65038

Erler &
Kalinowski, Inc.

TECHNICAL MEMORANDUM 1

Basis of Design
for the
Groundwater and Soils Remediation
Source Control Program

Texaco Tutu Service Station,
St. Thomas, U.S. Virgin Islands

26 June 1995
(EKI 940058.03)

TECHNICAL MEMORANDUM 1

Basis of Design for the Groundwater and Soils Remediation Source Control Program

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TUT 008 0316

SECTION A - INTRODUCTION

Gasoline constituents have been released to the subsurface in the vicinity of Texaco Tutu Service Station, St. Thomas, U.S. Virgin Islands (GCL, 1994; Geraghty & Miller, 1995a). In a 13 April 1995 document titled "Groundwater and Soils Remediation Program for Texaco Service Station, St. Thomas, U.S. Virgin Islands" (Erler & Kalinowski, Inc., 1995) ("April Report"), Texaco Caribbean Inc. ("TCI") proposed a conceptual design for soils and groundwater remediation program.

The primary objectives of the proposed site soils and groundwater remediation program are to:

- remove free-phase petroleum hydrocarbons (light non-aqueous phase liquid, "LNAPL"), if present,
- control and remediate groundwater with elevated concentrations of petroleum hydrocarbons in the vicinity of the site,
- remediate unsaturated soil and rock that may be affected petroleum hydrocarbons beneath the site, and
- control further migration of the petroleum hydrocarbon plume down-gradient of the site.

The TCI remediation program is planned for two locations: the Texaco Service Station Site itself ("Service Station Site") and the Vitelco Property ("Vitelco Site"), downgradient of the Service Station Site. The planned remedial action at the Service Station Site consists of construction of a soil vapor extraction system coupled with a groundwater extraction and treatment system. The remedial action at the Vitelco Site consists of construction of a groundwater extraction and treatment system.

The purpose of this Technical Memorandum 1 ("Tech Memo 1") is to provide to the regulatory agencies, U.S. EPA ("EPA") and the U.S. Virgin Islands Department of Planning and Natural Resources ("DPNR"), additional information regarding the basis for the design of the groundwater and soil remedial systems to be constructed at the Service Station and Vitelco Sites.

Tech Memo 1 is divided into five sections. This Introduction is Section A. Section B provides additional information regarding the proposed soil vapor extraction system at the Service Station Site. Section C provides additional information regarding the proposed groundwater extraction systems at both the

Service Station and Vitelco Sites. Section D discusses potential additional investigations at both sites, and Section E presents the plan for implementing the project and the proposed schedule at both sites. Numbered Sub Sections within each Section address discrete issues that require additional discussion. Back-up materials (e.g., figures, tables, specifications, calculations) are included at the back of each Sub Section for ease of review.

B

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SECTION B - SOIL VAPOR EXTRACTION SYSTEM

B-1. Remedial Action Objectives for Vadose Zone Soils

The overall remedial action objectives for vadose zone soil impacted by petroleum hydrocarbons at the Service Station Site are to protect human health and the environment by: 1) limiting direct exposure to impacted soils, and 2) limiting the potential for migration of the petroleum hydrocarbons from the soil to the groundwater. To meet these objectives, a soil vapor extraction ("SVE") system is being constructed to extract, to the extent practicable, petroleum hydrocarbons from the vadose zone soil. It is intended that the SVE system be operated until evaluation of performance criteria indicates that mass removal of petroleum hydrocarbons is no longer significant.

It is proposed that the mass removal rate of petroleum hydrocarbons will be considered no longer significant when any one of the three following alternative performance standards is satisfied:

1) Three sets of extracted gas concentration monitoring results show that all of the three following criteria are met:

a) the extracted gas concentration of petroleum hydrocarbons is less than ten (10%) of its value at the time of startup or less than the Practical Quantitation Limit ("PQL"), whichever is greater; and

b) the extracted gas concentration of petroleum hydrocarbons, in the most recent year of operation, has been reduced by less than ten percent (10%) of its value at the start of the year, or is less than the PQL, whichever is greater; and

c) the total aggregate removal rate for the petroleum hydrocarbons is less than three (3) pounds per day per 100 standard cubic feet per minute ("SCFM") of vapor removed.

2) Three sets of extracted gas concentration monitoring results, at intervals established in the approved Monitoring Plan, show that the extracted gas concentration of petroleum hydrocarbons is less than one percent (1%) of its value at the time of startup or less than the PQL, whichever is greater.

TUT 008 0323

3) Three years of SVE system operation have been completed and three sets of extracted gas concentration monitoring results, at intervals established in the approved Monitoring Plan, show that the extracted gas concentration of petroleum hydrocarbons is less than ten percent (10%) of its value at the time of startup or less than the PQL, whichever is greater.

