

# *REPORT*

## **HYDROGEOLOGIC ASSESSMENT/SOURCE IDENTIFICATION**

Upper Tutu Aquifer Basin  
Tutu, St. Thomas, U.S. Virgin Islands

October 1993



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UPPER TUTU AQUIFER BASIN  
TUTU, ST. THOMAS, U.S.V.I.**

**October 1993**

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## **1.0 EXECUTIVE SUMMARY**

Based upon a review of available site-specific empirical data, as well as, historic records and technical documents, the following can be concluded with respect to site hydrogeology, contaminant distribution (temporal and spatial), source identification, and remedial action applicability:

### **Site Hydrogeology**

1. The hydrogeologic framework of the upper Tutu aquifer basin is comprised of a thin veneer of unconsolidated saprolite/fill deposits overlying a combined volcanic and igneous fractured bedrock regime. Ground water is present under water table conditions (unconfined) and generally moves to the south/southwest under a steep hydraulic gradient. Ground water exists and moves primarily within the fractures (secondary porosity) of weathered and competent bedrock in the upper basin.
2. The significant topographic relief within the upper Tutu aquifer basin results in a steep hydraulic gradient on the water table surface.
3. The Tutu aquifer is heterogeneous and exhibits anisotropy (directional-specific hydraulic properties). Anisotropic conditions result from fault and fracture zones which predominantly trend in a general north-south orientation adjacent to the Four Winds Plaza. The primary significance of these anisotropic conditions is that ground water will be transported more readily parallel to the direction of predominant fracture orientation (generally north-south).
4. Pump tests conducted by Geraghty & Miller and Hydrologic Associates were neither implemented nor interpreted properly to assess the anisotropic characteristics of the localized aquifer.
5. The hypothetical simulations of the Tutu aquifer under both static and dynamic conditions, generated by Gartner Lee, Inc., were not representative of actual site conditions, thereby producing fictitious particle flow paths which were not supported by empirical, site-specific, contaminant distributions.
6. The production well capture zone calculations prepared by Hydrologic Associates, Inc. are erroneous as a result of over-simplifying assumptions regarding aquifer hydraulic properties (e.g., the absence of a regional hydraulic gradient, and anisotropic conditions).
7. Insufficient data presently exists to accurately estimate the velocity of ground water and solute transport (both halocarbons and aromatic hydrocarbons) within the aquifer.

## **Contaminant Distribution**

1. Data obtained in conjunction with soil vapor surveys should be considered qualitative or semi-quantitative at best. Therefore, data collected from soil vapor surveys are not necessarily indicative of subsurface soil and/or ground-water conditions within the study area.
2. The complete horizontal and vertical extent of ground-water quality impact, resulting from halocarbons remains undefined within the upper Tutu aquifer basin.
3. Elevated concentrations of halocarbons are widespread in the upper Tutu aquifer basin resulting in an amorphous (ubiquitous) distribution. The downgradient extent and eastern boundary of the halocarbon plume emanating from the former LAGA building remain undefined. All plume boundaries associated with chlorinated compound discharges from the O'Henri Dry Cleaner remain undefined.
4. Aquifer impact from aromatic hydrocarbon compounds has produced distinct, relatively confined, plumes. The downgradient extent of plumes emanating from the Tutu Texaco and Tutu Esso facilities, although not completely defined, have been generally identified.
5. The Tillett production well has been characterized by the historic presence of elevated concentrations of both halocarbons and aromatic hydrocarbons. Although concentrations of aromatic hydrocarbons have generally decreased subsequent to 1989, halocarbon concentration have remained essentially constant over this period.
6. Four Winds production well I has never consistently demonstrated the presence of aromatic hydrocarbons. Benzene and toluene have only been sporadically observed in this well at trace concentrations (below applicable Federal Maximum Concentration Limits - MCLs). Benzene was reported by Weston at 6.7 parts per billion (ppb) (slightly above the Federal MCL of 5 ug/L) on one occasion (July 1987). It is important to note that the majority of the Weston sampling from July 1987 through May 1989 was conducted by portable gas chromatography, not in a quantitative laboratory.
7. Four Winds production well I has demonstrated consistent concentrations of the halocarbons tetrachloroethene (PCE), trichloroethene (TCE), and dichloroethene (DCE) from 1987 through 1992.
8. Four Winds production well II has never demonstrated the presence of aromatic hydrocarbons above Federal MCLs. Similar to production well I, well II has been characterized by consistent concentrations of PCE, TCE, and DCE from 1990 through 1992.
9. Three of the Harthman wells have been consistently tested for ground-water quality, the Crusher, Bakery, and Estate Wells. Neither the Crusher nor the Estate wells demonstrated the confirmed presence of aromatic hydrocarbons from 1987 through 1992. The Bakery well only demonstrated the sporadic occurrence of benzene and toluene at trace

concentrations. In all cases, the detected concentrations of aromatic hydrocarbons, in all three wells, were below Federal MCLs.

10. The Harthman Crusher and Estate wells have demonstrated significant concentrations (above Federal MCLs) of PCE during the period 1987 through 1992. Additionally, the Crusher well has exhibited the presence of TCE above the applicable MCL on three occasions.
11. With the exception of the Tillett well, none of the potable wells periodically sampled by EPA has demonstrated the consistent presence of aromatic hydrocarbons either above or below applicable MCLs.

### **Source Identification**

1. Sufficient empirical data exists to, within a reasonable degree of scientific certainty, differentiate sources responsible for the impact on several of the potable water wells in the area (specifically, Tillett, Four Winds I & II, and Harthman - Crusher).
2. Discharges of aromatic hydrocarbons have occurred at the Tutu Esso station which have resulted in the localized impact on ground-water quality. Both the temporal and spatial distribution of aromatic compounds indicate that discharges at the Tutu Esso station did not, within a reasonable degree of scientific certainty, impact either the Tillett, Four Winds, or Harthman wells.
3. Although low concentrations of PCE were detected in shallow soils adjacent to the oil/water separator by Soil Tech on the Tutu Esso station, there is presently no data to indicate that activities at the Tutu Esso station have resulted in the presence of PCE or TCE in the localized ground-water regime.
4. The presence of both aromatic hydrocarbons and halocarbons in the Tillett well occurred, within a reasonable degree of scientific certainty, as a result of downgradient transport, under both static (regional flow) and dynamic (pumping) conditions, from the Tutu Texaco and former LAGA building. Insufficient data presently exists to determine if operations at either Ramsay Motors and/or Antilles/Gassett have resulted in an impact on ground-water quality in the Tillett well.
5. The presence of PCE, TCE, and DCE in Four Winds production wells I & II has resulted, within a reasonable degree of scientific certainty, from the downgradient transport, under both static and dynamic conditions, from the former LAGA building. Insufficient data presently exists to determine if operations at Tutu Texaco, Ramsay Motors, Antilles/Gassett facilities, as well as, anthropogenic activities have resulted in the presence of halocarbons in the Four Winds production wells.
6. The presence of PCE and TCE in the Harthman Crusher well is, within a reasonable degree of scientific certainty, a combined result of regional ground-water quality degradation (i.e., anthropogenic impact) and discharges from the O'Henri Dry Cleaner. There is presently insufficient data to determine if the plume of halocarbons emanating from the former LAGA building has impacted this area.

7. There is presently insufficient data to determine if the one occurrence of PCE, above the MCL, in the Harthman Estate (Racetrack) well is the result of regional ground-water quality degradation and/or discharges from the former LAGA building.
8. Underground storage tanks (waste oil and diesel tanks behind the Western Auto facility, and the "Ramp" tank) and surficial discharges on the Four Winds property have resulted in the degradation of soils, and more likely than not, ground water beneath the Four Winds Plaza.

#### **Remedial Action: Applicability**

1. Point-of-use treatment technologies (i.e., granular activated carbon, or air stripping in combination with carbon treatment) represent viable and proven means of treating extracted ground water to applicable drinking water standards. These technologies could be employed on the Tillett, Four Winds, and Harthman properties to facilitate production of potable water supplies.
2. Insufficient data presently exists to determine if the aromatic hydrocarbon contamination beneath either the Tutu Esso or Rodriguez Esso stations is capable of reaching the Harthman wells under regional flow or dynamic pumping conditions. Although this is the case, within a reasonable degree of scientific certainty, further plume migration under both scenarios can be arrested through site-specific remedial action programs incorporating hydraulic control.
3. Aromatic hydrocarbon plumes beneath both the Tutu Esso and Rodriguez Esso stations are capable of being remediated without restricting the use of adjacent properties.



## **2.0 INTRODUCTION**

### **2.1 Background**

The Tutu (Anna's Retreat) area of Saint Thomas (United States Virgin Islands) has been the focus of an ongoing Environmental Protection Agency (EPA) directed investigation subsequent to 1987. EPA's investigative activities were precipitated as a result of the detection of volatile organic compounds in several potable water wells located within the upper (northern) portion of the Tutu aquifer basin. Specifically, sampling conducted by Weston in July 1987, on behalf of the EPA, identified the presence of chlorinated organic compounds (halocarbons) and aromatic hydrocarbons at variable concentrations and in sporadic locations within a number of ground-water production wells in the Tutu area. Subsequent to July 1987, periodic water quality sampling of potable wells has been conducted by the EPA. Additionally, site inspections, document reviews, and sampling activities have been implemented in an attempt to identify potentially responsible parties (PRPs).

Most recently, EPA directed the Tutu Environmental Investigation Committee (TEIC), comprised of Texaco and Esso, to implement a joint hydrogeologic investigation within the Tutu area. In an attempt to characterize the extent and sources of ground-water contamination, ground-water monitoring wells were installed, soil/ground-water samples were collected, and aquifer hydraulic information was obtained. Findings from this investigation were presented by Geraghty & Miller in a Technical Memorandum (Tech Memo II) dated May 1993. This investigation program represented the first step in the iterative process through which a comprehensive Remedial Investigation/Feasibility Study (RI/FS) for the Tutu area will be completed. The most significant findings of the Geraghty & Miller investigation were the development of a ground-water quality

data base and the identification of data voids with respect to completing a Remedial Investigation.

Anna's Retreat (Tutu) is located on the eastern end of Saint Thomas. The Tutu area can be best characterized as a densely populated mixed residential, commercial and industrial area. This history of diverse land use has exerted significant stresses on the localized ground-water regime (aquifer). The most significant of these stresses is the degradation of ground-water quality as a result of the following:

- discharges of contaminants from industrial operations;
- discharges of contaminants from residential "backyard practices" (i.e., household use/disposal of solvents, cleaners, motor oil, gasoline, etc.);
- discharges from residential and commercial septic systems;
- the absence of regulations controlling the storage, handling and disposal of waste oils; and
- uncontrolled and/or unpermitted discharges into the storm sewer system.

As a result of these multiple and widespread sources, the upper Tutu aquifer basin has experienced a reduction in regional ground-water quality.

## **2.2 Investigation Objectives**

Through an analysis of available site-specific empirical data, as well as a review of pertinent historical information and technical reports, this assessment has addressed the following:

- the adequacy of existing site-specific data to characterize aquifer hydraulic parameters as they relate to the fate and transport of soluble contaminants within the ground-water regime;
- adequacy of existing site-specific data with respect to the delineation/divisibility of individual contaminants and contaminant plumes within the upper Tutu aquifer basin;
- the identification, within a reasonable degree of scientific certainty, of responsible parties for contaminant plumes within the subsurface; and

- a conceptual assessment of appropriate remedial techniques to allow ground-water pumping for potable/nonpotable use and/or arrest/restrict subsequent transport of specific contaminants within the ground-water regime.

### **3.0 ADEQUACY OF EXISTING STUDIES**

As previously noted, subsequent to July 1987, EPA has directed ongoing investigative activities in the Tutu area. As a result of these efforts, two significant data bases have been developed. The first is a compendium of ground-water quality data for area production wells, and the second is the hydrogeologic investigation recently completed by Geraghty & Miller (TEIC Investigation - May 1993). Prior to Geraghty & Miller's implementation of the TEIC Investigation, limited information was available with regard to the spatial distribution of volatile organic compounds within the upper Tutu aquifer basin. The historic production well sampling data are extremely significant with respect to analyzing the temporal occurrence of volatile organic compounds in certain portions of the aquifer.

In addition to EPA directed investigations, several parties have conducted independent investigations and/or data analyses. Several of these assessments, specifically those relating to the pending litigation, are identified below:

- Caribbean Hydro-Tech has conducted soil and ground-water sampling on the Four Winds Plaza property;
- Gartner Lee, Inc. has conducted a hypothetical numerical computer simulation of fictitious particle transport within the upper Tutu aquifer basin;
- Hydrologic Associates, Inc. has implemented several pump tests of Four Winds and Harthman production wells, as well as, assessed hypothetical capture zones for area production wells under various pumping scenarios;
- Several soil vapor surveys have been conducted by Target Environmental Services and Geoscience Consultants, LTD.; and
- ENSR, most recently, implemented an underground storage tank excavation program at the Western Auto facility located on the Four Winds Plaza.

