TRANSMITTAL

To: Ms. Caroline Kwan

From: John Virgie

Date: July 25, 1997

Subject: Revised Draft Remedial Investigation Work Plan - Phase III
Virgin Island Chemical Site
St. Croix, U.S. Virgin Islands

Project Number: 35241.7.2

Enclosed is the original and seven copies of the subject document. As discussed during a July 24, 1997 telephone conversation between me and Caroline Kwan of the U.S. Environmental Protection Agency (EPA), the issue of collecting sediment samples in the Fairplain Gut, as recommended by the National Oceanic and Atmospheric Administration, will be resolved during implementation of the Phase III site activities.

As previously stated, during field reconnaissance activities conducted during the preliminary Phase III site activities, Harding Lawson Associates (HLA) observed that several of the surrounding wells, included in the offsite well survey, were constantly pumping. HLA requested the well owners shut off these pumps simultaneously so non-pumping water levels could be measured. This request was not honored by all well owners. HLA made additional efforts to obtain water levels during low activity periods for the surrounding businesses (on weekends and early Monday mornings) to obtain as many non-pumping water levels as possible. This situation may complicate the interpretation of groundwater flow beneath the subject site. Accordingly, EPA's assistance with encouraging the owners to simultaneously shut off the surrounding pumps during upcoming water level measurement activities, would be appreciated.

If you have any questions or require additional information, please call me at (609) 936-0700.

cc: Distribution

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Draft
Remedial Investigation Work Plan
Addendum - Phase III
Virgin Island Chemical Site
St. Croix, U. S. Virgin Islands

Prepared for

Island Chemical Company

HLA Project No. 35241 7.2

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1.0 BACKGROUND

1.1 Introduction

Harding Lawson Associates (HLA) has prepared this *Remedial Investigation Work Plan Addendum* on behalf of Island Chemical Corporation (ICC) as part of the Remedial Investigation (RI) of the Virgin Island Chemical site (site) located in St. Croix, U.S. Virgin Islands. This RI Work Plan Addendum is intended to address issues discussed and agreed to during the meetings on October 17, 1996 and May 12, 1997, with the U.S. Environmental Protection Agency, Region II (EPA) and comments presented in EPA's letter dated December 23, 1996. The work described in this document will be performed in accordance with the project *Sampling and Analysis Plan* (SAP), *Health and Safety Plan* (HASP), and *Quality Assurance Project Plan* (QAPP) provided with the *Remedial Investigation Work Plan* (Work Plan), dated March 17, 1994 and revised August 5, 1994 (HLA, 1994). Addenda to these documents are included as Appendixes.

1.2 Site Description

1.2.1 Site Location

The site occupies approximately 3 acres in south central St. Croix, U.S. Virgin Islands (Figure 1-1). The site is located on Melvin Evans Highway (Route 66), approximately 1,500 feet north of the Alexander Hamilton Airport. The property is located on Plot 13Q of Estate Bethlehem Middle Works at 17°42'35" north latitude, 64°47'26" west longitude.

The site is bordered to the northeast and southeast by an intermittent stream identified as the River Gut. It is bordered to the west by an undeveloped lot and to the southwest by Route 66. A concrete batch plant and two automobile repair shops are located to the east of the site, across the River Gut. An asphalt paving company is located north-northwest of the site across the River Gut.

1.2.2 Site Structures

The facility is currently abandoned. The current layout of the facility is shown in Figure 1-2. Major onsite structures include the following:

- Laboratory and Warehouse Building
- Maintenance Building
- Above-Ground Storage Tank (AST) Farm
- Concrete Pads adjacent to AST Farm (former AST locations)
- Loading Dock
- Concrete Storage Pad
- Centrifuge and Dryer Building
- Reactor Process Area
- Former Process Pit (filled during previous work at this site)
- Generator Building
- Pump Building
- 250,000-Gallon Fire Water AST

1.2.3 Site Setting

The site is located in a valley. Surface elevations at the site range from approximately 30 to 40 feet above mean sea level (MSL). Land to the southwest (approximately 200 feet) and to the east (approximately 1,000 feet) of the site slopes steeply upward to roughly 150 to 200 feet above MSL.

The ground surface slopes gently across the site from southwest to northeast. Ground surface just beyond the northern and eastern fence lines slopes steeply downward approximately 12 to 15 feet into the River Gut. An earthen berm, approximately 4 feet high, partially separates the AST farm in the western part of the facility from the remainder of the site. On the western side of the berm, runoff drains from southwest to northeast. Surface drainage on the eastern portion of the site is controlled by the buildings, concrete paved areas, and two storm drains that channel runoff along the southeastern site boundary (Figure 1-2). Flow in the River Gut is intermittent and generally occurs only as a result of sufficient precipitation during the rainy season, between September and December. The Caribbean Sea is located approximately 4,500 feet south of the site.

Based on previous investigations, shallow soils beneath the site consist of alluvium. The geology and hydrogeology of St. Croix were discussed in detail in the Work Plan and in the *Draft Data Summary Report* (DSR), dated August 15, 1995 (HLA, 1995). Figure 1-3 presents a generalized geologic map of the island.

1.3 Previous Activities and Data Needs

Between September 1984 and March 1986, Enviro-Science, Inc. (ESI) performed a series of investigations of selected portions of the site. In September 1985 and March 1986, EPA collected several samples from the site. Between March 1989 and April 1991, EPA performed a preliminary assessment and a drum removal action. In February 1991, NUS Corporation (NUS) collected groundwater, soil and sediment samples as part of a Preliminary Assessment/Site Investigation, performed on behalf of EPA. Data generated during these activities were summarized in the Remedial Investigation Work Plan (HLA, 1994).

From October 1994 to August 1995, HLA implemented the EPA-approved Remedial Investigation Work Plan. Results of work performed through August 1995 were summarized in the Data Summary Report (DSR) (HLA, 1995). The key findings of that investigation were:

- Volatile organic compounds (VOCs) were detected in soils and shallow groundwater samples collected at monitoring well MW-1 in the vicinity of Tanks 8 and 9 in the above-ground storage tank (AST) area.

- The two primary constituents of concern identified in previous investigations, pyridine and chloroform, were not detected in any soil or groundwater samples collected during HLA's 1995 investigation.

- The visual reconnaissance performed after site clearing revealed no evidence of additional potential source areas.

Following EPA's review of the DSR, HLA prepared a proposal (April 12, 1996) and a draft Phase II RI Work Plan (May 15, 1996) to address the following as requested by EPA:

- Obtain additional information on shallow groundwater flow direction(s) over time through the use of automated water level recorders.

- Characterize the extent of impacted soil and groundwater identified in the vicinity of Tanks 8 and 9 in the AST area.

- Obtain groundwater quality data near the center of the site (Former Process Pit Area) by installing and sampling monitoring well MW-2 well as originally proposed in the RI Work Plan (HLA, 1994).

From May through August 1996, HLA implemented the EPA-approved Phase II RI Work Plan. Results of the work performed during the completion of Phase II activities were summarized in the *Draft*

Supplemental Data Summary Report, dated September 13, 1996 (HLA, 1996). The key findings of that investigation were:

- The lateral and vertical extent of VOCs in soils at the AST area were defined to the north, east, and south[1] of the identified source area, but not to the west (offsite). The extent of VOCs in groundwater was not defined in a locally downgradient (western) direction.
- Chloroform was detected above the Federal Maximum Contaminant Level (MCL) in shallow groundwater in the vicinity of the former process pit area (Monitoring Well MW-2).
- Based on several months of continuous groundwater level monitoring, a shallow groundwater divide trending north-south is interpreted to exist at the site. The groundwater flow direction across the majority of the site west of the divide is to the west and northwest, and the flow direction in the easternmost portion of the site east of the divide is to the east and northeast.

On October 17, 1996 and May 12, 1997, EPA met with the respondents' and HLA to discuss the findings of the *Supplemental Data Summary Report (HLA, 1996)*. EPA suggested that several data needs still remained and that they be addressed through supplemental investigative activities. HLA completed preliminary Phase III site assessment activities from June 9 through June 20, 1997. These activities were agreed upon at the May 12 meeting and documented in HLA's correspondence to EPA dated May 19, 1997. More work, as discussed below, is anticipated. Objectives of the Phase III RIWPA are discussed below.

1.4 Objective

The objective of this phase (Phase III) of the RI is to address the following data needs identified during the October 17, 1996 and May 12, 1997 meetings with EPA, which EPA deems necessary for evaluation of remedial alternatives justified by risk assessment.

- Characterize the lateral and vertical extent (onsite and offsite) of toluene, ethylbenzene, and xylene (TEX) previously detected in soils and groundwater related to the small area near Tanks 8 and 9 in the AST area.
- Evaluate background volatile and semi-volatile organic and metals concentrations in onsite soils.
- Estimate hydrogeologic properties (specifically hydraulic conductivity) of the shallow and deep water-bearing zones onsite.
- Further evaluate the local flow direction(s) in the deeper portion of the water-bearing zone.
- Install three deep monitoring wells in the vicinity of MW-2, MW-6, and a third location to be determined once the water level data from the preliminary assessment activities have been evaluated. EPA approval of the location of this well will be obtained prior to its installation.
- Collect groundwater samples from all new and existing onsite monitoring and production wells to further evaluate the extent of Target Compound List (TCL) VOCs, semivolatile organic compounds (SVOCs), and Target Analyte List (TAL) metals, in groundwater.
- Further evaluate the possible presence of TCL VOCs, SVOCs and TAL metals in soils in three additional location onsite and TCL SVOCs and TAL metals concentrations in sediments in the River

1 At the meeting on October 17, 1996, EPA's contractor, CDM Federal Programs, disputed that the extent of VOCs in soils had been defined to the south of the presumed source area, because VOCs had been detected in samples from southernmost boring SBB2. HLA noted that continuous field screening of soils from 0 to 18 feet at SBB2 did not detect VOCs. The presence of VOCs in soil samples from 20 to 22 feet and 22 to 24 feet at SBB2 is attributed to capillary effects and/or fluctuating water levels associated with underlying groundwater.

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- Further evaluate the possible presence of TCL VOCs, SVOCs and TAL metals in soils in three additional location onsite and TCL SVOCs and TAL metals concentrations in sediments in the River and Bethlehem guts.

- Update and further evaluate baseline ecological assessment information concerning potential ecological receptors and exposure pathways associated with the River Gut from the vicinity of the site to the confluence with the Bethlehem Gut.

- Preliminarily evaluate the potential applicability of soil vapor extraction (SVE) and/or bioventing as possible remedial alternatives for soil in the AST area.

- Obtain available water quality data which should be routinely collected from the Fairplains Well Field supply wells from the Virgin Island Water and Power Authority.

The tasks described in this RI Work Plan Addendum are designed to achieve these objectives. Following completion of these tasks, HLA will evaluate the findings of the RI and present results.

2.0 WORK PLAN TASKS

Figure 2-1 presents a flow chart which summarizes the proposed tasks to be implemented to address the data needs identified in Section 1.4. The tasks are explained in detail in Section 3.0. The tasks to be completed are as follows:

2.1 AST Area Investigation

2.1.1 Soils

- Install soil borings offsite (west) of previous boring SBB17/MW-6 to assess the vertical and horizontal extent of toluene, ethylbenzene, and xylene (TEX) in soils associated with the AST source area in the vicinity of monitoring wells MW-1 and MW-6.

- At the request of EPA, HLA installed four additional soil borings (SBAST 1 through SBAST 4, Figure 1-2) within the general AST area during preliminary Phase III site assessment activities (conducted in June 1997). Analytical data from these borings will be evaluated to determine if additional soil borings are needed to assess additional impacts, if present in the AST area. The EPA will be contacted to discuss the locations of additional boring(s) in the AST area, if needed. Data from previous soil boring SBE1, which was installed near the former concrete pad (Figure 3-1), will also be used in this evaluation.

- Preliminarily evaluate the applicability of SVE and/or bioventing as remedial alternatives by collecting and analyzing soil samples for analysis of grain size, moisture, total organic carbon, porosity, biological numeration, and nutrients.

2.1.2 Groundwater

- Characterize the lateral extent of TEX in shallow groundwater offsite to the west of the AST area by collecting and analyzing groundwater samples in the field. Temporary wells will be installed at multiple locations. A single, offsite shallow monitoring well will be installed near the downgradient extent of the plume as determined by data collected from the temporary wells; access restrictions may limit the final well location.

- Characterize the vertical extent of TEX in groundwater beneath the AST source area by installing a double-cased monitoring well adjacent to monitoring well MW-6 (Figure 3-1). A pilot soil boring will be advanced to approximately 5 feet below the screened interval of MW-6 or at a confining unit, whichever is encountered first. No soil sampling will be performed in this boring (soil sampling was already performed in these areas during previous RI investigations). A steel casing will then be grouted in place at that depth to prevent cross-contamination during deeper drilling. After the grout has set for at least 24 hours, a pilot boring will be advanced through the grout. Depth-discrete Hydropunch® groundwater samples will then be collected at 10-foot intervals (starting at the interval 5 feet below the steel casing). When the targeted sample depth is reached, depth- discrete Hydropunch® groundwater samples will be collected and analyzed in the field for VOCs using the onsite field gas chromatograph (GC). Co-located samples (collected in 40 mL VOA vials with no headspace) will be obtained for laboratory analysis at a rate of one sample for every five screening samples, or more frequently as deemed necessary. The borings will be advanced either to the top of bedrock, to the maximum depth limitation of the sampling/drilling equipment that is available (no deeper than 100 feet), or a depth where the field determined concentrations of any individual chemical do not exceed MCLs, whichever is encountered first. The boring will then be advanced 10 feet below this depth, reamed to 8 inches in diameter and a 4-inch diameter monitoring well with 10 feet of screen will be installed using the procedures outlined in the SAP.

- If needed, and pending the results of any additional soil investigations, shallow monitoring wells may be installed during a subsequent phase to evaluate the lateral and vertical extent of TCL VOCs, SVOCs, and TAL metals in shallow groundwater in the AST area. Installation of these wells will be based on analytical results of soil samples collected from borings installed in the AST area during the preliminary Phase III assessment activities.

2.2 Former Drum Area Investigation

2.2.1 Soils

- Three former drum areas were tentatively identified using the February 13, 1971 aerial photograph contained in the U.S. Environmental Photographic Interpretation Center's document entitled *Site Analysis; Island Chemical Company, St. Croix, Virgin Islands* dated April 1987. At the request of EPA, three borings were installed onsite at the possible former location of 238 drums. Two borings were installed onsite at the possible former location of 64 drums. One boring was installed onsite at the possible former location of 8 drums. These borings were installed and sampled (Figure 1-2) during preliminary Phase III site assessment activities to evaluate the possible presence of additional source(s) within these former drum areas. Analytical data from soil samples collected from these borings will be evaluated to determine if additional soil borings are needed to assess the additional source area(s) in the former drum areas, if present. The EPA will be contacted to discuss the locations of additional boring(s) in the former drum areas, if needed.

2.2.2 Groundwater

- If needed, additional monitoring well(s) may be installed to evaluate the lateral and vertical extent of TCL VOCs, SVOCs, and TAL metals in shallow groundwater in the former drum areas. Installation of these wells will be based on analytical results of soil samples collected from borings installed in the former drum areas during the preliminary Phase III assessment and other soil borings which may be installed during a subsequent phase.

2.3 Onsite Storm Drain Sediment and Soil Sampling

- Collect seven sediment samples within the onsite drainage system to characterize sediment within the onsite drainage system and two soil samples from each of the three onsite borings to be installed adjacent to the central drainage system to characterize the soil beneath the central storm drain (Figure 3-4). The sediment samples will be analyzed for TCL SVOCs, TAL metals, total organic carbon, particle grain size, pH, redox, percent moisture and conductivity. If the sediment is dry, pH and conductivity will not be measured. The soil samples will be analyzed for TCL VOCs, SVOCs and TAL metals.