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B-2. Service Station Site SVE System Design Summary

The Service Station Site SVE system will consist of three soil vapor extraction wells (including existing well TT-4), new monitoring points, and a soil vapor treatment unit. The locations of well TT-4, the two proposed extraction wells, and the containerized treatment system are shown on Figure B-2.1. The catalytic oxidizer vapor treatment unit within the containerized treatment system is designed to also treat air discharged from the groundwater air stripper (see Section C).

Discussed below are the design parameters for the Service Station Site soil vapor extraction system.

B-2.1 Well TT-4

Existing vadose zone well TT-4 is located within a fuel tank excavation backfilled with gravely clay (See monitoring well construction log at the back of Sub Section B-2). The existing wellhead will provided with a seal to limit potential short-circuiting.

B-2.2 Proposed Vapor Extraction Wells and Monitoring Points

The two new SVE wells (VE-2 and VE-3) will be 6 inches in diameter, and approximately 20 feet deep, and screened from approximately 4 to 16 feet below the ground surface ("bgs"). The annular space between the blank casing and the bore hole down to a depth of 4 feet will be sealed with bentonite. The zone from 16 to 20 feet bgs, with blank casing, will be a sump for possible future installation of a seepage pump.

New monitoring points will be installed on a radial line at approximately 10 foot intervals from the proposed SVE wells to assess the zones of influence of each of the SVE wells. Monitoring points well be constructed by first core-drilling the pavement, then driving 1/4 inch interior diameter steel casings into the subsurface soils to a depth of about 3 feet. These temporary monitoring points will be equipped with a vacuum gauge or water column to measure subsurface vacuum. Monitoring point locations will be determined in the field.

At monitoring points not indicating a subsurface vacuum, a vapor sample will be extracted if possible and screened with a PID for volatile organics as an indication of the possible presence chemicals of concern in the subsurface.

B-2.3 SVE System Capacity

As described in the April report, and based on existing monitoring well construction logs for wells TT-4 and TT-1, the subsurface soils consist of clays and weathered bedrock. (See lithologic descriptions on monitoring well construction logs, included at the back of Section B-2.) Based on past experience with similar soils, it is anticipated that each of the vapor extraction wells will have a radius of influence of approximately 20 feet at an applied vacuum of six (6) inches of mercury and vapor flow rate of 10 - 15 standard cubic feet per minute ("scfm") per well. Therefore, the total flowrate from the SVE system is estimated to be 30 to 45 scfm.

As a result of the applied vacuum from the SVE system, the groundwater elevation in the wells is anticipated to rise 6 to 7 feet. However, this rise is expected to be counteracted by the effects of groundwater pumping from the planned groundwater extraction wells. Modeling of the groundwater extraction system suggests that the expected drawdown due to pumping of groundwater will be 6 to 7 feet. (For additional discussion of the groundwater modeling, see Section C-2.) Therefore, the net effect is that the groundwater surface is expected to remain near its pre-pumping elevation.

B-2.4 Vapor Treatment Unit

Soil vapor extracted from the SVE wells will be treated by a catalytic oxidizer to control emissions of chemicals of concern; air discharged from the air stripper will also be treated by the catalytic oxidizer. (See Section C for a discussion of the groundwater extraction and treatment system.) The catalytic oxidizer is designed with a total capacity of 1,000 scfm of which 100 scfm has been allocated for the treatment of soil vapor from the SVE system. (See Sub Section B-3.2 for discussion of effluent from the catalytic oxidizer.)

EPA REGION II
SCANNING TRACKING SHEET

DOC ID # 65038

DOC TITLE/SUBJECT:

TUTU WELLS SUPERFUND SITE
FIGURE B-2.1
GROUNDWATER AND SOIL REMEDIATION SYSTEMS SITE LAYOUT TEXACO TUTU SERVICE STATION (Page: TUT 008 0328)

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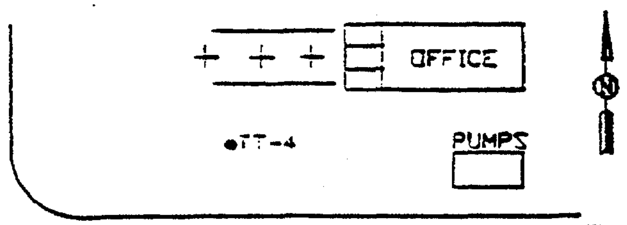
EXISTING MONITORING WELL CONSTRUCTION LOGS

LITHOLOGIC LOG (CUTTINGS)

LOCATION MAP:



__1/4 __1/4 __1/4 __1/4 S__ T__ R__

LOCATION No. 1

SITE ID: TEXACO TUTU LOCATION ID: TT-4
SITE COORDINATES (ft.):
N ________ E ________
GROUND ELEVATION (ft. MSL): ________
STATE: ST. THOMAS COUNTY: U.S.V.I.
DRILLING METHOD: AIR ROTARY/HAMMER
DRILLING CONTR.: CARRIBBEAN HYDRO-TECH
DATE STARTED: 12/2/93 DATE COMPLETED: 12/3/93
FIELD REP.: MAZZULLO/MONTANO
COMMENTS: ________

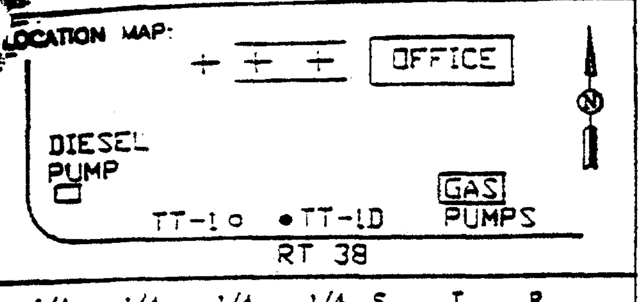
LOCATION DESCRIPTION: CENTER OF UST PIT AREA

DEPTH	WELL CONST.	LITH.	VISUAL %	SAMPLE TYPE	SAMPLE INTERVAL	LITHOLOGIC DESCRIPTION (LITH., GRAIN SIZE PROPORTIONS, WET COLOR, RNDG., SRTG., CONSOL., DIST. FEATURES)
						0.0–0.5 CONCRETE
				HEAD-SPACE	8.3 ppm	0.5–9.0 CLAYEY FILL = DARK GRAY TO GREENISH-GRAY (5G 4/1), GRAVELLY (UP TO 40%), MODERATELY PLASTIC CLAY, WITH LOCALLY MODERATE HEAVY-OIL ODOR.
5	4" PVC BLANK			PID	30.0 ppm	
				HEAD-SPACE	22.0 ppm	
				PID	16.0 ppm	9.0–16.5 WEATHERED BEDROCK = DARK GREENISH-GRAY (5G 4/1) ANDESITE BRECCIA, WITH DARK GREENISH-GRAY CLAY FILLING INTERSTICES.
10						
15						16.5–36.0 VOLCANIC BRECCIA = DARK GREENISH-GRAY (5G 4/1) AUGITE-ANDESITE BRECCIA, WITH SPORADIC DIKES OR INCLUSIONS OF BLACK (5G 2/1) BASALT BRECCIA. FRACTURES NOTEABLE NEAR 26-27 FT. AND SOFT WEATHERED ZONE NEAR 33 FT.
20	4" .020-SLOT PVC					
25						
30						
35						TD = 36.0 FT. B/SCREEN = 29.5 FT. INITIAL WATER LEVEL = 13.73 FT. BGL
40						
45						
50						

EXISTING MONITORING WELL CONSTRUCTION LOGS

LITHOLOGIC LOG (CUTTINGS)

LOCATION MAP:

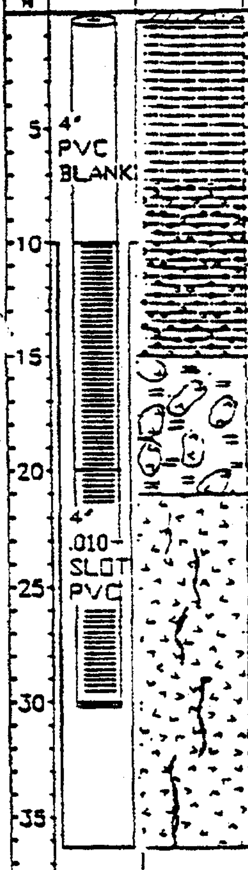


___1/4 ___1/4 ___1/4 ___1/4 S___ T___ R___

Location No. 1

SITE ID: TEXACO TUTU LOCATION ID: TT-1
SITE COORDINATES (ft.):
N ______ E ______
GROUND ELEVATION (ft. MSL):
STATE: ST. THOMAS COUNTY: U.S.V.I.
DRILLING METHOD: AIR ROTARY/HAMMER
DRILLING CONTR.: CARRIBEAN HYDRO-TECH
DATE STARTED: 12/8/93 DATE COMPLETED: 12/8/93
FIELD REP.: MAZZULLO/MONTANO
COMMENTS:

LOCATION DESCRIPTION: SOUTH END OF STATION ALONG CURB. 5 FT. WEST OF TT-1D



DEPTH	SAMPLE TYPE	SAMPLE INTERVAL
	PID	5 ppm
5	HEAD-SPACE	94 ppm
	HEAD-SPACE	48 ppm
10	HEAD-SPACE	19 ppm
15	PID	7 ppm
20	PID	16 ppm
25	PID	121 ppm
30	PID	24 ppm
	PID	6 ppm
35	PID	5 ppm

LITHOLOGIC DESCRIPTION (LITH., GRAIN SIZE PROPORTIONS, WET COLOR, RNDG., SRTG., CONSOL., DIST. FEATURES)

	Description
0.0–0.5	CEMENT
0.5–5.0	CLAY = MODERATE GREENISH-GRAY (5B 5/1), MODERATE PLASTICITY, SANDY TO PEBBLY (20-25%), WITH MILD WASTE OIL ODOR.
5.0–7.5	CLAY = OLIVE-GRAY (5Y 4/1), MODERATE PLASTICITY, SANDY (10-15%) WITH SOME LARGER ROCKS AND TREE ROOTS.
7.5–15.0	PEBBLY CLAY = GRAY-GREEN (5G 4/1), MODERATE PLASTICITY, 15-20% PEBBLES (LOCALLY HIGHER PROPORTION).
15.0–21.0	WEATHERED BEDROCK = DARK GREENISH-GRAY (5G 4/1), ALTERED ANDESITE AND BASALT BRECCIA, WITH INTERSTITIAL CLAY.
21.0–36.3	VOLCANIC BRECCIA = FRACTURED, BLACK (5G 2/1), BASALT BRECCIA, DOWN TO FRACTURED, DARK GREENISH-GRAY (5G 4/1), AUGITE-ANDESITE BRECCIA. SLIGHT GASOLINE ODOR TOWARDS BOTTOM.

TD = 36.3 FT.
B/SCREEN = 30 FT.
INITIAL WATER LEVEL = 12.45 FT. BGL

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B-3. SVE System Treatment Criteria

The design of the catalytic oxidizer unit is based upon the parameters discussed below.

B-3.1 Assumed Concentrations of Chemicals in the Extracted Soil Vapor

Due to the limited number of subsurface samples that have been collected and tested, there is some uncertainty whether the available soil data are fully representative of the concentrations of volatile chemicals in the vadose zone. Therefore, the concentrations of chemicals in groundwater were used to estimate the concentrations of chemicals in the extracted soil vapor. The chemical concentrations in the extracted soil vapor were estimated by converting the highest reported groundwater concentrations, in parts per million (ppm), from the former underground storage tank area to vapor phase concentrations in parts per million by volume (ppmv). The vapor phase concentrations were then converted to the mass of chemicals removed on a daily basis by assuming an air flow rate of 10 scfm for each SVE well. Table B-3.1 shows these concentrations and estimated mass removal rates for each chemical of concern. A calculation sheet showing the specific calculation for benzene is included at the back of Sub Section B-3.

The concentrations of each of the chemicals of concern shown in Table B-3.1 were used as the basis for determining the design parameters for soil vapor influent into the catalytic oxidizer (described in Section B-3.3). In addition, groundwater off-gas will enter the catalytic oxidizer. The estimated vapor concentrations from the groundwater off-gas, the SVE system, and total estimated vapor concentrations in the catalytic oxidizer influent are shown in Tables B-3.2 and B-3.2A. The determination of the required destruction efficiency of the catalytic oxidizer is described in Section B-3.2.

B-3.2 Air Emissions - Service Station Site

Based on discussions with the DPNR, air discharge limits or permitting requirements have not been promulgated for remediation facilities for the U.S. Virgin Islands. Air emissions of benzene, 1,2-dichloroethane, trichloroethene, tetrachloroethene, vinyl chloride and methylene chloride are of potential concern because these chemicals have been identified as human carcinogens (Class A) or probable human carcinogens (Class B2) (EPA, 1994). EPA uses a general risk range of 10^{-4} to 10^{-6} (the probability that an individual will contract cancer over a 70 year lifetime due to exposure to chemicals of concern) as an acceptable “target range” for cleanup (EPA, 1990). Table B-3.3 (revised from Table 5, page 1, in the April Report) shows estimated air emissions of these chemicals of concern, catalytic oxidation destruction efficiencies, estimated treated air emissions and estimated hydrochloric acid emissions following catalytic oxidation destruction at the Service Station Site.

The catalytic oxidizer destruction efficiencies specified for the unit that will be manufactured specifically for the Service Station Site are based on typical, achievable destruction efficiencies for catalytic oxidizers. The catalytic oxidizer specifications are included in this Sub Section. As discussed below, the catalytic oxidizer will produce air emissions that are expected to be in the risk range of 10^{-6}.