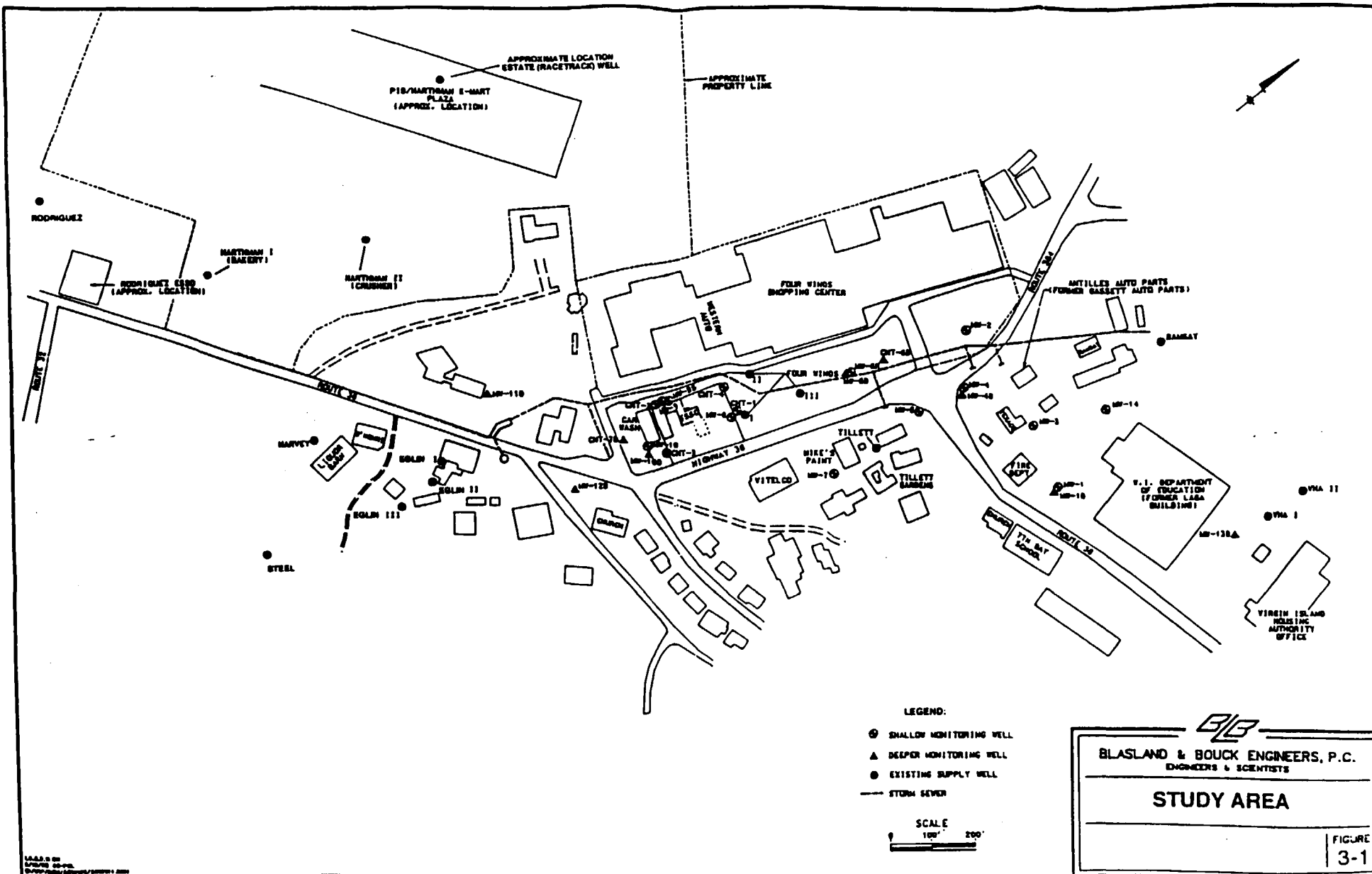
Significant aspects of these investigations are summarized in the following subsections.

### **3.1 Geraghty & Miller Hydrogeologic Investigation**

The most significant outcome of the TEIC Investigation, conducted by Geraghty & Miller, is the establishment of an array of ground-water monitoring wells designed to assess the spatial distribution of volatile organic contaminants in the upper Tutu aquifer basin. Prior to this investigation, data regarding ground-water quality was only available from existing production wells. The collection of ground-water samples from the nineteen TEIC monitoring wells (Figure 3-1) has facilitated a preliminary delineation of aromatic hydrocarbon and halocarbon impact areas within the aquifer. Although a sufficient number of monitoring wells has not been established to completely define the boundaries of individual plumes of contamination, source areas (i.e., responsible parties) impacting the Tillett, Four Winds, and Harthman production wells can be assessed.

The TEIC Investigation represents the first phase in the iterative process of completing a comprehensive Remedial Investigation and Feasibility Study for the upper Tutu aquifer basin. The scope of subsequent investigation phases is currently being discussed with EPA. The primary focus for the balance of Remedial Investigation tasks should be:

1. a comprehensive characterization of aquifer hydraulic parameters (i.e., hydraulic conductivity, anisotropy, ground-water velocity, seasonal hydraulic head variability, preferential recharge/discharge areas, and the effects of anthropogenic activities);
2. the complete delineation of contaminant plume boundaries;
3. an assessment of the fate and transport properties of the contaminants of concern (i.e., attenuation mechanisms, persistence, and solute velocities);
4. a determination of exposure pathways, likely receptors, and contaminant concentrations at exposure points (Risk Assessment);
5. the identification of all significant source areas contributing to the degradation of regional ground-water quality;
6. assess regional ground-water quality and the effects of anthropogenic activities on ground-water quality; and



7. the collection of requisite data to facilitate the evaluation of appropriate remedial technologies.

It is presently anticipated that this information will be available in the form of a final RI Report in the later part of 1994.

### **3.2 Caribbean Hydro-Tech Soil/Ground-Water Sampling**

As part of the pending litigation, Caribbean Hydro-Tech, in conjunction with Hydrologic Associates, Inc., has installed a series of monitoring wells on the Four Winds Plaza. These wells were installed specifically to assess ground-water quality adjacent to the Tutu Esso station, obtain subsurface stratigraphic information, and facilitate the implementation of two aquifer pump tests. In addition, Caribbean Hydro-Tech has collected soil and ground-water samples adjacent to three underground storage tanks on the Four Winds Plaza. Pertinent data obtained during these activities are presented in Section 4 of this report.

### **3.3 Gartner Lee - Hydraulic Analysis**

To assess the hypothetical flow paths of fictitious particles in the ground-water regime of the upper Tutu aquifer basin, Gartner Lee, Inc. implemented a computer hydraulic simulation of the study area. Both static (regional flow field) and dynamic (pumping) scenarios were assessed. As a result of insufficient input data and erroneous assumptions regarding aquifer hydraulics, the Gartner Lee assessment is purely a theoretical exercise which produces output not supported by site-specific, empirical, contaminant distribution data. The following points summarize the shortcomings of the numerical simulation:

1. The 1966 static hydraulic head distribution, used to calibrate the model, was generated with a limited number of control points and was based upon a topographic elevation datum with an error factor of plus or minus twenty feet. The head distribution utilized to calibrate the model (1966) exhibited a much greater degree of topographic control than was observed under static conditions with more control points in 1992.
2. Dynamic affects such as: a six month period of above average precipitation; and a "dramatic" increase in pumping activities, were ignored when calibrating the model under static conditions.

3. Empirical, site-specific, hydraulic conductivity and ground-water elevation data were neither utilized in the formulation nor the calibration of the model.
4. The one layer, homogeneous matrix, assumption utilized in the model is not consistent with fractured bedrock aquifer systems, and subsurface conditions observed by Geraghty & Miller and Hydrologic Associates.
5. The 1987 dynamic (pumping) head distribution, utilized to calibrate the model, was not representative of aquifer hydraulics during stressed conditions.
6. Output from the numerical model was not reconciled (correlated) with actual pump test data collected by Hydrologic Associates.
7. Aquifer recharge was erroneously assumed to be uniform over the model grid.
8. The most critical parameter, with respect to understanding the aquifer's response to dynamic conditions (hydraulic conductivity distribution), was calculated by the computer algorithm based upon erroneous input data. This process resulted in a non-unique solution of the problem (i.e., a number of combinations of hydraulic conductivity, recharge, porosity, and anisotropy ratios could result in the same output).
9. Hypothetical particle flow paths were not consistent with empirical, site-specific, data regarding the temporal and spatial distribution of contaminants.
10. Projected, future, hypothetical particle flow paths were not representative of actual site conditions because they did not incorporate the hydraulic effects of presently pumping wells (e.g., Eglin).
11. No solute transport analysis was conducted to assess contaminant transport pathways, receptor locations and discharge concentrations.

#### **3.4 Hydrologic Associates U.S.A., Inc. - Site Assessment**

To assess the impact of pumping production wells on the distribution of contaminants in the upper basin of the Tutu aquifer, Hydrologic Associates conducted several pumping test and analyzed the capture zones of production wells under various pumping scenarios. As with the Gartner Lee, Inc. assessment, over simplification of aquifer hydraulic properties resulted in the generation of erroneous hypothetical data. The following points summarize the Hydrologic assessment:



1. Pump testing of wells on the Four Winds Plaza and the Harthman properties resulted in non-representative data because:
  - a sufficient number of observations wells was not incorporated into the tests to assess anisotropic conditions of the aquifer;
  - in some instances, tests were not extended over a sufficient period of time to assess the aquifer's true response to stressed conditions;
  - curve matching techniques resulted in non-unique solutions;
  - wells were not subjected to preliminary step tests to evaluate optimal pumping rates; and
  - reinfiltration of pumped water into the storm sewer on the Four Winds Plaza may have resulted in the interference of test results.
2. The assumptions of a homogeneous, isotropic, aquifer matrix and the presence of a flat water table (i.e., no regional hydraulic gradient) resulted in a grossly over simplified representation of the aquifer regime. These assumptions generated production well capture zones that were completely symmetrical (circular). In reality, the aquifer's heterogeneous nature and anisotropic conditions would produce parabolic capture zones with limited extent in a direction transverse to the regional flow field (i.e., in an east-west direction) and downgradient of the regional flow field. Additionally, the utilization of parabolic capture zones would have a significant impact on the presence and location of induced ground-water divides.
3. The utilization of constant transmissivity values for production wells within a general area results in over simplification of the aquifer hydraulic regime. Pump testing demonstrated significant variability (i.e., several orders of magnitude) in calculated transmissivity values for wells within close proximity.
4. The observation of significant horizons of clay strata and competent bedrock argue against the conceptualization of the aquifer as non-layered and homogeneous in vertical cross-section.
5. No assessment of solute transport was considered to evaluate the temporal aspects of contaminant transport and estimate contaminant concentrations at hypothetical exposure points.
6. Site-specific, empirical, ground-water quality data do not support the hypothetical distribution of contaminants predicted by the Hydrologic model.

### **3.5 UST Excavation Program - Four Winds Plaza/Western Auto**

From October 6 through October 22, 1993, three underground storage tanks were excavated from the Four Winds Plaza. A 750 gallon capacity waste oil tank and two 250 gallon diesel fuel tanks were removed. Pertinent observations developed during these activities are summarized below:

- The waste oil tank, partially filled with sand and waste oil, demonstrated the presence of approximately four corrosion holes.
- The diesel fuel tank located directly behind the Western Auto facility was characterized by extensive corrosion and numerous holes.
- Soils beneath the 250 gallon "Ramp" diesel tank were visually stained and corrosion pin holes were observed in the tank.
- Phase-separated hydrocarbons (free product) was observed seeping through a crushed stone horizon adjacent to both of the tanks behind the Western Auto facility.
- The distribution of phase-separated hydrocarbons extended to the east (towards the Four Winds production wells) under the floor of the Western Auto facility.
- The complete extent of hydrocarbon impact to the east could not be delineated during tank removal without extensive excavation under the building foundation.
- The Department of Planning and Natural Resources has required the formulation of a site assessment programs/reports to completely assess the extent and magnitude of environmental impact as a result of releases from these underground storage tanks.

### **3.6 Soil Vapor Surveys (Target Environmental Services and Geoscience Consultants, LTD)**

Target Environmental Services, Inc. conducted two soil vapor surveys within the upper Tutu aquifer basin; one that focused on the Four Winds Plaza/Tutu Esso station (February 1992), and the second which addressed the Harthman/Rodriguez Esso properties. Geoscience Consultants, LTD. conducted a soil vapor survey of the Tutu Texaco/Four Winds Plaza properties in December 1987. Pertinent findings from these investigations are summarized below:

- False negative readings were generated during the February 1992 Target survey as exemplified by the absence of aromatic hydrocarbons at sample locations adjacent to monitoring well MW-5. Sampling of

well MW-5 by Geraghty & Miller resulted in the detection of 3,710 ug/L of total aromatic hydrocarbons.

- The February 1992 Target survey failed to identify the presence, magnitude, and extent of petroleum hydrocarbon impact behind the Western Auto facility.
- Lineations in Total FID Volatiles, MTBE, PCE, TCE, and DCE depictions in the February 1992 Target survey, suggest that the storm sewer beneath the Four Winds Plaza is functioning as a preferred transport pathway for VOCs.
- Findings from the Geoscience Consultants investigation indicate that a significant source(s) of VOCs exist on the Tutu Texaco station and that the associated plume of contamination extends onto the Four Winds Plaza.

## **4.0 CONTAMINANT OCCURRENCE/DISTRIBUTION**

### **4.1 Temporal Occurrence**

As previously noted, collection of ground-water quality data from production wells during the period 1987 through 1993 has facilitated an analysis of the temporal occurrence/distribution of volatile organic compounds within portions of the upper basin of the Tutu aquifer. A compendium of ground-water quality data has been presented in Table 4-1.

#### **4.1.1 Tillett Well**

As demonstrated by Table 4-1, the Tillett well has been characterized by the presence of both halocarbons and aromatic hydrocarbons above applicable MCLs from July 1987 through March 1993. Two distinct trends can be observed in this data set. Halocarbon concentrations, although exhibiting some fluctuation in concentration, have remained fairly constant during the sampling period. In contrast, aromatic hydrocarbons (primarily benzene and toluene) have exhibited a gradual decrease in concentration subsequent to October 1990. These temporal observations are significant when considering the fact that pumping of this well ceased in 1987 (in response to the EPA moratorium on well pumping in the Tutu aquifer). These data indicate that the Tillett well is positioned hydraulically downgradient of an ongoing halocarbon source under both pumping and regional flow conditions. Decreasing concentrations of aromatic hydrocarbons indicates that this well is positioned downgradient, but not directly, of the aromatic source under regional flow conditions.