2.4 Offsite River Gut and Bethlehem Gut Sampling

- Secure access to collect samples from offsite locations in River Gut. Collect two samples from each of the three borings in River Gut and fifteen sediment samples within the River Gut (Figure 3-4). Sampling in River Gut will be conducted upstream, across from, and downstream of the site. These data will be evaluated with data from previous sampling activities; access restrictions may limit the number of samples to be collected. The sediment samples will be analyzed for TCL SVOCs, TAL metals, total organic carbon, particle grain size, pH, redox, percent moisture and conductivity. If the sediment is dry, pH and conductivity will not be measured. The samples from the borings will be analyzed for TCL VOCs, SVOCs and TAL metals.

waste material not already targeted by this investigation. A total of three sediment samples will be collected from the Bethlehem Gut starting at the confluence of the River and Bethlehem Guts. One sample will be collected at the confluence with the River Gut, one sample will be collected 500 feet upstream from the confluence and one sample will be collected 1,000 feet upstream from the confluence (Figure 3-3). The samples will be analyzed for TCL SVOCs, TAL metals, total organic carbon, particle grain size, pH, redox, and conductivity. If the sediment is dry, pH and conductivity will not be measured.

- If needed, additional monitoring well(s) may be installed (outside of the River Gut) to evaluate the lateral and vertical extent of TCL VOCs, SVOCs, and TAL metals in shallow groundwater beneath the River Gut or Bethlehem Gut. Installation of these wells will be based on analytical results of soil samples from these guts during this phase and installed in the next phase, if needed.

2.5 Groundwater Sampling

- Evaluate site-wide distribution of TCL VOCs, SVOCs and TAL metals in groundwater by collecting groundwater samples from onsite and offsite wells including the newly installed shallow well(s), newly installed deep wells, shallow monitoring wells, and deep former production wells using low-flow purging techniques.

2.6 Evaluation of Groundwater Flow Direction and Aquifer Characteristics

- Perform downhole video surveys to evaluate the screen intervals and the integrity of onsite former production wells P1 and P2.

- Measure the water level in the new deep wells and existing onsite and accessible offsite production/monitoring wells to evaluate flow direction in the deep portion of the water-bearing zone. A minimum of three rounds of water level measurements will be collected. HLA will attempt to obtain construction details and driller or geologic logs of the onsite and offsite production/monitoring wells from sources on St. Croix.

- Estimate the hydrogeologic properties of the shallow and deep water-bearing zones by performing slug tests at one onsite shallow monitoring well (MW-2) and one onsite deep monitoring well (MW-2D) and by monitoring water level responses in nearby monitoring wells during development of the newly installed monitoring wells.

2.7 Data Validation

- Confirmation level laboratory data generated for investigative samples will be validated as discussed in the Work Plan.

2.8 Data Evaluation and Reporting

- Interpret, evaluate and summarize the results of the proposed supplemental investigation, incorporate the results with previous investigations, and prepare a Supplemental Data Summary Report for submittal to the EPA.

2.9 Meetings, Progress Reports, and Presentations to EPA

- One meeting with EPA will be requested following receipt, interpretation, and validation of data generated during the implementation of this RI Work Plan Addendum and prior to preparation of a final Draft Data Summary Report Addendum (DSRA) or preparation of the RI report, whichever is appropriate. At that time, the findings will be discussed along with the format for the final report. Additional meetings with EPA may be conducted as needed or upon request.

2.9 Meetings, Progress Reports, and Presentations to EPA

- One meeting with EPA will be requested following receipt, interpretation, and validation of data generated during the implementation of this RI Work Plan Addendum and prior to preparation of a final Draft Data Summary Report Addendum (DSRA) or preparation of the RI report, whichever is appropriate. At that time, the findings will be discussed along with the format for the final report. Additional meetings with EPA may be conducted as needed or upon request.

- Monthly progress reports will continue to be submitted to EPA on the 15th day of each month (or first business day thereafter). The monthly progress reports will be prepared in accordance with the Administrative Order on Consent and the Work Plan.

2.10 Management and Disposal of Investigation-Derived Wastes

- Investigation-derived waste (IDW) will be managed in accordance with procedures outlined in Section 3.6 of this Work Plan.

3.0 SUPPLEMENTAL REMEDIAL INVESTIGATION TASKS

The tasks to be completed during this phase of the RI are discussed below. Specifics of well locations, wells to be sampled, soil sample locations, analytical parameters, and other activities may be modified based on possible legal access restrictions, physical restrictions and on the findings of various phases of each task. A summary of the proposed samples to be collected is presented in Table 1. EPA will be notified of any substantive changes. These changes, if necessary, will be discussed with and approved by EPA prior to implementation. Work will be conducted following the procedures outlined in the previously approved Work Plan and associated supporting documents.

3.1 Field Sampling Program

3.1.1 Soil and Groundwater Investigation at AST Area

3.1.1.1 Property Access and Well Permits

ICC representatives have secured the majority of offsite property access agreements necessary for this investigation. Prior to mobilization, ICC will make its best efforts to secure necessary property access to offsite sediment, soil and groundwater sampling locations described in this Work Plan. Prior to mobilization, HLA or the drilling contractor will obtain the appropriate permits from the Virgin Island Department of Planning and Natural Resources to install the proposed monitoring wells.

3.1.1.2 Soil Sampling

AST Area

Soil sampling will be performed to:

- Characterize the lateral and vertical extent of TEX in soil offsite and adjacent to Tanks 8 and 9 (west of boring SBB17)
- Assess the potential impacted areas in the general AST area
- Collect preliminary data regarding the applicability of soil vapor extraction and bioventing in the AST area as a possible remedial alternatives

Proposed boring locations are shown on Figure 3-1. Three soil borings will be installed approximately 20 feet west, west-northwest, and northwest of previous boring SBB17. Additional offsite borings may be installed based on photoionization detector (PID) field screening results and field observations.

Four borings (SBAST-1 through SBAST-4) were installed and sampled onsite during the preliminary Phase III site assessment activities conducted in June 1997. These borings were located within the AST area (Figure 1-2) north and south of the previously defined impacted area. Analytical data from soil samples collected from these borings will be evaluated to determine if additional sampling is necessary to assess the extent of impact in the AST area. The EPA will be contacted to discuss the locations of additional boring(s) in the AST area, if needed. The results from soil boring SBE-1 (installed during Phase I activities adjacent to former Tank 20) will be used in conjunction with data from the four new borings to evaluate the general AST area (no PID readings were measured and no VOCs were detected above the detection limit in soil samples collected from the boring installed at this location).

Soil sampling will follow the detailed procedures described in the EPA-approved Work Plan and supporting documents and which have been implemented by HLA in previous phases of this RI. At

each boring, soil samples will be collected continuously from ground surface to the water table using a split-spoon. Upon opening the split-spoon, the sample will be physically scored and screened for the presence of organic vapors using a PID. A sample from each 2-foot interval will then be immediately placed into a laboratory-prepared container sealed and stored in a cooler. Additional sample volume from each interval if available, will be placed into resealable plastic bags and screened in the field for headspace organic vapors using the procedures described in the Work Plan. Procedures for sample handling, management, and shipping will be implemented as described in the Work Plan.

Two soil samples from each boring will be analyzed: one from directly above the water table and one from the sample interval with the highest PID reading. If no PID readings are observed, sample intervals will be based on lithology as described in the RI Work Plan. Soil samples will be analyzed for TCL VOCs.

Shelby tube samples will be collected from two of the onsite borings for analysis of grain size, moisture, total organic carbon (TOC), and porosity to preliminarily evaluate the applicability of SVE as a remedial alternative for soil in the AST area. These samples will be collected using 3-inch outside diameter Shelby tubes. The Shelby tubes will be constructed of stainless steel tubing or equivalent materials. The lower end is beveled to form a tapered cutting edge. The upper end of the Shelby tube is fastened to a check valve that helps hold the sample in place as it is being withdrawn. The Shelby tube is positioned at the upper portion of the interval to be sampled, and advanced the length of the tube (typically 2 feet). The advancement of the Shelby Tube is performed smoothly and steadily by the application of hydraulic pressure from the drill rig to the drilling rod connected to the Shelby tube. The Shelby tube is extracted using the same mechanisms operated in reverse. Storage, shipping and handling of these samples is described in the revised draft SAP. The analysis of the Shelby tube soil samples will be performed by Raytheon Environmental Services Laboratory located in Boothwyn, Pennsylvania.

Two soil samples will be collected from two separate onsite soil borings for analysis of total heterotrophic plate count and a hydrocarbon utilizer (HCU) bacteria count to preliminarily evaluate the applicability of bioventing as a remedial alternative for soil in the AST area. These two soil samples will also be submitted for analysis to evaluate the available nutrient levels. The nutrient profile will include analysis of TOC, alkalinity, iron, ammonia, sulfate, sulfide, nitrate, nitrite, pH, and ortho phosphorus. One of the soil sampling locations for the bacteria counts will be collected from a soil sampling interval which exhibits relatively high PID readings. The remaining sample will be collected from a sampling interval which exhibits moderate PID readings. Analysis of total heterotrophic plate count and an HCU bacteria count samples will be performed by HLA, if approved by EPA.

Former Drum Areas

Three former drum areas were tentatively identified using the February 13, 1971 aerial photograph contained in the U.S. Environmental Photographic Interpretation Center's document entitled *Site Analysis; Island Chemical Company, St. Croix, Virgin Islands* dated April 1987. At the request of EPA, three borings were installed onsite at the possible former location of 238 drums. Two borings were installed onsite at the possible former location of 64 drums. One boring was installed onsite at the possible former location of 8 drums. These borings (Figure 1-2) were installed and sampled during preliminary phase III site assessment activities to evaluate the possible presence of additional source(s) within these former drum areas. Analytical data from soil samples collected from these borings will be evaluated to determine if additional soil borings are needed to assess the former drum areas. The EPA will be contacted to discuss the locations of additional boring(s) in the former drum areas, if needed.

Background Areas

Three background samples (Figure 3-4) will be collected from areas on the site that have not been impacted by site operations to evaluate the background concentrations of metals in onsite soil. These samples will be collected from the 0-to-6-inch depth interval and will be analyzed for TCL VOCs, TCL SVOCs, and TAL metals.

3.1.1.3 Shallow Groundwater Investigation

AST Area

The purpose of this task is to characterize determine the areal extent of the dissolved TEX in groundwater, where the TEX concentrations exceed their respective MCL. Groundwater samples will be collected at the water table at three off-site locations (Figure 3-1) approximately 50 feet west, west-northwest, and northwest of MW-6 using temporary monitoring wells.

The temporary monitoring wells will be constructed of 2-inch diameter PVC screen and riser as described in Section 2.5 of Appendix B. A 10-foot long screen will be positioned across the static water level. A 6.5-inch diameter boring for the temporary wells will be advanced using hollow-stem auger drilling methods to a depth approximately 5 feet below the water table. The water table will be located by evaluating split-spoon samples collected from the borehole. The temporary well will be installed through the auger and the augers will be removed. The water level measuring points will be marked and later surveyed to allow for groundwater elevation calculations. An oil-water interface probe will be used to measure static water levels and monitor for the presence of liquid phase hydrocarbons in each temporary well. Once the water level in the boring has remained constant for at least 45 minutes, a Teflon® bailer will be lowered into the well to retrieve a groundwater sample which will be transferred to laboratory-cleaned 40-mL glass vials. The groundwater sample will be analyzed onsite as soon as possible using a portable GC calibrated for TEX. The data collected through field GC screening will be classified as screening level data,

Further investigation, if necessary, will be guided by the results of the onsite GC analysis of groundwater samples from the three temporary wells. If TEX concentrations exceed their respective MCLs, additional temporary wells will be installed and sampled using the above procedures at incremental 50-foot radial locations (i.e., approximately 100 feet from MW-6). If the results of all three of the first groundwater samples collected from the initial temporary well are below MCLs, then a 4-inch diameter monitoring well will be installed at the furthest downgradient or western location. The well will be installed and developed as described in the RIWP. The well screen will be 10 feet long, have a slot size of 0.020 inches, and extend approximately 5 feet below the encountered water table depth. Development water will be placed in 55-gallon drums and staged onsite pending disposal or stolen. A minimum of three rounds of water level measurements will be collected from these wells as part of the site-wide groundwater monitoring program.. The temporary wells will be removed within 2 weeks after their installation. The PVC screen and riser will be extracted and the borings will be abandoned as described in the RIWP.

Former Drum Areas

If needed, monitoring well(s) will be installed to evaluate the lateral and vertical extent of TCL VOCs, SVOCs, and/or TAL metals in shallow groundwater in the former drum areas. Installation of these wells will be based on analytical results of soil samples collected from borings installed in the former drum areas during the preliminary Phase III assessment activities. The EPA will be contacted to discuss the locations of monitoring well(s) in the former drum areas, if needed.

3.1.1.4 Onsite Deep Groundwater Investigation

The vertical extent of TCL VOCs in groundwater onsite will be evaluated by installation of double-cased monitoring wells to be located near MW-2, MW-6 and a third location to be determined once the water level data from the preliminary assessment activities can be evaluated. EPA approval of the location of this well will be obtained prior to its' installation. A pilot soil boring will be advanced to approximately 5 feet below the screened interval of the adjacent monitoring well or at a confining unit, whichever is encountered first. No soil sampling will be performed in these borings (soil sampling was already performed in these areas during previous RI investigations). A steel casing will then be grouted in place at that depth to reduce the potential for cross-contamination during deeper drilling. The steel casing will be installed as follows. The pilot boring will be reamed to a diameter of 12-inches to the designated depth using auger or mud rotary drilling techniques, as dictated by field conditions. An 8-inch diameter steel casing with welded joints will then be lowered to the bottom of the boring and centered. Cement grout will then be emplaced in the annular space around the casing via a tremie pipe from the bottom up. The drilling fluid in the annular space will be displaced by the grout, the drilling equipment will be decontaminated and the drilling fluid inside the casing will be circulated thoroughly with potable water until visible drilling fluids have been removed and relatively clear water remains inside the casing.

After the grout has set for at least 24 hours, a pilot boring will be advanced through the grout. Depth-discrete Hydropunch® samples will be collected at 10-foot intervals (starting at the interval 5 feet below the steel casing). The Hydropunch® sampler is a specialized tool designed to obtain groundwater samples within the saturated zone without the installation of a monitoring well. It is constructed of stainless steel and Teflon with viton O-rings. The Hydropunch® sampler is designed to be driven by the slide hammer commonly used for obtaining split-spoon samples. The Hydropunch® sampler will be removed from the boring between each sampling interval and decontaminated using procedures described in the SAP.

When the targeted sample depth is reached, the Hydropunch® sampler is opened by pulling back the outside sleeve of the tool. Soil friction holds the drive cone in place as the sleeve moves up. Once opened, groundwater flows through the dedicated disposable screen into the tool from the surrounding formation. After allowing sufficient time for groundwater to fill the sample chamber, a Teflon bailer will be lowered into the borehole to retrieve a groundwater sample which will be transferred to laboratory-prepared 40-mL glass vials. These samples will be analyzed for VOCs using the onsite field GC. Co-located confirmation samples (collected in 40 mL VOA vials with no headspace) will be obtained for laboratory analysis at a rate of one confirmation sample for every five screening samples. Samples will be analyzed for TCL VOCs by CLP methodology. These confirmation samples will be preserved and handled as described in Section A2.8 of the RIWP.

The borings will be advanced either to the top of bedrock, to the maximum depth limitation of the sampling/drilling equipment that is available (no deeper than 100 feet), or a depth where concentrations of any individual chemical do not exceed MCLs, whichever is encountered first. The boring will then be advanced 10 feet below this depth, reamed to 8 inches in diameter and a 4-inch diameter monitoring well with a 10-foot screen will be installed, using the procedures outlined in the SAP. A diagram of the proposed double-cased well is provided as Figure 3-2.

Automated water level devices (e.g., TUBERs or equivalent) will be installed in each of the newly installed deep monitoring wells.