Hydrochloric acid (HCl) will be formed as a result of the destruction of chlorinated VOCs. Estimated emissions of HCl are calculated to be on the order of 3 lb/day.

The risk screening analysis method used for the Service Station Site is based on the EPA Risk Assessment Guidance for Superfund (EPA, 1989) and EPA's Supplemental Guidance entitled "Standard Default Exposure Factors" (EPA, 1991). Three populations are considered in the evaluation of estimated incremental lifetime cancer risk due to inhalation of chemicals of concern emitted from the remediation system: 1) on-site employee risk; 2) off-site resident risk; and 3) off-site school student risk. Summary Table B-3.4, Detailed Risk Analysis Tables B-3.5 through B-3.8, EPA guidance formulas, back-up calculations, air simulation assumptions, and an EPA approved air dispersion model (SCREEN2, 1993) output are included in this Sub Section. Results of the risk analysis for EPA carcinogens are described below.

At the Service Station Site, benzene emissions from the soil vapor extraction system and the groundwater treatment system, without emissions control, are estimated to be on the order of up to 15 lb/day. Due to this potentially significant mass, air emissions treatment by catalytic oxidation has been included in the remedial design for this location.

A risk screening analysis was completed to estimate the incremental potential lifetime cancer risk due to exposure to treated air emissions from the Service Station Site remediation system. Based on estimated air emission rates and the results of emission scenarios calculated from the SCREEN2 simulation, health risk analyses were completed for on-site employees, off-site residents, and off-site school students due to exposure to the maximum calculated concentration at ground level.

The estimated incremental lifetime cancer risk for on-site employees at the Service Station Site, assuming a 25 year exposure duration, is estimated to be 1.0×10^{-6}. For off-site residents, the incremental lifetime cancer risk, assuming a 30 year exposure duration, is estimated to be 5.0×10^{-7}. The estimated incremental lifetime cancer risk for off-site students, assuming an 8 year exposure duration, is estimated to be 4.0×10^{-8}.

The risks are weighted toward the assumed benzene and vinyl chloride emissions. In response to a comment from EPA, an additional analysis was completed to look at the potential effects on risk due to hypothetical higher, simultaneous vinyl chloride and benzene levels. Table B-3.6 shows the sensitivity of the risk analysis to these elevated concentrations. If the vinyl chloride emission rate increased to 2.7×10^{-4} g/s (increasing the influent concentration to approximately 2 ppm from the assumed 100 ppb) and the benzene emission rate increased to 1.3×10^{-3} g/s (doubling the groundwater influent concentratlon to 34 ppm from the assumed 17 ppm) the estimated incremental lifetime cancer risk would be 5.0×10^{-6} for on-site employees assuming a 25 year exposure duration and 2.0×10^{-6} for on-site employees assuming a 10 year exposure duration.

The long term analyses may be conservative inasmuch as the exposure durations of 25 years for on-site employees, and 30 years for off-site residents are likely two to three times the probable operational life of the remediation system. In addition, chemical concentrations from the soil vapor extraction system are expected to significantly decline within a few years.

Therefore, it can be assumed that with the specified catalytic oxidizer destruction efficiencies, the conservative exposure durations used, and the expected reduction of chemicals from the soil vapor extraction sytem, there is adequate flexibility in the system to treat higher than assumed influent concentrations without increasing the estimated incremental lifetime cancer risk above 10^{-6}.

B-3.3 Catalytic Oxidation Treatment

Based on the air emmisions and the risk analysis described in Section B-3.2 and typical catalytic oxidizer destruction efficiencies, the catalytic oxidizer has been specified to have a destruction efficiency for BTEX compounds of 99% and a destruction efficiency of 96% for the chlorinated VOCs. The technical specifications for the catalytic oxidizer are included at the end of this section.

Based on an air discharge rate of 900 scfm from the air stripper and an estimated maximum soil vapor extraction rate of 100 scfm, it was determined that the catalytic oxidizer should have an air flow capacity of 1000 scfm.