**TABLE 4-1**  
**SUMMARY OF GROUND WATER ANALYTICAL DATA**  
**TUTU AREA SUPPLY WELLS**

**TUTU WELLS SITE**  
**St. Thomas, USVI**

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| WELL                                  | DATE       | SAMPLER | Benzene<br>(µg/L) | Toluene<br>(µg/L) | Ethylbenzene<br>(µg/L) | Xylenes<br>(µg/L) | PCE<br>(µg/L) | TCE<br>(µg/L) | 1,2-DCE<br>(µg/L) | MTBE<br>(µg/L) |
|---------------------------------------|------------|---------|-------------------|-------------------|------------------------|-------------------|---------------|---------------|-------------------|----------------|
| FOUR<br>WINDS I                       | 7/87       | WESTON  | 6.7               | 5.5               | NA                     | NA                | 64.2          | 18.8          | NO                | NA             |
|                                       | 8/87       | WESTON  | 2                 | 1                 | NA                     | NA                | 72            | 21            | 213               | NA             |
|                                       | 9/87       | WESTON  | ND                | 2                 | NA                     | NA                | 125           | <15           | 5                 | NA             |
|                                       | 10/87      | WESTON  | ND                | ND                | NA                     | NA                | 202           | 75            | 13                | NA             |
|                                       | 10/87*     | WESTON  | ND                | ND                | ND                     | ND                | 140           | 18            | 280               | 470            |
|                                       | 11/87      | WESTON  | ND                | ND                | NA                     | NA                | 104           | 34            | 4                 | NA             |
|                                       | 12/87      | WESTON  | 1                 | ND                | NA                     | NA                | 50            | 22.2          | 2.8               | NA             |
|                                       | 1/88       | WESTON  | ND                | ND                | NA                     | NA                | 480           | 100           | NA                | NA             |
|                                       | 2/88       | WESTON  | ND                | ND                | NA                     | NA                | 158           | 58            | 3                 | NA             |
|                                       | 11/88      | WESTON  | ND                | ND                | NA                     | NA                | 30            | 100           | NA                | NA             |
|                                       | 11/14/88*  | WESTON  | ND                | ND                | ND                     | ND                | 140           | 31            | 210 D             | ND             |
|                                       | 2/89       | WESTON  | ND                | ND                | NA                     | NA                | 120           | 43            | 5                 | NA             |
|                                       | 5/89       | WESTON  | ND                | ND                | NA                     | NA                | 138           | 28            | 10                | NA             |
|                                       | 10/2/91    | G & M   | 33 J              | ND                | ND                     | ND                | 36            | 9.8           | 89 D              | NA             |
|                                       | 11/14/91   | HA      | ND                | ND                | ND                     | ND                | 84            | 32            | 240               | 350            |
|                                       | 2/4/92     | G & M   | 0.8               | ND                | ND                     | ND                | 75 D          | 21            | 150 D             | NA             |
|                                       | 3/19/92    | CHT     | 2.9               | ND                | ND                     | ND                | 72            | 20            | 205.7             | NA             |
|                                       | 6/24/92    | CHT     | ND                | ND                | ND                     | ND                | 80            | 19            | 214.1             | NA             |
|                                       | 9/15/92    | G & M   | ND                | ND                | ND                     | ND                | 78            | 21            | 170               | NA             |
|                                       | 10/21/92   | CHT     | ND                | ND                | ND                     | ND                | 90            | 27            | 155.2             | NA             |
|                                       | 3/31/93    | G & M   | ND                | ND                | ND                     | ND                | 62            | 18            | 140               | NA             |
| FOUR<br>WINDS II                      | 9/26/90    | G & M   | ND                | ND                | ND                     | ND                | 25 J          | 6 J           | 75 J              | NA             |
|                                       | 9/26/90 FR | G & M   | ND                | ND                | ND                     | ND                | 18 J          | 4 J           | 61 J              | NA             |
|                                       | 2/5/91     | G & M   | ND                | ND                | ND                     | ND                | 90 D          | 21            | 230 D             | NA             |
|                                       | 6/5/91     | G & M   | ND                | ND                | ND                     | ND                | 34 DJ         | 12 J          | 130 DJ            | NA             |
|                                       | 10/2/91    | G & M   | ND                | ND                | ND                     | ND                | 80            | 25            | 180               | NA             |
|                                       | 2/4/92     | G & M   | 2.7               | ND                | ND                     | 4 J               | ND            | 15            | 130               | NA             |
| FOUR<br>WINDS III                     | 9/15/92    | G & M   | ND                | ND                | ND                     | ND                | 38            | 10            | 99                | NA             |
|                                       | 5/13/92    | CHT     | ND                | 2.2               | ND                     | ND                | 54            | 18            | 163.9             | NA             |
| HARTHMAN<br>I<br>(Bakery/<br>Gassett) | 7/87       | WESTON  | ND                | 6.3               | NA                     | NA                | 2.9           | ND            | ND                | NA             |
|                                       | 8/87       | WESTON  | ND                | ND                | NA                     | NA                | 3             | ND            | 1                 | NA             |
|                                       | 9/87       | WESTON  | ND                | ND                | NA                     | NA                | 1             | <1            | ND                | NA             |
|                                       | 10/87      | WESTON  | <1                | ND                | NA                     | NA                | ND            | <1            | <1                | NA             |
|                                       | 10/87*     | WESTON  | ND                | ND                | ND                     | ND                | ND            | 0.5           | ND                | ND             |
|                                       | 11/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | ND                | NA             |
|                                       | 12/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|                                       | 1/88       | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NA                | NA             |
|                                       | 2/88       | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | ND                | NA             |
|                                       | 5/88       | WESTON  | <1                | 33                | NA                     | NA                | ND            | 5             | NA                | NA             |
|                                       | 8/88       | WESTON  | ND                | 4                 | NA                     | NA                | <1            | <1            | NA                | NA             |
|                                       | 11/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | NA                | NA             |
|                                       | 11/14/88*  | WESTON  | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | ND             |
|                                       | 2/5/91     | G & M   | ND                | 44 D              | ND                     | ND                | ND            | 1             | ND                | NA             |
|                                       | 6/4/91     | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|                                       | 10/1/91    | G & M   | ND                | ND                | ND                     | ND                | ND            | .11 J         | ND                | NA             |
|                                       | 2/4/92     | G & M   | .06 J             | ND                | ND                     | ND                | ND            | .09 J         | .11 J             | NA             |
|                                       | 2/4/92 FR  | G & M   | .07 J             | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|                                       | 2/26/92    | HA      | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | ND             |
|                                       | 5/27/92    | G & M   | ND                | ND                | ND                     | ND                | ND            | .06 J         | ND                | NA             |
|                                       | 9/15/92    | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|                                       | 4/1/93     | G & M   | ND                | 0.4 J             | ND                     | ND                | ND            | ND            | ND                | NA             |
| HARTHMAN<br>II<br>(Crusher)           | 7/87       | WESTON  | ND                | 5.7               | NA                     | NA                | 102           | 7             | ND                | NA             |
|                                       | 8/87       | WESTON  | ND                | ND                | NA                     | NA                | 28            | 3             | 12                | NA             |
|                                       | 9/87       | WESTON  | ND                | ND                | NA                     | NA                | 14            | 1             | <1                | NA             |
|                                       | 10/87      | WESTON  | 5                 | ND                | NA                     | NA                | 29.5          | ND            | 4                 | NA             |
|                                       | 10/87*     | WESTON  | ND                | ND                | ND                     | ND                | 6.2           | ND            | ND                | ND             |
|                                       | 11/87      | WESTON  | ND                | ND                | NA                     | NA                | 5             | 7             | ND                | NA             |
|                                       | 12/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|                                       | 1/88       | WESTON  | ND                | ND                | NA                     | NA                | 4             | 1             | NA                | NA             |
|                                       | 2/88       | WESTON  | ND                | ND                | NA                     | NA                | 3             | 2             | <1                | NA             |
|                                       | 5/88       | WESTON  | ND                | 38                | NA                     | NA                | 130           | 48            | NA                | NA             |
|                                       | 8/88       | WESTON  | ND                | ND                | NA                     | NA                | 10            | 1             | NA                | NA             |
|                                       | 9/26/90    | G & M   | ND                | ND                | ND                     | ND                | 7 J           | 1 J           | 5 J               | NA             |
|                                       | 2/5/91     | G & M   | ND                | ND                | ND                     | ND                | 9             | 2             | 5 J               | NA             |
|                                       | 6/4/91     | G & M   | ND                | ND                | ND                     | ND                | 7 J           | 1 J           | 6 J               | NA             |
|                                       | 10/1/91    | G & M   | ND                | ND                | ND                     | ND                | 3.1           | 0.77          | 4.7               | NA             |
|                                       | 2/3/92     | G & M   | ND                | ND                | ND                     | ND                | 1.2           | .08 J         | .19 J             | NA             |
|                                       | 2/3/92 FR  | G & M   | ND                | ND                | ND                     | ND                | 5.3           | 0.95          | 4.2               | NA             |
|                                       | 2/26/92    | HA      | ND                | ND                | ND                     | ND                | 9.5           | ND            | 5                 | ND             |
|                                       | 9/16/92    | G & M   | ND                | ND                | ND                     | ND                | 10            | 2.3           | 11                | NA             |

TABLE 4-1, TUTU SUPPLY WELLS GROUND WATER DATA SUMMARY (cont.)