3.1.1.5 Aquifer Testing

Preliminary information on the hydrogeologic properties of the shallow and deep portions of the water-bearing zone will be obtained by conducting the following activities. During development of the newly installed wells, water levels will be continuously monitored in the well being developed and in the nearest wells using an automated data logger-pressure transducer system. This will

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provide information regarding possible hydraulic communication between the shallow and deep portions of the water-bearing zone. Monitoring of recovery of water levels in selected onsite wells after development will also provide information on relative hydraulic conductivity between the upper and lower portions of the aquifer. Slug tests will also be performed at one onsite shallow monitoring well and one deep monitoring well to supplement the data collected during well development.

3.1.1.6 Survey

The location and elevation of the temporary wells, soil borings and new wells will be surveyed as specified in the Work Plan. The horizontal and vertical position will be surveyed with respect to the Puerto Rican/Virgin Islands plane coordinate system (North American Datum of 1983, or NAD 83) to the nearest tenth of a foot. The well locations will be converted from plane coordinates to latitude and longitude. The vertical position of the temporary wells, soil borings, and new wells will be surveyed with respect to Mean Sea Level (MSL) to the nearest hundredth of a foot. Well elevations to be surveyed include the top of inner casing, top of outer casing, and adjacent ground surface. The location of the inner casing elevation measurement will be permanently marked for future water level measurements. Temporary well elevations to be surveyed include the top of casing and adjacent ground surface. The ground surface at each of the soil borings will also be surveyed.

3.1.2 Site-Wide Groundwater Quality Sampling

After installation and development of the new wells in the AST area, groundwater samples will be collected from the onsite and offsite monitoring wells and the deep production wells (P-1 and P-2). The site-wide groundwater sampling will be conducted to further evaluate groundwater quality at the site. Specifically, objectives of the site-wide groundwater sampling are (1) to evaluate the extent of TEX compounds related to the AST area, and (2) to assess the presence of chloroform previously reported at MW-2. Groundwater sampling will be conducted approximately 2 weeks after installation and development of the new wells. HLA will supply precipitation data for the two-week period prior to groundwater sampling activities are implemented.

At the request of EPA, low-flow (minimal drawdown) groundwater sampling procedures (as described in Puls and Barcelona, 1995) will be utilized in lieu of the procedures described in the Work Plan. A 2-inch diameter Grundfos® Redi Flo 2 submersible sampling pump or a bladder pump will be utilized for purging and sampling. As recommended by Puls and Barcelona (1995), HLA will purge and sample using a flow rate not to exceed 0.5 liters per minute. Water quality probes will be used to measure key indicator parameters (temperature, pH, specific conductance, redox, dissolved oxygen, and turbidity) during purging. After stabilization of the water quality indicator parameters, groundwater samples will be collected directly from the pump discharge line. Sample containers, preservation, shipping, and chain-of-custody procedures will be implemented as described in the Work Plan. Groundwater samples will be analyzed for TCL VOCs, TCL SVOCs, and TAL metals using CLP protocols. As requested by EPA, local precipitation records for the two-week period prior to each groundwater sampling event will be submitted with the groundwater analytical data.

3.1.3 Onsite Groundwater Elevation Monitoring

Groundwater elevations have been monitored at the site using automatic water level recorders (TUBERs) installed at MW-1 and MW-3 in August 1995 and at MW-4 and MW-5 in April 1996. Four recorders are currently installed. The most recent data (since June 1997) will be downloaded from these recorders during the upcoming field program. These data will be combined with water levels which will be measured manually from all wells prior to the site-wide groundwater sampling event. A minimum of three rounds of water levels measurements will be conducted. Groundwater contour maps will be prepared for selected dates using the water table elevations calculated from the manual and automated measurements.

3.1.4 Evaluate Groundwater Flow Direction In Deep Water-Bearing Zone

HLA has recently received documents from the U.S. Geological Survey (USGS) entitled *Water Resources Data Puerto Rico and the U.S. Virgin Islands Water Year 1992, USGS Water-Data Report PR-92-1,1993* and *Water Wells on St. Croix, U.S. Virgin Islands, Open File Report 91-503, 1994* . HLA has also requested the most recent Water Resources Data report and any other relevant information concerning water level data on St. Croix from the USGS. HLA will utilize these data in conjunction with information obtained from the onsite and offsite deep wells, as described below, to estimate the regional flow direction of the deeper portion of the water-bearing zone.

3.1.4.1 Onsite Deep Wells

The onsite deep production wells (P-1 and P-2) will be evaluated using a video television camera to assess well integrity and screen intervals. After the survey, water levels(minimum of three rounds) will be measured at P-1 and P-2 a minimum of three rounds as part of the site-wide monitoring program. These data will be combined with water level data from the new onsite deep wells to assess onsite flow direction in portions of the deep water-bearing zone.

3.1.4.2 Offsite Deep Wells

The purpose of this task is to measure groundwater levels in the offsite production wells to aid in evaluation of regional flow direction in the deep water-bearing zone in the vicinity of the site. The existence of these wells was field verified during the preliminary Phase III assessment activities. The locations have been plotted based on existing records and aerial photograph review. The offsite production wells from which water level measurements will be collected include (see Figure 3-3):

- Former WAPA well directly south of site
- Well at Charlie's Concrete Company (east of site)
- Well at Meridian Engineering (northwest of site)
- Virgin Islands Port Authority (VIPA) Wells 1 and 2 (west of site)
- U.S. Geological Survey wells downstream of the site near confluence with Bethlehem Gut
- Well at Carr's.
- Well at Zenon Construction

ICC has secured access agreements for the above wells. Prior to mobilization for the field sampling program, HLA will attempt to obtain relevant information regarding the construction, usage, and status of these wells. Groundwater levels will then be measured at the wells using the procedures outlined in the Work Plan.

The groundwater elevations calculated from the offsite and onsite deep wells will be used to evaluate flow direction in the deep portion of the water-bearing zone. Water level contour map(s) will be prepared.

3.1.5 Onsite Storm Drain Sediment and Soil Sampling

3.1.5.1 Sediment Sampling

Samples of sediments will be collected at onsite locations shown in Figure 3-4. Sediment samples SDCSD1 through SDCSD5 will be collected from the central storm drain system, if present. Samples SDSSD1 and SDSSD2 will be collected from sediments, if present, in the southern storm drain system. These samples will only be collected if sufficient material exists for analytical purposes. The locations may be modified in the field to nearby depositional areas where adequate sediment volumes are available. Sample SDCSD1 will be collected from the storm drain at a point approximately 25 feet below the process area. Sample SDCSD2 will be collected from the junction of the lines forming the

3.1.5.2 Soil Sampling

As requested by the EPA, one boring was to be installed at the approximate location where elevated photoionization detector (PID) field screening results were detected during the excavation of the former central storm drain constructed of 55-gallon drums attached end to end. Historical information and reports concerning the removal of the 55-gallon discharge line do not indicate the exact locations where elevated PID readings were detected. Therefore, three borings, spaced equal distance from each other (approximately every 40 feet), will be installed along the discharge line from the edge of the concrete pad to the River Gut.

Two soil samples from each boring will be analyzed: one from directly above the water table and one from the sample interval with the highest PID reading. If no PID readings are observed, sample intervals will be based on lithology as described in the RI Work Plan. Soil samples will be analyzed for TCL VOCs, SVOCs and TAL metals.

3.1.6 Offsite River and Bethlehem Gut Sampling

Samples SDRG1A through SDRG11 will be collected from the River and Bethlehem Gut stream channels (Figures 3-4 and 3-5).

- Samples SDRG1A, SDRG1B, and SDRG1C will be selected in the field at locations upstream of the abandoned railroad bridge, and upstream of drainage from the bulldozed area adjacent to the site 25 feet of each other in the River Gut. These samples will be evaluated as background sediment samples.

- Sample SDRG1 will be collected approximately 100 feet upstream of the site boundary in a depositional area of the stream bed, just downstream of the abandoned railroad bridge. Sample SDRG2 will be collected from the northeastern stream bank in an area of waste material observed in the fill. Sample location SDRG2 is located at a seep of petroleum-like material, if still present (visually identified by HLA in 1995 during ecological investigation activities), in the fill material on the northern bank of the River Gut.

- Sample SDRG3 will be collected from the depositional areas of the stream bed upstream of the former lab drain discharge.

- Sample SDRG4 will be collected from the depositional areas of the stream bed below the former lab drain.

- Sample SDRG5 will be collected from the depositional areas of the stream bed approximately 100 feet downstream from SDRG4.

- Sample SDRG6 will be collected in an area of waste material observed, if still present (visually identified by HLA in 1995 during ecological investigation activities), in the fill on the northeastern side of the River Gut bank.

- Sample SDRG7 will be collected from the depositional areas of the River Gut stream bed at a point approximately 50 feet upstream of the discharge of the central storm drain system.

- Sample SDRG8 will be collected from the depositional areas of the stream bed at a point where the central storm drain system from the site discharges to River Gut.

- Sample SDRG9 will be collected from the depositional areas of stream bed at the point where southern storm drain system from the site discharges to River Gut.

- Sample SDRG9A will be collected from the depositional areas of stream bed at approximately 500 feet downstream of sample SDRG9.

- Sample SDRG10 will be collected from sediment deposits on the upgradient side of the berm located in the River Gut channel near the site.

- Sample SDRG11 will be collected from sediment deposits on the upstream side of the sheet piling installed in the River Gut stream channel, downstream of the site.

- Samples SDRG12 through SDRG17 will be reserved for collecting sediments from the portions of the River Gut bank adjacent to the Golden Grove Correctional Facility, Meridian Engineering, Virgin Islands Asphalt Products Company and Charlie's Concrete in areas of observed waste material not already targeted by this investigation.

- Samples SDBG1 through SDBG3 will be collected from the Bethlehem Gut starting at the confluence of the River and Bethlehem Guts. One sample will be collected at the confluence, one sample will be collected 500 feet upstream from the confluence and one sample will be collected 1,000 feet upstream from the confluence.

The sediment samples will be analyzed for TCL SVOCs, TAL metals, total organic carbon, particle grain size, pH, redox, percent moisture and conductivity. Ph and conductivity will not be measured if the sediment is dry.

If physical access is possible and health and safety considerations are not compromised, one boring will be installed in the River Gut at each of the locations SBRG-1, SBRG-2, and SBRG-3 (Figure 3-4), as requested by the EPA. Two samples from each boring will be analyzed: one from directly above the water table and one from the sample interval with the highest PID reading. If no PID readings are observed, sample intervals will be based on lithology as described in the RI Work Plan. River Gut samples will be analyzed for TCL VOCs, SVOCs and TAL metals.

Additional onsite and offsite borings may be installed based on PID field screening results and field observations. Additional samples in the vicinity of the samples collected from borings installed in the River Gut may be collected based on analytical results of the samples collected during this phase.

If needed, additional monitoring well(s) may be installed to evaluate the lateral and vertical extent of TCL VOCs, SVOCs, and TAL metals in shallow groundwater beneath the River Gut. Installation of these wells will be based on analytical results of River Gut samples collected from the borings during this phase and will be installed during the next phase, if needed.

3.2 Data Validation

Confirmation level laboratory data generated for investigative samples will be validated as discussed in the Work Plan.

3.3 Data Evaluation

The data generated during this phase of the RI will be evaluated in conjunction with the data previously generated and reported by HLA (1995, 1996). The data will be evaluated to gain further information on the following:

- Onsite and offsite extent of TEX in soil and groundwater in AST Area

- Existence of potential impacts in the AST and former drum areas

3.3 Data Evaluation

The data generated during this phase of the RI will be evaluated in conjunction with the data previously generated and reported by HLA (1995, 1996). The data will be evaluated to gain further information on the following:

- Onsite and offsite extent of TEX in soil and groundwater in AST Area
- Existence of potential impacts in the AST and former drum areas
- Extent of dissolved TCL VOCs, SVOCs and TAL Metals in groundwater
- Flow direction(s) in the shallow and deep portions of the water-bearing zone
- Onsite sediment and River and Bethlehem gut sediment TCL SVOCs and TAL metals concentrations
- Onsite and offsite soil TCL VOC, SVOC, and TAL metals concentrations near the site drainage system
- Background soil TCL VOCs, TCL SVOCs and TAL metals concentrations.
- Potential applicability of SVE and bioventing as possible remedial alternatives for soil in the AST area
- Baseline ecological assessment information concerning potential ecological receptors and exposure pathways associated with the River Gut from the vicinity of the site to the confluence with the Bethlehem Gut.

3.4 Update/Track ARARs

The list of Applicable or Relevant and Appropriate Requirements (ARARs) will continue to be revised, as needed, throughout completion of the RI activities to take into consideration additional chemical data, site conditions, and potential remedial actions. Further, state and federal registers will continue to be reviewed periodically to identify changes to the ARARs that have already been identified.

3.5 Project Meetings and Reporting

3.5.1 Meetings with EPA

One meeting with EPA will be requested following receipt, interpretation, and validation of data generated during the implementation of this RI Work Plan Addendum and prior to preparation of a final Draft Data Summary Report Addendum (DSRA) or preparation of the RI, whichever is appropriate. At that time, the findings will be discussed along with the format for the final report. Additional meetings with EPA may be conducted as needed or upon request.

3.5.2 Monthly Progress Reports

Monthly progress reports will continue to be submitted to EPA on the 15th day of each month(or first business day thereafter). The monthly progress reports will be prepared in accordance with the Administrative Order on Consent and the Work Plan.

3.6 Management of Investigation-Derived Waste

Investigation-derived waste (IDW) will be managed in accordance with procedures outlined in the Work Plan.