TABLE B-3.1

TEXACO SERVICE STATION SOILS
VAPOR PHASE CONCENTRATIONS
Texaco Tutu Service Station
(EKI 940058.03)

CHEMICALS OF CONCERN	Conc H20 ppm	MW	Kh	Vapor Conc ppmv	Design Vapor Conc lb/day
Benzene	23	78	5.48E-03	1616	5
Toluene	25	92	6.74E-03	1832	6
Ethylbenzene	4	106	8.68E-03	328	1
Xylene	18	106	6.30E-03	1070	4
1,2-Dichloroethane (DCA)	0.3	99	9.10E-04	3	0.01
1,2-Dichloroethene (DCE)	0.7	97	9.38E-03	68	0.25
Tetrachloroethene (PCE)	0.06	166	2.87E-03	1	0.01
Trichloroethene (TCE)	0.05	131	9.90E-03	4	0.02
Vinyl chloride	0.06	63	5.60E-02	53	0.1
Methylene Chloride	7	84.93	2.00E-03	165	1

MW = Molecular weight
Kh = Henry's constant

Assumptions:

1. Estimate chemical concentrations in soil based on the highest groundwater concentrations found in the former underground storage tank area.
2. Assume equilibrium conditions for calculating lb/day based on 10 scfm.

Tutu 940058.03 | DAH | 3/20/95

CONVERT CHEMICAL CONCENTRATION IN WATER (PPM) TO PPMV

$$\frac{C_w\,(mg/l)}{MW\,(\frac{g}{mole})} \times K_H\left(\frac{atm\ m^3}{mole}\right) \times 1\times10^6 = ppmv$$

EXAMPLE:

BENZENE

$$\frac{23\ (mg/l)}{78} \times 0.00548 \times 1\times10^6 = 1616\ ppmv$$

CONVERT PPMV TO ug/l TO lb/DAY

$$ppmv \times \frac{MW}{24.04} = ug/l$$

$$ug/l \times \frac{1\times10^{-6}\,g}{ug} \times \frac{1\ lb}{454\,g} \times \frac{28.3\ l}{cf} \times SCFM \times 1440\,\frac{min}{DAY} = lb/day$$

EXAMPLE:

BENZENE

$$1616\ ppmv \times \frac{78}{24.04} \times 1\times10^{-6} \times \frac{1}{454} \times 28.3 \times 10\ scfm \times 1440 = 4.71\ lb/day$$

EPA REGION II
SCANNING TRACKING SHEET

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DOC TITLE/SUBJECT:

TUTU WELLS SUPERFUND SITE
FIGURE B-3.2
TEXACO TUTU SERVICE STATION ORGANIC CONCENTRATIONS: GROUNDWATER & VAPOR PHASE (1) (Page: TUT 008 0337)

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DOC TITLE/SUBJECT:

TUTU WELLS SUPERFUND SITE
FIGURE B-3.2A
TEXACO TUTU SERVICE STATION ORGANIC CONCENTRATIONS: GROUNDWATER & VAPOR PHASE (1) (Page: TUT 008 0337)

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TABLE B-3.3

ESTIMATED AIR EMISSIONS

Texaco Tutu, U.S. Virgin Islands
(EKI 940058.03)

CHEMICALS OF CONCERN	TEXACO TUTU SERVICE STATION with Emissions Control (1)						
	Mass in Air Air Stripper lb/day (2)	Mass in Air SVE lb/day (3)	Total Mass in Air lb/day	Cat-Ox Destruction % (4)	Treated Air Emissions lb/day	Treated Air Emissions g/s	HCl Emissions (5)
Benzene	10	5	15	99	0.15	7.7E-04	-
Toluene	9	6	15	99	0.15	8.0E-04	-
Ethylbenzene	2	1	3	99	0.03	1.7E-04	-
Xylenes	8	4	12	99	0.12	6.4E-04	-
1,2-Dichloroethane (DCA)	0.2	0.01	0.21	96	0.01	4.4E-05	0.1
1,2-Dichloroethene (DCE)	0.3	0.25	0.55	96	0.02	1.2E-04	0.4
Tetrachloroethene (PCE)	0.03	0.01	0.04	96	0.002	8.4E-06	0.05
Trichloroethene (TCE)	0.03	0.02	0.05	96	0.002	1.0E-05	0.05
Vinyl Chloride	0.06	0.1	0.16	96	0.01	3.4E-05	0.2
Methylene Chloride	2	1	3	96	0.14	7.1E-04	2.2
SUM HCl (pounds per day)							3.0

NOTES:

1. Off-gas from the air stripper and SVE will be treated by catalytic oxidation.
2. Assumed air mass is based on estimated removal rates of chemicals by air stripping as shown on Table C-3.1
3. Assumed SVE air mass is estimated from groundwater data as shown on Table B-4.1. Levels are expected to decrease with time.
4. Catalytic Oxidizer destruction efficiencies are specified in equipment Specification Section 13270.
5. Assumed hydrochloric acid (HCl) emitted to the atmosphere after air treatment by catalytic oxidation, in pounds per day.
6. Totals may be rounded.
7. This table is a revision of Table 5 included in the Groundwater and Soils Remediation Program Report dated 13 April 1995.