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| WELL                       | DATE       | SAMPLER | Benzene<br>(µg/L) | Toluene<br>(µg/L) | Ethylbenzene<br>(µg/L) | Xylenes<br>(µg/L) | PCE<br>(µg/L) | TCE<br>(µg/L) | 1,2-DCE<br>(µg/L) | MIBK<br>(µg/L) |
|----------------------------|------------|---------|-------------------|-------------------|------------------------|-------------------|---------------|---------------|-------------------|----------------|
| HARTHMAN<br>II<br>(Estete) | 8/87       | WESTON  | NO                | NO                | NA                     | NA                | 1             | NO            | NO                | NA             |
|                            | 9/87       | WESTON  | NO                | NO                | NA                     | NA                | NO            | NO            | NO                | NA             |
|                            | 10/87      | WESTON  | NO                | 1                 | NA                     | NA                | 2.5           | NO            | NO                | NA             |
|                            | 10/87*     | WESTON  | NO                | NO                | NO                     | NO                | NO            | NO            | NO                | NO             |
|                            | 12/87      | WESTON  | NO                | NO                | NA                     | NA                | NO            | NO            | NO                | NA             |
|                            | 1/88       | WESTON  | NO                | NO                | NA                     | NA                | NO            | NO            | NA                | NA             |
|                            | 2/88       | WESTON  | NO                | NO                | NA                     | NA                | NO            | NO            | NO                | NA             |
|                            | 5/88       | WESTON  | <1                | NO                | NA                     | NA                | 2             | NO            | NA                | NA             |
|                            | 8/88       | WESTON  | NO                | NO                | NA                     | NA                | NO            | NO            | NA                | NA             |
|                            | 11/14/88*  | WESTON  | NO                | NO                | NO                     | NO                | NO            | NO            | NO                | NO             |
|                            | 9/28/90    | G & M   | NO                | NO                | NO                     | NO                | 1 J           | NO            | 2                 | NA             |
|                            | 2/5/91     | G & M   | NO                | NO                | NO                     | NO                | 1             | NO            | NO                | NA             |
|                            | 9/4/91     | G & M   | NO                | NO                | NO                     | NO                | NO            | NO            | NO                | NA             |
|                            | 10/1/91    | G & M   | NO                | NO                | NO                     | NO                | 0.83          | NO            | 0.8 J             | NA             |
|                            | 2/3/92     | G & M   | NO                | NO                | NO                     | NO                | 12            | 0.8 J         | 1.9 J             | NA             |
|                            | 2/28/92    | HA      | NO                | NO                | NO                     | NO                | 1.3           | NO            | NO                | NO             |
|                            | 2/28/92    | HA      | NO                | NO                | NO                     | NO                | NO            | NO            | NO                | NO             |
| HARTHMAN<br>Botdate        | 2/28/92    | HA      | NO                | NO                | NO                     | NO                | NO            | NO            | NO                | NO             |
| HARTHMAN<br>Wired          | 2/28/92    | HA      | NO                | NO                | NO                     | NO                | NO            | NO            | NO                | NO             |
| HARTHMAN<br>Zero           | 2/28/92    | HA      | NO                | NO                | NO                     | NO                | NO            | NO            | NO                | NO             |
| RAMSAY                     | 8/87       | WESTON  | NO                | NO                | NA                     | NA                | 7             | NO            | 1                 | NA             |
|                            | 9/87       | WESTON  | NO                | NO                | NA                     | NA                | 7.5           | <1            | NO                | NA             |
|                            | 10/87      | WESTON  | 4.5               | NO                | NA                     | NA                | >50           | NO            | 2.7               | NA             |
|                            | 10/87*     | WESTON  | NO                | NO                | NO                     | NO                | 22            | 1.7           | 6.3               | NO             |
|                            | 11/87      | WESTON  | NO                | NO                | NA                     | NA                | 18            | <1            | NO                | NA             |
|                            | 12/87      | WESTON  | NO                | NO                | NA                     | NA                | 4             | NO            | NO                | NA             |
|                            | 1/88       | WESTON  | NO                | NO                | NA                     | NA                | 8             | 1             | NR                | NA             |
|                            | 2/88       | WESTON  | NO                | NO                | NA                     | NA                | 4             | <1            | NO                | NA             |
|                            | 5/88       | WESTON  | NO                | 30                | NA                     | NA                | 154           | 48            | NR                | NA             |
|                            | 8/88       | WESTON  | NO                | NO                | NA                     | NA                | 17            | 1             | NR                | NA             |
|                            | 2/89       | WESTON  | NO                | NO                | NA                     | NA                | 27            | 2             | NO                | NA             |
|                            | 5/89       | WESTON  | NO                | NO                | NA                     | NA                | 7             | 8             | NO                | NA             |
|                            | 10/1/90    | G & M   | NO                | NO                | NO                     | NO                | 3 J           | NO            | NO                | NA             |
|                            | 2/5/91     | G & M   | NO                | NO                | NO                     | NO                | 18            | 1             | 1 J               | NA             |
|                            | 5/8/91     | G & M   | R                 | R                 | R                      | R                 | 18            | R             | 2 J               | NA             |
|                            | 10/1/91    | G & M   | NO                | NO                | NO                     | NO                | 19            | 1.8           | 2.8               | NA             |
|                            | 2/4/92     | G & M   | NO                | NO                | NO                     | NO                | 23            | 3.7           | 17                | NA             |
|                            | 6/28/92    | G & M   | NO                | NO                | NO                     | NO                | 20            | 2.4           | 9.5               | NA             |
|                            | 9/15/92    | G & M   | NO                | NO                | NO                     | NO                | 18            | 0.94          | 1.4               | NA             |
|                            | 9/15/92 FR | G & M   | NO                | NO                | NO                     | NO                | 18            | 0.88          | 1.4               | NA             |
|                            | 3/31/93    | G & M   | NO                | NO                | NO                     | NO                | 18            | 0.88          | 1.4               | NA             |
| HARVEY                     | 8/87       | WESTON  | NO                | 1                 | NA                     | NA                | 7800          | 81            | 58                | NA             |
|                            | 9/87       | WESTON  | NO                | NO                | NA                     | NA                | >1000         | 25            | 5                 | NA             |
|                            | 10/87      | WESTON  | NO                | NO                | NA                     | NA                | >500          | 20            | 14                | NA             |
|                            | 10/87*     | WESTON  | NO                | NO                | NO                     | NO                | NO            | NO            | NO                | NO             |
|                            | 11/87      | WESTON  | NO                | NO                | NA                     | NA                | >1000         | 40            | <1                | NA             |
|                            | 12/87      | WESTON  | NO                | NO                | NA                     | NA                | >500          | 50            | NO                | NA             |
|                            | 1/88       | WESTON  | NO                | NO                | NA                     | NA                | >500          | 80            | NR                | NA             |
|                            | 2/88       | WESTON  | NO                | NO                | NA                     | NA                | >1000         | 9             | 3                 | NA             |
|                            | 5/88       | WESTON  | NO                | NO                | NA                     | NA                | >1000         | 350           | NR                | NA             |
|                            | 8/88       | WESTON  | NO                | NO                | NA                     | NA                | >1000         | 17            | NR                | NA             |
|                            | 9/28/90    | G & M   | NO                | NO                | NO                     | NO                | 880 J         | NO            | NO                | NA             |
|                            | 2/5/91     | G & M   | NO                | NO                | NO                     | NO                | 1500          | 80 J          | 180               | NA             |
|                            | 9/4/91     | G & M   | NO                | NO                | NO                     | NO                | 530 DEJ       | 38 DJ         | 80 DJ             | NA             |
|                            | 10/2/91    | G & M   | NO                | NO                | NO                     | NO                | 670 D         | 25            | 38                | NA             |
|                            | 2/3/92     | G & M   | NO                | 0.8 J             | NO                     | NO                | 500 D         | 23            | 39                | NA             |
|                            | 5/28/92    | G & M   | NO                | NO                | NO                     | NO                | 350           | 28            | 41                | NA             |
|                            | 9/14/92    | G & M   | NO                | NO                | NO                     | NO                | 280           | 48            | 49                | NA             |
|                            | 3/30/93    | G & M   | NO                | NO                | NO                     | NO                | 310           | 58            | 48                | NA             |
|                            | 3/30/93 FR | G & M   | 14 J              | 0.89 J            | NO                     | NO                | 290 DJ        | 83 DJ         | 45 D              | NA             |
|                            | 7/87       | WESTON  | 8050              | 492               | NA                     | NA                | 2040          | 711           | 327               | NA             |
|                            | 8/87       | WESTON  | 1400              | 33                | NA                     | NA                | 120           | 38            | 620               | NA             |
|                            | 9/87       | WESTON  | 250               | NO                | NA                     | 1:1A              | 475           | 75            | <10               | NA             |
|                            | 10/87      | WESTON  | 48                | NO                | NA                     | 1:1A              | >500          | 110           | 19                | NA             |
|                            | 10/87*     | WESTON  | NO                | NO                | NO                     | NO                | 140           | 25            | 800               | 470            |
|                            | 11/87      | WESTON  | >1000             | 30                | NA                     | NA                | 350           | 200           | 45                | NA             |
|                            | 12/87      | WESTON  | >500              | 180               | NA                     | NA                | 85            | NO            | NO                | NA             |
|                            | 2/88       | WESTON  | 48                | NO                | NA                     | NA                | 254           | 12            | 3                 | NA             |
|                            | 5/88       | WESTON  | >1000             | NO                | NA                     | NA                | >1000         | 420           | NR                | NA             |
|                            | 8/88       | WESTON  | >1000             | 110               | NA                     | NA                | 10            | 30            | NR                | NA             |
|                            | 11/14/88*  | WESTON  | 820 D             | 22                | 25                     | 180               | NO            | 12            | 50                | NO             |
|                            | 5/89       | WESTON  | 880               | 24                | NA                     | NA                | 88            | 82            | 87                | NA             |
|                            | 10/2/90    | G & M   | 32 J              | R                 | R                      | R                 | 120 J         | 58 J          | 280 J             | NA             |
|                            | 10/2/90 FR | G & M   | 28 J              | R                 | R                      | R                 | 98 J          | 47 J          | 270 J             | NA             |
|                            | 2/5/91     | G & M   | 27                | 1                 | NO                     | NO                | 100 D         | 38            | 200 D             | NA             |
|                            | 5/5/91     | G & M   | 3 J               | 0.8 J             | NO                     | NO                | 180 DJ        | 72 DJ         | 400 DEJ           | NA             |
|                            | 10/2/91    | G & M   | 71 J              | 3 J               | 17                     | 3.8 J             | 88            | 38            | 150               | NA             |
|                            | 10/2/91 FR | G & M   | 58 DJ             | 2.1 J             | 14                     | 2.7 J             | 83 D          | 35            | 140 D             | NA             |
|                            | 2/5/92     | G & M   | 1.7               | .05 J             | NO                     | NO                | 23            | 8.3           | 23                | NA             |
|                            | 5/28/92    | G & M   | 0.8 J             | NO                | NO                     | NO                | 200           | 58            | 470 DJ            | NA             |
|                            | 9/18/92    | G & M   | 7                 | .5 J              | 1.5 J                  | NO                | 140           | 62            | 280               | NA             |
|                            | 3/30/93    | G & M   | 8.5               | 42 J              | NO                     | NO                | 140           | 41            | 200               | NA             |

TABLE 4-1, TUTU SUPPLY WELLS GROUND WATER DATA SUMMARY (cont.)

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| WELL     | DATE      | SAMPLER | Benzene<br>(ug/L) | Toluene<br>(ug/L) | Ethylbenzene<br>(ug/L) | Xylenes<br>(ug/L) | PCE<br>(ug/L) | TCE<br>(ug/L) | 1,2-DCE<br>(ug/L) | MTBE<br>(ug/L) |
|----------|-----------|---------|-------------------|-------------------|------------------------|-------------------|---------------|---------------|-------------------|----------------|
| EGJN I   | 8/87      | WESTON  | ND                | ND                | NA                     | NA                | 38            | 11            | 63                | NA             |
|          | 9/87      | WESTON  | ND                | <1                | NA                     | NA                | 80            | <10           | <5                | NA             |
|          | 10/87     | WESTON  | ND                | ND                | NA                     | NA                | 104           | 28            | 4.5               | NA             |
|          | 10/87*    | WESTON  | ND                | ND                | ND                     | ND                | 100           | 10            | 96                | 270 J          |
|          | 11/87     | WESTON  | ND                | ND                | NA                     | NA                | 25            | 10            | 2                 | NA             |
|          | 12/87     | WESTON  | 2                 | 5                 | NA                     | NA                | 14            | 8             | 1.3               | NA             |
|          | 2/88      | WESTON  | ND                | ND                | NA                     | NA                | 22            | 11            | 3                 | NA             |
|          | 5/88      | WESTON  | ND                | ND                | NA                     | NA                | 480           | 300           | NR                | NA             |
|          | 8/88      | WESTON  | ND                | ND                | NA                     | NA                | 38            | 22            | NR                | NA             |
|          | 11/88     | WESTON  | <1                | ND                | NA                     | NA                | 8             | 58            | NR                | NA             |
|          | 11/14/88* | WESTON  | ND                | ND                | ND                     | ND                | 52            | 21            | 110               | ND             |
|          | 2/89      | WESTON  | ND                | ND                | NA                     | NA                | 78            | 88            | 9                 | NA             |
|          | 5/89      | WESTON  | ND                | ND                | NA                     | NA                | 80            | 34            | ND                | NA             |
|          | 10/2/90   | G & M   | R                 | R                 | R                      | R                 | 32 J          | 10 J          | 68 J              | NA             |
|          | 2/5/91    | G & M   | ND                | ND                | ND                     | 1 J               | 28            | 8             | 80 J              | NA             |
|          | 6/5/91    | G & M   | R                 | R                 | R                      | R                 | 32 J          | 10 J          | 68 J              | NA             |
|          | 10/2/91   | G & M   | ND                | ND                | ND                     | ND                | 24            | 7.5           | 45                | NA             |
|          | 2/3/92    | G & M   | ND                | .08 J             | ND                     | ND                | 18            | 7             | 17                | NA             |
|          | 5/27/92   | G & M   | ND                | .08 J             | ND                     | ND                | 14            | 6.3           | 13                | NA             |
|          | 9/16/92   | G & M   | ND                | ND                | ND                     | ND                | 11            | 4.5           | 12                | NA             |
|          | 3/29/93   | G & M   | ND                | .054 J            | ND                     | ND                | 9.3           | 4.1           | 12                | NA             |
| EGJN II  | 7/87      | WESTON  | 3.1               | 5.9               | NA                     | NA                | 57.8          | 16.5          | ND                | NA             |
|          | 8/87      | WESTON  | ND                | ND                | NA                     | NA                | 43            | 13            | 74                | NA             |
|          | 9/87      | WESTON  | ND                | <5                | NA                     | NA                | 40            | 10            | <5                | NA             |
|          | 10/87     | WESTON  | ND                | ND                | NA                     | NA                | 62            | 21            | 4.5               | NA             |
|          | 10/87*    | WESTON  | ND                | ND                | ND                     | ND                | 22            | 7.5           | 37                | 260 J          |
|          | 11/87     | WESTON  | ND                | ND                | NA                     | NA                | 22            | 12            | 2                 | NA             |
|          | 12/87     | WESTON  | ND                | ND                | NA                     | NA                | 8.8           | 5.8           | 1.4               | NA             |
|          | 2/88      | WESTON  | ND                | ND                | NA                     | NA                | 25            | 14            | 3                 | NA             |
|          | 5/88      | WESTON  | ND                | ND                | NA                     | NA                | 780           | 404           | NR                | NA             |
|          | 2/89      | WESTON  | ND                | ND                | NA                     | NA                | 27            | 34            | 2                 | NA             |
|          | 5/89      | WESTON  | ND                | ND                | NA                     | NA                | 23            | 14            | 2                 | NA             |
|          | 9/27/90   | G & M   | ND                | ND                | ND                     | ND                | 71 J          | 22 J          | 120 J             | NA             |
|          | 2/5/91    | G & M   | ND                | ND                | ND                     | ND                | 34 DJ         | 19            | 72 DJ             | NA             |
|          | 6/5/91    | G & M   | R                 | R                 | R                      | R                 | 61 DJ         | 19 J          | 130 DJ            | NA             |
|          | 10/2/91   | G & M   | ND                | ND                | ND                     | ND                | 54            | 18            | 67                | NA             |
|          | 2/3/92    | G & M   | ND                | ND                | ND                     | ND                | 18            | 6.7           | 20                | NA             |
|          | 5/27/92   | G & M   | .07 J             | ND                | ND                     | ND                | 38            | 14            | 31                | NA             |
|          | 9/16/92   | G & M   | ND                | .081 J            | ND                     | ND                | 11            | 4.7           | 11                | NA             |
| EGJN III | 8/87      | WESTON  | ND                | ND                | NA                     | NA                | 57            | 18            | 66                | NA             |
|          | 9/87      | WESTON  | ND                | ND                | NA                     | NA                | 105           | <20           | <5                | NA             |
|          | 10/87     | WESTON  | ND                | ND                | NA                     | NA                | 104           | 30.5          | 7.5               | NA             |
|          | 10/87*    | WESTON  | ND                | ND                | ND                     | ND                | 40            | 8.4           | ND                | 270 J          |
|          | 11/87     | WESTON  | ND                | ND                | NA                     | NA                | 55            | 20            | 1                 | NA             |
|          | 12/87     | WESTON  | ND                | ND                | NA                     | NA                | 24            | 9.2           | 1.7               | NA             |
|          | 2/88      | WESTON  | ND                | ND                | NA                     | NA                | 41            | 20            | 2                 | NA             |
|          | 5/88      | WESTON  | ND                | ND                | NA                     | NA                | 500           | 288           | NR                | NA             |
|          | 8/88      | WESTON  | ND                | ND                | NA                     | NA                | 12            | 4             | NR                | NA             |
|          | 11/88     | WESTON  | ND                | ND                | NA                     | NA                | 9             | 36            | NR                | NA             |
|          | 11/14/88* | WESTON  | ND                | ND                | ND                     | ND                | ND            | 22            | ND                | ND             |
|          | 2/89      | WESTON  | ND                | ND                | NA                     | NA                | 98            | 45            | 2                 | NA             |
|          | 5/89      | WESTON  | ND                | ND                | NA                     | NA                | 109           | 28            | 3                 | NA             |
|          | 9/27/90   | G & M   | ND                | ND                | ND                     | ND                | 44 J          | 14            | 52 J              | NA             |
|          | 2/5/91    | G & M   | ND                | ND                | ND                     | ND                | 35            | 11            | 45 J              | NA             |
|          | 6/5/91    | G & M   | ND                | ND                | ND                     | ND                | 40 J          | 15 J          | 69 DJ             | NA             |
|          | 10/2/91   | G & M   | .05 J             | ND                | ND                     | ND                | 38            | 12            | 51                | NA             |
|          | 2/3/92    | G & M   | ND                | ND                | ND                     | ND                | 41 D          | 16            | 39                | NA             |
|          | 5/28/92   | G & M   | ND                | ND                | ND                     | ND                | 39            | 14            | 31                | NA             |
|          | 9/16/92   | G & M   | ND                | ND                | ND                     | ND                | 34            | 13            | 32                | NA             |
|          | 3/29/93   | G & M   | ND                | 18 J              | ND                     | ND                | 30            | 12            | 27                | NA             |
| VIHA I   | 7/87      | WESTON  | 15.3              | 6                 | NA                     | NA                | 35.7          | 9.4           | ND                | NA             |
|          | 8/87      | WESTON  | ND                | 1                 | NA                     | NA                | 10            | 3             | 12                | NA             |
|          | 9/87      | WESTON  | ND                | ND                | NA                     | NA                | 14            | <1            | ND                | NA             |
|          | 10/87     | WESTON  | ND                | ND                | NA                     | NA                | 8             | ND            | 2.3               | NA             |
|          | 10/87*    | WESTON  | ND                | ND                | ND                     | ND                | 5.2           | 0.4           | 4.9               | ND             |
|          | 11/87     | WESTON  | ND                | ND                | NA                     | NA                | 2             | <1            | ND                | NA             |
|          | 12/87     | WESTON  | ND                | ND                | NA                     | NA                | 1             | ND            | ND                | NA             |
|          | 1/88      | WESTON  | ND                | ND                | NA                     | NA                | 3             | ND            | NR                | NA             |
|          | 2/88      | WESTON  | ND                | ND                | NA                     | NA                | 1             | ND            | ND                | NA             |
|          | 5/88      | WESTON  | ND                | ND                | NA                     | NA                | 10            | <1            | NR                | NA             |
|          | 8/88      | WESTON  | <1                | <1                | NA                     | NA                | 20            | 3             | NR                | NA             |
|          | 11/88     | WESTON  | ND                | ND                | NA                     | NA                | 8             | 7             | NR                | NA             |
|          | 11/14/88* | WESTON  | ND                | ND                | ND                     | ND                | 28            | 6             | 28                | ND             |
|          | 2/89      | WESTON  | ND                | ND                | NA                     | NA                | 39            | 7             | <1                | NA             |
|          | 5/89      | WESTON  | ND                | ND                | NA                     | NA                | 27            | 9             | ND                | NA             |
|          | 9/27/90   | G & M   | ND                | ND                | ND                     | ND                | 5 J           | ND            | 6 J               | NA             |