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4.0 ANTICIPATED SCHEDULE

The following is the anticipated schedule to implement the Phase III RI activities as described in this Work Plan. This schedule assumes that all necessary drilling and access permits will be secured prior to August 4, 1997. The schedule has not been finalized with the drilling subcontractor, therefore the schedule is subject to change:

ACTIVITY	DATE
Implement Revised Phase III Work Plan	August 4, 1997 - September 19, 1997
-AST Area Investigation	August 4 - August 15
-Onsite Deep Groundwater Investigation	August 18 - August 27
-Onsite Storm Drain Sediment and Soil Sampling	August 28 - September 3
-Offsite River and Bethlehem Gut Sampling	September 4-September 5
-Site-Wide Groundwater Quality Sampling	September 8 - September 12
-Contingency	September 15 - September 19

TABLES

TABLE 1.
SUMMARY OF PROPOSED SAMPLES
REMEDIAL INVESTIGATION -PHASE III
VIRGIN ISLAND CHEMICAL SITE
ST.CROIX, U.S. VIRGIN ISLANDS

Location	Sample Type	No.of Borings/Monitoring Wells	No. of Samples	Analysis
AST Area	Soil grab	3	8	TCL VOCs,SVOCs,TAL metals
AST Area	Soil grab	N/A	2	(HCU) bacteria count,TOC, alkalinity, iron,ammonia,sulfate,nitrate, nitite,pH, ortho phosphorous
AST Area	Shelby Tube soil	N/A	3	grain size, moisture, total organic carbon (TOC), and porosity
Onsite Background	Soil grab	N/A	3	TCL VOCs,SVOCs,TAL metals
AST Area	GW grab	3 shallow temp.,1 shallow perm.	4	TCL VOCs,SVOCs,TAL metals
Onsite	GW Hydropunch	3 deep	10-ft intervals	Onsite portable GC for VOCs; 20% lab confirmation samples
Onsite	GW grab	3 deep perm.	3	TCL VOCs,SVOCs,TAL metals
Onsite	GW grab	existing MWs(5) and prod wells (2)	7	TCL VOCs,SVOCs,TAL metals
River and Bethlehem Gut	Sediment grab	N/A	2 4	TCL SVOCs,TAL metals, TOC, pH, alkalinity conductivity, redox, percent moisture, particle grain size
Onsite Storm Drain System	Sediment grab	N/A	7	TCL SVOCs,TAL metals, TOC, pH, alkalinity conductivity, redox, percent moisture, particle grain size
Onsite Central Storm Drain	Boring Sample	3	6	TCL VOCs,SVOCs,TAL metals
River Gut	Boring Sample	3	6	TCL VOCs,SVOCs,TAL metals

N/A - Not applicable
MW- Monitoring Well
GW- Groundwater
G:\work\35241\phaseIII\wptbl.doc

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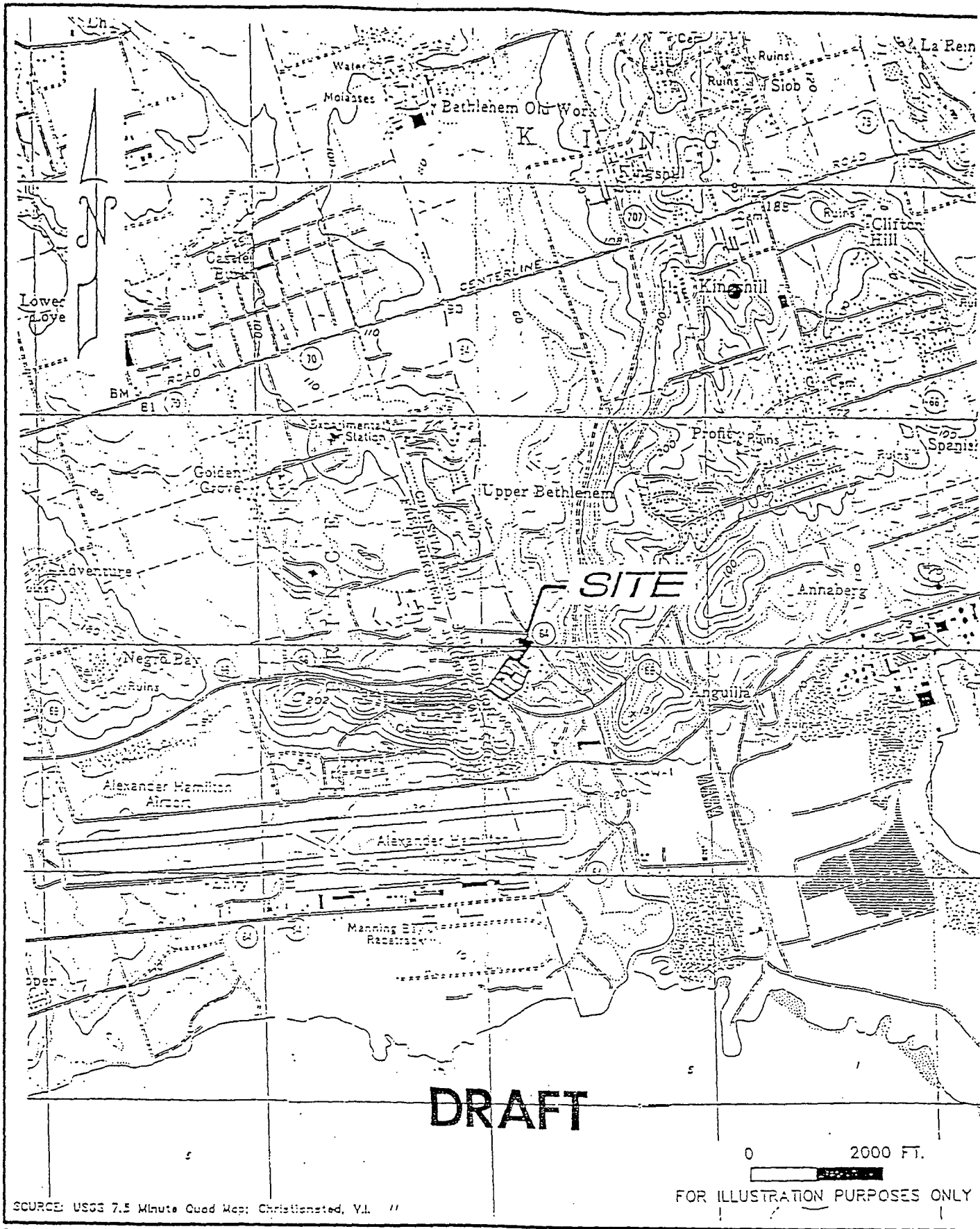
FIGURES



SOURCE: USGS 7.5 Minute Quad Map: Christiansted, V.I.

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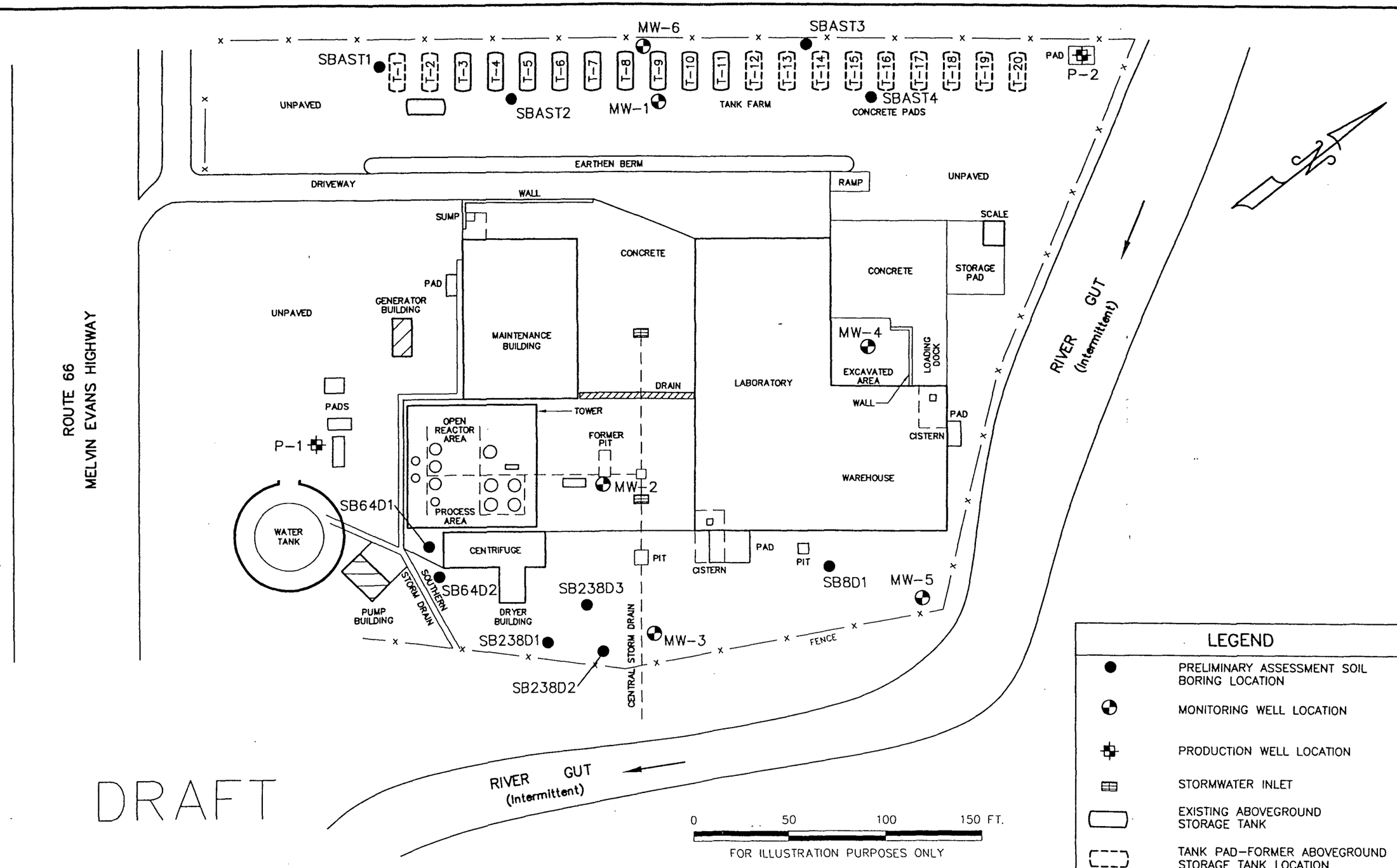
131 North Third Street
Philadelphia, Pennsylvania 19106
215-627-4505

SITE LOCATION MAP 302318

VIRGIN ISLAND CHEMICAL SITE
St. Croix, U.S. Virgin Islands

FIGURE 1-1

DRAWN	JOB NUMBER	APPROVED	DRAWING NUMBER	DATE	REVISED DA
WGA	35241.5		35241A0A	11/5/96	



LEGEND

- PRELIMINARY ASSESSMENT SOIL BORING LOCATION
- MONITORING WELL LOCATION
- PRODUCTION WELL LOCATION
- STORMWATER INLET
- EXISTING ABOVEGROUND STORAGE TANK
- TANK PAD–FORMER ABOVEGROUND STORAGE TANK LOCATION

SOURCE:
ADAPTED FROM SITE MAP, VI CHEMICAL, ST. CROIX, U.S.V.I. BY NUS CORPORATION DOCUMENT 02-9101-04-5I, UNDATED

Harding Lawson Associates
Engineering and Environmental Services
14 Washington Road
Princeton Junction, New Jersey 08550
609-936-0700

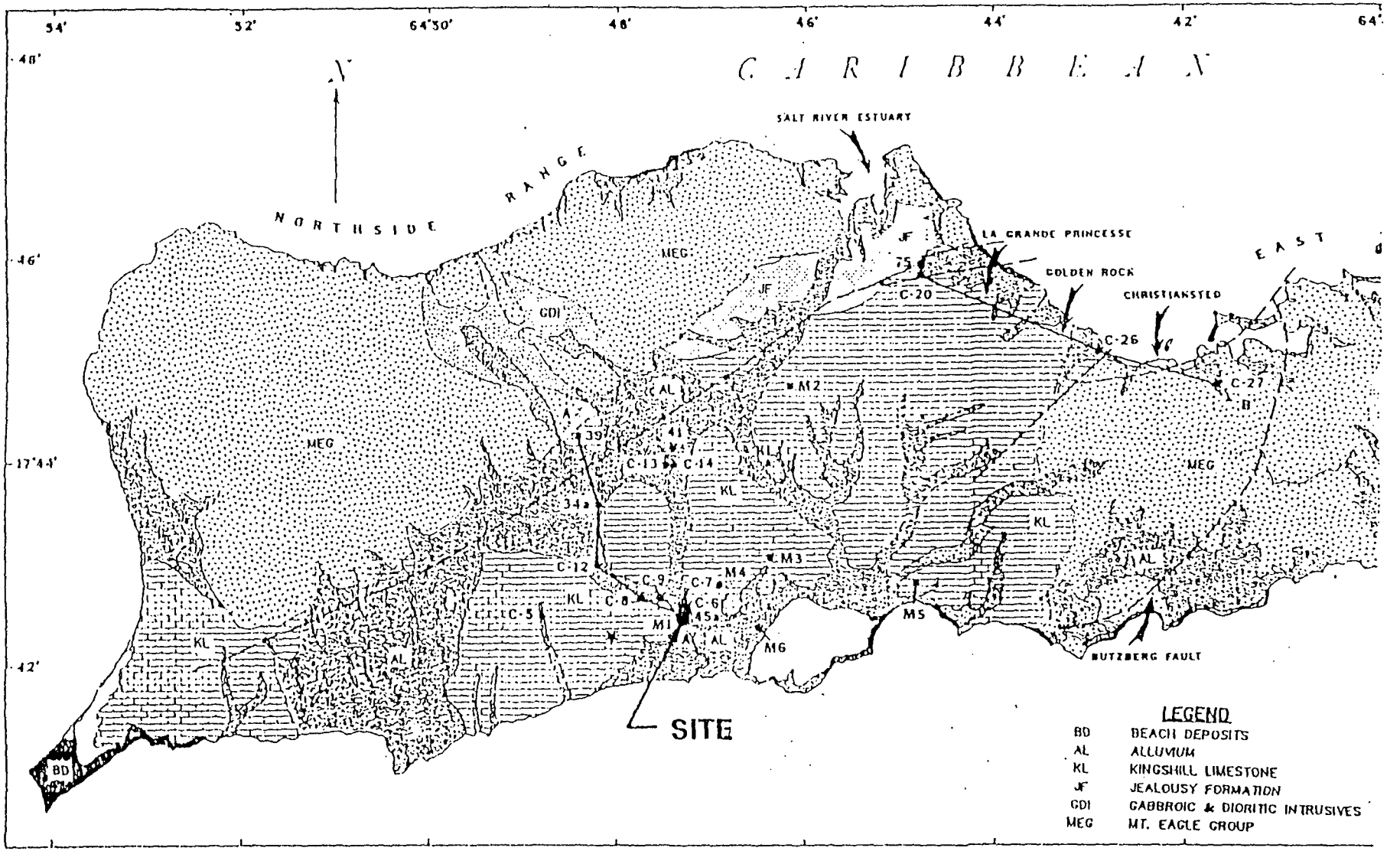
LOCATION OF MONITORING AND PRODUCTION WELLS AND PRELIMINARY ASSESSMENT SOIL BORINGS

VIRGIN ISLAND CHEMICAL SITE
St. Croix, U.S. Virgin Islands

FIGURE 1-2

DRAWN	JOB NUMBER	APPROVED	DWG. No.	DATE	REVISED DATE
JSW/WGA	35241.2.12		35241D03	11/3/88	

302319



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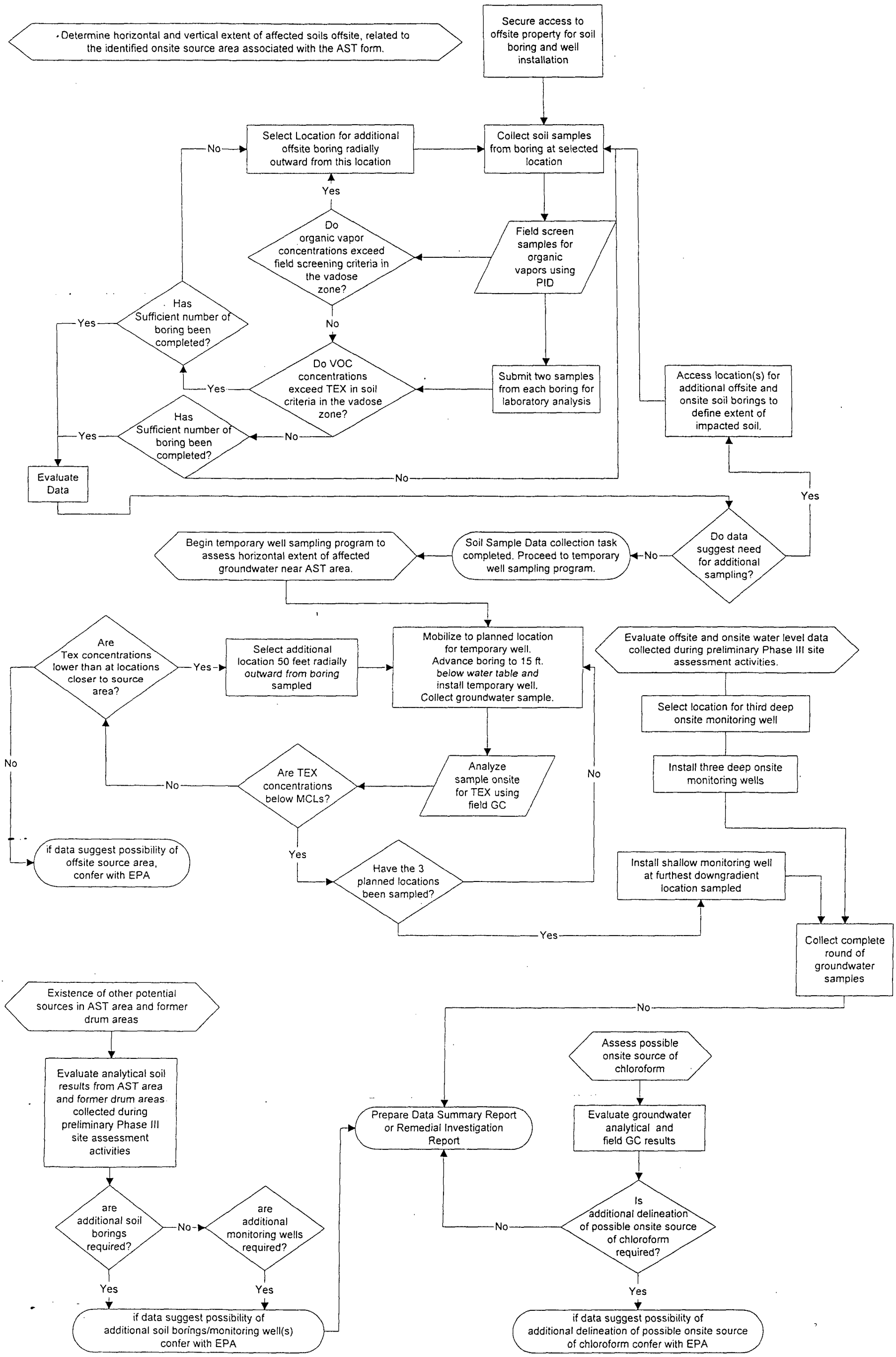
REGIONAL GEOLOGICAL MAP