TABLE B-3.4

AIR EMISSIONS
SUMMARY OF HEALTH RISK ANALYSIS FOR EPA CARCINOGENS
Tutu Texaco Service Station
(EKI 940058.03)

LOCATION	ESTIMATED INCREMENTAL LIFETIME CANCER RISK		
	On-Site Employees 25 Year Exposure	Off-Site Residents 30 Year Exposure	Off-site Students 8 Year Exposure
Texaco Service Station	1.0E-06 5.0E-06 (1)	5.0E-07	4.0E-08

NOTES:

1. Increased risk based on vinyl chloride and benzene concentrations greater than design concentrations.
2. Increased risk based on vinyl chloride concentrations greater than design concentrations.

RISK ANALYSIS TABLES

TABLE B-3.5

TREATED AIR EMISSIONS - TEXACO SERVICE STATION LOCATION
HEALTH RISK ANALYSIS FOR EPA CARCINOGENS

Tutu Texaco Service Station
On-Site Employees Health Risk Analysis
(EKI 940058.03)

Chemical of Concern	Estimated Emission Rate (g/s) (1)	Maximum Ground Concentration for 1g/s Emission (ug/m^3) (2)	Maximum Ground Concentration for Estimated Emission Rate (ug/m^3) (3)	Chronic Daily Intake (mg/(kg -d)) (4,5)	Slope Factor (1/mg/(kg - d))	Estimated Incremental Lifetime Cancer Risk (25 Year Exposure) (9)	Estimated Incremental Lifetime Cancer Risk (10 Year Exposure) (10)
Benzene	7.7E-4	540.0	4.2E-1	2.9E-05	2.9E-2 (6)	8.5E-7	3.4E-7
1,2-Dichloroethane (DCA)	4.4E-5	540.0	2.4E-2	1.7E-06	9.1E-02 (6)	1.5E-7	6.1E-8
Tetrachloroethene (PCE)	8.4E-6	540.0	4.5E-3	3.2E-07	2.0E-03 (7)	6.4E-10	2.6E-10
Trichloroethene (TCE)	1.0E-5	540.0	5.7E-3	4.0E-07	6.0E-03 (8)	2.4E-9	9.4E-10
Vinyl Chloride	3.4E-5	540.0	1.8E-2	1.3E-06	2.9E-01 (8)	3.7E-7	1.5E-7
Methylene Chloride	7.1E-4	540.0	3.9E-1	2.7E-05	1.6E-03 (6)	4.4E-8	1.8E-8
			Total Estimated Incremental Lifetime Cancer Risk			1.0E-6	6.0E-7

NOTES:
1. Emission rates are based on estimated design mass emissions from groundwater air stripper off gas and soil vapor extraction treated by catalytic oxidation.
2. Maximum long term impact at the approximate ground elevation of the stack base and located 22 meters (72 ft) away from the stack based on a 1 g/s total chemical emission rate from the stack (10% of one hour value obtained using SCREEN2 program, Model No. 5, 1000 SCFM, flat terrain downwash from Antilles Auto Parts, Stack ht = 6.1 meters (20 ft))
3. Maximum ground concentration = estimated emission rate x maximum ground concentration for 1 g/s emission rate
4. On-site exposure factors due to inhalation of chemicals of concern: inhalation Rate = 2.5 m^3/hr for 8 hrs/day; exposure frequency = 250 days/year; averaging time = 70 years x 365 days/year = 25,550 days
5. Chronic Daily Intake = (maximum ground concentration x inhalation rate x exposure frequency x exposure duration)/ (averaging time x body weight of 70 kg)
6. Slope factors are converted from unit risk factors included in IRIS (1995).
7. Slope factors are converted from unit risk factors included in U.S. EPA Health Assesment documents.
8. Slope factors are converted from unit risk factors included in the U.S. EPA Health Effects Assessment Summary Tables, FY 1994 Annual.
9. Estimated Incremental Lifetime Cancer Risk Averaged over 70 years with 25 years of exposure = (chronic daily intake x slope factor)
10. Estimated Incremental Lifetime Cancer Risk Averaged over 70 years with 10 years of exposure = 25 year risk x (10/25)
11. Totals may be rounded.