TABLE 4-1. TUTU SUPPLY WELLS GROUND WATER DATA SUMMARY (cont.)

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| WELL      | DATE      | SAMPLER | Benzene<br>(ug/L) | Toluene<br>(ug/L) | Ethylbenzene<br>(ug/L) | Xylenes<br>(ug/L) | PCE<br>(ug/L) | TCE<br>(ug/L) | 1,2-DCE<br>(ug/L) | MTBE<br>(ug/L) |
|-----------|-----------|---------|-------------------|-------------------|------------------------|-------------------|---------------|---------------|-------------------|----------------|
| VIAH II   | 8/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | 7                 | NA             |
|           | 9/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | ND                | NA             |
|           | 10/87     | WESTON  | <1                | ND                | NA                     | NA                | 1             | 1             | <1                | NA             |
|           | 10/87*    | WESTON  | ND                | ND                | ND                     | ND                | ND            | 0.3           | ND                | ND             |
|           | 11/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | ND                | NA             |
|           | 12/87     | WESTON  | ND                | 2.5               | NA                     | NA                | ND            | ND            | ND                | NA             |
|           | 1/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|           | 2/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|           | 6/88      | WESTON  | ND                | ND                | NA                     | NA                | 2             | <1            | NR                | NA             |
|           | 8/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|           | 11/88     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|           | 11/14/88* | WESTON  | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | ND             |
|           | 2/89      | WESTON  | ND                | ND                | NA                     | NA                | 1             | <1            | <1                | NA             |
|           | 5/89      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|           | 9/28/90   | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|           | 2/5/91    | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
| RODRIGUEZ | 8/87      | WESTON  | ND                | ND                | NA                     | NA                | 1             | ND            | ND                | NA             |
|           | 9/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|           | 10/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | <1                | NA             |
|           | 10/87*    | WESTON  | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | ND             |
|           | 11/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | ND                | NA             |
|           | 12/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|           | 1/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|           | 2/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|           | 5/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|           | 8/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|           | 11/88     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|           | 11/14/88* | WESTON  | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | ND             |
|           | 2/89      | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | ND                | NA             |
|           | 6/89      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|           | 9/24/90   | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|           | 2/5/91    | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|           | 2/5/92    | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|           | 3/30/93   | G & M   | ND                | 07 J              | ND                     | ND                | ND            | ND            | ND                | NA             |
| LEONARD   | 8/87      | WESTON  | ND                | ND                | NA                     | NA                | 1             | ND            | ND                | NA             |
|           | 9/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|           | 10/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|           | 11/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|           | 12/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|           | 1/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|           | 2/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|           | 5/88      | WESTON  | ND                | 1                 | NA                     | NA                | 3             | ND            | NR                | NA             |
|           | 8/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | NR                | NA             |
|           | 11/88     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|           | 2/89      | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | ND                | NA             |
|           | 5/89      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|           | 9/24/90   | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|           | 2/5/91    | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|           | 2/5/92    | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|           | 4/1/93    | G & M   | ND                | ND                | ND                     | ND                | 12 J          | ND            | ND                | NA             |
| MATTHIAS  | 8/87      | WESTON  | ND                | 1                 | NA                     | NA                | 66            | 4             | 9                 | NA             |
|           | 9/87      | WESTON  | ND                | ND                | NA                     | NA                | 118           | 3             | <1                | NA             |
|           | 10/87     | WESTON  | ND                | ND                | NA                     | NA                | 17.8          | ND            | <1                | NA             |
|           | 10/87*    | WESTON  | ND                | ND                | ND                     | ND                | 3.8           | 0.4           | ND                | ND             |
|           | 11/87     | WESTON  | ND                | ND                | NA                     | NA                | 88            | 14            | 2                 | NA             |
|           | 12/87     | WESTON  | ND                | ND                | NA                     | NA                | 35            | 2.8           | ND                | NA             |
|           | 1/88      | WESTON  | ND                | ND                | NA                     | NA                | 100           | <66           | NR                | NA             |
|           | 2/88      | WESTON  | ND                | ND                | NA                     | NA                | 49            | 4             | <1                | NA             |
|           | 6/88      | WESTON  | ND                | ND                | NA                     | NA                | 348           | 18            | NR                | NA             |
|           | 8/88      | WESTON  | ND                | ND                | NA                     | NA                | 25            | 2             | NR                | NA             |
|           | 2/89      | WESTON  | ND                | ND                | NA                     | NA                | 78            | 5             | <1                | NA             |
|           | 5/89      | WESTON  | ND                | ND                | NA                     | NA                | 66            | 7             | ND                | NA             |
|           | 10/1/90   | G & M   | ND                | ND                | ND                     | ND                | 120 J         | 11            | 22                | NA             |
|           | 2/5/91    | G & M   | ND                | ND                | ND                     | ND                | 76            | 7 J           | 21                | NA             |
|           | 6/6/91    | G & M   | ND                | ND                | ND                     | ND                | 59 DJ         | 12            | 36 J              | NA             |
|           | 10/3/91   | G & M   | ND                | ND                | ND                     | ND                | 81            | 8.6           | 19                | NA             |
|           | 2/5/92    | G & M   | ND                | ND                | ND                     | ND                | 60 D          | 7.5           | 17                | NA             |
| FRANCOIS  | 8/87      | WESTON  | ND                | ND                | NA                     | NA                | 120           | 28            | 140               | NA             |
|           | 9/87      | WESTON  | ND                | 1                 | NA                     | NA                | 180           | 25            | 5                 | NA             |
|           | 10/87     | WESTON  | ND                | ND                | NA                     | NA                | >50           | 70            | 3.6               | NA             |
|           | 10/87*    | WESTON  | ND                | ND                | ND                     | ND                | 130           | 15            | 100               | ND             |
|           | 11/87     | WESTON  | ND                | ND                | NA                     | NA                | 80            | 20            | 2                 | NA             |
|           | 12/87     | WESTON  | ND                | ND                | NA                     | NA                | 25            | 7             | 1                 | NA             |
|           | 1/88      | WESTON  | ND                | ND                | NA                     | NA                | 275           | 100           | NR                | NA             |
|           | 2/88      | WESTON  | ND                | ND                | NA                     | NA                | 82            | 29            | 4                 | NA             |
|           | 5/88      | WESTON  | ND                | ND                | NA                     | NA                | >1000         | 180           | NR                | NA             |
|           | 8/88      | WESTON  | ND                | 1                 | NA                     | NA                | 140           | 40            | NR                | NA             |
|           | 11/88     | WESTON  | ND                | ND                | NA                     | NA                | 32            | 100           | NR                | NA             |
|           | 11/14/88* | WESTON  | ND                | ND                | ND                     | ND                | 120           | 29            | 170               | ND             |



TABLE 4-1. TUTU SUPPLY WELLS GROUND WATER DATA SUMMARY (cont.)

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| WELL    | DATE      | SAMPLER | Benzene<br>(ug/L) | Toluene<br>(ug/L) | Ethylbenzene<br>(ug/L) | Xylenes<br>(ug/L) | PCE<br>(ug/L) | TCE<br>(ug/L) | 1,2-DCE<br>(ug/L) | MTBE<br>(ug/L) |
|---------|-----------|---------|-------------------|-------------------|------------------------|-------------------|---------------|---------------|-------------------|----------------|
| DAMITH  | 8/87      | WESTON  | ND                | ND                | NA                     | NA                | 2             | ND            | ND                | NA             |
|         | 9/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 10/87     | WESTON  | <1                | ND                | NA                     | NA                | <1            | <1            | <1                | NA             |
|         | 10/87*    | WESTON  | ND                | ND                | ND                     | ND                | 0.8           | ND            | ND                | ND             |
|         | 11/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 12/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 1/88      | WESTON  | ND                | 3                 | NA                     | NA                | ND            | ND            | NR                | NA             |
|         | 2/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 5/88      | WESTON  | ND                | ND                | NA                     | NA                | 4             | 2             | NR                | NA             |
|         | 8/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|         | 11/88     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|         | 11/14/88* | WESTON  | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | ND             |
|         | 2/89      | WESTON  | ND                | ND                | NA                     | NA                | <1            | <1            | ND                | ND             |
|         | 10/1/90   | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|         | 2/5/91    | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|         | 10/87*    | WESTON  | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | ND             |
|         | 11/14/88* | WESTON  | ND                | ND                | ND                     | ND                | 45            | 3 J           | 10                | ND             |
| DENCH   | 8/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 9/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 10/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | 1                 | NA             |
|         | 10/87*    | WESTON  | ND                | ND                | ND                     | ND                | 0.1           | ND            | ND                | ND             |
|         | 11/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 12/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 1/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|         | 2/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | <1                | NA             |
|         | 5/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|         | 8/88      | WESTON  | <1                | <1                | NA                     | NA                | <1            | ND            | NR                | NA             |
|         | 11/88     | WESTON  | ND                | <1                | NA                     | NA                | ND            | 10            | NR                | NA             |
|         | 11/14/88* | WESTON  | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | ND             |
|         | 2/89      | WESTON  | ND                | ND                | NA                     | NA                | <1            | 1             | ND                | NA             |
|         | 5/89      | WESTON  | ND                | <1                | NA                     | NA                | ND            | 3             | ND                | NA             |
|         | 9/25/90   | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|         | 2/5/91    | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|         | 2/5/91 FR | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|         | 3/31/93   | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
| DEDE    | 8/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 9/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 10/87     | WESTON  | <1                | ND                | NA                     | NA                | ND            | <1            | 1                 | NA             |
|         | 10/87*    | WESTON  | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | ND             |
|         | 11/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 12/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 1/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|         | 2/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 5/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|         | 8/88      | WESTON  | <1                | <1                | NA                     | NA                | <1            | <1            | NR                | NA             |
|         | 11/88     | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | NR                | NA             |
|         | 11/14/88* | WESTON  | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | ND             |
|         | 2/89      | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | ND                | NA             |
|         | 5/89      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 9/25/90   | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|         | 2/5/91    | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|         | 2/5/92    | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|         | 3/31/93   | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
| BRYAN   | 8/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 9/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 10/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 10/87*    | WESTON  | ND                | 2.4               | ND                     | ND                | ND            | ND            | ND                | ND             |
|         | 11/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | ND                | NA             |
|         | 1/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|         | 2/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 5/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|         | 8/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | NR                | NA             |
|         | 11/88     | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | NR                | NA             |
|         | 11/14/88* | WESTON  | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | ND             |
|         | 2/89      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 5/89      | WESTON  | ND                | ND                | NA                     | NA                | ND            | 5             | ND                | NA             |
|         | 10/1/90   | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|         | 2/5/91    | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
| DEVCONT | 8/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 9/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 10/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | <1                | NA             |
|         | 10/87*    | WESTON  | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | ND             |
|         | 11/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | <1                | NA             |
|         | 12/87     | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 1/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|         | 2/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 5/88      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|         | 8/88      | WESTON  | <1                | ND                | NA                     | NA                | ND            | <1            | NR                | NA             |
|         | 11/88     | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | NR                | NA             |
|         | 11/14/88* | WESTON  | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | ND             |
|         | 2/89      | WESTON  | ND                | ND                | NA                     | NA                | ND            | <1            | ND                | NA             |
|         | 5/89      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|         | 9/24/90   | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |

TABLE 4-1, TUTU SUPPLY WELLS GROUND WATER DATA SUMMARY (cont.)

