

The three groundwater extraction wells associated with GWTF #1 are RW-6, RW-7, and RW-9. Extraction wells RW-7 and RW-9 are completed in the shallow, more productive portion of the aquifer, with access to the groundwater at 30 to 80 bgs and 40 to 60 feet bgs, respectively. Extraction well RW-6 is completed in the deeper, less productive portion of the aquifer with access from 80 to 130 ft bgs. Extraction well RW-7 is operated on a continuous basis. Extraction well RW-9 operates as required to maintain the target groundwater elevation and is typically operated during and following heavy rain events. Extraction well RW-6 is operated approximately one hour per week, at a flow rate of approximately two gallons per minute (gpm), until the extraction well pump shuts down as a result of a low water level in the well. Treated water is discharged to Turpentine Run on the adjoining property to the northwest.

Overall, the site-wide remedy was operated by EPA from 2004 to 2013. Operation and maintenance of the treatment system was transferred from EPA to the USVI government in April 2013. As part of the long-term response action for the site, groundwater monitoring is routinely completed to assess progress. Groundwater monitoring was completed on a quarterly basis from system startup in 2004 until April 2007, and it has been conducted annually since 2007. Groundwater from a total of 30 monitoring and residential wells is analyzed for the presence of site-related contamination as part of site monitoring, and groundwater levels are measured on a monthly basis from 36 monitoring wells. Influent monitoring is performed monthly at two of the extraction wells (RW-6 and RW-7) using the GWTF #1 influent sampling port.

An SVE system was constructed in 2004 to remediate the unsaturated zone source of the CVOC groundwater contamination. The system included two SVE wells with discharge to the GWTF off-gas treatment system. The system was shut down in April 2006 due to a significant decrease in influent concentrations and achievement of asymptotic conditions.

EPA's Environmental Response Team (ERT) performed two investigations to characterize the potential for vapor intrusion into the Curriculum Center building. The investigations were performed in December 2007 and December 2011. The extent of soil vapor with elevated concentrations of PCE and TCE did not change noticeably between the two sampling rounds. All but one sample exceeded the soil vapor action level for PCE. The area of the highest sub-slab concentrations was found in the warehouse area located in the central portion of the Curriculum Center building and extends into the adjoining maintenance and office areas. The extent of TCE concentrations that exceeded action levels in soil vapor falls within the area of highest PCE concentrations.

A 2011 evaluation of the remediation system resulted in a conclusion that extraction well RW-7 was too far upgradient to effectively contain the Curriculum Center source area, and it was recommended that a new containment system with additional wells screened across the shallow and deep zones be considered.

Consistent with the law, EPA formally reviews the remedy every five years to assure it is meeting its remedial action objectives. Results of the second five-year review, completed in 2014, revealed that the existing remedy would not achieve its objective of restoring the aquifer to drinking water standards. Of particular concern to EPA was the potential presence of DNAPL as an ongoing source of groundwater contamination to the deep aquifer in the northern portion of the groundwater plume. The review resulted in a recommendation for the installation of additional wells to further evaluate the presence of DNAPL, the evaluation of groundwater monitoring results and the development of a conceptual site model (CSM) to determine a strategy for addressing the ongoing sources of CVOCs at the Curriculum Center property. The review further reported that vapor intrusion concerns had been addressed by sampling in 2007, because, although the sub-slab results exceeded screening values, the indoor air concentrations were negligible and well below risk-based concentrations.

RESULTS OF THE FOCUSED SOURCE REMEDIAL INVESTIGATION (FSRI)

The FSRI Report, dated March 2018, provides the analytical results of sampling conducted between April 2016 and June 2017, the purpose of which was to further investigate the source or sources of groundwater contamination in the northern portion of the site, specifically in the area of the Curriculum Center. The FSRI activities included a surface geophysical survey, rock matrix diffusion sampling and analysis, a borehole geophysical investigation, packer testing and sampling, monitoring well installation, groundwater sampling and groundwater level monitoring, and DNAPL monitoring.

The investigation focused on six contaminants, based on the site history, frequency of detection, and concentrations that exceeded cleanup standards: PCE, trichloroethene (TCE), 1,1-dichloroethene (1,1-DCE), *cis*-1,2 dichloroethene *(cis*-1,2-DCE), *trans*-1,2 dichloroethene *(trans*-1,2-DCE), and vinyl chloride (VC).

The following conclusions were made based on the FSRI results:

- The bedrock aquifer can be divided into two general zones; a shallow, more hydraulically conductive zone at depths less than 90 feet bgs and a deep, less conductive zone between the approximate depths of 90 and 140 feet bgs. Water bearing fractures in the vicinity of the Curriculum Center property are consistent with regional trends. The degree and orientation of fracturing observed below 140 feet bgs suggests limited potential for vertical contaminant migration below this depth;

- DNAPL is present within the shallow and deep bedrock zones based on direct observation and the presence of high levels of dissolved phase contamination. Evidence also indicates that DNAPL may be present in multiple source areas; on the surface of bedrock either beneath the Curriculum Center building, at the suspected waste pit, and/or in the former drum storage area. DNAPL is present in a partially mobile state and it has been concluded that it will act as an ongoing source of dissolved phase contamination at the Curriculum Center property;

- Dissolved phase CVOC contamination consisting of PCE, TCE, *cis*-1,2-DCE and VC is present at the Curriculum Center property ranging in concentration from low microgram per liter (µg/l) to milligram per liter (mg/l) concentrations. The plume of contaminated groundwater is primarily located in the shallow bedrock zone on the northwest side of the Curriculum Center and migrates to the southwest. Contaminants have also migrated to the east of the Curriculum Center and into the deep zone at the southwest corner of the building;

  Matrix diffusion data indicate that contamination of the rock matrix can be expected in areas where high levels of contaminants of concern (COCs) are present in groundwater. Contaminants present in the rock matrix will continue to back-diffuse from the rock matrix and impact groundwater in the Curriculum Center area for an estimated 17-25 years after source removal.

- The degree of reductive dechlorination varies throughout the Curriculum Center area. PCE degradation on the northwest side of Curriculum Center has resulted in high levels of TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and VC, while areas to north, east and south show more limited to no degradation.; and

- The influence of the existing extraction system is dependent on the fractures, fracture systems, and faults that intersect the extraction wells. Although the impact of pumping can be observed at distances of 50 feet or more, the capture zone of the existing extraction system does not extend the full width of the plume or far enough in a downgradient direction to contain potential source material in the drum disposal area or in the immediate area of monitoring well OU2-MW3 at the southwestern corner of the Curriculum Center.

Based on visual evidence and concentrations indicative of DNAPL, the presence of DNAPL has been confirmed in the fractured bedrock aquifer underlying the Curriculum Center property.

Principal Threat Waste

Principal threat wastes are considered source materials, i.e., materials that include or contain hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or as a source for direct exposure. Contaminated groundwater is generally not considered to be source material; however, the presence of DNAPL in the subsurface may be viewed as source material. Please refer to the text box entitled, “What is a Principal Threat” for more information on the principal threat concept.

SUMMARY OF SITE RISKS

A baseline human health risk assessments was conducted as part of the FSRI to estimate the risks associated with exposure to contaminants based on current and likely future uses of the site as commercial/industrial. Relevant information associated with this risk assessment is summarized below.

An ecological risk assessment was not performed for OU2, as the focus of this investigation was ground water, which does not discharge to surface water anywhere within the OU2 area. Ecological receptors are not expected to have contact with ground water; therefore, exclusion of an ecological risk assessment is consistent with EPA guidance that states ecological risk related to ground water is to be considered only if there is potential for impacts on ecological receptors. It is also consistent with the scope of the 1996 RI, which limited the evaluation of ecological risk to surface soil contamination at the site.

WHAT IS A “PRINCIPAL THREAT”?

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water or air, or acts as a source for direct exposure. Contaminated ground water generally is not considered to be a source material; however, Non-Aqueous Phase Liquids (NAPLs) in ground water may be viewed as source material. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur. The decision to treat these wastes is made on a site-specific basis through a detailed analysis of the alternatives using the nine remedy selection criteria. This analysis provides a basis for making a statutory finding that the remedy employs treatment as a principal element.

Human Health Risk Assessment

EPA conducted a four-step baseline human health risk assessment (HHRA) as part of the FSRI to assess site-related cancer risks and non-cancer health hazards in the absence of any remedial action. The four-step process is comprised of: Hazard Identification, Exposure Assessment, Toxicity Assessment, and Risk Characterization (refer to the text box, “What is Risk and How is it Calculated”).

The HHRA began with selecting chemicals of potential concern (COPCs) in groundwater that could potentially cause adverse health effects in exposed populations. The COPC screening of the HHRA identified 13 COPCs. The potential exposure scenarios considered in the HHRA include drinking water ingestion, dermal contact and inhalation of groundwater by residents, drinking water ingestion and dermal contact by indoor and outdoor workers as well as incidental ingestion, contact and inhalation with groundwater by a construction worker in a trench.

The evaluation of potential cancer risks and noncancer hazards to future, on-site receptors from exposure to COPCs in environmental media indicates that there are several primary COPCs, now identified as COCs, whose concentrations in environmental media contribute to the hazard and risk estimates, and exposure to these COCs may result in potential adverse health effects.

WHAT IS RISK AND HOW IS IT CALCULATED?

A Superfund baseline human health risk assessment is an analysis of the potential adverse health effects caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these releases under current- and anticipated future-land uses. A four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios.

Hazard Identification: In this step, the chemicals of potential concern (COPCs) at the site in various media (*i.e.*, soil, groundwater, surface water, and air) are identified based on such factors as toxicity, frequency of occurrence, and fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence, and bioaccumulation.

Exposure Assessment: In this step, the different exposure pathways through which people might be exposed to the contaminants identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of and dermal contact with contaminated soil and ingestion of and dermal contact with contaminated groundwater. Factors relating to the exposure assessment include, but are not limited to, the concentrations in specific media that people might be exposed to and the frequency and duration of that exposure. Using these factors, a "reasonable maximum exposure" scenario that portrays the highest level of human exposure that could reasonably be expected to occur is calculated.

Toxicity Assessment: In this step, the types of adverse health effects associated with chemical exposures and the relationship between magnitude of exposure and severity of adverse effects are determined. Potential health effects are chemical-specific and may include the risk of developing cancer over a lifetime or other non-cancer health hazards, such as changes in the normal functions of organs within the body (*e.g.*, changes in the effectiveness of the immune system). Some chemicals are capable of causing both cancer and non-cancer health hazards.

Risk Characterization: This step summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site risks for all COPCs. Exposures are evaluated based on the potential risk of developing cancer and the potential for non-cancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 10^{-4} cancer risk means a "one-in-ten-thousand excess cancer risk"; or one additional cancer may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions identified in the Exposure Assessment. Current Superfund regulations for exposures identify the range for determining whether remedial action is necessary as an individual excess lifetime cancer risk of 10^{-4} to 10^{-6}, corresponding to a one-in-ten-thousand to a one-in-a-million excess cancer risk. For non-cancer health effects, a "hazard index" (HI) is calculated. The key concept for a non-cancer HI is that a "threshold" (measured as an HI of less than or equal to 1) exists below which non-cancer health hazards are not expected to occur. The goal of protection is 10^{-6} for cancer risk and an HI of 1 for a noncancer health hazard. Chemicals that exceed a 10^{-4} cancer risk or an HI of 1 are typically those that will require remedial action at a site and are referred to as chemicals of concern, or COCs, in the final remedial decision document or Record of Decision.

The evaluation for future, on-site workers indicates that VC, TCE, PCE and cis-1,2-DCE have been identified as COCs for groundwater exposure, based on an excess lifetime cancer risk (ELCR) exceeding 1×10^{-4} or resulting in an HI greater than or equal to one.

PCE and TCE volatilizing into buildings are also of potential concern to workers based on groundwater, indoor air and sub-slab soil gas data. Volatilizing of VC into buildings may be of potential concern based on groundwater concentrations; however, VC was non-detect in the sub-slab soil gas and indoor air during two sampling events in 2007 and 2011. Note that the Curriculum Center building has been condemned due to damage during hurricanes Irma and Maria. Future use of the building is currently unknown.

1,1-DCE does not exceed the noncancer threshold, however, it exceeds its MCL, so it is included as a COC.

The ELCRs for a potential future resident's exposure to COPCs in groundwater are significantly above the threshold of 1×10^{-4} at 7×10^{-1}, and largely result from ingestion of VC, TCE and PCE. This assumes the groundwater is used for potable purposes with no treatment, as is required to be done in a baseline HHRA. The vapor intrusion risk evaluation indicates that these same COCs could also result in excess risks to future residents from exposure to contaminated soil vapor should an occupied building be located on the site.

These cancer risks and noncancer health hazards indicate that there is significant, potential risk from direct exposure to groundwater for future residents and site workers. The results of the HHRA indicate the proposed alternative will be necessary to mitigate potential risks associated with existing contamination. A more detailed discussion of the exposure pathways and estimates of risk can be found in the February 2018 HHRA in the Administrative Record of this action. Refer Table 1, Risk Summary.

Table 1: Risk Summary – Future Scenario

COC	Construction Worker		Worker		Resident		
	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Adult Noncancer Hazard	Child Noncancer Hazard
PCE	1.07E-04	7.10E+02	4.03E-04	8.96E+01	3.80E-03	8.08E+02	9.25E+02
TCE	5.71E-04	4.78E+03	2.38E-03	2.90E+02	4.06E-02	3.97E+03	4.06E+03
1,1-DCE***	N/A	2.50E-01	N/A	1.28E-02	N/A	1.77E-01	1.80E-01
cis-1,2-DCE***	N/A	6.05E+01	N/A	4.01E+02	N/A	1.20E+03	1.97E+03
trans-1,2-DCE***	N/A	1.28E-01	N/A	8.47E-01	N/A	2.52E+00	4.16E+00
VC	1.53E-03	2.11E+02	5.33E-02	6.91E+01	9.88E-01	2.93E+02	4.09E+02
1,1,2-Trichloroethane	1.13E-07	2.45E+00	1.56E-07	1.92E-03	2.59E-06	1.70E+00	1.44E+00
Total Risk and HQ	2.20E-03	5.77E+03	5.48E-02	8.50E+02	7.18E-01	6.27E+03	7.37E+03

Notes:
*** N/A = Not available. No cancer toxicity values are available for these COCs; no risks have been calculated.
Total cancer risks and HQs include all constituents evaluated in the HHRA.

Conclusion

The results of the HHRA indicate that the contaminated groundwater presents an unacceptable exposure risk. It is the EPA's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan or on the superfund records website https://semspub.epa.gov/src/collections/02/AR/VID982272569 , is necessary to protect public health or welfare or the environment from actual or threatened releases of pollutants or contaminants from this site which may present an imminent and substantial endangerment to public health or welfare.

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are specific goals to protect human health and the environment. These objectives are based on available information and standards such as applicable or relevant and appropriate requirements (ARARs), to-be-considered guidance, and site-specific, risk-based levels.

Based on technical impracticability matrix diffusion modeling conducted as part of the FS and described more in the next section, the restoration of the groundwater within a reasonable time frame may be possible notwithstanding the presence of DNAPL.

As such, the following RAOs have been established for the source areas and groundwater:

- Decrease DNAPL mass in the bedrock aquifer;
- 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
- Protect human health by preventing exposure to contaminated groundwater.

The preliminary remedial goal (PRGs) for groundwater are identified in Table 2.