VIRGIN ISLAND CHEMICAL SITE
St. Croix, U.S. Virgin Islands

FIGURE
1-3

DRAWN	JOB NUMBER	APPROVED	DRAWING NUMBER	DATE	REVISED DATE
WGA	35241.5				



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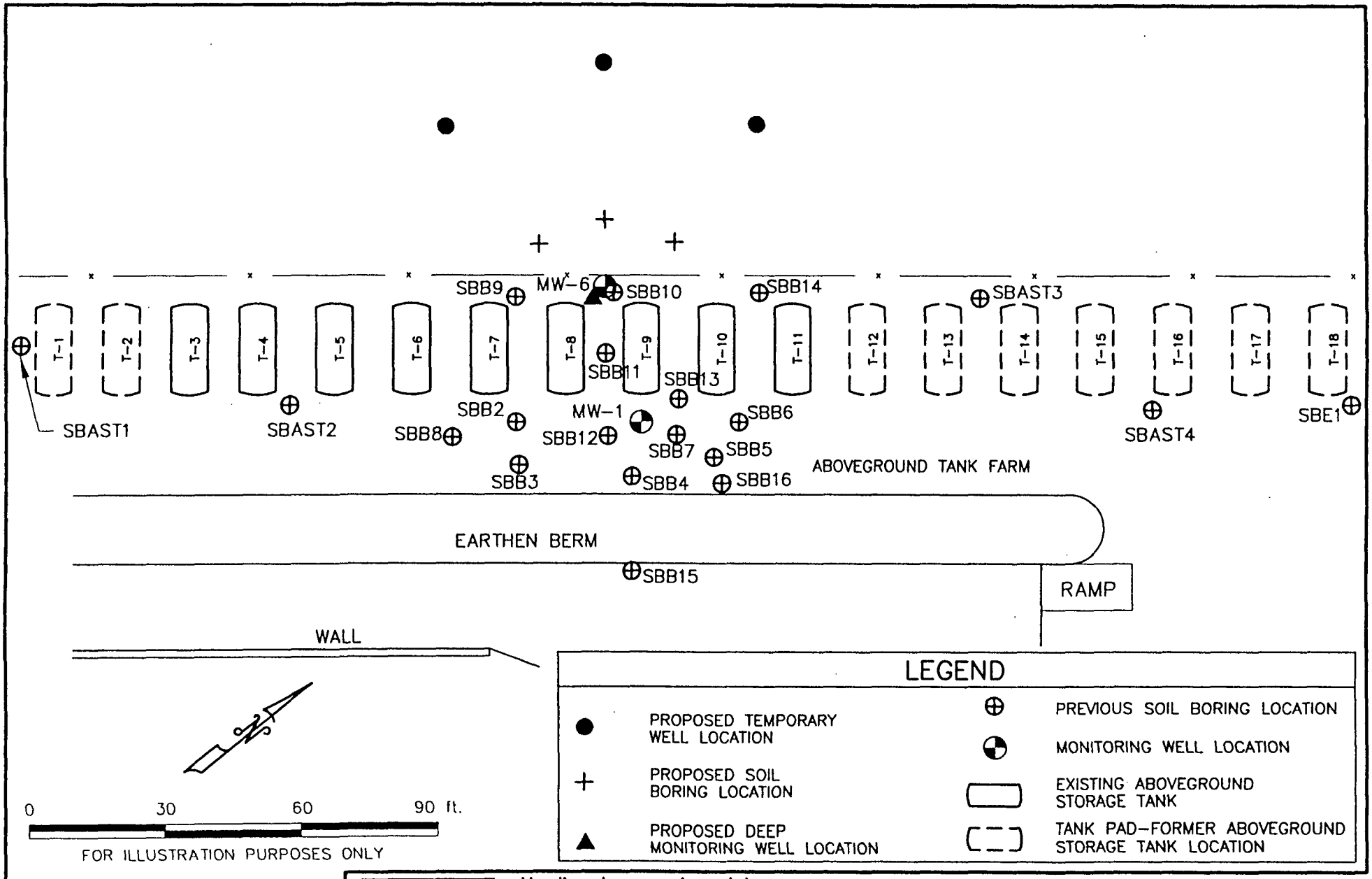
FLOW CHART

VIRGIN ISLAND CHEMICAL SITE
St. Croix, U.S. Virgin Islands

DRAWN	JOB NUMBER	APPROVED	FILE	DATE	REVISION NO.
TJC	30241.13		30241B01.WSD	1/21/91	

FIGURE 2-1



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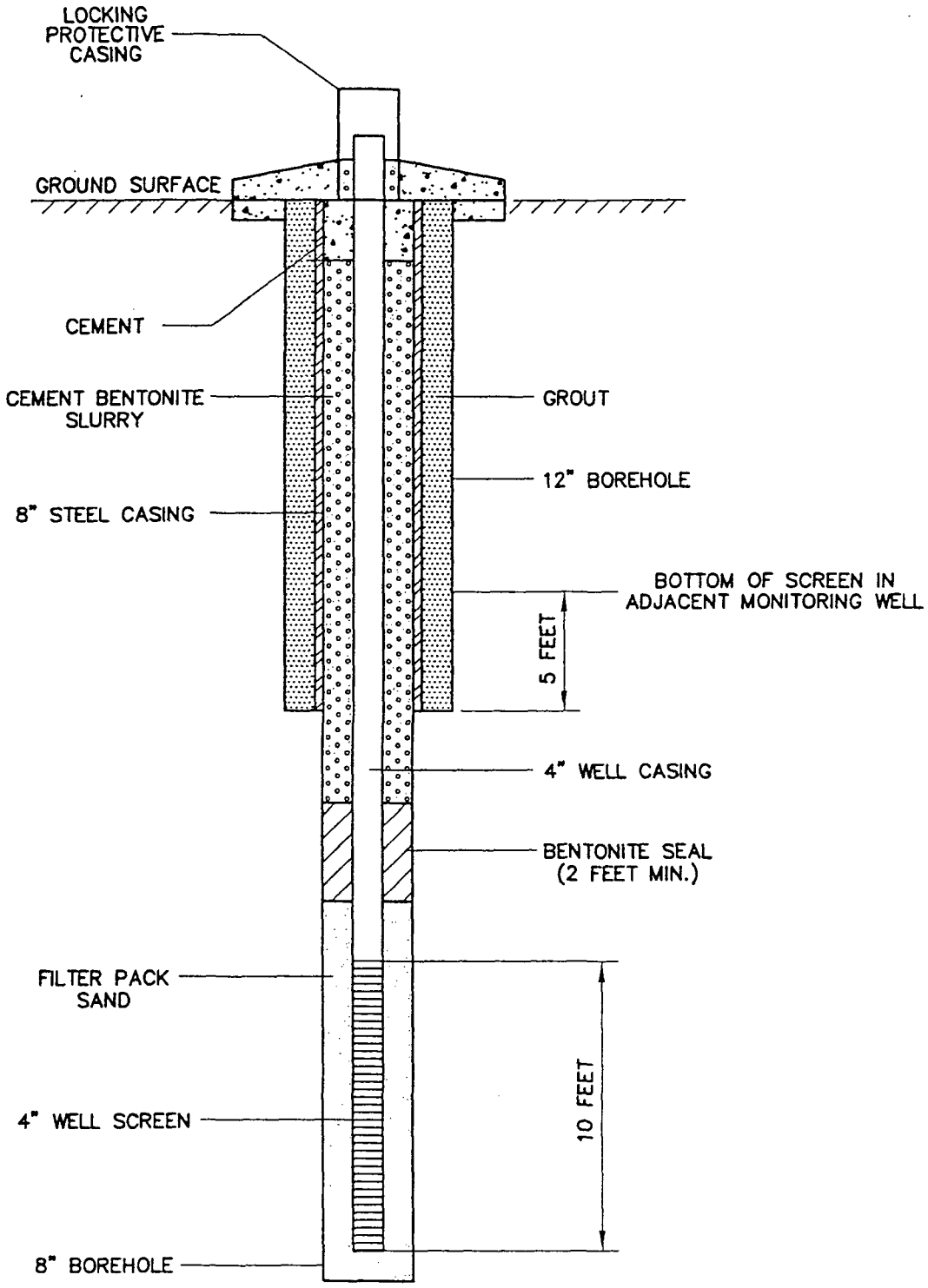
PROPOSED SAMPLING LOCATIONS

VIRGIN ISLAND CHEMICAL SITE
St. Croix, U.S. Virgin Islands

FIGURE
3-1

DRAWN	JOB NUMBER	APPROVED	DRAWING NUMBER	DATE	REVISED DATE
WGA	35241.5		35241A11	11/7/96	6/20/97



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DOUBLE-CASED MONITORING WELL CONSTRUCTION DIAGRAM

VIRGIN ISLAND CHEMICAL SITE
St. Croix, U.S. Virgin Islands

FIGURE 3-2

DRAWN	JOB NUMBER	APPROVED	DRAWING NUMBER	DATE	REVISED DATE
ETG/WGA	35241.5		35241A07	11/7/96	7/21/97

GOLDEN GROVE ADULT CORRECTIONAL FACILITY

UNDEVELOPED

ARGICULTURAL

ROUTE 64

MERIDAN ENGINEERING COMPANY

VIRGIN ISLANDS ASPHALT PRODUCTS COMPANY

VIRGIN ISLANDS PAVING COMPANY

FIX-IT-RIGHT TRANSMISSION

BETHLEHEM GUT

VIPA WELLS 1 and 2

UNDEVELOPED LOT

CARR'S

KING'S AUTOMOTIVE AUTO BODY

THREE SUBDIVISIONS (APPROXIMATE)

SITE

CHARLIES CONCRETE COMPANY (2 WELLS)

MELVIN EVANS HIGHWAY

RIVER GUT

U.S.G.S. MONITORING WELLS

WAPA WELL #1

ROUTE 66

FEDERAL GOVERNMENT

CATCHMENT AREA

0 200 400 600 FT.

FOR ILLUSTRATION PURPOSES ONLY

ZENON #1

LEGEND

- BUILDING
- STREAM
- ROAD
- TREE LINE
- EXPECTED LOCATION OF OFFSITE WELLS

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APPROXIMATE LOCATION OF OFFSITE PRODUCTION WELLS

VIRGIN ISLAND CHEMICAL SITE
St. Croix, U.S. Virgin Islands

FIGURE 3-3

SDRG-1A, SDRG-1B and SDRG-1C will be field located above abandoned railroad bridge and bulldozed fill material area.

SDRG-1A
SDRG-1B
SDRG-1C
SDRG-2
Abandoned Railroad Bridge
SDRG-1
MW-6
MW-1
UNPAVED
T-1 T-2 T-3 T-4 T-5 T-6 T-7 T-8 T-9 T-10 T-11 T-12 T-13 T-14 T-15 T-16 T-17 T-18 T-19 T-20
TANK FARM CONCRETE PADS
PAD
P-2
B-3
DRIVEWAY
WALL
EARTHEN BERM
UNPAVED
RAMP
SCALE
SUMP
B-1
PAD
GENERATOR BUILDING
Flow
MAINTENANCE BUILDING
CONCRETE
CONCRETE
STORAGE PAD
UNPAVED
MW-4
LOADING DOCK
SDCSD-1
LABORATORY
TRENCH
PADS
P-1
OPEN REACTOR AREA
TOWER
PROCESS PIT
Flow
SDCSD-2
SBCSD1
CISTERN
PAD
WAREHOUSE
MW-2
SDCSD-3
WATER TANK
CENTRIFUGE
PIT
CISTERN
PAD
PIT
MW-5
SDCSD-4
PUMP BUILDING
Flow
DRYER BUILDING
MW-3
UNPAVED
B-2
SDSSD-2
STORM DRAIN
SOUTHERN
CENTRAL STORM DRAIN
Flow
SBCSD2
SDCSD-5
SDSSD-1
SBCSD3
BERM
SDRG-3
RG-4
SBRG-1
SDRG-5
SDRG-6
SDRG-7
SDRG-8
SBRG-2
SDRG-9
SBRG-3
SDRG-10
SDRG-11
ROUTE 66
MELVIN EVANS HIGHWAY
RIVER GUT (Intermittent)
CONCRETE PLANT

Location of samples SDRG-10 and SDRG-11 is southeast of site on up-stream side of USGS installed berm and Sheet Piling respectively.