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| WELL       | DATE       | SAMPLER | Benzene<br>(µg/L) | Toluene<br>(µg/L) | Ethylbenzene<br>(µg/L) | Xylenes<br>(µg/L) | PCE<br>(µg/L) | TCE<br>(µg/L) | 1,2-DCE<br>(µg/L) | MTBE<br>(µg/L) |
|------------|------------|---------|-------------------|-------------------|------------------------|-------------------|---------------|---------------|-------------------|----------------|
| DEVCON II  | 3/31/83    | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
| DEVCON III | 8/87       | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|            | 9/87       | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|            | 10/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|            | 10/87*     | WESTON  | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | ND             |
|            | 11/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|            | 12/87      | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|            | 1/88       | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|            | 2/88       | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|            | 5/88       | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | NR                | NA             |
|            | 8/88       | WESTON  | <1                | <1                | NA                     | NA                | <1            | <1            | NR                | NA             |
|            | 11/88      | WESTON  | <1                | <1                | NA                     | NA                | ND            | <1            | NR                | NA             |
|            | 11/14/88*  | WESTON  | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | ND             |
|            | 2/89       | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|            | 5/89       | WESTON  | ND                | ND                | NA                     | NA                | ND            | ND            | ND                | NA             |
|            | 9/24/90    | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
|            | 2/5/91     | G & M   | ND                | ND                | ND                     | ND                | ND            | ND            | ND                | NA             |
| LAPLACE    | 10/2/90    | G & M   | R                 | R                 | R                      | R                 | 88 J          | 24 J          | 140 J             | NA             |
|            | 2/5/91     | G & M   | ND                | ND                | ND                     | ND                | 110 D         | 32            | 200 D             | NA             |
|            | 2/5/91 FR  | G & M   | ND                | ND                | ND                     | ND                | 100 D         | 31            | 190 D             | NA             |
|            | 6/6/91     | G & M   | ND                | ND                | ND                     | ND                | 88 DJ         | 31 D          | 250 DEJ           | NA             |
|            | 6/6/91 FR  | G & M   | ND                | ND                | ND                     | ND                | 84 DJ         | 32 J          | 170 DJ            | NA             |
|            | 10/3/91    | G & M   | ND                | ND                | ND                     | ND                | 100 D         | 30            | 170 D             | NA             |
|            | 2/6/92     | G & M   | 15 J              | 11 J              | ND                     | ND                | 84 D          | 23            | 140 D             | NA             |
|            | 2/6/92 FR  | G & M   | 14 J              | ND                | ND                     | ND                | 81 D          | 23            | 140 D             | NA             |
|            | 5/28/92    | G & M   | ND                | ND                | ND                     | ND                | 80            | 18            | 100               | NA             |
|            | 9/17/92    | G & M   | 29 J              | ND                | ND                     | 85 J              | 67            | 22            | 130               | NA             |
|            | 4/1/93     | G & M   | ND                | ND                | ND                     | ND                | 62            | 17            | 110               | NA             |
| SMITH      | 8/87       | WESTON  | ND                | ND                | NA                     | NA                | 120           | 17            | 81                | NA             |
|            | 9/87       | WESTON  | ND                | ND                | NA                     | NA                | 135           | 10            | <5                | NA             |
|            | 10/87      | WESTON  | ND                | ND                | NA                     | NA                | >500          | 70            | 3.6               | NA             |
|            | 10/87*     | WESTON  | ND                | ND                | ND                     | ND                | 150           | 21            | 100               | NA             |
|            | 11/87      | WESTON  | ND                | ND                | NA                     | NA                | 50            | 3             | <1                | NA             |
|            | 12/87      | WESTON  | ND                | ND                | NA                     | NA                | 9.6           | 1.4           | ND                | NA             |
|            | 1/88       | WESTON  | ND                | ND                | NA                     | NA                | >50           | 5             | NR                | NA             |
|            | 2/88       | WESTON  | ND                | ND                | NA                     | NA                | 28            | 5             | <1                | NA             |
|            | 5/88       | WESTON  | ND                | ND                | NA                     | NA                | >1000         | 130           | NR                | NA             |
|            | 8/88       | WESTON  | ND                | ND                | NA                     | NA                | 35            | 3             | NR                | NA             |
|            | 11/88      | WESTON  | ND                | ND                | NA                     | NA                | 17            | 8             | NR                | NA             |
|            | 11/14/88*  | WESTON  | ND                | ND                | ND                     | ND                | 87            | ND            | 17                | ND             |
|            | 2/89       | WESTON  | ND                | ND                | NA                     | NA                | 120           | 15            | <1                | NA             |
|            | 5/89       | WESTON  | ND                | ND                | NA                     | NA                | 337           | 21            | 2                 | NA             |
|            | 9/24/90    | G & M   | ND                | ND                | ND                     | ND                | 330 J         | 20            | 58                | NA             |
|            | 2/5/91     | G & M   | ND                | ND                | ND                     | ND                | 180 J         | 23            | 42 J              | NA             |
|            | 6/6/91     | G & M   | ND                | ND                | ND                     | ND                | 180 D         | 28            | 82 D              | NA             |
|            | 10/3/91    | G & M   | 1 J               | ND                | ND                     | ND                | 250 D         | 20            | 58 D              | NA             |
|            | 2/5/92     | G & M   | 07 J              | 05 J              | ND                     | ND                | 230 D         | 21            | 48 D              | NA             |
|            | 5/28/92    | G & M   | ND                | ND                | ND                     | ND                | 140           | 15            | 40                | NA             |
|            | 5/28/92 FR | G & M   | ND                | ND                | ND                     | ND                | 150 D         | 14            | 37                | NA             |
|            | 9/16/92    | G & M   | ND                | ND                | ND                     | ND                | 170           | 21            | 60                | NA             |
|            | 3/30/93    | G & M   | ND                | ND                | ND                     | ND                | 170           | 20            | 52                | NA             |
| STEELE     | 8/87       | WESTON  | ND                | ND                | NA                     | NA                | 270           | 20            | 61                | NA             |
|            | 9/87       | WESTON  | ND                | ND                | NA                     | NA                | 575           | 9             | <5                | NA             |
|            | 10/87      | WESTON  | ND                | ND                | NA                     | NA                | >500          | 27            | 1.8               | NA             |
|            | 10/87*     | WESTON  | ND                | ND                | ND                     | ND                | 320           | 15            | 47                | 37 J           |
|            | 11/87      | WESTON  | ND                | ND                | NA                     | NA                | 300           | 12            | <1                | NA             |
|            | 12/87      | WESTON  | ND                | ND                | NA                     | NA                | 130           | 14.8          | 0.8               | NA             |
|            | 1/88       | WESTON  | ND                | ND                | NA                     | NA                | 500           | 100           | NR                | NA             |
|            | 2/88       | WESTON  | ND                | ND                | NA                     | NA                | 48            | 11            | 1                 | NA             |
|            | 5/88       | WESTON  | ND                | ND                | NA                     | NA                | >1000         | 180           | NR                | NA             |
|            | 8/88       | WESTON  | ND                | ND                | NA                     | NA                | 41            | 5             | NR                | NA             |
|            | 11/88      | WESTON  | ND                | ND                | NA                     | NA                | 105           | 42            | NR                | NA             |
|            | 11/14/88*  | WESTON  | ND                | ND                | ND                     | ND                | 480 D         | 37            | 73                | ND             |
|            | 2/89       | WESTON  | ND                | ND                | NA                     | NA                | 217           | 88            | 2                 | NA             |
|            | 5/89       | WESTON  | ND                | ND                | NA                     | NA                | 987           | 83            | 8                 | NA             |
|            | 9/25/90    | G & M   | ND                | ND                | ND                     | ND                | 130 J         | 48            | 120               | NA             |
|            | 2/5/91     | G & M   | ND                | ND                | ND                     | ND                | 65            | 12            | 44                | NA             |
|            | 6/5/91     | G & M   | ND                | ND                | ND                     | ND                | 150 DJ        | 42 DJ         | 180 DJ            | NA             |
|            | 10/1/91    | G & M   | 08 J              | ND                | ND                     | ND                | 54 D          | 28            | 150 D             | NA             |
|            | 2/4/92     | G & M   | ND                | ND                | ND                     | ND                | 55            | 28            | 110               | NA             |
|            | 5/27/92    | G & M   | ND                | ND                | ND                     | ND                | 40            | 27            | 150 D             | NA             |
|            | 9/14/92    | G & M   | ND                | ND                | ND                     | ND                | 65            | 33            | 140               | NA             |
|            | 3/29/93    | G & M   | ND                | ND                | ND                     | ND                | 61            | 45            | 130               | NA             |

## NOTES:

ND = Not Detected

PCE = Tetrachloroethene

NA = Not Analyzed

TCE = Trichloroethene

NR = Not Reported

1,2-DCE = 1,2-Dichloroethene (cis/trans)

FR = Field Replicate

MTBE = Methyl tert-butyl ether

HA = Hydrologic Associates

R = Rejected

G &amp; M = Gershty &amp; Miller

CHT = Caribbean Hydro-Tech

J = Result detected below calibration range and/or is an estimated value.

D = Compound analyzed at secondary dilution level.

E = Concentration exceeds calibration range.

\*Indicates TCL laboratory analysis. All other Weston data obtained by Photovac portable GC screening.

#### 4.1.2 Four Winds Production Wells (I, II, and III)

Four Winds production wells, with one exception, have not exhibited the presence of aromatic hydrocarbons above applicable MCLs. Only trace concentrations of benzene and toluene have been sporadically detected in these wells. On one occasion (July 1987) benzene was observed in Well I at a concentration exceeding the applicable MCL. Data collected by Weston from July 1987 through May 1989 (with two exceptions - October 1987 and November 1988) were analyzed with a field gas chromatograph not in a quantitative analytical laboratory, thereby these data should be considered with a lower level of confidence. These data clearly indicate that the Four Winds production wells were not positioned within an aromatic hydrocarbon plume under either dynamic (pumping) or static (regional flow) conditions. Rather, the sporadic detection of trace concentrations of aromatic hydrocarbons is, more likely than not, a result of regional ground-water quality degradation or the transport of contaminants from upgradient sources through a preferred conduit such as the storm sewer (e.g., the direct discharge of oily fluids into the storm sewer, upgradient of the Four Winds Plaza, was observed on the Texaco property during a site visit) or crushed stone subbase of the plaza building (e.g., USTs behind Western Auto).

Both Four Winds production wells I & II have demonstrated relatively stable concentrations of PCE, TCE and DCE from July 1987 through 1993. All three constituents have been, and presently are, detected at concentrations exceeding applicable MCLs. As with the Tillett well, the temporal occurrence of halocarbons in the Four Winds production wells demonstrate that these wells are positioned downgradient of an ongoing source of halocarbons under both dynamic

and regional flow conditions. Moreover, these data indicate that operations at the Tutu Esso station have not resulted in the presence of PCE, TCE, and DCE in the Four Winds production wells.

#### 4.1.3 Harthman Production Wells

The Harthman production wells (Table 4-1), have demonstrated only the sporadic, and predominantly unconfirmed, detection of aromatic hydrocarbons at trace concentrations (below applicable MCLs). These data clearly indicate that these wells have not been impacted by an aromatic hydrocarbon plume. Rather these concentrations are, more likely than not, a result of the degradation of regional ground-water quality.

Chlorinated hydrocarbons PCE, TCE and DCE have been consistently detected in the Harthman Crusher well. The temporal trend in halocarbon concentrations appears to be relatively stable with evidence of a slight decrease subsequent to July 1987. These data would indicate that under both pumping and regional flow conditions, this well has received contamination from an upgradient source.

### 4.2 Spatial Distribution

Ground-water quality data obtained during the Geraghty & Miller TEIC Investigation, taken in conjunction with historic production well sampling results, have been instrumental in identifying the spatial distribution of contaminants within the upper Tutu Aquifer basin. Ground-water quality data obtained for all monitoring wells (those installed during the TEIC Investigation and other independent studies) have been summarized in Table 4-2.