Table 2: PRGs for Groundwater

COC	MCLs (μg/L)	PRG (ug/l)
PCE	5	5
TCE	5	5
1,1-DCE	7	7
cis-1,2-DCE	70	70
trans-1,2-DCE	100	100
VC	2	2
1,1,2-Trichloroethane	5	5

http://www.epa.gov/safewater/consumer/pdf/mcl.pdf.

SUMMARY OF REMEDIAL ALTERNATIVES

Section 121(b)(1) of CERCLA, 42 U.S.C. § 9621(b)(1), mandates that remedial actions must be protective of human health and the environment, cost-effective, comply with ARARs, and utilize permanent solutions, alternative treatment technologies and resource recovery alternatives to the maximum extent practicable. Section 121(b)(1) of CERCLA also establishes a preference for remedial actions that employ, as a principal element, treatment to reduce permanently and significantly the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants at a site. Section 121(d) of CERCLA, 42 U.S.C. § 9621(d), further specifies that a remedial action must attain a level or standard of control of the hazardous substances, pollutants, and contaminants that at least attains

ARARs under federal and territory laws, unless a waiver can be justified pursuant to Section 121(d)(4) of CERCLA, 42 U.S.C. § 9621(d)(4).

The objective of the focused FS was to identify and evaluate remedial action alternatives for addressing the contamination associated with the source areas and to meet the RAOs. A total of four alternatives were developed in the FS. Alternative 2 also includes four enhancement options. Detailed descriptions of the remedial alternatives are provided in the FS Report, dated March 2018. Expansions to the existing remedy as well as new remedial alternatives were assessed in the FS.

Common Elements

All of the alternatives, with the exception of the no action alternative, include common components.

Matrix diffusion modeling was performed to simulate the fate and transport of PCE in fractured bedrock where matrix diffusion plays a role in attenuating the contaminant's life in the system after the source has been removed. Results of the matrix diffusion modeling indicate concentrations at the property boundary are predicted to drop below the MCL within an estimated range of 17 - 25 years after complete source removal.

Alternatives 2 through 4 include long-term monitoring to ensure that groundwater quality improves following implementation of these alternatives until such time as clean up levels are achieved.

Assumptions were made in the FS for areas that were not fully investigated during the FSRI, specifically, beneath the northern portion of the Curriculum Center building. Alternatives 2 through 4 will include a pre-design investigations (PDI) to verify FS assumptions, to address data gaps and to obtain design parameters for the completion of an RD at the Curriculum Center source areas. The timeframes for remediation presented below include the time for PDIs, remedial design, contract procurements and the actual time required to construct and implement the action.

Alternatives 2 through 4 also include ICs that will rely on groundwater use restrictions in the form of local well use laws until RAOs are achieved to ensure the remedy remains protective. Specifically, Title 12, Chapter 5, Virgin Islands Code, regulates installation of any well other than a public water supply well in the Virgin Islands. ICs will include vapor intrusion restrictions for any new construction at the Site.

A site management plan (SMP) would be developed to provide for the proper O&M of the site remedy post-construction, and it would include long-term groundwater monitoring, institutional controls, and periodic reviews until clean up levels are achieved.

Additionally, because it will take longer than five years to achieve cleanup levels under all of the alternatives, CERCLA requires that a review of conditions at the site be conducted no less often than once every five years until such time as cleanup levels are achieved. Alternatives 2 through 4 will be subject to these five year reviews, as required by CERCLA 121(c) and the NCP [40 C.F.F.§300.430(f)(4)(ii)].

Alternative 1: No Action

The NCP requires that a "No Action" alternative be developed and considered as a baseline for comparing other remedial alternatives. Under this alternative, no additional action would be implemented beyond the remedy selected in the 1996 ROD. Existing ICs that were required under the 1996 ROD would remain in place.

Capital Cost:	$0
O&M Costs:	$0
Present-Worth Cost:	$0
Time frame:	Not Applicable

Alternative 2: Expand and Optimize Existing Groundwater Extraction and Ex-Situ Treatment (Pump and Treat)

Capital Cost:	$4,616,924
Annual O&M Costs:	$7,600,039
Present-Worth Cost:	$12,273,313
Time frame:	*30* years

This remedial alternative consists of expanding the current groundwater treatment system with the addition of new extraction wells downgradient from the Curriculum Center. The addition of downgradient wells will allow for more flexibility in containing the plume as it moves away from the source area. Alternative 2 also includes upgrading the current system capacity, and adding alternate pumping and dual-phase extraction (DPE)/enhanced fluid recovery (EFR) from existing monitoring wells with high contaminant concentrations.

For the conceptual design, it is estimated that two additional extraction wells would be installed downgradient from the existing recovery wells to a target depth of 140 feet bgs It is estimated that the existing treatment system capacity will be upgraded from 60 to 100 gpm and will operate in "flow control" mode rather than at the current "constant head" configuration and all existing treatment equipment will be replaced with newer, more efficient equipment to accommodate the additional flow. The above ground conveyance system within the facility from each of the existing extraction wells will be upgraded on an as needed basis to accommodate the higher capacity. The current 1,000 gallon equalization tank will be replaced with a similar capacity tank that is designed for flow equalization in addition to DNAPL recovery. The DNAPL that is collected at the bottom of the recovery tank will be removed and disposed at a licensed waste disposal facility. Extracted groundwater will be treated with air stripping and discharged via the existing outfall to Turpentine Run.

Alternative 2 will include alternate pumping from existing monitoring wells with high contaminant concentrations. It is assumed that the source area wells will include wells identified as OU2-MW3, RD-9, OU2-MW6, OU2-MW2, IW-1, IW-2, and OU2-MD1. The well selection will be made during the RD phase. It is assumed that a small pump connected to a flexible HDPE line will be placed inside each of these monitoring wells, and groundwater will be pumped into the DNAPL recovery tank, treated through the existing treatment system as described above, and then discharged at the existing outfall. It was assumed that this will be done in sequence at each well for a total estimated duration of one week per event.

Alternative 2 will also include DPE/EFR from existing monitoring wells where high contaminant concentrations are present. The DPE/EFR is a portable system that will extract groundwater from designated monitoring wells that are present in source areas at the Curriculum Center property. A pilot study will be conducted to obtain design parameters for the DPE/EFR. The well head of each extraction point/monitoring well will be sealed, and a DPE/EFR mobile system will be used to apply a high vacuum to each well in order to remove contaminated groundwater/DNAPL from source areas. The recovered contaminated groundwater will be treated through the existing pump and treat system and then discharged at the outfall. The DNAPL that is collected at the bottom of the recovery tank will be removed and disposed at a licensed waste disposal facility. At a minimum, the DPE/EFR system will include a vacuum blower, knockout tank, air filters and silencers, flow meters, transfer pump and a control panel. It is assumed that DPE/EFR events will be twice a year at each well, for a period of five years. The frequency of the events will be refined during the RD.

Based on calculations, it is estimated that clean up time for the Curriculum Center source areas using groundwater pump and treat will be in excess of 30 years. For cost-estimating and planning purposes, an estimated remediation time frame of 30 years is used for developing costs associated with O&M activities. It is assumed that active remediation would be employed in the targeted treatment areas until the MCL for each of the COCs is attained within the targeted treatment area. Natural processes would be relied upon to achieve the MCLs for areas outside the capture zone and not targeted for active remediation. The success of the remedy in meeting the RAOs will be evaluated through the above-mentioned statutorily required 5-Year reviews.

The conceptual design would be refined during the remedial design phase if this alternative is selected.

Alternative Enhancement 2A: Reinjection

Capital Cost:	$425,260
Annual O&M Costs:	$51,364 plus Alt 2
Present-Worth Cost:	$476,624
Time frame:	*30* years

This enhancement for Alternative 2, the cost of which would be in addition to Alternative 2, includes enhancing the existing pump and treat system as described in Alternative 2 with reinjection of the treated groundwater downgradient from the Curriculum Center in an effort to act as a hydraulic barrier to further, off property migration of the contamination.

For the conceptual design, it is estimated that two injection wells would be installed downgradient from the existing and proposed extraction wells and along major fracture/weathered zone trends identified during the FSRI.

For cost-estimating and planning purposes, an estimated remediation time frame of 30 years is used for developing costs associated with O&M activities. Alternative Enhancement 2A, using reinjection, will not reduce the remedial timeframe; however, reinjection of groundwater downgradient will help maintain water balance.

Alternative Enhancement 2B: Air Sparging/Soil Vapor Extraction

Capital Cost:	$1,710,790
Annual O&M Costs:	$169,501 plus Alt 2
Present-Worth Cost:	$1,880,291
Time frame:	*30* years

This enhancement for Alternative 2 consists of enhancing the existing pump and treat system as described earlier in Alternative 2 with air sparging/soil vapor extraction (AS/SVE) in source areas, including the area beneath the northern portion of the building, in order to help mobilize residual DNAPL within the zone influenced by air sparging and thereby reducing the remedial timeframe of the groundwater extraction and treatment system.

For the conceptual design, it is estimated that 25 SVE wells and 30 AS wells would be installed at the Curriculum Center property. It is estimated that each SVE well will be installed to a depth of approximately 15 feet bgs, and each AS well will be installed to a depth of approximately 140 feet bgs. For cost estimating purposes, granular activated carbon and potassium permanganate is assumed as the vapor phase treatment option for the enhancement to the treatment system.

For both cost-estimating and planning purposes, an initial five years of AS/SVE is proposed. Based on calculations, it is estimated that the clean up time for the Curriculum Center source, areas after complete removal of source concentrations, will be within about 25 years. It is therefore assumed that the remedial system will be active for a period of 30 years.

Alternative Enhancement 2C: In-Situ Chemical Oxidation

Capital Cost:	$93,920
Annual O&M Costs:	$98,620 plus Alt 2
Present-Worth Cost:	$192,540
Time frame:	*30* years

This enhancement for Alternative 2 consists of enhancing the existing pump and treat system as described earlier in Alternative 2 with in-situ chemical oxidation (ISCO) treatment at the potential source areas as an enhancement. This process involves introducing strong oxidizing agents through existing monitoring wells within the potential source areas via slow-release cylinders or a comparable delivery method. Operating the pump and treat system could potentially enhance the distribution of oxidants across the source zone and maintain hydraulic control of the dissolved-phase plume emanating from the source areas.

For the conceptual design, it is estimated that 64 cylinders will be deployed in a total of 12 monitoring wells in the potential source areas. It is estimated that the cylinders will be removed and replaced on a yearly basis.

For cost estimating purposes, an initial five years of ISCO treatment is proposed before evaluating if further source area treatment is necessary. Based on calculations, it is estimated that the clean up time for the Curriculum Center source areas, after complete removal of source concentrations, will be within about 25 years. For cost estimating purposes, it is assumed that the remedial system will be active for a period of 30 years in order to capture contaminated groundwater beyond the active treatment source areas.

Alternative Enhancement 2D: Surfactant Flushing

Capital Cost:	$1,222,799
Annual O&M Costs:	Same as Alt 2
Present-Worth Cost:	$1,222,799
Time frame:	*26* years

This enhancement for Alternative 2 consists of enhancing the existing pump and treat system as described earlier in Alternative 2 with in-situ flushing of fractures with surfactants at the potential source areas as an enhancement.

For the conceptual design, it is estimated that two deep injection wells and five shallow injection wells will be installed in the potential source areas. Extraction wells are required to maintain hydraulic control, bring emulsified/dissolved DNAPL to the surface for treatment and to clear the aquifer of surfactant solution.

As a result of challenges associated with surfactant flushing in a bedrock aquifer, it is assumed that surfactant flushing will be performed in source areas for one year. For cost estimating purposes, two rounds of injections are assumed. Based on calculations, it is estimated that clean up time for the Curriculum Center source areas, after complete removal of source concentrations, will be within about 25 years. For cost estimating purposes, it is assumed that the remedial system will be active for a period of 26 years in order to capture contaminated groundwater beyond the active treatment source areas.

Alternative 3: In-Situ Thermal Treatment and Pump and Treat

Capital Cost:	$79,015,003
Annual O&M Costs:	$4,094,323
Present-Worth Cost:	$83,221,216
Time frame:	*12* years

This remedial alternative includes in-situ thermal treatment (ISTT) to target DNAPL in potential source areas with downgradient pump and treat for hydraulic control.

The ISTT proposed for the Curriculum Center property consists of in-situ bedrock heating as a means to provide significant mass reduction (>99%) of CVOCs and DNAPL in groundwater within the fractured bedrock of the potential source areas with a time frame of approximately two years. Heat causes the underground contaminants, DNAPL and water to boil, creating in-situ steam and vapor. Contaminated vapor and steam are extracted using vacuum recovery wells and treated above ground. The heater wells will be co-located with the recovery wells. Each recovery well is connected to the conveyance pipe that routes the steam and vapors to the condenser. All conveyance piping and cable will be above grade.

For the conceptual design, it is estimated that 260 to 270 heater wells, co-located with 260 to 270 vacuum extraction points, would be used to treat groundwater within the area beneath the northern portion of the Curriculum Center building and the potential source areas. It is assumed that each heater well boring will be installed from 1 to 140 feet bgs within the bedrock. The average distance between heater wells will be approximately 17 feet. It is estimated that 15 temperature monitoring points will be installed to monitor the subsurface temperature data continuously.

Alternative 3 includes the addition of two new extraction wells downgradient of the Curriculum Center to provide hydraulic control during in-situ thermal treatment at the source areas. Alternative 3 also includes upgrading the current treatment system to a capacity of 100 gpm. It is estimated that operating the treatment system at a total flow rate of 100 gpm will establish hydraulic control and capture the deep bedrock groundwater in the vicinity of the Curriculum Center source areas. This hydraulic containment will limit or prevent the downgradient migration of contaminants from the Curriculum Center property.

All existing treatment equipment will be replaced with newer, more efficient equipment to accommodate the additional flow as described in detail in Alternative 2, above.

It is anticipated that the duration of operating the active thermal treatment system will be on the order of two years. During this time, the pump and treat system will remain operational in order to maintain hydraulic control of the downgradient dissolved plume. It is estimated that contamination outside of the thermal treatment area will take 10 years to reach the perimeter pump and treat system. For cost estimating purposes, it is assumed that the enhanced groundwater treatment system will be active for a period of 12 years in order to capture contaminated groundwater beyond the active treatment source areas.

The conceptual design would require further evaluation during the remedial design phase if this alternative is selected.

Alternative 4: In-Situ Steam Injection and Pump and Treat

Capital Cost:	$23,541,419
Annual O&M Costs:	$7,169,229
Present-Worth Cost:	$30,773,828
Time frame:	*27* years

This remedial alternative consists of steam injection at the potential source areas to mobilize the DNAPL in bedrock fractures and to cause destruction of contaminants in potential source areas. Mobilized DNAPL will be captured by the pump and treat system at the Curriculum Center property.

Under the conceptual design, 60 steam injection wells and 30 multi-phase extraction wells would be installed across the source area. This configuration is intended to facilitate outward, horizontal advancement of the steam front from the steam injection wells toward the dual-phased extraction wells. The injection wells would be screened across the low-productive zone of the aquifer (approximately 80 to 140 feet bgs). The pressure of steam injection would also mobilize and transport contaminants vertically based upon the higher permeability of the overlying shallow zone and the enhanced upward gradient imposed on the aquifer by shallow-zone remedial pumping associated with the pump and treat system. It is estimated that 10 temperature monitoring points would be installed to monitor the subsurface temperature data continuously.