LEGEND

- PROPOSED SEDIMENT SAMPLE LOCATION
- PROPOSED BACKGROUND SOIL SAMPLE LOCATION
- PROPOSED SEDIMENT AND SOIL BORING LOCATION
- PROPOSED SOIL BORING LOCATION
- MONITORING WELL LOCATION
- PRODUCTION WELL LOCATION
- STORMWATER INLET
- EXISTING ABOVEGROUND STORAGE TANK
- TANK PAD-FORMER ABOVEGROUND STORAGE TANK LOCATION

0 80 160 240 ft.
FOR ILLUSTRATION PURPOSES ONLY

NOTES:

1) SAMPLES SDRG-12 THROUGH SDRG-17 WILL BE FIELD LOCATED IN AREAS OF OBSERVED NON-SITE RELATED MATERIAL ADJACENT TO COMMERCIAL FACILITIES IN THE VICINITY OF THE SUBJECT SITE AND THE RIVER GUT. (SEE FIGURE 3-3)

2) SAMPLES SDBG-1 THROUGH SDBG-3 WILL BE COLLECTED FROM BETHLEHEM GUT EVERY 500 FEET UPSTREAM FROM CONFLUENCE WITH RIVER GUT (SEE FIGURE 3-5)

SOURCE:
SITE MAP, VI CHEMICAL, ST. CROIX, U.S.V.I. BY NUS CORPORATION DOCUMENT 02-9101-04-5I, UNDATED AND AERIAL PHOTOGRAPHS

Harding Lawson Associates
Engineering and Environmental Services
14 Washington Road
Princeton Junction, New Jersey 08550
609-936-0700

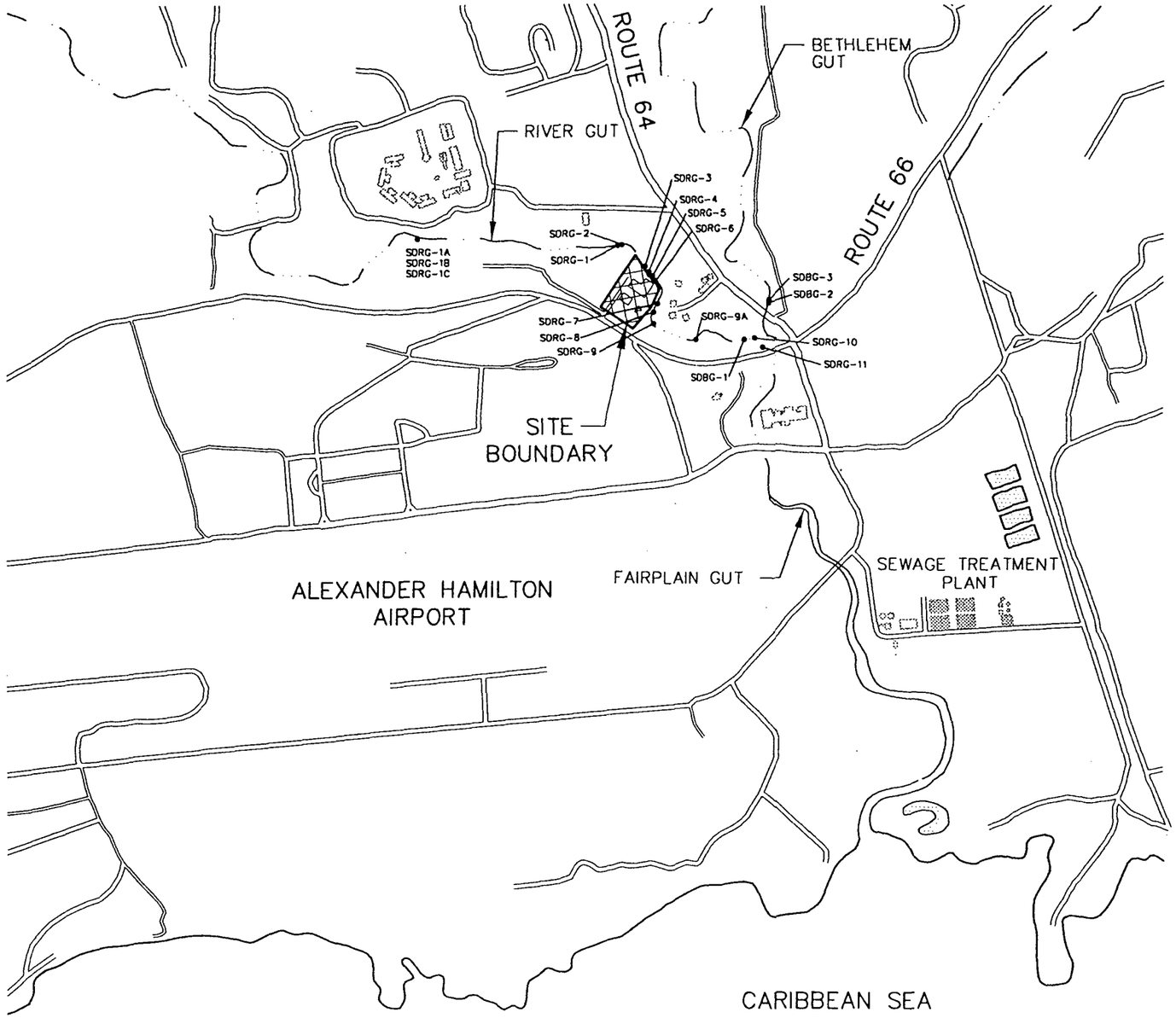
DRAWN JOB NUMBER APPROVED

PROPOSED SAMPLING LOCATIONS ONSITE AND RIVER GUT

VIRGIN ISLAND CHEMICAL SITE
St. Croix, U.S. Virgin Islands

FIGURE 3-4

302325



LEGEND

- SURFACE WATER
- ROAD
- STREAM
- PROPOSED SEDIMENT SAMPLE LOCATION

0 1000 2000 3000

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PROPOSED SAMPLING LOCATIONS
RIVER AND BETHLEHEM GUT

ISLAND CHEMICAL COMPANY
ST. CROIX, U.S. VIRGIN ISLANDS

FIGURE 3-5

DRAWN | JOB NUMBER | APPROVED | FILE | DATE

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APPENDIX A

CONTAINERS, PRESERVATION, PACKAGING, AND SHIPPING REQUIREMENTS

Appendix A. Containers, Preservation, Packaging, and Shipping Requirements
Island Chemical Company
St. Croix, U.S. Virgin Islands

Analysis	Containers	Preservation	Technical Holding Time[1]	Volume of Container	Shipping	Normal Packaging
Groundwater Organic Analyses						
TCL VOCs	Three 40-ml glass vials with Teflon septum-lined caps	1:1 HCl to pH <2, cool to 4°C in dark storage	14 days	Fill completely, no air bubbles	Ship within 24-hours of collection by overnight carrier	Bubble pack
TCL SVOs	Two 1-liter amber glass bottles with Teflon™-lined caps	Cool to 4°C in dark storage	Extract within 7 days, analyze within 40 days after extraction	Fill 90% full	Ship within 24-hours of collection by overnight carrier	Bubble pack
Pyridine	Two 1-liter amber glass bottles with Teflon™-lined caps	Cool to 4°C in dark storage	Extract within 7 days, analyze within 40 days after extraction	Fill 90% full	Ship within 24-hours of collection by overnight carrier	Bubble pack
TCL Pesticides and PCBs	Two 1-liter amber glass bottles with Teflon™-lined caps	Cool to 4°C, $Na_2S_2O_3$	Extract within 7 days, analyze within 40 days after extraction	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Groundwater Inorganic Analyses						
TAL metals (unfiltered)	One 1-liter polyethylene bottle	HNO_3 to pH <2.0	6 months, except Hg - 28 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
TAL metals (filtered)	One 1-liter polyethylene bottle	HNO_3 to pH <2.0	6 months, except Hg - 28 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Cyanide	One 1-liter polyethylene bottle	NaOH to pH >12, cool to 4°C	14 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Soil Organic Analyses						
TCL VOCs	One 120-ml vial with Teflon™-septa lined lid	Cool to 4°C in dark storage	10 days	Fill completely	Ship within 24-hours of collection by overnight carrier	Bubble pack
TCL SVOs and Pyridine	Two 16-oz. amber glass jars with Teflon™-lined lid	Cool to 4°C in dark storage	Extract within 7 days and analyze within 40 days after extraction	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack

Appendix A. Containers, Preservation, Packaging, and Shipping Requirements
Island Chemical Company
St. Croix, U.S. Virgin Islands

Analysis	Containers	Preservation	Technical Holding Time[1]	Volume of Container	Shipping	Normal Packaging
TCL Pesticides and PCBs	One 4-oz wide-mouth glass jar with Teflon™-lined lid	Cool to 4°C	Extract within 7 days and analyze within 40 days after extraction	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Soil Inorganic Analyses						
TAL Metals	One 8-oz wide-mouth glass jar with Teflon™-lined lid	Cool to 4°C	6 months, except Hg - 28 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Cyanide	To be analyzed using material from metals sample	Cool to 4°C	14 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Nitrate/Nitrite	One 32-oz glass bottle*	Cool to 4°C	28 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Sulfate	One 32-oz glass bottle*	Cool to 4°C	28 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Sulfide	One 32-oz glass bottle*	Cool to 4°C	7 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Iron (total)	One 8-oz wide-mouth glass jar with Teflon™-lined lid	Cool to 4°C	6 months	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Alkalinity	One 32-oz glass bottle*	Cool to 4°C	14 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Ammonia	One 32-oz glass bottle*	Cool to 4°C	28 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack

Appendix A. Containers, Preservation, Packaging, and Shipping Requirements
Island Chemical Company
St. Croix, U.S. Virgin Islands

Analysis	Containers	Preservation	Technical Holding Time[1]	Volume of Container	Shipping	Normal Packaging
Ortho phosphorus	One 32-oz glass bottle*	Cool to 4°C	48-hours	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
pH	One 32-oz glass bottle	Cool to 4°C	As soon as possible	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Total Organic Carbon	Shelby Tube	None	28 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Moisture	Shelby Tube	None	As soon as possible	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Grain size	Shelby Tube	None	None Set	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Porosity	Shelby Tube	None	None Set	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
HCU bacteria Count	500-ml Glass	Cool to 4°C	24-hours or as soon as possible	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Total plate bacteria count	500-ml Glass	Cool to 4°C	24-hours or as soon as possible	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack

Notes:
Parameters and detection limits will be consistent with methods listed in Tables C1-2 through C1-7 of the Quality Assurance Project Plan
Sample containers will be prepared according to OSWER Directive No. 9240-05-05A, "Specification and Guidance for Obtaining Contaminant-Free Sample Containers, (December 1992)" or certified clean containers (e.g., I-Chem 300 series) will be used. Certificates of analysis verifying sample container cleanliness will be retained and available for review by USEPA.

* There are no SW-846, Test Methods for Evaluating Solid Waste" protocols for nitrite, alkalinity, ammonia, or ortho-phosphate. We have proposed using EPA Chemical Analysis of Waters and Waste Methods. Because these methods were written for liquids, not solids, minor modifications will be required. Although nitrite can be analyzed by method SW 9200 we are not aware of any laboratories that still run this method. We propose analyzing nitrate similarly to nitrite. The following are brief descriptions of method modifications for each parameter:

1. Alkalinity - 10 grams of sample aliquot is leached with 100 ml of DI water for 1 hour. Decant 50 ml of leachate. Titrate as prescribed in method.
2. Ammonia - Distill 2 grams of sample to a final volume of 100 ml. Analyze by colorimetric autoanalyzer as prescribed in method.
3. Nitrate - 10 grams of sample aliquot is leached with 100 ml of DI water for 1 hour. Analyze by colorimetric autoanalyzer as prescribed in method.
4. Nitrite - 10 grams of sample aliquot is leached with 100 ml of DI water for 1 hour. Analyze by colorimetric autoanalyzer as prescribed in method.

ortho-phosphate - 10 grams of sample aliquot is leached with 100 ml of DI water for 1 hour. Analyze by colorimetric autoanalyzer as prescribed in method.

[1] The time of sample collection to extraction/analysis.

G	gram	<	less than	>	greater than	°C	degree Celsius
HNO_3	nitric acid	HCl	hydrochloric acid	H_2SO_4	sulfuric acid	Hg	mercury
oz.	ounce	ml	milliliter	NaOH	sodium hydroxide	$Na_2S_2O_3$	Sodium thiosulfate
VOCs	volatile organic compounds	SVOs	semivolatile organic compounds	TAL	Target Analyte List	TCL	Target Compound List

APPENDIX B

FIELD SAMPLING PLAN ADDENDUM

APPENDIX B
CONTENTS

302333

1.0 INTRODUCTION

Harding Lawson Associates (HLA) has prepared this addendum to the EPA-approved Remedial Investigation Work Plan (RIWP) - Sampling and Analysis Plan (SAP) (HLA, 1994) on behalf of Island Chemical Company, Inc. (ICC). This SAP Addendum will be included in the RIWP as Appendix AD in support of the RIWP Addendum (RIWPA) and responds to requirements set forth in the National Contingency Plan. The RIWPA includes the following activities which were not specified in the original RIWP:

- Collection of stream sediment samples
- Collection of undisturbed soil samples using a Shelby tube sampling device
- Collection of groundwater samples using a Hydropunch® sampling device
- Onsite analysis of groundwater samples using a portable gas chromatograph (GC)
- Installation of soil borings and monitoring wells using mud-rotary drilling methods
- Installation of temporary monitoring wells
- Installation of double-cased monitoring wells
- Collection of groundwater samples using low-flow groundwater sampling procedures
- Estimation of hydraulic properties of the shallow aquifer using slug testing methods

Procedures for additional activities planned during the implementation of the RIWPA are described in the SAP, Appendix A of the original RIWP.

2.0 FIELD INVESTIGATION PROGRAM

Specific field procedures to perform the activities identified in Section 1.0 above are presented in this addendum.

2.1 Stream Sediment Sampling

Efforts will be made to collect stream sediment samples when River Gut is not flowing. Section 2.1.1, presents the sampling procedures to be followed if the stream is dry. However, if it is necessary to collect sediment samples when River Gut is flowing, HLA will follow the sampling procedures described in Section 2.1.2.

2.1.1 Sediment Sampling When Stream is Dry

1. The proposed sample locations shown in Figure 3-4 of the RIWPA will be located by measuring from fixed visible reference points using a tape measure.

2. The area within roughly 10 to 20 feet of the proposed sample locations will be inspected visually to determine qualitatively the area of greatest sediment deposition. This area will be selected as the final sampling location.

3. A field-decontaminated, stainless steel hand auger will be used to collect the composite sediment sample from the 0-6-inch interval from three locations within the roughly 10 to 20 foot area described in step 1. The hand auger will be decontaminated before use following the procedures specified in Section A2.4.2.2 of the RIWP.

4. The sediment samples will be placed directly into a decontaminated stainless steel bowl, homogenized and transferred to laboratory-prepared sample containers. The sample containers will then be sealed, labeled as described in Section A2.10.1 of the RIWP, and placed directly into a cooler with ice (approximately 4°C).

5. The final sample location area will be marked and photographed to show its location with respect to fixed references.

6. The distance from each sampling point will be measured with respect to at least three fixed references and recorded to allow future relocation of the sample.

2.1.2 Sediment Sampling When Stream is Flowing

If possible, sediment sampling will be postponed until the stream is dry. If this is not practical, the stream sediments will be sampled using the following procedures:

1. Stream flow will be evaluated to determine if the stream can be entered safely.

2. Beginning at the furthest downstream location, HLA personnel will enter the stream at a location downstream of the proposed sampling location. All sample locations will be approached from the downstream direction to avoid disturbing upstream sediments that might be carried to downstream locations not yet sampled.

3. The proposed and final sample locations will be determined as described in Steps 1 and 2 of Section 2.1.1.

4. A field-decontaminated Eckman Dredge sampler will be used to collect the three sediment samples at each location to be combined as one composite sample.

5. The three sediment sample will be placed in a decontaminated stainless steel bowl, homogenized and transferred to laboratory-prepared sample containers. The sample containers will then be sealed, labeled as described in Section A2.10.1 of the RIWP, and placed directly into a cooler with ice (approximately 4°C).

6. The sample location will be photographed and recorded as described in Steps 5 and 6 of Section 2.1.1.

2.2 Shelby Tube Soil Sample Collection

Soil samples will be collected from fine-grained material using a Shelby tube sampling device. The Shelby tubes will be approximately 2 feet long, 3 inches in diameter and constructed of stainless steel tubing or equivalent materials. The upper end of the Shelby tube will be fastened to a check value that helps hold the sample in place as it is being withdrawn. Field documentation and equipment decontamination will be conducted as specified in the RIWP. The following procedures will be used to obtain undisturbed soil samples using the Shelby tube:

1. The boring will be advanced to the top of the interval to be sampled.

2. The drill bit and drilling rods will be removed from the boring and a field decontaminated Shelby tube sampler will attached to the drill rod assembly and lowered to the bottom of the boring.

3. The Shelby tube will then be pushed to the required depth, if possible. The Shelby tube will be advanced by the application of hydraulic pressure from the drill rig to the drill rod assembly.

4. Once the Shelby tube has been advanced to the final depth, activities will be halted for several minutes to allow the soil sample to equilibrate within the Shelby tube. The drill rod assembly will then be rotated 1/4 to 1/2 turn to separate the sample from the underlying soils.

5. The rod assembly with the Shelby tube sampler will then be withdrawn from the boring.

6. The Shelby tube will be disconnected from the drilling rod assembly and approximately 1 to 2 inches of soil will be removed from the bottom of the tube after it is recovered.

7. Both ends of the sample will then be sealed with several inches of paraffin, liquefied by heating. Care will be taken to completely seal the ends of the soil sample to prevent moisture loss

8. Once the paraffin has dried, any void space in the top of the tube will be filled tightly with a packing material, such as crumpled paper. Each end of the tube will be secured with a plastic end cap taped in place.

9. The outside of the Shelby tube will be labeled to indicate the sample identification, date of sampling, and top of the sample. Care will be taken to keep the sample in an upright position during handling. Instructions will be provided to the carrier to ship the samples in an upright

position.