#### 4.2.1 Halocarbons

As demonstrated in Table 4-2 and Technical Memorandum II, prepared by Geraghty & Miller, the presence of halocarbons within the upper Tutu aquifer basin has resulted in an amorphous (ubiquitous)

**TABLE 4-2**  
**SUMMARY OF GROUND WATER ANALYTICAL DATA**  
**MONITORING WELLS**

**TUTU WELLS SITE**  
**St. Thomas, USVI**

| Well    | Date       | Sampler | Benzene<br>(µg/L) | Toluene<br>(µg/L) | Ethylbenzene<br>(µg/L) | Xylenes<br>(µg/L) | MTBE<br>(µg/L) | PCE<br>(µg/L) | TCE<br>(µg/L) | 1,2-DCE<br>(µg/L) |
|---------|------------|---------|-------------------|-------------------|------------------------|-------------------|----------------|---------------|---------------|-------------------|
| MW-1    | 10/6/92    | G & M   | <50               | <50               | <50                    | <50               | <50            | 590           | 190           | 1000              |
| MW-1D   | 10/2/92    | G & M   | rej               | rej               | rej                    | rej               | rej            | 190 J         | 52 J          | 600 J             |
| MW-2    | 9/30/92    | G & M   | <10               | <10               | <10                    | <10               | <10            | 15            | 3 J           | 26                |
| MW-3    | 9/30/92    | G & M   | <25               | <25               | <25                    | <25               | 24 J           | 58            | 19 J          | 530 E             |
| MW-4    | 9/30/92    | G & M   | <10               | <10               | <10                    | <10               | 1.2 J          | 25            | 8 J           | 86                |
| MW-4D   | 10/7/92    | G & M   | <10               | <10               | <10                    | <10               | <10            | 44            | 11            | 150               |
| MW-5    | 10/1/92    | G & M   | 1000              | 180 J             | 930                    | 1600              | 6200           | <500          | <500          | <500              |
| MW-5 FR | 10/1/92    | G & M   | 950               | 170 J             | 890                    | 1500              | 6200           | <500          | <500          | <500              |
| MW-6D   | 9/30/92    | G & M   | <10               | <10               | <10                    | <10               | <10            | <10           | <10           | <10               |
| MW-6R   | 9/29/92    | G & M   | <10               | <10               | <10                    | <10               | <10            | 13            | 3 J           | 39                |
| MW-7    | 10/5/92    | G & M   | <10               | <10               | <10                    | <10               | 5.8 J          | 110           | 29            | 170               |
| MW-8    | 9/29/92    | G & M   | <10               | <10               | <10                    | <10               | 51             | 38            | 14            | 140               |
| MW-9    | 10/7/92    | G & M   | 26                | <10               | 19                     | 2 J               | 2700 D         | <10           | <10           | <10               |
| MW-9 FR | 10/7/92    | G & M   | 28                | <10               | 24                     | 3 J               | 2900 D         | <10           | <10           | <10               |
| MW-9S   | 10/7/92    | G & M   | 16                | 2 J               | 5 J                    | 2 J               | 2200 D         | <10           | <10           | 2 J               |
| MW-10   | 10/6/92    | G & M   | <33               | <33               | <33                    | <33               | 660            | 25 J          | 29 J          | 130               |
| MW-10D  | 10/6/92    | G & M   | <50               | <50               | <50                    | <50               | 780            | 40 J          | 18 J          | 180               |
| MW-11D  | 10/2/92    | G & M   | <10               | <10               | <10                    | <10               | <10            | <10           | <10           | <10               |
| MW-12D  | 10/5/92    | G & M   | <10               | 1 J               | <10                    | <10               | 11             | <10           | <10           | 2 J               |
| MW-13D  | 10/6/92    | G & M   | <10               | 1 J               | <10                    | <10               | <10            | 7 J           | <10           | <10               |
| MW-14   | 10/1/92    | G & M   | <10               | <10               | <10                    | <10               | <10            | 1 J           | <10           | 44                |
| CHT-1   | 2/27/92    | HA      | ND                | ND                | ND                     | ND                | 55             | 69            | 14            | 170               |
| CHT-2   | 2/29/92    | HA      | <50               | <50               | 120                    | <50               | NA             | <50           | <50           | <50               |
|         | 5/27/92    | HA      | NA                | NA                | NA                     | NA                | NA             | ND            | ND            | ND                |
| CHT-3   | 2/27/92    | HA      | 26000             | 38000             | 2400                   | 38000             | 62000          | <1000         | <1000         | <1000             |
|         | 5/27/92    | HA      | NA                | NA                | NA                     | NA                | NA             | ND            | ND            | ND                |
| CHT-4   | 2/27/92    | HA      | ND                | ND                | ND                     | 5.4               | <10            | 73            | 18            | 210               |
|         | 2/27/92 D  | HA      | ND                | ND                | ND                     | ND                | ND             | 110 J         | 22            | 97 J              |
| CHT-6D  | 12/10/92   | CHT     | 11                | ND                | ND                     | ND                | 120            | 55            | 19            | 130               |
|         | 12/16/92   | CHT     | 1.3               | 0.75              | ND                     | ND                | NA             | 3.2           | 0.54          | 31                |
|         | 12/16/92 D | CHT     | 2.3               | 3.2               | ND                     | ND                | NA             | 3.3           | 0.64          | 32                |
|         | 12/17/92   | CHT     | 1.7               | 0.85              | ND                     | ND                | NA             | 1.6           | 0.52          | 29                |
| CHT-7D  | 5/13/92    | CHT     | 2.9               | ND                | ND                     | ND                | NA             | 43            | 13            | 113.2             |
|         | 12/18/92   | CHT     | 14                | ND                | 3.8                    | 2.7               | NA             | 83            | 14            | 140               |
| SUMP    | 11/14/91   | HA      | 540               | <500              | <500                   | <500              | NA             | <500          | <500          | NA                |
|         | 2/27/92    | HA      | <25               | <25               | <25                    | <25               | 7700           | <25           | <25           | <25               |
|         | 5/27/92    | HA      | NA                | NA                | NA                     | NA                | NA             | ND            | ND            | ND                |

**Notes:**

FR = Field Replicate

rej = Result rejected.

< = Result was not detected at the corresponding analytical detection limit.

J = Result was detected, but below the analytical detection limit.

D = Analyte is identified at a secondary dilution level.

E = Result is detected in exceedance of calibration range.

ND = Not Detected

NA = Not Analyzed

HA = Hydrologic Associates, Inc.

CHT = Caribbean HydroTech, Inc.

distribution of PCE, TCE and DCE. Within the amorphous distribution is a core area of significantly elevated concentrations. Based upon available data, this core area emanates from the former LAGA building and extends generally from the northeast to the southwest past the Tutu Esso station. Presently, eastern boundaries of the core halocarbon area have not been defined.

Available ground-water quality data from monitoring wells surrounding potential source areas on the Tutu Esso station (MW-9, MW-9S, CHT-2, CHT-3, and the CHT "Sump" well) have not demonstrated the presence of PCE or TCE. An estimated concentration of 2 ug/L of 1,2-dichloroethene was detected in monitoring well MW-9S. These data presently indicate that oil water separators and underground storage tanks on the Esso station have not functioned as sources for significant concentrations of halocarbons in the ground-water regime.

An analysis of the spatial distribution of PCE, TCE, and DCE, downgradient of the purported discharge area on the former LAGA property (Table 4-3 and Figure 4-1), indicates the following:

- a steady decrease in halocarbon concentrations is exhibited downgradient of the former LAGA building;
- no significant increase in halocarbon concentrations is observed upgradient of the Tutu Esso station; and
- all halocarbon constituents (i.e., PCE, TCE and DCE) exhibit a uniform decrease in concentration downgradient of the former LAGA building.

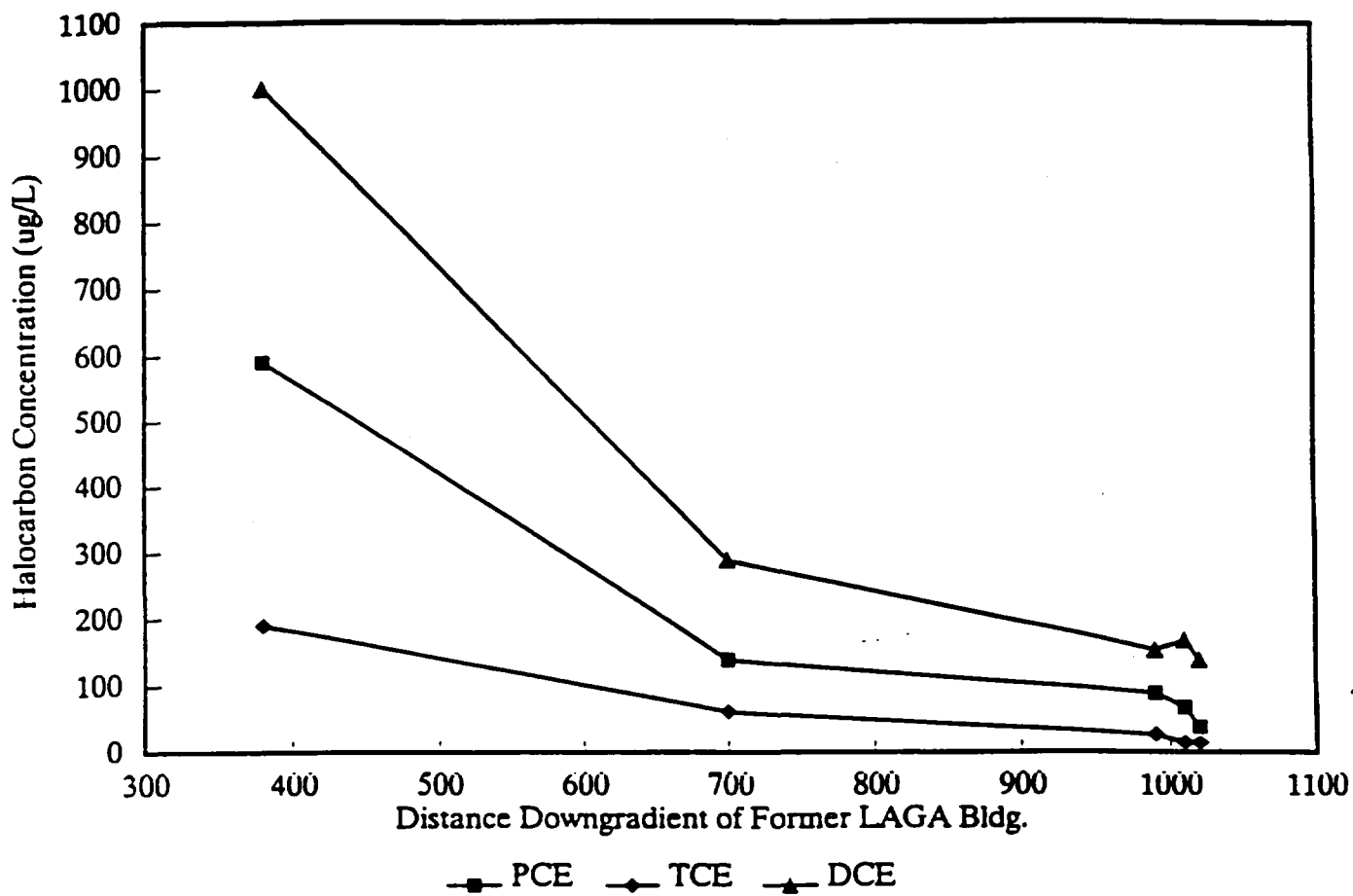
These data clearly indicate that discharges from the former LAGA property are responsible for the halocarbon impact of both the Tillett and Four Winds production wells. Moreover, there is presently no data to indicate that

**Table 4-3**  
**Halocarbon Concentration Gradient**  
**Downgradient of Former LAGA Building**  
**(September/October 1992)**

| Sample Location | Distance From<br>LAGA Building (ft) | PCE<br>Concentration (ug/L) | TCE<br>Concentration (ug/L) | DCE<br>Concentration (ug/L) |
|-----------------|-------------------------------------|-----------------------------|-----------------------------|-----------------------------|
| MW-1            | 380                                 | 590                         | 190                         | 1000                        |
| TILLET          | 700                                 | 140                         | 62                          | 290                         |
| FOUR WINDS I    | 990                                 | 90                          | 27                          | 155.2                       |
| CHT-1 *         | 1010                                | 69                          | 14                          | 170                         |
| MW-8            | 1020                                | 38                          | 14                          | 140                         |

\* Sampled on 2/27/92

FIGURE 4-1  
Halocarbon Concentration Gradient





operations at the Tutu Esso station have resulted in halocarbon impact of either the Tillett, Four Winds, or Harthman production wells.

#### 4.2.2 Aromatic Hydrocarbons

The spatial distribution of aromatic hydrocarbons within the upper Tutu aquifer basin is more confined than that of the halocarbon compounds. Based upon available ground-water quality data (Table 4-2), two areas of aromatic hydrocarbon impact can be delineated. Operations at both the Tutu Texaco and the Tutu Esso stations have resulted in the localized impact of ground-water quality by aromatic hydrocarbons. The impact area is generally centered along Route 38 extending from the Tutu Texaco station to a point approximately 200 feet southwest of the Tutu Esso station.

An analysis of the spatial distribution of aromatic hydrocarbons adjacent to the Four Winds Plaza (Table 4-4 and Figure 4-2), indicate the following:

- two distinct core areas of aromatic contamination can be delineated;
- the distribution of BTEX compounds beneath the Tutu Esso station does not migrate northward past the upgradient boundary of the station property as exhibited by the absence of these compounds in monitoring wells MW-8 and CHT-1, as wells as, Four Winds production well I; and
- The distribution of BTEX compounds extends downgradient from the Tutu Texaco station through the Tillett supply well beneath Route 38.