Alternative 4 includes the addition of two new extraction wells downgradient from the Curriculum Center to provide hydraulic control to maintain hydraulic control during steam injections at the source areas. Alternative 4 also includes upgrading the current system to a capacity of 100 gpm. It is estimated that operating the system at a total flow rate of 100 gpm will establish hydraulic control and capture the deep bedrock groundwater at the Curriculum Center source areas. This hydraulic containment will limit or prevent the downgradient migration of contaminants from the Curriculum Center property.

All existing treatment equipment will be replaced with newer, more efficient equipment to accommodate the additional flow as described in detail in Alternative 2, above.

It is anticipated that the duration of operating the steam injection system will be on the order of two years. During this time, the pump and treat system will remain operational in order to maintain hydraulic control of the downgradient dissolved plume. Based on calculations, it is estimated that clean up time in the Curriculum Center area after complete removal of source area concentrations will be within about 25 years. For cost estimating purposes, it is assumed that the enhanced groundwater treatment system will be active for a period of 27 years in order to capture contaminated groundwater beyond the active treatment source areas.

EVALUATION OF ALTERNATIVES

In evaluating the remedial alternatives, each alternative is assessed against the nine evaluation criteria set forth in the NCP, namely overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; cost; and State and community acceptance. Refer to the text box for a more detailed description of these evaluation criteria.

This section of the Proposed Plan evaluates the relative performance of each alternative against the nine criteria, noting how each compares to the other options under consideration. A detailed analysis of alternatives can be found in EPA's FS Report supporting this decision, dated March 2018.

Overall Protection of Human Health and the Environment

Alternative 1 (No Action) would not meet the RAOs and would not be protective of human health and the environment since no action would be taken. Alternatives 2 through 4 are the active remedies that address groundwater contamination, minimize the migration of contaminated groundwater, and would restore groundwater quality over the long-term.

Under Alternative 2, the pump and treat system will capture and treat the contaminants at and downgradient from the potential source areas. Expanding the pump and treat system by installing additional extraction wells downgradient from the Curriculum Center will prevent groundwater from migrating further downgradient and reduce the contaminant concentrations in the area.

Alternatives 3 and 4 will prevent impact to groundwater because these alternatives will remove the DNAPL and dissolved CVOC contamination from the bedrock aquifer and will prevent further downward migration of CVOC contamination to groundwater by operating newly installed downgradient extraction wells.

Until RAOs are met, protectiveness under Alternatives 2 through 4 requires a combination of actively reducing contaminant concentrations in groundwater and limiting exposure to residual contaminants through existing ICs for groundwater use. ICs are anticipated to include existing governmental controls in the form of DPNR well use regulations.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

EPA has promulgated MCLs (40 CFR Part 141), which are enforceable standards for various drinking water contaminants (and are chemical-specific ARARs). The USVI does not have drinking water source-based quality standards for organics in groundwater, as drinking water is taken from rainwater cisterns or from pumped water supply using desalinated seawater. In the absence of any USVI regulations for CVOCs in groundwater, compliance with the federal standard is required.

Alternative 1 would not comply with ARARs. Action-specific ARARs do not apply to this alternative since no remedial action would be conducted under the no action alternative.

Alternative 2 would achieve chemical-specific ARARs through extraction and *ex-situ* treatment of contaminated groundwater. Alternative 3 could achieve chemical-specific ARARs through *in-situ* thermal treatment. Alternative 4 would achieve chemical-specific ARARs through *in-situ* steam injections; however, Alternative 4's long-term effectiveness would need to be verified in the field because it relies on its ability to contact, heat, and physically displace contaminants.

For Alternatives 2 to 4, action-specific ARARs would be met through compliance with local construction codes, health and safety requirements, off-gas treatment requirements, if applicable, and water discharge criteria when applicable. There are no location-specific ARARs associated with the site.

It is estimated that the RAOs would be achieved in 30 years with Alternative 2, 12 years with Alternative 3, and 27 years with Alternative 4. Active remediation under Alternatives 2 through 4 would be employed in the targeted treatment areas until the MCL for each of the COCs is attained within the targeted treatment area.

Long-Term Effectiveness and Permanence

Alternative 1 would not provide long-term effectiveness and permanence since groundwater contamination would not be addressed. Alternatives 2 through 4 are considered effective technologies for treatment and/or containment of contaminated groundwater, if designed and constructed properly.

EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES

Overall Protectiveness of Human Health and the Environment evaluates whether and how an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that pertain to the Site, or whether a waiver is justified.

Long-term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.

Reduction of Toxicity, Mobility, or Volume (TMV) of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.

Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, the community, and the environment during implementation.

Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.

Cost includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

State/Support Agency Acceptance considers whether the State agrees with EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.

Community Acceptance considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

Alternatives 2 through 4 would provide long-term effectiveness and permanence by using in-situ treatment processes to reduce the contaminant mass in the treatment area. Alternatives 2 through 4 would also provide hydraulic control to prevent off-property migration of the contaminated plume at the Curriculum Center property.

Alternative 2's approach has been proven to be an effective technology in reducing the concentrations of VOC contaminated groundwater. Extraction and treatment of contaminated groundwater will limit downgradient migration of the contaminants and reduce groundwater contamination. Alternative 2 on its own might be ineffective at removing DNAPL from the low-yielding fractured bedrock. Enhancements associated with Alternative 2 will likely be effective in reducing source area concentrations and mobilizing the DNAPL if implemented in conjunction with the pump and treat system.

Among Alternatives 2 through 4, Alternative 3 using *in-situ* thermal treatment would provide the highest mass reduction of groundwater contamination at the potential source areas in the shortest period of time, followed by Alternative 4 using steam injections.

Alternative 4, *in-situ* steam injections, has the potential to significantly reduce contaminant concentrations in the treatment zones but has only limited application in the field for bedrock. Properly designing the injection and the recovery system will be critical to the success of this alternative and to ensure that the system does not drive the contamination deeper into the subsurface.

Alternatives 2 through 4 would control risk to human health through the implementation of ICs until clean up levels are achieved.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 1, no action, does not address the contamination through treatment, so there would be no reduction in toxicity, mobility, or volume of the contaminants, and the alternative does not include long-term monitoring of groundwater conditions.

Alternatives 2, 3, and 4 would provide reduction of toxicity, mobility, and volume through treatment and removal of contaminants. Alternative 3, using *in-situ* thermal remediation, would be the most effective in reducing toxicity and volume of contamination in groundwater through treatment, followed by Alternative 4 using in-situ steam injections, and finally Alternative 2 using pump and treat system.

Short-Term Impact and Effectiveness

Alternative 1 would not have short-term impacts since no action would be implemented.

There would be significant short-term impacts to the local community and workers for Alternatives 2 through 4 as a result of the active remedial actions undertaken and associated with construction, operation and/or treatment activities. Efforts could be made to minimize noise and impact from construction activities related to the operations of the Curriculum Center, if applicable. Currently, the building is closed because of damage from the 2017 hurricanes. The future of the building and previous operations is unknown.

Coordination and access would be required from DPNR and VIDE for staging or remedial action purposes. Noise and community air monitoring plans would be developed during the design and discussed with owners and local authorities. Engineering controls and appropriate personnel protective equipment would be used to protect the community and workers for Alternatives 2 through 4.

It is estimated that construction for each of the Alternatives 2 to 4 will be over a period of 1 year.

Implementability

Alternative 1, no action, would be the easiest of all the alternatives to implement. Alternatives 2 through 4 are all implementable, although each present different challenges.

Services, materials and experienced vendors are readily available in the continental USA. Shipping equipment to the USVI from the United States would be required for a majority of the equipment needed for Alternatives 2 – 4 because local supplies of these materials are scarce. Pilot studies could be implemented to obtain site-specific design parameters for Alternatives 2 through 4. A permit equivalent would be developed for in-situ treatment technologies into the subsurface and/or to discharge treated vapor to the atmosphere under Alternatives 2 through 4.

The success rate of Alternatives 2 through 4 depends on site-specific conditions. Based on the conditions at this site, with high levels of contamination and DNAPL in bedrock fractures, Alternative 3, using in-situ thermal remediation, will have the highest success rate followed by Alternative 4, using in-situ steam injections, and then Alternative 2, using an expanded pump and treat system (Alternatives 3 and 4 also employ the expanded pump and treat system).

Of the three active remediation alternatives, Alternative 2 would be the easiest alternative to construct since this technology has been implemented under the 1996 ROD as part of the site-wide remedy, and it would result in less disruption to the existing, operating system.

Alternative 4 would be the most difficult to implement because delivery of steam to the source material through small aperture fractures can be problematic. Properly designing the injection and the recovery system in Alternative 4 will be critical to ensure that the system does not drive the contamination deeper into the subsurface. Alternative 3 may require an alternative power source because existing sources are insufficient in part because of the demand of the community, particularly when considering damage caused by the 2017 hurricanes. The construction activities for Alternative 3 would also result in the greatest disruption since this alternative requires installation of a significant number of wells when compared with the two new extraction wells and two injection wells in Alternative 2.

Alternatives 2 through 4 would require routine groundwater quality, performance and administrative monitoring including five-year CERCLA reviews.

Cost

The estimated capital cost, O&M, and present worth cost are discussed in detail in the March 2018 FS Report. For cost estimating and planning purposes, a 30-year time frame was used for O&M and long term monitoring under Alternative 2, 12-years for Alternative 3, and 27-years for Alternative 4. Based on calculations, for the enhancement Alternatives 2A through 2C, a 30-year timeframe was assumed and a 26-year timeframe was used for Alternative 2D. The cost estimates are based on the available information. Alternative 1 (No Action) has no cost because no activities would be implemented. The highest present value cost is Alternative 3 at $83.22 million. Of the three alternatives with active remedial components, Alternative 2 is the least expensive at $12.27 million.

The estimated capital, O&M, and present-value costs for each of the alternatives are as follows:

Alternative	**Capital Cost ($)**	**Annual O&M Cost ($)**	**Present Value Cost ($)**
1 No Action	0	0	0
2 Pump & Treat	4,616,924	7,600,039	12,273,313
2A Reinjection	425,260	51,364	476,624
2B AS/SVE	1,710,790	169,501	1,880,291
2C ISCO	93,920	98,620	192,540
2D Surfactant Flushing	1,222,799	Same as Alt 2	1,222,799
3 *In-situ* Thermal and Pump & Treat	79,015,003	4,094,323	83,221,216
4 *In-situ* Steam and Pump & Treat	23,541,419	7,169,229	30,773,828

State/Support Agency Acceptance

DPNR is reviewing the preferred alternative.

Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and all comments are reviewed. Comments received during the public comment period will be addressed in a responsiveness summary section of the OU2 ROD. The ROD is the document that will formalize the selection of the remedy for the site.

PREFERRED ALTERNATIVE

Based upon an evaluation of the remedial alternatives, EPA proposes Alternative 2, Expand Existing Groundwater Extraction and Ex-Situ Treatment (Pump and Treat) with Alternative 2A, Reinjection, as the preferred remedial alternative for the Curriculum Center source areas. Combined Alternatives 2 and 2A have the following key components:

- Expansion of the existing pump and treat system to include two downgradient extraction wells;
- Upgrade pump and treat system to higher flow rate;
- Upgrade all treatment equipment to accommodate additional flow and improve efficiency;
- Reinjection of treated water;
- Alternate pumping from existing monitoring wells with high contaminant concentrations;
- Dual phase extraction from source area wells; and
- Long-term groundwater monitoring.

A contingency remedy to Alternative 2A, Reinjection will be Alternative 2B, Expand Existing Groundwater Extraction and Treatment System with AS/SVE.

The “principal threat” concept is applied to the characterization of “source materials” at a Superfund site. DNAPL in groundwater maybe viewed as source material. Principal threat waste will be addressed by designing active remediation elements to achieve the clean up levels by establishing containment, decreasing DNAPL mass in the bedrock aquifer, and restoring groundwater. The enhanced extraction and treatment system would operate until remediation goals are attained. Natural processes would be relied upon to achieve the MCLs for areas not targeted for active remediation. Figure 3 provides the conceptual locations of the new extraction and injection wells and the existing treatment plant. The exact number and placement of extraction wells and injection wells would be determined during the remedial design.

The effectiveness of the preferred alternative would be evaluated based upon the attainment of specific performance standards and cleanup goals during the 5 year reviews (e.g., reduction in CVOC concentrations, hydraulic control, etc.). Should the preferred alternative fail to attain these standards and goals (e.g., there is persistence of high CVOC concentrations) or should its implementation prove ineffective (e.g., ineffective hydraulic control due to the inability of the bedrock aquifer to accept the re-injected water and thereby create a hydraulic mound to support the hydraulic capture of the contaminant plume), Alternative 2B, "Expand Existing Groundwater Extraction and Treatment System with AS/SVE", would be evaluated as a contingency remedy. Should Alternative 2 with alternative 2B enhancement prove to be ineffective, the need for a technical impracticability waiver could be evaluated. The ineffectiveness of Alternative 2 with Alternative 2B enhancement would imply the presence of DNAPL in the bedrock fractures beneath the Curriculum Center building that was not accessible during the remedial investigation. DNAPL presence in the aquifer beneath the Curriculum Center could have major impacts on the remediation approach and extend remediation timeframes warranting technical impracticability evaluations**.**

A long-term groundwater monitoring program would be implemented to track and monitor changes in the groundwater contamination to ensure the RAOs are attained. The results from the long-term monitoring program would be used to evaluate the migration and changes in VOC contaminants over time.

Existing ICs will ensure that the remedy remains protective until RAOs are achieved for protection of human health over the long term. Institutional controls for groundwater use would consist of DPNR well use laws and for new construction vapor intrusion prevention.

A SMP would also be developed and would provide for the proper management of the site remedy post-construction, and it would include long-term groundwater monitoring, institutional controls, and periodic reviews until such time as clean up levels are attained.

The total, estimated, present-worth cost for the selected remedy is $12,749,937. Further detail of the cost is presented in Appendix A of the FS Report. This is an engineering cost estimate that is expected to be within the range of plus 50 percent to minus 30 percent of the actual project cost.

While this alternative would ultimately result in reduction of contaminant levels in groundwater such that levels would allow for unlimited use and unrestricted exposure, it is anticipated that it would take longer than 30 years to achieve these levels. As a result, in accordance with Section 121(c) of CERCLA, the performance of the remedy in meeting the RAOs will be reviewed at least once every five years until remediation goals are achieved.

Alternative 2, extraction and treatment, is a proven technology which has demonstrated effectiveness at reducing contaminant mass and providing containment to achieve cleanup standards for VOC-contaminated groundwater. While Alternative 3, *in-situ* thermal treatment, and Alternative 4, *in-situ* steam injections are both proven technologies to actively remediate VOC-contaminated groundwater, the uncertainty associated with the location and quantity of DNAPL in the source area and beneath the Curriculum Center, coupled with the complexity of the fractured bedrock aquifer, increase the design challenges with these treatment technologies.

Based upon the information currently available, EPA believes that the preferred alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing criteria. EPA expects the preferred alternative to satisfy the following statutory requirements of Section 121(b) of CERCLA: 1) the proposed remedy is protective of human health and the environment; 2) it complies with ARARs; 3) it is cost effective; 4) it utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and 5) it satisfies the preference for treatment. Long-term monitoring would be performed to assure the protectiveness of the remedy. With respect to the two modifying criteria of the nine criteria, territory acceptance and community acceptance, DPNR and community acceptance will be evaluated upon the close of the public comment period.