2.3 Hydropunch® Groundwater Sampling

Groundwater samples will be collected from the pilot boring for deep monitoring wells MW-6D, MW-2D and a third deep monitoring well (location to be determined) using a Hydropunch® sampling device. The Hydropunch® is a 5-foot long sampling device that consists of a drive point; 1-inch diameter, 4-foot long disposable screen; and a retractable stainless steel sleeve. The screen is made of poly vinyl chloride (PVC) or polypropylene. The Hydropunch® will be used to collect groundwater samples from selected depth intervals using the following procedures:

1. Once the boring has been advanced to the selected depth by the driller, the drill bit and rods will be removed.

2. The Hydropunch® sampler, equipped with an unused, disposable screen, will be attached to the drill rods and set at the bottom of the boring.

3. The Hydropunch® sampler will be driven into the formation using a 140- or 300-pound hammer. The Hydropunch® sampler will be driven 4-feet into the formation or until refusal is encountered. A total of 100 blows over a six-inch interval will be considered refusal. The number of blows and distance driven will be recorded.

4. If the Hydropunch® sampler is driven less than 1-foot before refusal is encountered, no sample will be collected, the boring will be advanced 5 feet, and a second attempt will be made to drive the Hydropunch® sampler into the formation.

5. If the Hydropunch® sampler is driven 1-foot or more, the sleeve will be retracted approximately one-half the distance that the sampling device was driven (i.e., retract the sleeve 2 feet if the sampler is driven 4 feet), exposing the disposable screen to the formation. Sufficient time will be given to allow groundwater to flow into the Hydropunch®. An electronic depth-to-water probe will be lowered inside the drill rods and Hydropunch® to monitor groundwater recharge.

6. Groundwater will be allowed to equilibrate in the Hydropunch® for a minimum of 30 minutes or until the water level inside the drill rods has reached 90 percent of the distance from the water table to the bottom of the sampler.

7. A field-decontaminated 1/2-inch diameter Teflon™ bailer will be lowered on Teflon™-coated stainless steel cable through the Hydropunch® rods to collect a groundwater sample from the screened interval. Prior to use at each sampling interval, the Teflon™ bailer and cable will be decontaminated following the procedures described in Section A2.4.2.2. The bailer holds approximately 20 ml. Therefor the bailer will be lowered several times at each interval to completely fill the 40 ml vial with no headspace.

8. The color, qualitative and quantitative turbidity and other pertinent observations of the groundwater sample will be noted and recorded in the field book.

9. Approximately 20 milliliters (mL) of groundwater sample will be poured directly into an unpreserved 40-mL glass vial, and submitted for onsite analysis of toluene, ethylbenzene, and xylenes by the field GC as described in Section 2.7.

10. Co-located groundwater samples will be obtained for laboratory analysis at a rate of one sample for every ten screening samples. HLA will submit a minimum of one groundwater sample for laboratory analysis collected from zones displaying no detected volatile organic compounds (VOCs) by field screening. The co-located samples will be collected in 40-mL vials prepared by the laboratory, preserved in the field and submitted to the laboratory for analysis of Target Compound List (TCL) VOCs by Contract Laboratory Program (CLP) methodologies as specified in the RIWP. The co-located samples will be collected, preserved and handled as described in steps 23 through 27 of Section A2.8 of the RIWP.

2.4 Mud Rotary Drilling Methods

Mud-rotary drilling methods will be utilized to advance the deep boring for the double-cased well in the AST area. Mud-rotary drilling techniques are described below. Double cased well construction is described in Section 2.5.1.1

1. Prior to set up, the drill rig and equipment will be decontaminated by steam cleaning and/or a potable water wash as described in Section A2.4.2 of the SAP.

2. The drill rig and mud tub will be placed at the selected drilling location. The mud tub will contain baffles to enhance settlement of solids entrained in the drilling fluid.

3. A tri-cone roller or wing bit will be attached to the drill rods.

4. The mud tub will be partially filled with potable water. The potable water will be obtained from the driller's office, consistent with previous work on this project. The driller will then circulate the water through the drilling tools and mud tub adding bentonite-based drilling mud as necessary to create a viscous drilling fluid. The amount of bentonite added and the viscosity of the fluid will be established in the field at the discretion of the driller.

5. Once the driller is satisfied that the drilling fluid is of adequate consistency, the driller will advance the borehole to the desired depth. During drilling, the drilling fluid will be pumped down through the drilling rods. The fluid will circulate to the ground surface by rising in the annular space of the boring. Cuttings from the boring will be entrained with the rising fluid and will be separated to the extent possible in the mud tub at the surface. The viscosity of the fluid may be altered during drilling activities at the driller's discretion by adding water or mud.

6. During drilling, solids will be removed from the mud tub as needed and containerized onsite in 55-gallon drums. Drummed investigation-derived waste will be staged onsite until proper disposal arrangements are completed.

7. Soil samples will be collected and logged as described in Section A2.4.3 of the SAP.

8. The volume of drilling fluid lost to the formation will be monitored during drilling and recorded on the field boring log.

2.5 Monitoring Well Installation

Drilling methods for the installation of monitoring wells will be selected based on field conditions and the anticipated depth of the borehole. It is anticipated that the borings for the shallow soil zone will be drilled using hollow-stem augers and that mud-rotary drilling methods will be necessary for the

installation of deeper wells. Mud-rotary drilling methods may also be necessary for installation of shallow monitoring wells if problems with auguring are encountered.

The procedures described below will be used to construct the proposed double-cased and temporary groundwater monitoring well. Procedures for well development and for construction of single-cased monitoring wells are described in Section A2.5 of the RIWP. Well construction details will be recorded by an HLA geologist. Equipment decontamination will be conducted as described in Section A2.4.2 of the RIWP.

2.5.1 Double-Cased Well Construction

The following procedures will be implemented during installation of the double-cased monitoring well at the site:

1. Prior to set up, the drill rig and equipment will be decontaminated by steam cleaning and/or a potable water wash as described in Section A2.4.2 of the SAP.

2. The driller will advance a 12-inch diameter boring to approximately 5 feet above the predicted water table depth using mud-rotary drilling techniques as described in Section 2.4. The approximate depth to the water table will be estimated before drilling activities begin based on groundwater elevations measured at nearby monitoring wells.

3. Beginning at this depth, the driller will collect soil samples using a split-spoon sampling device as described in Section A2.4.3. Split-spoon samples will be collected continuously until the water table is encountered. An HLA geologist will examine the soil samples to determine the level of the water table.

4. The driller will then advance the boring to 5 feet below the screened interval of the adjacent monitoring well or at a confining unit, whichever is encountered first.

5. An 8-inch diameter steel casing with welded or threaded joints will be lowered to the bottom of the boring and centered. The casing will be long enough to extend to the ground surface and will be seated using a hammer assembly.

6. A Portland cement/bentonite grout will be emplaced from the bottom up in the annulus around the casing using a tremmy pipe. The grout will be pumped into the boring until it displaces the drilling fluid and reaches the ground surface.

7. After the grout has set for at least 24 hours, the drilling fluid inside the casing will be circulated thoroughly with potable water until visible drilling fluids have been removed and clear water remains inside the casing.

8. Drilling equipment will be decontaminated and the drilling fluid will be replaced. If possible, water will be used instead of mud to drill the remainder of the boring. If mud is necessary, efforts will be made to minimize the amount of mud added to the drilling fluid.

9. An 8-inch diameter boring will be advanced through the casing to the final well depth. Sampling will be performed as appropriate following procedures described in other sections of the RIWP.

10. The remainder of the well construction methods will be the same as those used to construct single-cased monitoring wells as described in Section A2.5.1 of the RIWP.

Figure 3-2 depicts typical double-cased monitoring well construction. Equipment decontamination will be conducted as described in Section A2.4.2 of the RIWP.

2.5.2 Temporary Monitoring Well Construction

Temporary groundwater monitoring wells will be installed following the methods described in Section A2.5.1 for single-cased monitoring wells. In general, the following procedures will be used unless field conditions require modifications:

1. Prior to set up, the drill rig and equipment will be decontaminated by steam cleaning and/or a potable water wash as described in Section A2.4.2 of the SAP.

2. The driller will advance a 6.5-inch diameter boring to approximately 5 feet below the predicted water table depth using hollow-stem auger drilling techniques as described in Section A2.4.1. The approximate depth to the water table will be estimated before drilling activities begin based on groundwater elevations measured at nearby monitoring wells.

3. Beginning at this depth, the driller will collect soil samples using a split-spoon sampling device as described in Section A2.4.3. Split-spoon samples will be collected continuously until the water table is encountered. An HLA geologist will examine the soil samples to determine the level of the water table.

4. The driller will then advance the boring to between 5 and 6 feet below the water table.

5. The temporary monitoring well will be constructed of 2-inch diameter, schedule 40, flush-joint, threaded PVC with a 10-foot section of 0.020-inch factory-slotted screen. The PVC well will be lowered into the boring and suspended such that approximately 5 feet of screen is above and below the water table. If the boring is drilled with hollow-stem augers, the well will be constructed inside the augers before they are removed. If the boring is drilled using rotary drilling techniques, the drilling tools will be removed before the well is constructed.

6. The boring will be allowed to collapse naturally around the well screen. If necessary, a small amount of filter sand will be poured into the boring to bring the bottom of the boring to the appropriate depth. If addition of sand is necessary, it will be poured slowly to avoid bridging.

7. Plastic sheeting will be taped securely around the riser pipe approximately one foot above grade and spread out to form a skirt that extends radially at least 18 inches from the center of the well. The edges of the skirt will be covered and weighted prevent runoff from entering the well annulus.

8. The temporary well will be capped with a locking, expandable plug.

9. If the well boring is advanced using mud rotary drilling techniques, the well will be initially developed by pumping and surging with potable water to remove the visible drilling fluid. After a minimum of 48-hours following the initial development, the temporary well will be developed again using the same techniques. If the well is installed using hollow-stem augers or water rotary methods, only one phase of well development will be performed.

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Equipment decontamination will be conducted as described in Section A2.4.2 of the RIWP.

If the decision is made to complete a temporary well as a permanent monitoring well, the 2-inch casing and screen will be removed, the boring will be reamed and the well constructed as described in Section A2.5 of the RIWP. If the well is not converted to a permanent monitoring well, the temporary well will be abandoned by removing the 2-inch casing and screen and backfilling the boring with powdered bentonite.

2.6 Low Flow Purging and Groundwater Sampling

Groundwater monitoring wells will be purged and sampled using low-flow groundwater sampling procedures as described in EPA's Groundwater Issue (EPA, April 1996). Groundwater sampling procedures will generally follow the steps described in Section A2.8. Field documentation, sampling preparation, and sampling apparatus decontamination procedures will be consistent with the RIWP. The low-flow groundwater sampling procedures are described below:

BEFORE ENTERING THE FIELD

- Project objectives and quality assurance procedures, sampling locations, sampling procedures, preservation, packaging and shipping requirements, and analytical parameters will be reviewed with field personnel.
- Previous water level measurements for each well, if available, will be reviewed before leaving for the site, and a summary of previous water level data will be taken to the field.
- Health and safety procedures will be reviewed with all personnel.
- A list of wells to be sampled and analyses to be performed will be prepared and transmitted to the laboratory.
- All field equipment will be tested to ensure that it is operating properly. Because of the remote location of the site, duplicate instruments will be mobilized to limit down time due to possible equipment malfunction.
- The laboratory will provide clean glassware required to collect the samples. The glassware will be cleaned in accordance with OSWER Directive 9240.0-05A. The glassware will include required preservatives and a list of which preservatives correspond to each analyte will be included with the glassware. The laboratory will provide sufficient glassware and/or samples for trip blanks, field blanks, and duplicate samples to be collected at the frequency described in the Quality Assurance Project Plan (QAPP) presented in Appendix C of the RIWP.

IN THE FIELD

- Sampling crews will receive labeled sample kits from the field manager and will confirm that the kits contain appropriate sample bottles, preservatives, filter pumps, ice, sample labels, chain-of-custody records, and well construction information.
- Before purging or sampling each well, equipment will be decontaminated. Decontamination of pumps will include rinsing the pump and tubing with soapy water and deionized water before use.

- The well number, date, pertinent observations (e.g., weather, well condition), casing diameter, screened interval, and field instrument identifications will be recorded on groundwater sampling forms .

- Monitoring instruments will be calibrated against known standards before making well measurements (generally calibrated once per day). Calibration will be recorded on field calibration data sheets .

- The well will be uncapped from the upwind direction and a photo-ionization detector (PID) or flame-ionization detector (FID) will be used to record relative organic vapor concentrations upwind from the well, at the top of the casing and within the well casing. Procedures for use of the FID or PID will be consistent with the manufacturer's manual, which may vary slightly from model to model. The manual will be kept onsite at all times during equipment use.

- Depth to water will be measured using an electronic interface probe. The probe will be lowered into the well until a contact with the water surface is indicated by an electronic signal.

- The tape will be marked or held at the measuring point.

- The electric tape will be checked to ensure that it has not been cut by a sharp casing edge after it is placed in and removed from the well.

- The depth to water will be measured to an accuracy of 0.01 foot.

- The probe will then be lowered below the groundwater and raised until the signal indicates that the probe is above the water table. The depth to water will be measured again as described in steps 7 through 9 above.

- The groundwater elevation relative to mean sea level (MSL) will be determined by subtracting the depth to water from the surveyed top of casing elevation (measuring point). Measurements at each well will be taken at the marked survey point on the inner casing and will be repeated until two consecutive measurements are obtained that agree within ±0.02 foot. Water level measurements will be recorded on water level measurement forms (Appendix AA). Well identification, date, time, depth in feet to groundwater and remarks relevant to groundwater level measurements will be noted. Previous water level measurements for the well will be checked. If the difference between the current water level and the previous water level is greater than one foot, the water level will be remeasured.

- The sample (pump intake) depth will be determined before sampling equipment is introduced into the well. In the wells in which the water level is above the top of the screen, the pump intake will be set at the middle of the screened interval. If the well is screened across the water table, the pump intake will be set at the mid-point between the groundwater level and the bottom of the well. Every effort will be made to avoid placing the pump intake or water level indicator within two feet of the bottom of the well.

- A field-decontaminated 2-inch diameter stainless steel submersible electrical sampling pump (Grunfos™ Redi-Flo II™ or equivalent) and dedicated 1/2-inch diameter Teflon™-lined tubing (tubing inner diameter will be between 1/4 and 3/8 of an inch) will be used to purge and sample the well. To minimize excessive mixing of the standing water column in the riser with the water in the screened interval and to minimize the disturbance of solids which may have settled on the bottom, the pump and tubing will be carefully and slowly lowered to the pre-determined

installation depth.

- Depth to water will be measured after the pump has been installed to evaluate the effect of water displacement. Prior to purging, a final depth-to-water measurement will be recorded. At the start of purging, the flow rate will be monitored until a rate between 0.1 and 0.5 liters per minute (Lpm) is obtained. The flow rate will be measured using a volume-calibrated container and a watch. The water level will be monitored periodically as a guide to flow rate adjustment. Efforts will be made to keep drawdown to less than 0.1 meters (0.328 feet) during purging. If this minimal drawdown cannot be sustained, the water level will be monitored until a constant drawdown is achieved.

- If drawdown does not stabilize at the minimum purge rate of 0.1 Lpm, the pump will be shut down periodically during purging to allow the well to recharge so that the water level does not fall below the pump during purging.

- After the drawdown has stabilized, HLA will measure specific conductivity, temperature, pH, reduction/oxidation (Redox) potential, dissolved oxygen (DO), and turbidity using an in-line flow-through cell approximately every three to five minutes. Efforts will be made to sustain turbidity measurements less than 25 nephelometric turbidity units (NTUs) for the three monitoring cycles. Field measurements will be performed at a minimum of once every 3 minutes as described in Section A4.0 of the SAP.