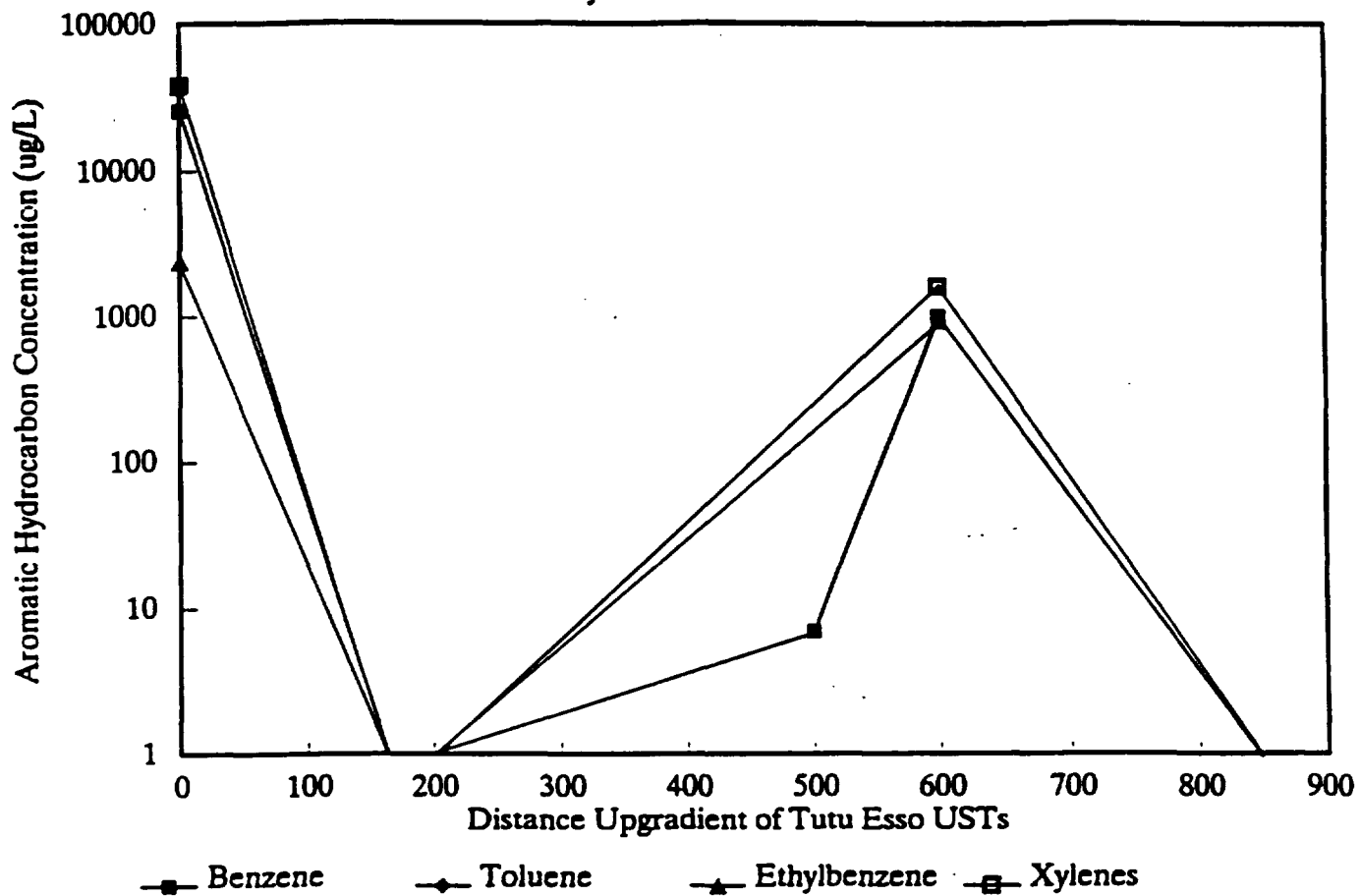
When the spatial distribution of aromatic contaminants is evaluated (Table 4-4 and Figure 4-2) in conjunction with the temporal occurrence of BTEX constituents in Four Winds Well I and the Tillett supply well (Table 4-5), it becomes obvious that a plume of aromatic hydrocarbons did not migrate upgradient (northward) from the Tutu Esso station and impact the Tillett supply well under pumping conditions. If such a scenario occurred, plume transport would have resulted in the sustained presence of aromatic hydrocarbons at

**Table 4-4**  
**Aromatic Hydrocarbon Concentration Gradient**  
**Upgradient of the Tutu Esso Tank Field**  
**(September/October 1982)**

| Sample Location | Distance Upgradient of<br>Tutu Esso USTs | Benzene<br>Concentration (ug/l) | Toluene<br>Concentration (ug/l) | Ethylbenzene<br>Concentration (ug/l) | Xylene<br>Concentration (ug/l) |
|-----------------|------------------------------------------|---------------------------------|---------------------------------|--------------------------------------|--------------------------------|
| CHT-3 *         | 0                                        | 26000                           | 38000                           | 2400                                 | 38000                          |
| MW-8            | 160                                      | <10                             | <10                             | <10                                  | <10                            |
| CHT-1 *         | 180                                      | ND                              | ND                              | ND                                   | ND                             |
| FOUR WINDS I    | 200                                      | 0                               | 0                               | 0                                    | 0                              |
| TILLET          | 500                                      | 7                               | 0.5 J                           | 1.5 J                                | 0                              |
| MW-5            | 600                                      | 1000                            | 180 J                           | 930                                  | 1600                           |
| MW-3            | 840                                      | <25                             | <25                             | <25                                  | <25                            |

\* Sampled on 2/27/92

**FIGURE 4-2**  
**Aromatic Hydrocarbon Concentration Gradient**



**Table 4-5**  
**Temporal Aromatic Hydrocarbon Occurrence**  
**Tillett and Four Winds I Production Wells**

| Sample Date | Tillett Well                    | Four Winds Production Well I    |
|-------------|---------------------------------|---------------------------------|
|             | Total BTEX Concentration (ug/L) | Total BTEX Concentration (ug/L) |
| Jul-87      | 7442                            | 12.6                            |
| Aug-87      | 1433                            | 3                               |
| Sep-87      | 250                             | 2                               |
| Oct-87      | 0                               | 0                               |
| Nov-87      | > 1030                          | 0                               |
| Dec-87      | > 680                           | 1                               |
| Feb-88      | 49                              | 0                               |
| Nov-88      | 1047 D                          | 0                               |
| May-89      | 704                             | 0                               |
| Oct-91      | 94.6 J                          | 0.33 J                          |
| Feb-92      | 1.75 J                          | 0.8                             |
| Sep-92      | 9 J                             | 0                               |
| Mar-93      | 6.9 J                           | 0                               |

significant concentrations in Four Winds Well 1. These data clearly identify the Tutu Texaco station as the primary source of aromatic compounds in the Tillett well.

## **5.0 SOURCE IDENTIFICATION**

Based upon an analysis of the temporal and spatial distribution of contaminants in the upper Tutu aquifer basin, taken in conjunction with a conceptual understanding of the aquifer's hydraulic properties, source areas for VOC impact on the Tillett, Four Winds, and Harthman production wells can be identified within a reasonable degree of scientific certainty.

**Table 5-1**  
**Source/Impact Area Identification**

| PRODUCTION WELL                       | CONTAMINANT SOURCE AREA                                                                                                                                                                                                                                                                                                         |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TILLET                                | Halocarbons - Former LAGA Building<br>Aromatic Hydrocarbons - Tutu Texaco                                                                                                                                                                                                                                                       |
| FOUR WINDS PLAZA<br>(I, II, and III)  | Halocarbons - Former LAGA Building<br>Aromatic Hydrocarbons (sporadic detection) -<br>Regional ground-water quality degradation or<br>transport from upgradient sources as a result<br>of migration through preferential pathways.                                                                                              |
| HARTHMAN<br>(Crusher, Bakery, Estate) | Halocarbons (Crusher Well) - Combined impact<br>from regional ground-water quality degradation<br>and discharges at the O'Henri Dry Cleaner<br><br>Halocarbons (Bakery and Estate Wells) -<br>Regional ground-water quality degradation<br><br>Aromatic Hydrocarbons (All Wells) - Regional<br>ground-water quality degradation |

Insufficient data presently exists to determine the impact on ground-water quality as a result of other sources (e.g., Ramsay Motors, Antilles/Gassett, and anthropogenic activities) within the upper Tutu aquifer basin.

Data/observations are available to identify sources for soil contamination on the Four Winds Plaza property. Available information indicates that soil quality on the Four Winds Plaza property has been impacted by:

- discharges from underground storage tanks on the Four Winds Plaza property;
- surface discharges in the parking lot of the Four Winds Plaza property; and
- operations at the Tutu Esso station.

Presently insufficient data exists to identify the presence of soil contamination beneath the Harthman property.

## 6.0 REMEDIAL ACTION APPLICABILITY

veral of the production wells within the upper Tutu aquifer basin  
ted with VOCs, point-of-use treatment technologies (i.e., granular  
, or air stripping in combination with carbon treatment) represent  
en means to achieve treatment of extracted ground water to  
ing water standards. These technologies could be employed on  
Winds, and Harthman properties to facilitate production of  
supplies.

data presently exists to determine the mobility and persistence  
ocarbon contamination beneath either the Tutu Esso or Rodriguez

Although this is the case, within a reasonable degree of  
plume migration under both regional ground-water flow and  
ing conditions toward the Harthman wells, and under dynamic  
tions toward the Four Winds production wells can be arrested  
ecific remedial action programs incorporating hydraulic control.  
omatic hydrocarbon plumes beneath the Tutu Esso and Rodriguez  
are capable of being remediated without restricting the use of  
arties.

NDIX A

L MCLs



**APPLICABLE FEDERAL MCLs**

| <b>Volatile Organic Compound</b> | <b>Applicable Federal MCL (ug/L)</b> |
|----------------------------------|--------------------------------------|
| <b>Benzene</b>                   | <b>5</b>                             |
| <b>Toluene</b>                   | <b>1000</b>                          |
| <b>Ethylbenzene</b>              | <b>700</b>                           |
| <b>Xylene</b>                    | <b>10000</b>                         |
| <b>MTBE</b>                      | <b>-</b>                             |
| <b>Tetrachloroethene</b>         | <b>5</b>                             |
| <b>Trichloroethene</b>           | <b>5</b>                             |
| <b>Dichloroethene cis/trans</b>  | <b>70/100</b>                        |



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Where quality is a science.

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ASR000 D 2 2  
06734 .0

Blasland, Bouck & Lee  
1 East Uwchlan Avenue, Ste 112  
Exton, PA 19341-1281

LLI Sample No. SW 2042570  
Date Reported 11/ 5/93  
Date Submitted 10/23/93  
Discard Date 11/20/93  
Collected 10/22/93 by DC  
Time Collected  
P.O. 58101  
Rel.

SS-11 Grab Soil Sample  
Esso Tutu / 58101

|                               | RESULT        |       | LIMIT OF     |            |
|-------------------------------|---------------|-------|--------------|------------|
|                               | DRY WT. BASIS |       | QUANTITATION | LAB CODE   |
| Base Neutral cont SW846/8270A |               |       |              |            |
| anthracene                    | 1,500.        | ug/kg | 860.         | 377600000P |
| di-n-butyl phthalate          | < 860.        | ug/kg | 860.         | 377700000P |
| fluoranthene                  | 1,500.        | ug/kg | 860.         | 377800000P |
| pyrene                        | 6,500.        | ug/kg | 860.         | 119500000P |
| benzidine                     | < 8,600.      | ug/kg | 8,600.       | 377900000P |
| butyl benzyl phthalate        | 2,600.        | ug/kg | 860.         | 378000000P |
| benzo (a) anthracene          | < 860.        | ug/kg | 860.         | 378100000P |
| chrysene                      | 18,000.       | ug/kg | 1,700.       | 378200000P |
| 3,3'-dichlorobenzidine        | < 1,700.      | ug/kg | 1,700.       | 378300000P |
| bis (2-ethylhexyl) phthalate  | 3,800.        | ug/kg | 860.         | 378400000P |
| di-n-octyl phthalate          | < 860.        | ug/kg | 860.         | 378500000P |
| benzo (b) fluoranthene        | 5,700.        | ug/kg | 860.         | 378600000P |
| benzo (k) fluoranthene        | < 860.        | ug/kg | 860.         | 378700000P |
| benzo (a) pyrene              | < 860.        | ug/kg | 860.         | 378800000P |
| indeno (1,2,3-cd) pyrene      | 980.          | ug/kg | 860.         | 378900000P |
| dibenz (a,h) anthracene       | < 860.        | ug/kg | 860.         | 379000000P |
| benzo (ghi) perylene          | 2,700.        | ug/kg | 860.         | 379100000P |

The GC/MS semivolatile internal standard peak areas were outside of the QC limits for both the initial injection and the re-injection. The values here are from the initial injection of the sample.

Benzo(b)fluoranthene and benzo(k)fluoranthene were not resolved under the sample analysis conditions. The result reported for benzo(b)fluoranthene represents the combined total of both isomers.

The quantitation limits for the GC/MS semivolatile compounds were raised due to the high concentration of non-target compounds.

1 COPY TO Blasland, Bouck & Lee  
1 COPY TO Data Package Group

ATTN: Mr. Thomas Maguire

Questions? Contact Environmental  
Client Services at (717) 656-2301

Respectfully Submitted  
Lancaster Laboratories, Inc.  
**201**



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