FOR FURTHER INFORMATION

The Administrative Record file, which contains copies of the Proposed Plan and supporting documentation are available at the following information repositories:

U.S. Environmental Protection Agency
Virgin Islands Field Office
Tunick Building, Suite 102
1336 Beltjen Road
St. Thomas, VI 00801
(340) 714-2333
Hours of operation:
Mon-Fri 9:00 am – 4:30 pm

USEPA – Region II
Superfund Records Center
290 Broadway, 18th Floor
New York, New York 10007-1866
(212) 637-4325
Hours: Monday – Friday: 9:00 am to 4:30 pm

In addition, the Administrative Record file is available on-line at:

https://www.epa.gov/superfund/tutu-wellfield

United States Environmental Protection Agency

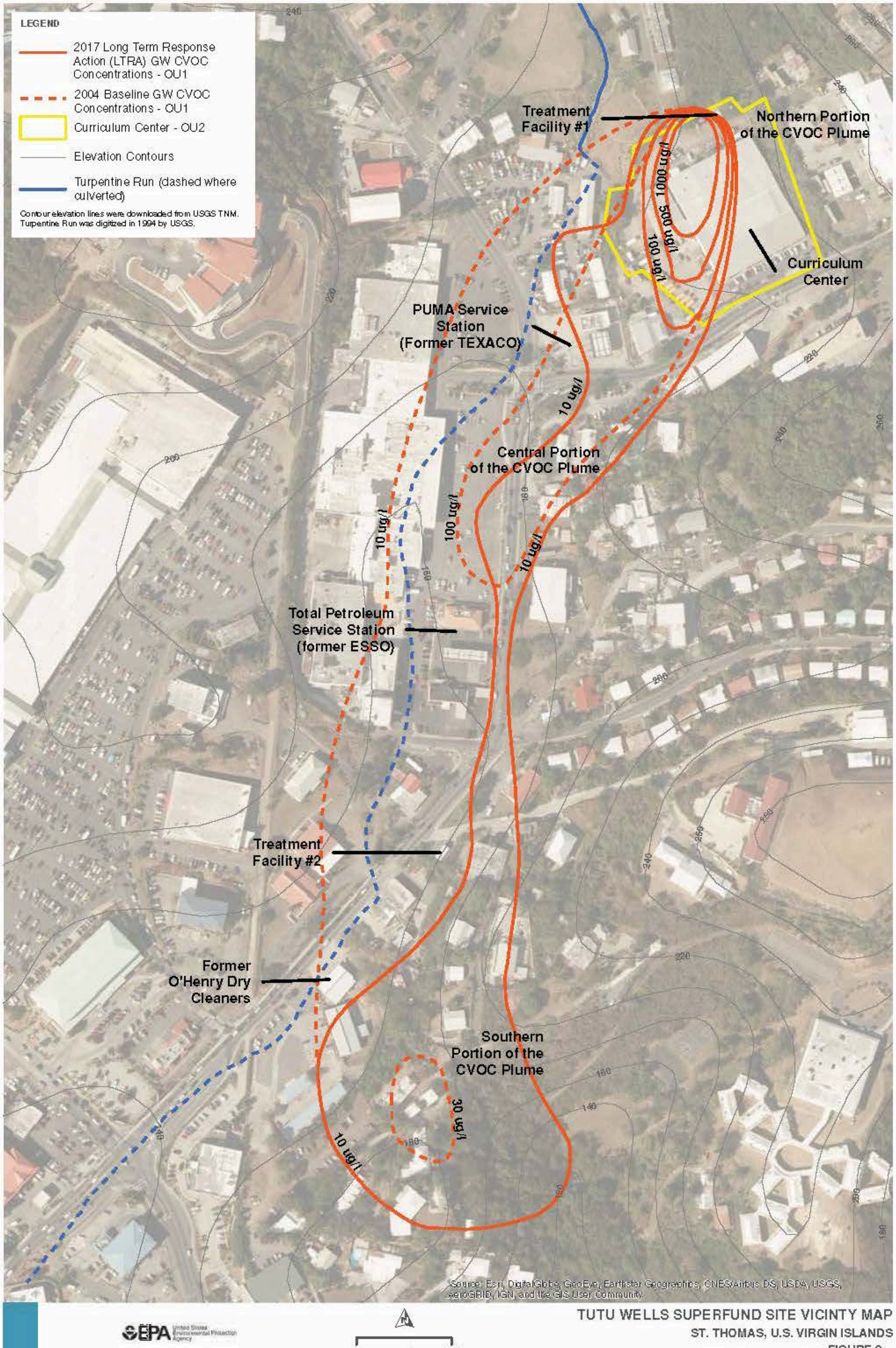
SITE LOCATION MAP

ST. THOMAS, U.S. VIRGIN ISLANDS

FIGURE 1

TUTU WELLS SUPERFUND SITE FOCUSED SOURCE RI/FS OU2

PATH: ... USER: CWEAVER - DATE: 10/12/2017



TUTU WELLS SUPERFUND SITE VICINTY MAP

ST. THOMAS, U.S. VIRGIN ISLANDS

FIGURE 2

EPA United States Environmental Protection Agency

ALTERNATIVE 2A - EXPANSION OF PUMP AND TREAT SYSTEM AND REINJECTION

TUTU OU2, ST. THOMAS, U.S. VIRGIN ISLANDS

FIGURE 3

ATTACHMENT B

PUBLIC NOTICES:

Commencement of Public Comment Period

Legal Notice Public Notices

EPA Notice of Proposed Cleanup Plan

Lara Halliday July 14, 2021

EPA United States Environmental Protection Agency

EPA Invites Public Comment on a Proposed Cleanup Plan
for Tutu Wellfield Superfund Site in East-Central St. Thomas, U.S. Virgin Islands

The U.S. Environmental Protection Agency (EPA) re-issued a Proposed Plan for the Tutu Wellfield Superfund site in St. Thomas, U.S. Virgin Island, with support from the U.S. Virgin Island's Department of Planning and Natural Resources. The preferred cleanup plan consists of: expanding and enhancing the existing pump and treatment system to restore the groundwater so that concentrations of site-related contaminants are below the standards set for drinking water, preventing migration of groundwater contamination from the source areas, and protecting human health by preventing exposure to contaminated groundwater.

A 30-day public comment period on the Proposed Plan, which identifies EPA's preferred cleanup plan among other cleanup options, begins on July 14, 2021 and ends on August 13, 2021. EPA will release a pre-recorded presentation about the preferred cleanup plan and other options considered on July 14 at 12:00 p.m. Atlantic Standard Time. To receive an email as soon as the recording is available to the public, please contact Donette Samuel, EPA's Community Involvement Coordinator, by email at samuel.donette@epa.gov or phone at (212) 637-3570. You may also access the Proposed Plan and recording by visiting EPA's website at https://www.epa.gov/superfund/tutu-wellfield.

Written comments on the Proposed Plan must be sent to Caroline Kwan, EPA's Remedial Project Manager, postmarked no later than August 13, 2021. Caroline Kwan, EPA Region 2 Office, 290 Broadway, 18th floor, New York, New York 10007. Electronic comments must be emailed to kwan.caroline@epa.gov.

The Administrative Record file containing the documents used or relied on in developing the alternatives and preferred cleanup plan is permanently stored at the following information repositories and can be accessed online at the above EPA website.

EPA Virgin Islands Field Office Tunick Building 1336 Beltjen Road, Suite 102 St. Thomas, Virgin Islands 00901	EPA Region 2 Superfund Records Center 290 Broadway, 18th Floor New York, New York 10007

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UPCOMING EVENTS

AUG 13 10:00 am **Senate: Homeland Security, Justice, Public Safety**

AUG 13 3:00 pm **V.I. Board of Education to Meet**

AUG 14 10:00 am **Legal Services VI Board to Meet**

AUG 18 2:00 pm **Career & Technical Education Board to Meet**

AUG 25 10:00 am **Zoom Panel on Climate Change/Health**

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EPA Notice of Proposed Cleanup Plan

Lara Halliday July 14, 2021

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AUG 13 10:00 am Senate: Homeland Security, Justice, Public Safety

AUG 13 3:00 pm V.I. Board of Education to Meet

AUG 14 9:00 am - 1:00 pm Humane Society: Free Pet Food Event

AUG 14 10:00 am Legal Services VI Board to Meet

AUG 15 11:00 am - 2:00 pm Humane Society: Free Pet Food Event

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Charlotte Amalie
83 °

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VI JOB OPPORTUNITIES

EPA Invites Public Comment on Proposed Plan for Cleanup of the Tutu Wellfield Superfund Site St. Thomas, U.S. Virgin Islands

The U.S. Environmental Protection Agency has issued a Proposed Plan for the Tutu Wellfield Superfund Site in St. Thomas, U.S. Virgin Islands. A 30-day public comment period on the Proposed Plan, which identifies the EPA's preferred cleanup plan and other cleanup options that were considered by the EPA, begins on August 8 and ends on September 7, 2018.

The EPA's preferred cleanup plan consists of: expanding and enhancing the pump and treat system in order to restore the groundwater so that concentrations of site-related contaminants are below the standards set for drinking water, prevent migration of groundwater contamination from the source areas, and protect human health by preventing exposure to contaminated groundwater.

During the public comment period, the EPA will hold a public meeting in St. Thomas, U.S.V.I. to receive comments on the preferred cleanup plan and other options that were considered. The meeting will be held on **Thursday, August 23,** 2018 at 7 PM at Grace Gospel Chapel - 148-320-321 & 322 Estate Anna's Retreat St. Thomas, VI 00802.

The Proposed Plan is available at www.epa.gov/superfund/tutu or by calling Cecilia Echols, EPA's Community Involvement Coordinator, at (212) 637-3678 and requesting a copy by mail.

Written comments on the Proposed Plan, postmarked no later than September 7, 2018, may be mailed to Caroline Kwan, EPA Project Manager, U.S. EPA, 290 Broadway, 20th Floor, New York, NY 10007-1866 or emailed no later than September 7, 2018 to kwan.caroline@epa.gov.

The Administrative Record file containing the documents used or relied on in developing the alternatives and preferred cleanup plan is available for public review at the following information repositories:

EPA Virgin Islands Field Office located at the Tunick Building, 1336 Beltjen Road, Suite 102, St. Thomas, V.I. 00801.

www.epa.gov/superfund/tutu

EPA Region 2 Superfund Records Center located at 290 Broadway, 18th Floor, New York, NY.10007.

ATTACHMENT C

July 14, 2021 PRE-RECORDED PUBLIC MEETING TRANSCRIPT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
PRE-RECORDED PRESENTATION

PROPOSED CLEANUP PLAN FOR
GROUNDWATER REMEDIATION AT THE
TUTU WELLFIELD SUPERFUND SITE
CURRICULUM CENTER

DATE OF RECORDING
JULY 14TH, 2021

PERSONS RECORDED:

Donette Samuel, Community Involvement Coordinator

Caroline Kwan, Remedial Project Manager

MS. SAMUEL: Hi, everyone. Thanks for joining us for the pre-recorded presentation for the Tutu Wellfield Superfund site. Today we'll be presenting the revisions made to the proposed cleanup plan for groundwater remediation at the curriculum center.

Just a disclaimer that this presentation -- the proposed plan and the alternatives we're presenting are the same as the 2018 alternatives as presented a few years ago, however we did make some changes and revisions to the cost-benefit analysis and so the prices will be a little bit different, and we also have a few more additions to the plan that we've made.

So you might see a lot of similarities, but also be aware of the little nuances, differences, that we will be presenting.

My name is Donette Samuel, and I'm the community involvement coordinator at the EPA, and also on this presentation we have Caroline Kwan, who is a remedial project manager.

So our objectives today are to share information about the conclusions for the focus source remedial investigation, risk assessment and feasibility study.

These are just some research and assessments we've been doing at the site in order to influence the proposed plan and the alternatives that might be best fitted for this

site.

We will present about revisions made to the 2018 proposed plan with updated cost-benefit analysis and will also share proposed plan for the cleanup of the contaminant source, which is at the curriculum center of the Tutu wellfield site.

After the presentation we do welcome and encourage you all to submit comments if you have any, and we'll be accepting comments until August 13.

So our agenda today, just very quickly, overview of superfund. We'll also be discussing site background, remedial investigation, risk assessment, feasibility study, preferred remedy, and then we'll just share some information about how you can present your questions or comments after the presentation.

Now we'll hand it over to Caroline so she can present about the overview.

MS. KWAN: Thank you, Donette. Hello. This is Caroline Kwan, the remedial project manager for the Tutu Superfund well site in the Virgin Islands, St. Thomas.

Superfund law. Superfund law was created by Congress in 1980 to take care of toxic waste disposal at disasters around the nation. It provides federal funding for cleanup of hazardous waste sites. It allows the EPA to respond to emergency involving discharge of hazardous

substance. It empowers the EPA to compel potential responsible party to pay for or conduct a site cleanup.

The superfund cleanup process. Let me describe the Superfund remedial cleanup process. We start with site assessment, discovery of contaminations at a site. EPA will conduct preliminary assessment and site inspection, gathering any available data and evaluate in a hazardous waste package. If the score is high enough, it would become a National Priority List -- an NPL listing.

The next step is characterization. EPA will conduct a remedial investigation, and the purpose of the remedial investigation is to find the extent of contamination at the site.

Using that information that is gathered from the remedial investigations, EPA will conduct a feasibility study, which evaluates the various cleanup alternatives to clean up the problem at the site.

Issue -- EPA will issue proposed plans to explain the remedial investigations and also the various cleanup options and proposed remedial alternatives. We are at this phase now at the Tutu well site.

At that -- after the 30-day public comment period from a proposed plan, EPA will issue a record of decision selecting the cleanup alternative to clean up the site.

After that, we will do the cleanup. EPA will

conduct a remedial design, designing the remedial action, and implement the remedial action.

Post-construction, operation and maintenance of this remedial action, and hopefully we will delete the hazardous waste site off the NPL listing.

Again, from cleanup to post-construction operation, we do conduct a five-year review to make sure that the remedy, the cleanup alternative, is still operationally functional, protective of human health and the environment.

Again, as you see this long arrow, community involvement and planning for site redevelopment are all integral parts of this entire process.

Site background. The location of the Tutu superfund site is at the northeast part of St. Thomas in the Anna's Retreat section.

Site history. 1969 the curriculum center property was owned by LAGA Industries, Ltd. (LAGA), a textile manufacturing company facility. 1970 to 1978 it was purchased by Duplan Corporation. It begun using a dry-clean operation using this chemical called tetra-chloroethene, PCE.

1979 to 1981 it was purchased by Panex. It was sold to the Virgin Islands Department of Education. From 1982 to 2017, multi-use of the building was used by the Virgin Islands Department of Education.

1982 to 1989, multiple investigations were conducted by the EPA and the potential responsible party. 1994 to 1995, remedial investigation -- RI -- identified a commingled plume with chlorinated volatile organic compounds -- CVOC's -- and that contained also petroleum and gasoline components within that plume.

1995, this site was listed on the National Priority List, NPL. The studies concluded that the CVOC plume with dichloroethene -- DCE -- tetrachloroethene -- PCE -- trichloroethene -- TCE -- and vinyl chloride originated at or near the curriculum center.

In 1996, a record of decision was issued for sitewide remediation. We selected two groundwater pumping treatment systems to restore the groundwater at the Tutu well site.

From 2004 to 2013, EPA constructed two pumping treatment systems, which include two groundwater treat systems -- groundwater systems to treat the CVOC plume.