- Purging will continue until the following five parameters measured in the field have stabilized for three successive readings. Readings will be considered stabilized based on the following criteria set forth by EPA (*Groundwater Issue,* April 1996):

  - Conductivity ± 3 percent
  - pH ± 0.1 Standard Units
  - Redox potential ± 10 millivolts
  - DO ± 10 percent
  - Turbidity ± 10 percent

Temperature will be monitored but will not be used to establish stabilization.

- Data on method and amount of water purged will be recorded on a groundwater sampling form (Appendix AA).

- Water purged from the monitoring wells will be collected and stored at the site in properly labeled 55-gallon drums. The information specified on the drum label(s) will include, at a minimum, the date and well number(s) corresponding to the wells from which the water was removed. The water will be stored until final disposal arrangements are completed.

- Sample collection will begin immediately after the five parameters noted above have stabilized.

- During sample collection, the flow rate will remain the same as the established purge rate.

- Except as noted in Step 24 and in Section A2.9, groundwater samples will be transferred directly from the pump discharge to the sample containers. VOC vials will be filled in a manner that minimizes head space or air bubbles. Samples for VOC analyses will be collected first. VOC sample vials will be filled to capacity and tightly capped to avoid retention of air bubbles.

Remaining sample containers will be filled to approximately 90 percent of capacity. VOC sample containers will be preserved and filled according to EPA Region II CERCLA Quality Assurance Manual protocol (p. 31) as follows:

- Collect three 40-milliliter vials of sample for VOC analysis.
- Adjust the pH of one of the vials to less than 2 Standard Units by carefully adding 1:1 Hydrochloric acid (HCl) drop by drop to one of the filled 40-milliliter VOA vials. The number of drops of 1:1 HCl required will be recorded. The first vial may then be discarded.
- Carefully add the same number of drops to the remaining two vials to be submitted for laboratory analysis. (The pH in the two vials for laboratory analysis should not be tested directly.)
- Seal the vials.
- The pH test is to be performed at each sampling location.
- A fresh sample will be collected if an air bubble is detected in a VOC sample vial after sampling is complete.

- Non-VOC samples will be placed into pre-preserved laboratory-prepared sample bottles. A small portion of the sample will be poured over pH paper from the filled sample bottle into a second clean container. The pH of the sample material in the second container will be tested in the field to confirm that it falls within the requirements of the QAPP. Additional preservative and sample material will be used to adjust the pH of the sample, if necessary.

- Immediately after filling, samples will be placed in storage coolers on ice. Samples will be checked periodically with a thermometer to ensure preservation requirements are met. The temperature of the samples will also be recorded by the laboratory upon receipt.

- Sample depth will be recorded, the groundwater sampling field data sheet will be completed and signed, and the chain-of-custody form will be signed.

- The well cap will be closed and the well will be locked.

Quality assurance/quality control (QA/QC) samples are discussed in the QAPP (Appendix C).

2.7 Onsite VOC Analysis by Gas Chromatograph

Groundwater samples will be handled and analyzed onsite using a portable GC as described below.

- Groundwater samples will be collected as described in steps 2 through 21 of Section 2.6.

- 20 mLs of groundwater will be collected in a 40-mL vial.

- The sample will then be agitated (shaken) for 2 minutes.

- A dedicated syringe will then be inserted into the vial and a measured volume of gas from the sample vial headspace will be collected for analysis using the GC. The GC utilized will be a PID equipped with an 10.6 electron volt lamp. The chromatographic column will be a 10-meter capillary column of fused silica coated with the adsorptive material. The inner diameter of the capillary column will be 0.021 inches (0.53 mm). Precolumn backflush will use a 9-meter analytical column and a 1-meter precolumn. Computing integrators will be used to plot the

chromatogram for the detector analysis and to compute and record the area of the chromatographic peaks. The peak areas will be used to calculate concentrations for each of the compounds analyzed.

The field QC procedures will be performed as set forth in the QAPP addendum (Appendix CD).

As discussed during the May 12, 1997 meeting with EPA, the results of the proposed onsite analysis of TEX compounds in groundwater using a field gas chromatograph (GC) will be defined as "Screening Data with Definitive Confirmation". A detailed definition of "Screening Data with Definitive Confirmation" was supplied to the EPA in Section C2.0 of HLA's *Draft Remedial Investigation Workplan* (Workplan), dated August 5, 1994. Confirmatory samples will be collected at the rate (10%) described in this Workplan. The confirmatory samples will be analyzed using CLP methodologies by a certified laboratory.

Field screening will be performed on the headspace of a water sample utilizing a GC equipped with a photoionization detector (PID). The field screening method is based upon the principle that when a water sample containing VOCs is sealed in a vial, VOCs will equilibrate between the water and vial headspace. The application of field screening methods for determination of VOCs in water has been reliably demonstrated as described by the following :

> Mackay, D., Shiu, W.Y., and Wolkoff, A.W., 1975: Gas Chromatographic Determination of Low Concentration of Hydrocarbons in Water by Vapor Phase Extraction; in Water Quality Parameters, ASTM STP 573, American Society for Testing and Materials, p. 251-258. ; And
>
> McAuliffe, J., 1976: GC Determination of Solutes by Multiple Phase Equilibrium; Chemical Technology, v.1 p. 46-51.

This method of field screening has also been compared to purge and trap procedures with excellent correlation and exhibits a standard deviation of 5% for routine analysis of water as described by the following :

> Dietz, E.J., Jr. And Singley, K.F., 1979: Determination of Chlorinated Hydrocarbons in Water by Headspace Gas Chromatography; Analytical Chemistry, v.51 No. 11 p. 1809-1814.

2.8 Aquifer Slug Testing

Aquifer slug tests will be performed at select wells during the implementation of the RIWPA. One rising head test will be performed at the wells in which the water table intersects the screened interval. In wells in which the water level is above the top of the screened interval, a falling head and a rising head test will be performed. The tests will be conducted using a data logger and pressure transducers with chemically resistant cables. The data logger will be pre-programmed to collect incremental water level measurements using an approximately logarithmic time scale. Field decontamination procedures will be conducted as described in Section A2.4.2.2. The following procedures will be used during the slug tests:

1. Before beginning each test, the following information will be recorded:
   - Well internal diameter
   - Location and elevation reference point from which water depth measurements are made
   - Pre-test static water level (and elevation) of groundwater with respect to the reference point
   - Date, time, and name(s) of personnel conducting test

- Well, depth, screen depth and length, well radius, and depth, length, and radius of the gravel pack
- Volume of dimensions of slug
- Type of test (falling or rising head)
- Test number as recorded by the data logger
- Type of measuring device used

2. An initial depth-to-water measurement will be collected and recorded.

3. A decontaminated pressure transducer will be lowered into the well to a depth below the anticipated greatest depth of the slug. The water level will then be allowed to equilibrate.

4. The data logger will be initialized and set to the referenced water level

5. To initiate the falling head test, a decontaminated PVC or stainless steel slug will be completely introduced into the well as rapidly as possible while the data logger is started simultaneously. The slug will be of sufficient volume to displace a quantity of water that will require the well at least five minutes to equilibrate.

6. The falling head test will continue until the water level has returned to 90 percent of static.

7. Once the water level has returned to static, the rising head test can begin. The rising head test will be conducted by completely removing the slug from the well as rapidly as possible while simultaneously starting the data logger simultaneously started. The rising head test will continue until the water level returns to at least 90 percent of static.

8. The data will be downloaded directly from the datalogger to a portable computer in the field. The data will be used for analysis (using AQTESOLV®) of hydraulic conductivities using the Bower and Rice method.

9. If the data cannot be downloaded directly to a computer, the data will be printed in the field.

A field geologist or engineer will keep detailed notes for each test.

APPENDIX C

QUALITY ASSURANCE PROJECT PLAN ADDENDUM

APPENDIX CD
CONTENTS

302349

CD1 INTRODUCTION

This Addendum to the Quality Assurance Project Plan (QAPP, HLA 1994) has been prepared by Harding Lawson Associates (HLA) on behalf of Island Chemical Company, Inc. (ICC). This QAPP Addendum has been prepared as an Appendix to the EPA-approved Remedial Investigation Work Plan (RIWP). This Addendum to the QAPP will be included in the RIWP as Appendix CD. The RIWP Addendum (RIWPA) includes the following analytical activities which were not specified in the original EPA-approved RIWP, and therefore not included in the original QAPP:

- Onsite analysis in groundwater using a gas chromatograph (GC)
- Shelby tube soil sampling for analysis of grain size, percent moisture, total organic carbon (TOC), and porosity
- Nutrient profile in soil including analysis of alkalinity, ammonia, iron, sulfate, sulfide, nitrate, nitrite, pH, and ortho phosphorus.

Other procedures and quality assurance and quality control (QA/QC) protocol for activities planned during the implementation of the RIWP Addendum are discussed in the RIWP- Quality Assurance and Procedures Plan (QAPP, Appendix C).

CD2 ONSITE VOC ANALYSIS USING THE GC

Sample documentation will be consistent with that described the QAPP (Section 3.0), with the exception of a chain-of-custody form. The samples collected for onsite analysis will be logged in the field book, and analyzed immediately after collection. The following information will be recorded in the field book for each sample:

- Sample identification number
- Date and time of sample collection
- Sample location and depth
- Sampling techniques
- Sample type (media sampled)
- Container type

Onsite calibration and maintenance records of the onsite GC will be maintained by the field GC operator. These records will be filed onsite and may be subject to a QA audit. The onsite GC operator will maintain spare parts for equipment and will be capable of making minor repairs as needed.

Calibration records will be maintained as follows:

1. The GC operator will maintain a calibration record that will be kept with the GC at all times.
2. A label will be affixed to the GC showing description, manufacturer, model numbers, date of last calibration, calibrator's signature and due date of next calibration (where applicable). Reports and compensation or correction figures will be maintained with the instrument.
3. Written step-wise calibration procedures will be available for each measurement instrument.

The calibration procedures for the field GC are described below (Source: Vironex Field Analytical Services):

1. GC operator will perform a two-point calibration using a 5 microgram per liter (µg/L) 50µg/L and a 500 µg/L standard of target compounds (toluene, ethylbenzene, and xylenes [TEX]). The 5 µg/L standard is prepared by filling a 40 milliliter (mL) vial with 20 mLs of deionized water and adding .5 microliters (µL) of a 200 µg/mL standard solution of VOCs in methanol. The 50 µg/L standard is prepared by filling a 40 mL vial with 20 mLs of deionized water and adding 5 µL of a 200 µg/mL standard solution of VOCs in methanol. The 500 µg/L standard is prepared by filling a 40 mL vial with 20 mLs of deionized water and adding 50 µL of a 200 µg/mL standard solution of VOCs in methanol. The detection limits (e.g. 5µg/L) will be verified prior to sample analysis and at the start of each day
2. Agitate (shake) standards for 2 minutes prior to analysis.
3. Calculate the response factor (RF) for each target compound for each calibration concentration prior to analyzing site samples.
4. Determine the average RF for each target compound. The RF for each compound must be within 80-120 percent of the average RF from the initial calibration.
5. Determine percent relative standard deviation (%RSD) for each target compound (the RSD may not exceed 20 percent).

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The GC analysis QA/QC techniques and frequencies are summarized below:

- Analyze a instrument blank (as described in Section C6.3.2) at the start and end of each day.
- Analyze a method blank (as described in Section C6.3.2) at the beginning of each day and after any sample containing one or more target compounds.
- Analyze one standard after every 10 samples.
- Analyze one duplicate sample for every 20 samples.
- Calibrate the instrument 1) at the start of each day, or 2) when the GC operating conditions have changed, or 3) when the GC column type is changed, or 4) when the RF of the daily mid-point calibration check is not within 85 percent to 115 percent of the average RF from the initial calibration.
- Analyze a matrix spike sample and matrix spike duplicate samples at a rate of one per 20 samples.

Groundwater samples will be analyzed onsite with a modified EPA Method 602 for toluene, xylenes, and ethylbenzene. A portable GC/PID (Photovac 11S+) equipped with a 11.7 electron volt lamp will be utilized for analysis. The groundwater samples will be handled and analyzed as described below.

1. Groundwater samples will be collected as described in steps 2 through 21 of Section AD2.6.
2. 40 mls of groundwater will be collected in a 40-ml vial and the cap with a Teflon septum will be sealed with no headspace. The sample will then be submitted to the onsite GC operator.
3. The operator will then transfer a 20-ml aliquot of sample to a second, clean 40 ml VOA vial and the cap will be sealed.
4. The 20-ml sample will then be agitated for 2 minutes in the vial. This process efficiently transfers the aromatics from the aqueous phase to the vapor phase (McAuliffe, 1976).
5. A dedicated gas-tight syringe will then be inserted into the vial and a measured volume of gas will be collected from the sample vial headspace.
6. The measured volume of gas will be injected into the gas chromatograph column, which will have been preheated to a temperature of 40° Celsius. The chromatographic column will be a 10-meter capillary column of fused silica coated with the adsorptive material. The inner diameter of the capillary column will be 0.021 inches (0.53 mm).
7. The gaseous sample will be transported through the capillary column by laboratory grade 99.99 % hydrocarbon free purified air. The GC is temperature programmed to separate the purgeables to be detected by the PID. The sample will then pass the PID where it will be ionized by the 11.7 eV lamp. Computing integrators will be used to plot the chromatogram for the detector analysis and to compute and record the area of the chromatographic peaks. The peak areas will be used to calculate concentrations for each of the compounds analyzed. Precolumn backflush will use a 9-meter analytical column and a 1-meter precolumn.

The field QC procedures will be performed as set forth in the QAPP addendum (Appendix CD).

CD3 LABORATORY ANALYTICAL PARAMETERS AND METHODS

Several groundwater samples will be submitted for onsite GC VOC analysis. A certified laboratory will perform several analyses on soil samples. Analytical parameters and methods for the onsite GC analysis are described in Section CD3.1. Analytical parameters and methods for the certified laboratory analyses are identified in Section CD3.2.

CD3.1 Onsite GC Analysis

The onsite analysis using the GC will be conducted in accordance with EPA Methods 601 and 602 Modified. The method detection limits (MDLs) for the target compounds are as follows:

- Toluene 5 µg/L
- Ethylbenzene 5 µg/L
- Xylenes 5 µg/L
- Methylene chloride 5 µg/L
- Chloroform 5 µg/L

The GC that will be used to perform the onsite analyses can estimate concentrations lower than those listed above. If detected concentrations are below the given MDL, the result will be qualified to indicate that the concentration is estimated.

CD3.2 Certified Laboratory Procedures

Laboratory analytical parameters, methods, and method reporting limits to be used during the implementation of the RIWPA, which were not specified in Section C5.4, are as follows:

SOIL

ANALYSIS	METHOD	REPORTING LIMIT
Nitrate	EPA Method 353.2	0.5 mg/kg
Nitrite	EPA Method 353.2	0.5 mg/kg
Sulfate	SW-846 9036	100 mg/kg
Sulfide	SW-846 9030	0.2 mg/kg
Iron (total)	EPA Method 6010	10 mg/kg
Alkalinity	EPA Method 310.1	10 mg/kg
Ammonia	EPA Method 350.2	2.5 mg/kg
Ortho Phosphorus	EPA Method 365.1	0.5 mg/kg
Total Organic Carbon	SW-846 9060	100 mg/kg
pH	SW-846 9045 C Modified (M)	Not Applicable
Grain Size Analysis	ASTM D-422	Not Applicable
Porosity	By ASTM D-2216 and D-854	Not Applicable
HCU bacteria count	Standard Methods 9215C M	Not Applicable
Total plate bacteria count	Standard Methods 9215C M	Not Applicable
Percent moisture	EPA 160.3 Modified	Not Applicable

NOTES: mg/kg = milligrams per kilogram.

The listed reporting limits are subject to a slight change based on moisture content.

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Addendum-Phase III
Virgin Island Chemical Site
St. Croix, U.S. Virgin Islands

July 25, 1997

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