The groundwater treatment facility was operated by EPA. It has since transferred to the USVI DPNR -- Department of Planning and Natural Resource -- to operate and maintain in 2013.

In April 2015, EPA created Operable Unit 2 to investigate potential additional contaminant source in source areas, particularly in the curriculum center.

(Inaudible) present to you the status of the

sitewide remediation (inaudible) Operable Unit 1. We have installed Treatment Number 1, as I point out here, behind the curriculum center to treat the contaminations.

These -- this is the plume, the (inaudible) plume that we have talked about, that I mentioned. We also installed a groundwater treatment plant, number 2, down here, just a little above the former O'Henry dry cleaner.

EPA also installed a soil vapor extraction unit at the -- behind the curriculum center to extract out the contaminated vapor from the ground from 2004 to 2006.

In the two years of operation, the vapor contamination was reduced significantly. Therefore, we turned off the soil vapor extraction system.

Unfortunately, insufficient reduction of groundwater contamination was still happening at the curriculum center up here. Therefore, EPA created an Operable Unit 2 source area of remedial investigations.

In these source remedial investigations that were conducted, this outlined figure, the study area, which is -- this is the curriculum center and this is behind the curriculum center -- we have a treatment center right here.

We installed a bunch of monitoring wells as defined in OU2. These are monitoring wells that were installed during Unit 2 in this box and also outside of the curriculum center at the perimeter, OU2 monitoring well 4, 5, 3, et

cetera, and then also OU2-MD1.

The source area remedial investigation, it was conducted from April 2016 to 2017 -- to June 2017. What we did is from the surface geophysical survey EPA did eight transits of electrical resistance (inaudible) to identify subsurface geophysical features, such as fracture area and possible dense non-aqueous phase liquid -- DNAPL.

This information was used to locate monitoring wells and bedrock fractures.

Rock matrix diffusion was also used at two locations and -- at two locations, one at the disposal area and one downgrade to verify if the product has absorbed into the rock and continued to be a source of contamination.

We also installed seven additional monitoring wells, which include two shallows and five deep, in areas with data gaps.

We also performed borehole geophysical investigations at 17 locations to document the subsurface conditions at each location and identify the orientation of the fractures at six newly-installed monitoring wells, at two of the matrix diffusion boreholes, eight existing monitoring wells, and at one former supply well.

We also conducted packer testing and sampling at four of the newly-installed monitoring well locations to collect samples from the isolated intervals in the borings so

that we can identify the source of high concentration and to install well screens in those selected intervals to sample.

Groundwater sampling was also conducted along with groundwater level monitoring at all the 26 wells, plus newly-installed wells. DNAPL -- dense non-aqueous phase liquid -- monitoring was also conducted at all the Operable Unit 2 monitoring wells.

The result of this source area groundwater sampling. We characterized that aquifer as a shallow, and a more hydrological conductive zone exists at a depth of less than nine feet below ground surface and a deep less conductive zone at about 90 to 140 feet below ground surface.

Unfortunately, dense non-aqueous phase liquid -- DNAPL -- is still present and will act as an ongoing source of the dissolved phase contaminations.

Dissolved phase chlorinated volatile organic compound contamination of PCE, TCE, cis-1,2-dichloroethene and vinyl chloride is still present at a concentration range from low microgram per liter to milligram per liter in concentration.

Contaminants absorbed in the rock will continue to leach from the rock into the groundwater for an estimate of 17 to 25 years after the source is removed.

The east side of the curriculum center appears to have the highest degradation rate. The capture zone with the existing extraction system does not extend far enough in a downgradient direction because of nature and the configuration of the bedrock and the fracture in the bedrock.

In this map -- this figure shows you the data that we had collected from this phase of the study. All the bold have been -- those are the exceedances of the EPA criteria for that particular compound. As you can see, they met exceedance at the curriculum center at the source area.

Conceptual site model. Let me give you the orientation of this conceptual 3D site model. This is the curriculum center. The front is the -- was the office. The back was the warehouse. This is the former drum disposal area.

This little square box is the treatment building where EPA, under the sitewide remediation, we have constructed the pumping treatment system to take care of this plume. We have installed a bunch of wells here, as I described from the remedial investigations.

We have two zones, as I described before. We have a shallow zone, and we have a deep zone that goes down to 140 feet approximately.

It seems like there are two possible pathways of migration. Contaminants that migrate along the east side of the building turn west to the Smith Bay Road. Contamination that migrates along the north side of the building also turns

south. Both of these migrate on site, unfortunately, to continue as the sitewide plume.

The two treatment plants, unfortunately, were damaged during Hurricane Irma and Maria because of electrical problems. Repair work -- EPA came in to make the repairs in 2020 and the system has been back in place as of last month, but unfortunately contamination continues to migrate downgradient of site.

To assess the impact of the treatment systems being shut down, the EPA conducted supplemental groundwater sampling in June and October of 2019, and the findings are that analytical results confirmed that the extent of chlorine compounds in the groundwater still exists.

Concentrations of samples from the curriculum center wells were generally lower than those established in the 2017 remedial investigation.

Concentrations detected in the residential wells were generally below maximum contaminant levels. That's the drinking water standard by EPA. But one sample did exceed the drinking water for TCE, but that well is used for irrigation purposes, not for drinking.

Comparison of the 2017 and 2019 groundwater sampling is presented on the next figure. Here we see -- where I'm pointing is the 2017 plume, chlorinated volatile organic plume, and this -- when we had the shutdown from the

two hurricanes, EPA came in to conduct sampling of this whole plume through all of the wells here in 2019, and unfortunately, of course, the plume had expanded, as you can see, vertically and laterally.

Risk assessment. The four-step process of hazard identification, exposure assessment, toxicity assessment and risk characterization.

Hazard identification. What are the sources of contamination? Identify source at or near the curriculum center. We have 13 groundwater contaminants identified, including PCE, TCE, cis-1,2-DCE and vinyl chloride. Exposure assessment.

How much of the contamination are people exposed to over time? The curriculum center was closed due to hurricane damage. This means there is no current drinking water exposure from groundwater.

However, the human health risk assessment evaluated risk for future populations if the groundwater is used as drinking water as required by Superfund.

Future residents: drinking water ingestion, thermal contact and inhalation of groundwater during daily activity, such as showering.

Future workers: composed of indoor and outdoor drinking water ingestion and contact with groundwater. Future construction worker: incidental ingestion, contact and

inhalation of groundwater in the trench.

Toxicity assessment. What are the potential health problems caused by long-term exposure to the contamination? Applied science of cancer and non-cancer toxicity value from scientific literature to evaluate potential (inaudible) was evaluated.

Risk characterization. What is the risk of health problems in people exposed to contamination at the site? Chemicals that exceed a 1 in 10,000 cancer risk or hazardous index of 1 can require remedial action. These are referred to as chemicals of concern, or COC, in the record of decision.

Summary of this risk assessment the EPA conducted based on the findings of Phase 2 of the source remedial investigation. The contaminated groundwater still presents an unacceptable exposure risk.

Vinyl chloride, TCE, PCE and cis-1,2-DCE still pose a lifetime cancer risk, exceeding 1 to 10 to minus 4. Vapor intrusion from PCE and TCE are also of a potential concern to workers. Future use of the building is currently unknown.

The results of the human health risk assessment indicated that the proposed alternative won't be necessary to mitigate potential risks associated with existing contamination.

A more detailed discussion of the exposure pathway and estimate of the risk can be found in the February 2018 report in the minutes of record of this section. Refer to Table 1, "Risk Summary."

Feasibility study. The purpose of the feasibility study is taking all the data collected from the remedial investigation to see the extent of contamination and to identify alternatives to clean up the site.

There are four cleanup alternative options for this operable unit source control cleanup. Alternative 1: no action. Alternative 2: expanding the existing pump and treatment system. Alternative 3: in-situ thermal treatment and pump and treat. Alternative 4: in-situ steam injection and pump and treat.

No action. No action to remediate the contaminated groundwater, no institutional control. What we do is that -- this is the basis for comparison with other process options. Since there's no action, there's no capital cost.

Alternative 2, expand the existing pump and treat system. We have four possible add-on alternatives. 2A, we reinjection. 2B, air sparging/soil vapor extraction. 2C, in-situ chemical oxidation (ISCO). 2D, surfactant flushing. And I will explain that more in the next few slides.

Alternative 2, expand existing pump and treat system. Here, additional extraction wells downgradient of this -- of the facility will need to be installed (inaudible)

when we do this -- for this alternative.

We will also upgrade the existing treatment facility, replace all the equipment to insure that we can accommodate additional float for treating the contamination at this location.

We will also alternate pumping from different monitoring wells with high contaminant concentration at least once a week to pump out the contaminant.

A dual-phase extraction/enhanced liquid recovery from different source areas will also be conducted. Again, the pro of this is the contaminant plume will be removed, especially the dense non-aqueous phase liquid.

Estimated time is in excess of 30 years. The capital cost for this alternative 2 is $4.8 million. The 30-year lifetime of this operation maintenance is $8.5 million.

Alternative 2A. This enhanced existing pump and treat system, as I described before in Alternative 2, now for 2A, reinjection, we will treat the -- the treated ground-- the treated water that's pumped from the treatment facility will be reinjected downgradient from the curriculum center to potentially act as a hydro barrier to offsite migration of the contaminant.

The pros of this is it will give us a better hydraulic control and maintain a water balance of this aquifer. It will be, again, estimated timeframe in excess of

30 years. The capital cost for this is $437,000, and the operation of these injection wells is $51,000 a year.

Alternative 2B, enhancing the existing pump and treat system, as I described in Alternative 2, now the potential source area will include a portion of the contaminant pool in the rear of this curriculum center, which is (inaudible), and also a portion of the contaminant pool beneath the slab of the building.

Also, we will install about 25 soil vapor extraction wells and 30 air sparging wells, and what that does is the air sparging would involve injecting air directly into the subsurface to volatilize the contamination from liquid phase to vapor for treatment and removal via the soil vapor extraction.

The AS and SVE wells will be at a potential source area, including the area beneath the building to help to mobilize the residual DNAPL within the zone influenced by the air sparging.

Again, the pro of this is that these wells will actually mobilize the residual DNAPL in these zones by the air pushing them out and the soil vapor extraction will extract the contaminant vapor and treat it.

This will increase the mass removal, reducing the timeframe of the pump and treat system. We assume that the timeframe to operate this AS/SVE system at the source area

will be five years.

Based on the modeling calculations, the downgradient plume will reach drinking water standards in 25 years. The capital cost for this -- installing these wells, $1.7 million, and the operation and maintenance of these wells yearly is $205,000.

Alternative 2C, in-situ chemical oxidation, ISCO. What this does is, this ISCO treatment at the potential source area acts as an enhancement using a slow-releasing cylinder. They are constructed with oxygen and wax.

We will install 64 cylinders at 12 monitoring wells, replaced yearly. These cylinders are composed of 38 percent potassium permanganate, 38 percent sodium persulfate, 24 percent paraffin wax or comparable oxygen.

These chemicals will be used to reduce the source area concentration at selected monitoring wells.

It is assumed that these cylinders will be vertically stacked inside the well, enhance the distribution of oxygen across the source zone. The pump and treat system will maintain hydraulic control of the dissolved phase plume from coming off the site.

The pro of this is passive treatment from source area concentration is less expensive. We assume that this area in-situ chemical oxidation with these cylinders will be treated for five years.

Based on modeling calculations, the downgradient contaminant source will reach drinking water standards in 25 years. The capital cost of these cylinders is $99,000 and the annual operation to replace these cylinders is $117,000 a year.

2D, surfactant flushing. What this does is -- in-situ flushing with surfactant solution at the potential source area is an enhancement.

We assume that 4 percent surfactant solution will be injected into select monitoring wells within the source area via injection wells.

Extraction wells are also required to maintain hydraulic control, to bring the emulsified dissolved DNAPL to the surface for treatment and to clear the aquifer of surfactant solution.

Due to the chance associated with the flushing of this solution in a (inaudible) aquifer, one year of active treatment is assumed. The pro of this is removal of source area concentration.

The timeframe is this flushing will occur for one year. Again, based on the calculations in the modeling, the downgradient plume will reach drinking water standards in 25 years. The capital cost of this is $1.2 million.

Alternative 3, in-situ thermal treatment and pump and treat system. This is an independent alternative,

Alternative 3. What this is, a thermal treatment to target the DNAPL in a potential source area to reduce the high dissolved contaminant concentration in the groundwater.

Heat causes the underground contaminant, DNAPL, in the water to boil, creating in-situ steam and vapor. The contaminant vapor is extracted using a vacuum recovery well and treated above ground.

Operating the pump and treat system with downgradient extraction is also needed to maintain the hydraulic control.

The pro of this is ability to penetrate the fractured rock matrix and to treat the source of this DNAPL and the chlorinated volatile organic. Unfortunately, this is a very high capital cost.

The timeframe for this thermal source treatment is for two years. Based on the calculations in the modeling, the downgradient source will be treated in less than ten years -- will be ten years, but the capital cost of this alternative is $89 million and the annual operation and maintenance is $4.5 million.

Alternative 4, in-situ steam injection and pump and treat. Steam injection at potential source areas to mobilize the DNAPL in the (inaudible) and to cause destruction of the contaminant -- of this contaminant and mobilize the DNAPL, and it will be captured by the pump and treat system.

What we will do is we will install 60 steam injection wells and 30 multi-phase extraction wells. We will still need to install these two downgradient extraction wells, RW10, RW11.

What this does is that it will mobilize the DNAPL, which will be captured by the -- by these extraction wells, and we will actually steam both -- steam these source areas for two years.

Based on the calculations in the modeling, the drinking water, again, will be -- reach drinking water standards in 25 years. The capital cost of this is $25 million and the annual operation is $8.5 million.

The common elements for Alternatives 2, 3 and 4 that I have proposed and described is that assumptions were made in the feasibility study for areas that were not fully investigated during the remedial investigation, specifically beneath the northern part of the curriculum center building, so the following additional work will need to be performed during the pre-design investigation, PDI, to address the -- to verify these assumptions made (inaudible).

During the pre-design investigation we will install five temporary monitoring points for groundwater screen samples. We will still conduct a site-wide groundwater sampling for baseline. We'll pump-test to estimate this capture zone at the full system capacity.

We will develop an extraction well. We will conduct an evaluation of the existing treatment system to determine any necessary improvements to upgrade the capacity.

Part of the common elements, of course, we have the long-term monitoring, a site management plan, and five-year reviews to insure that the remedy is still operationally functional and also protective of human health and the environment.

Now, the EPA uses the nine criteria for selecting these cleanup plans, these nine criteria to evaluate the remedial alternatives presented in this FS, and we choose which to implement.

The nine criteria are organized into three groups: threshold criteria, balancing criteria and modifying criteria.

The threshold criteria. Number one, overall protection of human health and the environment. Will the plan protect people and the plant and animal life on and near the site? EPA cannot and will not choose a plan that does not meet this basic criteria.

Number two, compliance with applicable or relevant and appropriate requirements. Does the alternative meet all federal, state and territorial environmental statutes, regulations and requirements? The chosen cleanup plan must meet this criterion.

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Balancing criteria. Number three, long-term effectiveness and permanence. Will the effect of the cleanup last or could it be ineffective and cause future risks?

Number four, reduction in toxicity, mobility or volume through treatment. Does the alternative reduce the harmful effects, spread of, and amount of the contaminated material?

Five, Short-term effectiveness. How soon will site risks be reduced? Could the cleanup cause short-term hazards to workers, residents or the environment?

Six, Implementability. Is the alternative technically feasible? Are the right goods and services -- example, treatment machinery, space at an approved disposal facility -- available to complete the plan?

Cost, number 7. What is the total cost of an alternative over time? EPA must choose a plan that gives protection at reasonable cost.

Modifying criteria. Eight, state, territory acceptance. Do state and territory environmental agencies agree with EPA's proposal?

Nine, community acceptance. Acceptance of the preferred alternative by the impacted community will be assessed following the public comment period, August 13, 2021, so please provide your comments.

Preferred remedy. The EPA preferred remedy with

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the support of the government of the Virgin Islands, proposed Alternative 2, expand existing groundwater extraction (pump and treat) and in-situ treatment with Alternative 2A, reinjection of the treated groundwater to the ground.

We will expand the existing pump and treat system to include the two extraction wells. We will upgrade the pump and treat system to a higher flow rate to accommodate the extra contaminant extraction.

We will upgrade all the treatment equipment to accommodate additional flow and improve efficiency, reinject the treated water. We will conduct alternate pumping from existing monitoring wells to extract the high contaminant concentrations.

We will conduct this dual phase extraction from source area and conduct long-term groundwater monitoring.

Contingency plan for Alternative 2 with Alternative 2B, AS wells and soil vapor extraction. We will again expand the existing pump and treat system to include downgradient extraction wells, upgrade the pump and treat system to a higher flow rate, upgrade all the treatment equipment to accommodate additional flow rate and improve efficiency, air sparging and soil vapor extraction at source areas, and long-term groundwater monitoring.

Donette, I will turn this over to you now. Thank you.

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MS. SAMUEL: Thanks, Caroline. So if you have questions or comments based on what Caroline just presented, you can contact me for a copy of the proposed plan or you can also send me an email requesting updates as we kind of move forward in the process of remediating the site. My email address is samuel.donette@epa.gov.

And if you have specific questions about the alternatives presented or just technical questions about what's happening at the site and how we will be proceeding you can just contact Caroline, or you can also share your comments with her about whether or not you agree with the alternatives, or if you disagree and why, you can e-- you can mail her at the U.S. Environmental Protection Agency's main office at 290 Broadway on the 18th floor, New York, New York, 10007 -- a thousand -- and so -- yeah -- and then you can email her at kwan.caroline@epa.gov.

Thank you all for watching our pre-recorded presentation. We would also like to encourage you to visit our EPA webpage at www.epa.gov/superfund/tutuwellfield. Thank you again.

[END OF TRANSCRIPT]

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T R A N S C R I P T I O N I S T ' S
C E R T I F I C A T E

I, Kimberly H. Nolan, Transcriptionist, do hereby certify that this transcript is a true and accurate record of the electronically recorded proceedings, transcribed by me this 1st of August, 2021.

Kimberly H. Nolan

KIMBERLY H. NOLAN

Transcript of Public Meeting held on August 23, 2018

THE ENVIRONMENTAL PROTECTION AGENCY

OF THE UNITED STATES OF AMERICA

Charlotte Amalie, St. Thomas

Virgin Islands

* * *

TUTU WELLFIELD SUPERFUND SITE

August 23, 2018

Grace Gospel Chapel

148 Anna's Retreat

St. Thomas, United States Virgin Islands

PRESENTERS:

CAROLINE KWAN, EPA Project Manager
GEOFFREY GARRISON, EPA On-Scene Coordinator

I N D E X

P-R-O-C-E-E-D-I-N-G-S:

* * *

(The Environmental Protection Agency Tutu Wellfield Superfund Meeting commenced at 7:10 p.m. and proceeds as follows:)

MR. GARRISON: Hello. Welcome everyone and good evening. Thank you all for coming out tonight to learn more about the clean-up at the Tutu Wells Superfund Site. Can everyone hear me okay in the back? The EPA is doing the oversight of this clean-up, and my name is Geoff Garrison. I'm an On-Scene Coordinator with EPA Region II. I am normally stationed out of Puerto Rico, but I do quite a few sites in the Virgin Islands. I'm substituting for Cecilia Echols. She is the Community Involvement Coordinator for this site, and she had a prior commitment. She could not make it, but she does send her greetings. And if you'll see the paperwork, she's the Community Involvement Coordinator for correspondence and that kind of stuff. I would also like to thank Mr. Woodley and the members of the Grace Gospel Church. We really appreciate the use of the facility, very nice.

Tonight's meeting is to discuss the clean-up options to address the contaminated soil and groundwater at the Tutu Wellfield Superfund site located in east Tutu. To that end, presenting tonight right next to me here is Caroline Kwan. She's the EPA Project Manager for this site, and although they're not presenting there are a few members of the local government. I do want to recognize Ms. Worrell-George the DPNR Director; Mr. Syed from DPNR, and there's couple other representatives and so on from the contracting world as well.

On the agenda, the objectives -- please thanks. On the agenda as you can see some of the following objectives. But before we get to that and before Caroline begins her presentation, I did want to convey a few words about EPA Community Involvement Program. It's a program designed to engage communities in the decision-making process about hazardous waste sites located within the community. It's basically to give you a voice in that process, and that's what we're doing. This is part of tonight.

As you can see there is a stenographer present. She's here to document not only our presentations but more importantly, your questions and your response to those questions or our responses to those questions.

Tonight's meeting will become part of the public record called appropriately enough the “Record of Decision” that will be issued after the comments are received and taken into consideration. Speaking of comment periods, the period -- the comment period for this clean-up actually began on August 8th and is currently ongoing and will close September 7th. Those are important days.

All site related documents to this presentation or to this site itself can be found at a Superfund website. I'm not going to cover it right now, because fear not at the very end the last slide will have it, and you can write it, jot down if you like. And not only does it have that at the presentation it's there as well, and for those of you like me who like to put their hands on, you know, hard copy documents, we also have our EPA office up in the Tunick Building does have some selected, doesn't have everything, but has quite a few documentation there as well.

A few ground rules to make the presentation and request as effective as possible. Please hold off your questions until the end of the presentation. I think most folks have already signed in, thank you very much for that. But if haven't please do, and if you make it legible as possible makes it easy for us to transcribe it, and do include your e-mail and your mailing address so we can keep you on our mailing list for this site.

As to the question and answer period itself also if you state your name that helps document it with the stenographer. So, without any further comments.

MS. KWAN: Thank you Geoff. Again, thank you for attending this public meeting. I will discuss some of the agenda we had out there. I will discuss the background, the Superfund itself, the remediation investigation that was done, the risk assessment, the clean-up options, and the EPA preferred recommendation for clean-up for the aquifer here at Tutu. And then we will end up with comment and questions. Next slide, please.

Now the Superfund law it was created in 1980 to address toxic waste, hazardous waste site. That was the prime example we had in the 1980s. Also, to provide thorough funding to clean up hazardous waste sites and -- thorough funding to clean up hazardous waste site. In addition, if we had the responsible party we will request that they come to the forefront and clean-up also. Also allow EPA to spend federal dollars to conduct emergency involving hazardous substance and hazardous waste. Next, please.

A simple road map of this Superfund clean-up process. You saw the site discovery. We will do a preliminarily assessment and site inspection. From there we will list the site on the Superfund listing for the National Priority List, which Tutu is. We will conduct remedial investigations. We will conduct a feasible study. We will issue a proposed plan. We will select the remedy; document it under our Record of Decisions where we'll pursue the design, construction. When construction is done, we will -- the next phase is the operation maintenance, and hopefully we will delist a site off the list. That's the whole scope of process and road map.

Now today's agenda, I’ll talk about the Superfund overview. Give you some background of this project. Next, please.

The Tutu Wellfield Superfund site is at the east end of the island by Anna's Retreat where we are. Next slide.

Back in 1969, the Curriculum Center by Department of Education, was owned by LAGA Industry, a textile manufacturing company. From '70 to '78, it was purchased by Duplan Corporation and began its dry-cleaning operation using the chemical tetrachloroethene. Back in '79, '81, it was purchased by Panex, and next it was sold to the Virgin Islands Department of Education, the Government of the Virgin Islands.

So, from '82 to present that building that you see the Curriculum Center the front of all this building, again from '82 to 2017 the Curriculum Center had multi-use. It had the administration building. Your superintendent was there in the back. You had maintenance crew; they had storage with the books. They do a lot of these things making for all the schools in St. Thomas. But, unfortunately, back in Hurricane Irma and Maria it damaged the Curriculum Center. So right now, it is condemned. It has been condemned, the Curriculum Center, and you do not know the fate of the Curriculum Center now. Next, please.

Again, back in '82 to '89, we had multiple remedial investigation conducted by the responsible party at that time. In '94 to '95 from these investigations, we have identified a plume of chlorinated volatile organic and petroleum/gasoline product of these plumes in these contamination of groundwater. In September '95, we list this Tutu Wells site on the National Priority List, the Superfund site. And those studies conclude that these chemicals dichloroethene, tetrachloroethene, trichloroethene, vinyl chloride are coming near the Curriculum Center.

Back in 1996, we issued a clean-up decision back then for the first operable unit to take care of the groundwater and the soil of this whole site. We did -- we installed groundwater extraction well back in 2004, actually two. One is at the Curriculum Center and one is above the laundromat on this island there. And we've been running those two plants and Tutu wells until 2013 when we transferred over the operation and maintenance of those two plants to the Virgin Islands.

Now we're back in 2015, we initiated a second operable unit to identify -- to conduct additional studies at the source area, which is the Curriculum Center. We believe the Curriculum Center is major contributor of this contamination to the whole Tutu aquifer. Next, please.

Now, we'll give you a little history of the OU the first operable unit remediation. So, we had to install the first pump and treat well behind the Curriculum Center. You point to that please over there, and we also have the groundwater treatment system behind -- above the laundromat down here, just right down the Grace Gospel Chapel. We also had installed a soil vapor extraction to take care of soil behind the Curriculum Center. We operated it for two years, and we turned it off in 2006, because we reviewed that a significant amount of contamination was extracted from the soil vapor extractions. Next, please.

Next one, we want now for this meeting -- for this clean-up we want to focus on the Second Operable Unit that we did which focused on the Curriculum Center, Department of Education. Next, please.

This slide shows this box is where we have, you know, we have focused our study for this Operable Unit 2 behind the Curriculum Center where we believe the source of contamination comes from. What we did is part of the focus is we did a bunch of field wells, which will restore the groundwater and additional wells. We did some packer testing, geophysical survey and bunch of stuff for over a year and a half. We had identified, unfortunately, that a Dense Non-Aqueous Phase Liquid, DNAPL, are present in the aquifer behind the Curriculum Center. Next, please.

Now the same result does show that, again, we have identified the DNAPL, the Dense Non-Aqueous Phase Liquid. There's an ongoing source contamination into the water that you are in the valley. We have, unfortunately, this situation in this location. So, what happened is we have these DNAPL contaminant into the rock. It's very hard for them to come out, to extract them out. So, we would treat, you know, things like that. Next, please.

Example of what I'm showing you here is these are a bunch of wells they took samples during the last two years, and I want you to focus on one RD-9, number RD-9 is the well ID. This has the highest concentration of tricholorethene a 160,000 PPB. That is where we have identified as the major source of this DNAPL, Dense Non-Aqueous Phase Liquid, in that well in that location. Plus, there is a bunch of wells that shows a high number but that was the highest concentration right behind the Curriculum Center. Next, please.

Again, what we did is we used all these results and we come up with something like a model. And what this shows is that we have -- first of all, we have installed a bunch of wells around the Curriculum Center. We did not install any wells inside the building, because we couldn't get access to the building, which is not possible to drill inside a building. So, we drilled outside the building to see what's going on. We had a contaminant going in from there over toward, you know, look there's a firehouse right around the Curriculum Center, towards the firehouse going down the valley. We have another contamination from behind the building going down again to the aquifer again going toward, you know, the highway Smith Bay down Turpentine Run. Those are where the groundwater is flowing, the contamination is flowing.

Also, as a part of our process, we have to do -- conduct a risk assessment. Next, please. And the purpose of risk assessment we have four steps. Step one hazardous identification. What kind of these chemicals, what kind of chemicals we have here and would pose a risk, a hazard to us, to the people, to the environment. We try to answer those questions.

Step two exposure. Well, we have specific pathway of what -- some sort of pathway that this contamination -- this contaminant will expose to us, you know, evaluate the current use of the groundwater. This is the groundwater, and we also evaluated future use of the groundwater.

Toxicity. How toxic are these chemicals that we have identified. So, we do a calculation of the toxicity, using all the result that we had gathered from the hazardous identification.

Step four, we take first all these evaluations, Step 1, 2 and 3 we come up with the risk. What kind of risk are we exposed to with this contamination, with exposure, with exposure pathway that we have identified, people drinking the groundwater, by touching the contaminated water, people inhaling the contaminant, things like that. Next, please.

Now, the bottom line is that the result the groundwater does pose an unacceptable exposure risk. Unfortunately, no one should be drinking the groundwater in the Tutu area. I know a number of wells -- a bunch of wells were closed, decommissioned by DPNR back in -- starting back in '86, it affect the residential well. We provided truck water and since then about five years ago Geoff helped assist me to oversee installing these WAPA lines to these impacted residents. So, no one should be drinking the groundwater as a drinking water source from the Tutu Well site.

We do have these chemicals and the vinyl chloride, trichloroethene, tetrachloroethene, *cis*-1,2 dichloroethene, it does pose a cancer risk in 1 in 10,000 people based on the result we have done. We might have some vapor intrusion in a building in the Curriculum Center in the back there, but there's only a potential. Again, the building has been abandoned and unfortunately for them we don't know the fate of that building. Next, please.

The next I want to talk on is the feasibility study, which is the number of clean-up options that we have identified based on the, you know, the result that we got from the studies. We have actually three alternatives. I share each one.

No. 2 Alternative -- there are sub-alternative A, B, C, and D. Those A, B, C, and D are enhancement -- an enhancement actively targeting the DNAPL contaminant, the source area those what you call the enhancement, the enhanced treatment.

First -- next slide, please. We have, again, three and four that's another alternative we have -- we came up with, options to clean up the problems. Next slide, please.

No action. Under the Superfund law, we have to evaluate what no further actions is going to do for this site what's going to happen. If no further action for this project except that we do have a pump and treat system that we've installed back in 2004. The Curriculum Center is also down here. So, what I mean no action is no additional action for this upper unit to target the source at the Curriculum Center, but the first operable unit is still moving, ongoing. Unfortunately, the first operable unit we had is not working now because of the disaster that you experienced back in

Hurricane Irma and Maria. The pump, you know -- we had to fix the pump, try to get FEMA to do the recovery. Again, if there's no action, the contamination in the ground will continue to spread and then it will cause human, health and environmental risk will remain. The alternative two, please.

I just want to give you this is what is actually at the Curriculum Center, behind the Curriculum Center. The building is still standing because when I built it -- when we built it in 2004, it was a hurricane proof building. So, everything in the whole structure is intact. Unfortunately, since we had lost power for a long time, a lot of the pumps, a lot of the computers were damaged, because it was like humidity and things like that. So those have to be replaced and stuff.

So, this is what it looks like, the existing pump and treat. I just want to talk about the common elements that we have on these alternatives. I'm going to describe in the next few slides, where we will conduct a predesign investigations. We will also upgrade the current system. We also, of course, do a long-term monitoring like sampling the wells on the whole Tutu area. We will issue some site management plan, operation plan, and we always conduct a five-year review on these projects. Next, please.

Now focusing on Alternative 2, what Alternative 2 does is that it will expand the existing pump and treat system that we have -- that you have at the Curriculum Center behind the -- you just saw the slide. We will add two more extraction wells, 10 and 11 right down toward the edge of the Curriculum Center. We will upgrade, you know, the system capacity, replace the existing equipment. We will also conduct this Dual Phase Extraction, DPE, and enhanced recovery.

What that does is that it will actively if we know DNAPL, which is the source of like the contamination, exist behind the Curriculum Center, we saw at the RD-9, which is highest concentration, we will probably locate more areas behind there. We will actually pump, suck those DNAPL out. And then when we suck it out, it will disturb hopefully bring it, suck it out, and then we'll bring it back to the water. We'll bring it down to the 10 and 11 to treat -- extract and treat the water. That's what we're trying to focus on.

Again, you know, our timeframe for this is about 30 years for this treatment. And the capital cost to install these -- those two additional wells, upgrade existing system, you know, replacing the existing equipment, after pumping, you know, at these wells that we saw will be about $4.6 million in capital cost.

And let me describe the annual O&M. What that is, is that 30 years of operations maintenance cost with three percent increase every year, inflation. The total cost of the work is $12 million. That is if we have $12 million now to invest in today's value with seven percent interest every year, that will take care of the capital cost and the 30 years of operational cost. That's what we call the present worth value of this remedy, $12.3 million. That means we set aside $12 million down now -- that would take care of the capital cost and 30 years operation with seven percent interest rate every year. Next slide, please.

Now as I said 2A, 2B, and 2C and 2D are enhancements. What we're going to do for this 2A, we will be expanding, you know, the current treatment plan; putting additional treatment wells and things like that. We want to install two new injection wells right here (Indicating) to -- and the purpose is really to get a better control and maintaining a water balance of this aquifer and bring it -- to bring the treated water back into the aquifer to recycle and things like that. Again, this is a 30 year timeframe, and again the capital cost is $425,000 just to install these two injection wells. Next, please.

2B. 2B is called soil vapor extraction and the air sparging. We will be installing a bunch of wells behind, again, focusing on the source area behind the Curriculum Center. That's where we found the concentration, this DNAPL. We will install about 25 soil vapor extraction wells and 30 air sparging wells. And what this does is that the air, we're blowing air disturbing this DNAPL. When this stir up, hopefully it will push out this DNAPL out of the bedrock and move it down to 10 and 11 to treat it, extract it, and to treat and extract -- extract and treat these

DNAPL. So, we are actually forcing, you know, air, you know, into the ground to disturb the soil, disturb contaminants. So, we're moving out of these, you know, bedrock, you know, things like that.

Again, the time what we wanted to do is for this year we will operate the system for five years. That's how it boils down. And based on the calculation that we have done some sort of modeling and things like that, hopefully in 25 years we will get to a drinking water standard in our aquifer, this aquifer of yours. Because the capital cost for this, just for this putting the extraction, the soil vapor extraction the 30 air sparging well is going to run about $1.7 million, you know. In addition, this is $1.7 million plus the four that's included. It's included with the first one, the number two. Next one, please, 2C.

Now this is called in-situ Chemical Oxidation. What it really is that we are putting chemicals into these, into 64 cylinders, and we will be putting these cylinders into monitoring wells in the back of the Curriculum Center area, and these chemical biologically eat, eat those contaminant, DNAPL. So, when - when they eat these DNAPL, hopefully, it will move these contaminant out of those rocks into the extraction system that we have. We could extract and treat like the groundwater. We plan to run this -- if we're going to choose this alternative, we plan to do this for five years, putting these cylinders -- replacing these cylinders with chemical every five years. Now based on our calculation, it could reach drinking water standards in 25 years again with this active, the cylinder, the chemical in there biologically eating the contaminant. Again, the capital cost for putting these cylinders in monitoring wells about $94,000.00. Next slide.

2D, next slide. Now what this is 2D surfactant flushing. It's detergent, high concentration detergent. That's where it's effective. We will install a bunch of -- five wells, shallow well, two deep wells in the back there. Put high concentration of detergent in these wells, and we'll -- I said washing machine. Wash, wash, wash flush out this contamination out of these rocks that we have -- that you have under the Curriculum Center and bring it to these extraction wells to treat. Bring it back to our plan to treat and stuff.

Now we would want to just run this for a year. And based on the calculation again in 25 years, in our lifetime the drinking water will be restored in the aquifer. But for this, the capital cost is $1.2 million. Next, please.

Now this is a -- the whole different Alternative 3. It's called the In Situ Thermal Treatment and Pump Treatment. Again, this one here we're focused on heat. We will be installing about 260 to 270 heater wells. And then also co-locating with vacuum extraction pump in the back. What that does, we are putting high temperature heating rods into these wells to heat up these DNAPL, stir them up, and they will come out, you know, of the rock again, and flush it down to about 10, 11 to extract and treat; bring it back to the treatment system.

Again, this is we will try to do that. If we choose this alternative we'll try to do it for two years. Again, based on this calculation we can restore this aquifer in ten years, but the capital cost is $79 million. There is also a lot of -- also a lot of heat we're putting into the aquifer, a lot of electrical power. Next, please.

Number 4, it's a similar situation but this time we're using steam. We are putting -- we are installing a bunch of wells again. We are doing a high pressure steam. These high pressure steam that would be injected into these extraction well, injection well will disturb the contaminant, make them come out of these rock, and then they will -- then they will come out to these -- to our -- again to our 10, 11 extraction wells and bring back to our treatment system to treat the water and things like that.

For this steam injection, we foresee about two years we will operate this steam injection. And for this one, you know, 25 years we feel that we could -- that area could be going back to drinking water standards. This is $23 million for this capital cost. Next, please.

Now, all these alternatives I explained and proposed on this plan here, we have -- we are mandated by Congress to compare these clean-up plans to a nine criteria that the Congress has set up. We use these nine criteria to evaluate the clean-up option that we have in the report. You see which one we will want a preferred remedy to choose. Next, slide.

Now, we have these two threshold criteria. Whenever we pick or choose EPA with the concurrence of the local government, we got to make sure this clean-up option is protective of human health and environment. And that this clean-up option must also comply with all of the laws, local law and all the federal law, regulations requirements.

Now we have another five criteria called -- next slide, please -- the balancing criteria. To answer those questions, it's the alternative that we pick long-term effectiveness and permanence. With these -- will the effect of these clean-up last, and will it become effective and pose, you know, give you more risk in the future? It reduce the toxicity and the mobility and volume of this, you know, new treatment. Does this like alternative reduce the harmful effect of the spread of contaminations, the short term effectiveness? I mean how soon will the risk be reduced? I mean does it compose of a short-term hazards to the worker, to the resident or to the environment?

Implementability. I mean is it feasible to employ this alternative? I mean do we have the goods and service available on the island for this plan and the cost? I mean we must chose a plan that gives the necessary protection at a reasonable cost.

Now, we are also at the last two criteria called modifying criteria. We do ask in this instance whether we go to the territory, the Government of the Virgin Islands and the Department of Planning and Natural Resources if they agree and concur with our chosen remedy, preferred remedy, and community acceptance. That is our scope of process that I just said we engage the public. We open up the proposed plan for 30 days from the comment period, and we have to explain what has EPA done; how EPA chose the alternative if I explain the clean-up options.

Next.

Now to summarize, this a table that I put together describing all the alternatives I have explained. Again, No Action, $0; Expanded and Existing Pump and Treat $4.6. Now the Annual O & M is like $433,000 that's in year 1 to 30. Every year is from $433,000.

Now, the periodic cost. This is last year, 30-year. What that does is decommission the building by knocking down the treatment plan, decommissioning all the wells that we don't need anymore, because it's clean-up and all of these things like that. That is what that block on the fourth column is, things like that. And In Situ because that's the number of well and treatment plan that's what they are you know. Next, please.

Now the Preferred Remedy. What we at EPA has as preferred remedy. Again, the preferred remedy is that we would like to expand the existing treatment system that you have up in the Curriculum Center. Also besides expanding it, upgrading it, modernize it, improve efficiency, we also want to choose Alternative 2A to reinject these treated water back to the aquifer. Again, you know, for the high concentration area in the back of the Curriculum Center the source area of the contaminant that we found, DNAPL, we are to actively do this dual phase extraction where we actually pumping, getting -- use a high pump to pump out this source material out of this well. It could be either once a month, once every few months depends on what we found, what we're going to do, when we do the pre-investigation, predesign investigation and things like that. Again, we will continue the long-term monitoring to make sure that our pump and treat systems is effective. Next slide.

The next one. We do have a contingency remedy in case an injection well does not work or it does not work in the timeframe that we would want it to; we would also want to do the air sparging. We would want to install a bunch of air sparging well and extraction well in the back of the Curriculum Center to disturb the -- to actually disturb the contaminant moving it up the crevice and bring it back to the treatment to actually treat those contaminants. Next slide, please.

Now I have come to the end of my technical presentation. Let me turn over to Geoff please for question and answer.

MR. GARRISON: I don't know if you remember when I first started I mentioned the website. It's there that you also if you picked up one of the yellow flyers you have it.

We're now going to enter, to listen to your comments, questions, any concerns you may have. I found out that it helps with the microphone. So what I would do is I'll try to bring the microphone as close as the cord allows me to you if you have a question, and remember to you give us your name we can also help the stenographer document that.

So at this moment any questions or comments? Who wants to kick it off? Yes, sir.

MR. BERNIER: Kent Bernier. What was the impact with the storm? What did it incur? Did it make more work for you? Did the pump shut down, and what cost do you have to recover since those pumps went down, additional pumps?

MS. KWAN: Like I said, the pump and treat system has been turned over -- the operation reign has been turned over to the Virgin Islands Government since back in April 2013. They've been operating it. As you saw from the slide, I built a hurricane proof structure, but the pump inside -- everything is fine post hurricane. But, unfortunately, we lost power for a long time. So when you have a pump that's not -- that has been working and no electricity, the pump gets rust, all the computers, all the CPU, motherboard that's run by, you know --

MR. BERNIER: Everything is seized up.

MS. KWAN: Yes. So the building is fine, but the equipment is fine; but the pump is not working. So that needs to be replaced.

MR. BERNIER: Yes. Now, your source of funding now does that come from the federal side or we would have to reestablish the source of funding based on damages, as well as the additional funding that I'm seeing for the next 25 years. That comes out of your Superfund source of funding that's federally will be administered to the local government?

MS. KWAN: Now for the first part of your question is, you know, the damage to the hurricane. So I understand that, you know, and I don't want to speak for DPNR. They had asked FEMA on the recovery to, you know, replace --

MR. BERNIER: Disaster.

MS. KWAN: -- yes, the disaster. It didn't happen because of the hurricane that's not effective. So they're in the process of going through FEMA to get a replacement. It has not been operational for almost a year because, you know, September 16th, the first hurricane. Now this new project that we're working on will be a combination of federal funding. It could be some local funding also, because if we find any additional potential responsible party who was a, you know, a contributing to this contamination, we will also go after them.

MR. BERNIER: You're still doing a feasibility assessment as to who else might have been involved although you already have a feasibility study? Are they --

MS. KWAN: Well, the feasibility is for clean-up option not for -- looking for -- not find -- identification of chemical -- that we do need an investigation by doing this. But we do still have enforcement action to look for all the responsible parties ongoing or past who could be responsible for contaminating the aquifer and things like that.

MR. BERNIER: You're saying we haven't put a cap on that and the source of damage to the well. That's -- that would be open and continuous looking for someone that might have impacted the well up to today?

MS. KWAN: Well, you had -- enforcement I'm not an attorney for the enforcement. But from technical side, we know what's happening behind the Curriculum Center; we identified the source. That's why we're here to propose the clean-up option to take care of the area.

Now the course, again, I want to stress that it is a Superfund site. It will be, you know, shared by the federal government. If we do find other responsible parties we will ask them to join us at the table to fund. It could be also some portion like, you know, the local government things like that. That has not been decided yet things like that. It's not just, you know, all federal funds. Whatever we have type of -- it's all parties.

MR. BERNIER: One question. You made a statement that building a well -- you made a statement that some of this water is going to Smith Bay. You aware what you said when you say that? There is a reason why I'm asking you that, because after the storm our Smith Bay run off on the hill was running for months, like six months. And I want to know it's not a part of that?

MS. KWAN: No, it's not.

MR. KLERIDES: The system was shut down right after the storm.

MS. KWAN: Yeah. The pump and treat was shut down right after the storm. There was no power to the well. The thing is that --

MR. BERNIER: When you table -- the water table goes high in the storm.

MS. KWAN: I know, yes.

MR. BERNIER: We have water running for days. Is this water a part and go elsewhere or it stays within the basin? That's what because -- does the contamination stay in the basin or with a high because all your sewage goes down, everything gets clogged up. Is this -- is your plume flowing somewhere else or it stay in that one basin?

MS. KWAN: No. It's going to underground, the aquifer. But you have, you know, you do have a lot of water. I mean --

MR. BERNIER: Substantial amount of water.

MS. KWAN: Yeah, I know. I was here for the hurricane response for two months, in November and December, and I see the rain that you had, all the flooding that goes up. So, yeah, it's not just -- it's not -- it's not just our contamination it's everything back up, the whole system, you know. So.

MR. GARRISON: Any further questions?

MR. SYEDALI: Hi. My name Syed Syedali. I have a very easy easy question. I know that in the past the Curriculum Center was standing, and you were not able to directly sample within that footprint of the building. But it has since been destroyed by the hurricane. Are there any plans to at least look at what's beneath that slab?

MS. KWAN: Well, the thing is, you know, we would love to drill under the building, but that's where the mother load is probably. But I know for a fact that when I was here for the hurricane, the Army Corp and possibly EPA and FEMA went to do an inspection of that building, and they wrote a report which I might have shared with you guys or you might have shared with us. They condemned the building. No one is suppose or allowed to go in there. So no one cannot go in there. They condemned the building. So we cannot -- even if we wanted to drill a well there we can't go in to drill the well, because the building is condemned by Army Corps of Engineers and by FEMA due to the hurricane, you know, destruction.

MR. KLERIDES: Yes, if the building is demolished.

MS. KWAN: Right. If the building is demolished, we will love to drill in there to get that out and see what's going on out there, you know, if that building is demolished. But we're not here to demolish the building.

Yes.

J. BERNIER: I'm James Bernier. I'm the engineer with the Department of Education. So if we do not rebuild there, you're asking to be able to drill down in there and is that going to be a 30-year process?

MS. KWAN: Oh, no. If that building is demolished, we will probably conduct this work through a predesign investigation that I said at the beginning. Before we do the design of the whole treatment plan, we will want to do some redesign work to make sure that we have the adequate capture zone of this treatment plan; that we're going to upgrade and make improvement. So we will want to install wells in that footprint to see if -- we already know what's behind the building. We're on that; the high concentration of trichloroethene 160,000 PPB. So I won't be surprised that it is under this building. There's a much higher concentration. With the drilling, I understand what's down there, and then we can act to treat that location and stuff. So that's not a 30-year process.

The 30-year process unfortunately because it takes time, we cannot just suck the thing out. It takes time to just get it out and, you know. We don't want to over pump the aquifer, because you have salt water. You have, you know, the ocean. So you don't want to over pump the aquifer and get salt water intrusion that is not good.

MS. SHAZOR: Gail Shazor. Understanding that this was a facility prior to becoming a Superfund site, will there have any impact with rebuilding an educational facility on that same site? Would that have any other type of --

MS. KWAN: No. No. Well, you saw my history, you know, it was, you know, LAGA they did back in the 60s LAGA, the manufacturing company, that's where the mother lode is. That's where the chemical come from. And then it's sold to Duplan, and then sold to the Virgin Islands Department of Education. So that location is the Government of the Virgin Islands, it's Department of Education. It's really up to them to do what they need to do. Either they knock the building down and, you know, put a new building up. I mean there is no problem. It's just the underground, the water, that's where the problem is, you know, underground, groundwater. The groundwater is the aquifer. It's really those things you know what I mean? There's no problem to the, you know, the air or whatever. It's fine.

MS. IBLE-CASTLEBERRY: Sorry, Paulette. The focus right now is on the --

MS. KWAN: Curriculum Center.

MS. IBLE-CASTLEBERRY: -- Curriculum Center. But you also mentioned the O'Henry Cleaner. Where does that come in into this whole process?

MS. KWAN: The O'Henry Cleaner, the laundromat, I know the O'Henry Cleaners has been out business for a long time. But what we did is saw into the first operable unit back in 2004 where we installed a treatment plant. One was the Department of Education, where we're focusing now, and we also installed a treatment plant we call downgradient, you know. The water comes from the Curriculum Center. It's goes all the way down, down to Turpentine Run, you know, and then we have the treatment center No. 2 right by above O'Henry, right above the laundromat, to treat -- the intent of that treatment plant was to treat whenever the contaminant comes out, whatever that residual contamination from the Curriculum Center comes out both this O'Henry -- what was O'Henry above treatment No. 2 to care of it, and we did. For the pass, ever since we installed these two treatment plants in 2004 until now, that's what we do really - monitoring. We saw the concentration decrease.

This line here, this contamination line actually shrunk before it -- it all went out toward that turn toward almost --

MR. KLERIDES: Almost to the concrete plant.

MS. KWAN: -- almost to the concrete plant down that highway.

MR. BERNIER: That's what we were wondering, how far out. Now you say the concrete plant --

MS. KWAN: That's a long time ago.

MR. BERNIER: -- yeah that's over by Bovoni. Okay. So I'm saying that's where the question was --

MS. KWAN: Right.

MR. BERNIER: -- there were two category five. Was that able to actually increase and go out further than its normal position that you're saying to me. In other words, the plume was contained within the O'Henry in that area, that's what you're saying? It never went out its course?

MS. KWAN: No. We contained it. And that's all -- sorry.

MR. BERNIER: That's what we're saying. We already tested it, but we contained it.

MS. KWAN: Oh, we know because like I said we do monitoring every year.

MR. BERNIER: Have you done it -- have you done it this year since your pump was down and everything was destroyed?

MS. KWAN: Yes, we did unfortunately. The Department of Education and Department of Planning did because they, you know, it has been turned over to them. So they have done it in January. We just got the report.

MR. BERNIER: You know you sound like you need a hug, you know. You're telling me DPNR had time to do that with all what's going on? I want to hear it from DPNR.

MS. KWAN: In January.

MR. BERNIER: In January. Thank you so much. Congratulations sweetheart. With all what you been through that's a great job.

MS. GRIMES: Hi. I'm Kristin Grimes, and I'm the Director for the Virgin Islands Water Resources Research Institute. So to answer your question, sir, probably during the hurricanes there were greater conductivity between groundwater and the extent of that plume. So it's good that in January DPNR tested that plume and saw that it's back to an extent if that's true, but there is probably greater conductivity. It probably followed the landscape. So your question earlier now did this plume move over and go down to Smith Bay side. No, because it's going to still follow the landscape, which is basically it's like a bay side it goes down.

So I have two questions. One is having actually to do with that elevated concentration from the southern plume. So to me that seems to indicate which is that ring there that there might be a secondary source of contaminants. So I'm wondering if somebody could answer that?

MS. KWAN: Secondary source that's actually under the old -- new one, the first operating unit. What we're focusing on is the what we called the bottle water as well. The secondary source hopefully again the treatment of the two will eventually take care of that, you know what I mean. It has to go down. It's not going down as much as we would like to and things like that. So that is, you know, that is again what we want is to take care of it the treatment of two that we have in place -- that we have in place that DPNR has been monitoring and operating.

MR. GARRISON: So it was working when it was operating?

MS. KWAN: It was working, yes.

MS. GRIMES: My second question directed to you deals with remediation in option two. It's in the -- in your option the DNAPL would be treated on-site. And so my question had to do with -- sorry, my notes here -- with how well will that extraction do and when we disposed of it? So how long will it be held on site? How is it -- where does it go?

MR. KLERIDES: Can you repeat the question? I'm sorry.

MS. GRIMES: So option two talks about treating the DNAPL. And it said that --

MS. KWAN: DNAPL.

MS. GRIMES: DNAPL, sorry. That it would be treated and then held on-site until it was properly disposed of. And so I'm curious about how long was it held on-site, and who are -- who is the licensed party that's responsible for removing that DNAPL?

MR. KLERIDES: It's has not been determined who is going to be taking that off-site, and how long it's going to be staying here. It's not going to be long-term. It will be taken out, okay. But definitely it will have to be handled properly through licensed contractors who basically are licensed to do business here, and will have to be disposed of at a facility somewhere in the States.

MR. GARRISON: Any other questions?

J. BERNIER: Is there a capital cost included if you were to purchase this -- our property then would belong to Property and Procurement. Department of

Education sitting on this property right now. Does your capital cost would include the purchase of the property so that you can clean up the property?

MS. KWAN: No. We don't do that. We don't purchase anything unless -- now there are cases for example we had to buy people's house, because they were condemned; and we don't pay them. But we don't buy the Department of Education, because we need to, you know, treat.

J. BERNIER: Is this site capital?

MS. KWAN: The capital is just for upgrading of all these like wells.

J. BERNIER: Is this site can have homes built on the site? If I have a building on this site you mentioned in the beginning vapor intrusion that's through the soil or that's through the concrete?

MS. KWAN: Well, what happened with here vapor intrusion is groundwater -- vapor intrusion -- what vapor intrusion is when you have a high concentration of groundwater contaminant in the groundwater that is shallow, 50 feet and above the contaminant can vaporize, come up, right.

MR. BERNIER: So that's what he's saying. Environmental if someone is in the building --

MS. KWAN: Right. Well, the thing is we have tests we have done, two vapor intrusion tests in December with an expert back about one was December 2015 and '17 I think, yes. It all shows that there really was no risk, because again vapor intrusion only happen when we have high contaminant, but the water the groundwater is shallow. But here also in concentrated -- not concentrated in a close space, what we did is we put a bunch of A-canister in the administration building, because the air conditioner and when people are there the teachers and, you know, the secretary, they also put a bunch A-canisters in the back where they do maintenance where you're exposed to like, you know, the paints and things like that.

In the front office despite with the air-conditioning on, close all the window, there was no risk. In the back there was some reading, but again in the back in the main shed it was, you know, the doors were open. There's really no air condition in there. So it's all like how you call it it was open air. I wrote down "potential" because don't forget it is cement. So it won't get through cement. But, again, when you do knock down the building we would want to investigate a little bit more. The thing is we did two more vapor intrusion and there was no risk for this office building things like that.

MR. LAWRENCE: Hi. I'm Ralph Lawrence. The question is if they decide to demo the building, the slab is there, and you go in and you do testing and you find the contaminants need further remediation, what is your recommendation to rebuild or not?

MS. KWAN: It is not EPA decision, yes.

MR. KLERIDES: It's the property owner’s decision if there will be a building built again at that property. Depending on what we find under the building, EPA may recommend that they put in a vapor mitigation system under the building, which is nothing but a plastic layer, cover so it does not allow the vapor to go inside the building. That's the only thing they can do. As far as the building it's the property owner decision. It's not EPA's decision.

MR. LAWRENCE: Exactly my point is whatever you find makes the determination of what they do with the building after you do a core sampling to determine how bad it is, and what the remediation is to decide if you actually want to go back there.

MR. KLERIDES: The soil is not contaminated. The soil has been clean-up before. So this is groundwater, and the only thing that could cause is vapor intrusion, okay. And that's basically, you know, it can mitigate it by, you know, vapor mitigation system.

MR. LAWRENCE: Wouldn't that mean tearing out the whole slab?

MS. GRIMES: Is there soil underneath the slab that is contaminated?

MS. KWAN: Again, like I said we don't control that building so we don't know.

MR. KLERIDES: There was something that was done under the concrete slab during the redesign investigation back in the late 90s. And--

MS. KWAN: It did not show anything.

MR. KLERIDES: It did not show any significant contamination under the soil -- under the building in the soil.

MS. KWAN: In the soil.

J. BERNIER: Where there's no concrete and I have BIDE employees walking around especially on this side on the south side, this side of the building and there's just dirt, is there vapor intrusion that can affect employees?

MS. KWAN: You want to clarify? You mean in the back?

MR. J. BERNIER: Where there's dirt.

MS. KWAN: Where there's dirt, no. He's saying that there's dirt, you know, in the back. There is a lot of dirt in the back, you know, I mean things like paint. Is the vapor intrusion going to hurt the workers, no. I mean don't forget it's open air; it vaporized. So it's not -- the vapor intrusion is in a building that is closed, and you have AC or heat running you have these vapor coming in without any outlet that's the problem. But here the potential problem is in that main shed in the back, but it's all open, you know and things like that. All open potential not really release anything maybe about two grams.

MS. GRIMES: Does the nature of the bedrock complicate the reinjection process that was under option 2A?

MR. KLERIDES: Yes. That's why the redesign investigation will be testing that. We will install those wells trying to test them to see, you know, if we are successful or not.

MS. GRIMES: A better question -- a better way to ask this question is in what way is the bedrock effected by reinjection. So I guess could you just explain a little bit more about what would happen in that phase and what we will be looking for?

MR. KLERIDES: It's a little bit early right now for us to give you a concrete answer for those things, because they will be all part of the plans. But is bedrock fractures, again, it would be depending on whether we're intersecting some of the major fractures that would be able to take the water. If we do not intersect any major fractures, has and only hair line fractures we're not going to be successful.

MS. GRIMES: So in the geophysical surveys that you did before, were you able to drill below the surface, below the slab at all or go back and be part of those additional test that you do, because it goes into you're being able to trying to make an informed decision, right, about some of these alternatives. I understand what you're able to provide. I'm just trying to understand it a little bit more.

MR. KLERIDES: As part of the additional studies that we will do, if the building is not there, the additional studies will determine, you know, what's under the building. The same way we determined from the information, the structures around the building and found out how the water is basically going from the top of building and warehouse escaping out of the recovery area. We will probably be doing something similar to that, and that would give us a good indication as to how to proceed. But yes that's, you know, one of the things that we are waiting also to find out is what's the fate of the building.

MS. SHAZOR: Gail. As we do get the watershed in Turpentine Road does that have any affect on the farmers, the animals, contaminants in water? Have you had yet to look at how has that impacted any of the farmers along that run or any of livestock along that run?

MS. KWAN: From the first risk assessment when we did from the OU-1, we have done a very detailed risk assessment about the human health, ecological health, because, you know, Turpentine Run the discharges to the mangrove lagoon and things like that, there was more risk for the ecological and things. We did not do an evaluation of sheep or goats and things like that. But again our focus is on human health, people ingesting the groundwater which is a no no.

Dermal contact is okay, because, you know, at that time showering is okay, because it's a shower. You're not there for a half hour. You're only there for a few minutes in groundwater you know what I mean? So there was really the main risk was ingesting the water, drinking this contamination that gave you like I said 1 to 10,000 -- one person per ten thousand people would get cancer if you ingested the groundwater. I was saying since day one no one should be drinking the groundwater in Tutu things like. But we did ecological assessment and see about the fish, the mangrove and things like that there was no risk.

MR. GARRISON: Pretty much been going from 7:10 to 8:15. Anymore questions?

MR. BERNIER: I have a question. Can this water be used for farming? We have a big issue with water. It can't be used -- when I say farming could it be used for orchards, avocado trees, big trees when we had a drought situation like in Bordeaux, and the Bordeaux farmers need water to irrigate not for -- they transfer to water plants. Because we have a water issue here, and if it can be used or could be put in a treatment before it could be set up that way from an agriculture point of view that handles the people that's capable of dealing with it.

MS. KWAN: Let me explain. From the first operable unit, we did request with DPNR to treat the water for drinking, because when you drink the water it's treated. They opt not to. So we had to discharge in Turpentine Run. It's not up to us, because we -- the water belongs to the people of the Virgin Islands. So if --

MR. BERNIER: I appreciate what you saying. If DPNR -- what you're saying to me is if we have the technology and the means of paying and making the investment as heading up agriculture to be used for our nurseries, for our farms, which is very important for us as a community for self-sustainability, I can grow five hundred -- five hundred different what it is papaya trees, avocado basic, and we can put it through a treatment even if we have to make the investment and is certified by the same DPNR. I'm asking if can it be done, because water is a serious issue we have now.

MS. KWAN: Water is a resource. We understand. You have a drought and you know.

MR. BERNIER: So I'm asking from your professional expertise that it can be done provided that you go through --

MS. KWAN: Right.

MR. BERNIER: -- the proper procedure--

MS. KWAN: Right.

MR. BERNIER: -- of a local institution. That's the question I'm asking.

MS. KWAN: Yes.

MR. BERNIER: Thank you.

MS. KWAN: It could be done. You have to go through the proper procedure, because, you know, like I said we have to obey all the federal and local laws and regulations and requirements.

MR. BERNIER: But the expert right here I just want to make sure once it goes through the proper whatever is required by DPNR in setting up a proper treatment plant to recycle it, and it goes through a proper process that it can be used. That's what I'm asking.

MS. KWAN: The use is very important. That's also we're under a mandate that EPA's headquarter we use something that we fix -- clean-up the property.

MR. GARRISON: Any further questions?

MR. BASS: Lochton Bass. I was saying the 30 years period when did it start?

MS. KWAN: The 30 years period for this new 30 years of operation to bring this back to a clean-up, as soon as when we start the construction, and we start pumping it, and we start operation and maintenance, the first year of operation that triggers the 30 years timeline. So we have to design this treatment system. Design this remedy, this clean-up option and then construct it. Run the operation to make sure -- run the operation for a year to make sure to get all the kinks out, and then we start back the -- the clock start. Yes we have to, you know, again decide which in terms of we need to choose this operation that's why I'm here. What EPA prefer alternative is you know.

MR. GARRISON: That pretty much wraps it up. If there's no last question. The good news is this is not the end of the process. You can provide comments. Again, the web page is there. You can send comments directly to Caroline. DPNR is a great resource. They can also bring stuff to our attention.

So on behalf of Cecilia thank you so much for coming out tonight. I know your time is precious. Thank you for getting involved, and just thank you again to the church for hosting us very graciously. Unless you have anything else this concludes the public meeting.

(The Environmental Protection Agency Superfund meeting is hereby adjourned.)

C-E-R-T-I-F-C-A-T-E

I, Nataya A. Melchior-Munoz, a Certified Reporter and Notary Public for the U.S. Virgin Islands, Charlotte Amalie, St. Thomas, do hereby certify that the above meeting held on Thursday, August 23, 2018 at the Grace Gospel Chapel.

I, further certify that all the proceedings set forth was transcribed accurately to the best of my ability.

IN WITNESS WHEREOF, I affixed my signature and official seal this August 30, 2018, at Charlotte Amalie, St. Thomas, United States Virgin Islands.

Nataya A. M. Munoz

Notary