TABLE B-3.6

TREATED AIR EMISSIONS - TEXACO SERVICE STATION LOCATION
HEALTH RISK ANALYSIS FOR EPA CARCINOGENS

Hypothetical Increase in Benzene & Vinyl Chloride Emission Rates
Tutu Texaco Service Station
On-Site Employees Health Risk Analysis
(EKI 940058.03)

Chemical of Concern	Estimated Emission Rate (g/s) (1)	Maximum Ground Concentration for 1g/s Emission Rate (ug/m^3) (2)	Maximum Ground Concentration for Estimated Emission Rate (ug/m^3) (3)	Chronic Daily Intake (mg/(kg -d)) (4,5)	Slope Factor (1/mg/(kg - d))		Estimated Incremental Lifetime Cancer Risk 25 Year Exposure (9)	Estimated Incremental Lifetime Cancer Risk (10 Year Exposure) (10)
Benzene	1.3E-3	540.0	7.0E-1	4.9E-5	2.9E-2	(6)	1.4E-6	5.7E-7
1,2-Dichloroethane (DCA)	4.4E-5	540.0	2.4E-2	1.7E-6	9.1E-2	(6)	1.5E-7	6.1E-8
Tetrachloroethene (PCE)	8.4E-6	540.0	4.5E-3	3.2E-7	2.0E-3	(7)	6.4E-10	2.6E-10
Trichloroethene (TCE)	1.0E-5	540.0	5.7E-3	4.0E-7	6.0E-3	(8)	2.4E-9	9.4E-10
Vinyl Chloride	2.7E-4	540.0	1.5E-1	1.0E-5	2.9E-1	(8)	3.0E-6	1.2E-6
Methylene Chloride	7.1E-4	540.0	3.9E-1	2.7E-5	1.6E-3	(6)	4.4E-8	1.8E-8
			Total Maximum Incremental Cancer Risk				5.0E-6	2.0E-6

NOTES:
1. Emission rates are based on estimated design mass emissions from groundwater air stripper off gas and soil vapor extraction treated by catalytic oxidation.
2. Maximum long term impact at the approximate ground elevation of the stack base and located 22 meters (72 ft) away from the stack based on a 1 g/s total chemical emission rate from the stack (10% of one hour value obtained using SCREEN2 program, Model No. 5, 1000 SCFM, flat terrain downwash from Antilles Auto Parts, Stack ht = 6.1 meters (20 ft))
3. Maximum ground concentration = estimated emission rate x maximum ground concentration for 1 g/s emission rate
4. On-site exposure factors due to inhalation of chemicals of concern: inhalation Rate = 2.5 m^3/hr for 8 hrs/day; exposure frequency = 250 days/year; averaging time = 70 years x 365 days/year = 25,550 days
5. Chronic Daily Intake = (maximum ground concentration x inhalation rate x exposure frequency x exposure duration)/ (averaging time x body weight of 70 kg)
6. Slope factors are converted from unit risk factors included in IRIS (1995).
7. Slope factors are converted from unit risk factors included in U.S. EPA Health Assesment documents.
8. Slope factors are converted from unit risk factors included in the U.S. EPA Health Effects Assessment Summary Tables, FY 1994 Annual.
9. Estimated Incremental Lifetime Cancer Risk Averaged over 70 years with 25 years of exposure = (chronic daily intake x slope factor)
10. Estimated Incremental Lifetime Cancer Risk Averaged over 70 years with 10 years of exposure = 25 year risk x (10/25)
11. Totals may be rounded.

TABLE B-3.7

TREATED AIR EMISSIONS - TEXACO SERVICE STATION LOCATION
HEALTH RISK ANALYSIS FOR EPA CARCINOGENS

Tutu Texaco Service Station
Off-Site Resident Health Risk Analysis
(EKI 940058.03)

Chemical of Concern	Estimated Emission Rate (g/s) (1)	Maximum Ground Concentration for 1g/s Emission Rate (ug/m^3) (2)	Maximum Ground Concentration for Estimated Emission Rate (ug/m^3) (3)	Chronic Daily Intake (mg/(kg -d)) (4,5)	Slope Factor (1/mg/(kg - d)) (6,7,8)		Estimated Incremental Lifetime Cancer Risk 30 Year Exposure (9)
Benzene	7.7E-4	115.0	8.9E-2	1.0E-5	2.9E-2	(6)	3.0E-7
1,2-Dichloroethane (DCA)	4.4E-5	115.0	5.1E-3	5.9E-7	9.1E-2	(6)	5.4E-8
Tetrachloroethene (PCE)	8.4E-6	115.0	964.7E-6	1.1E-7	2.0E-3	(7)	2.3E-10
Trichloroethene (TCE)	1.0E-5	115.0	1.2E-3	1.4E-7	6.0E-3	(8)	8.4E-10
Vinyl Chloride	3.4E-5	115.0	3.9E-3	4.5E-7	2.9E-1	(8)	1.3E-7
Methylene Chloride	7.1E-4	115.0	82.0E-3	9.6E-6	1.6E-3	(6)	1.6E-8
			Total Maximum Incremental Cancer Risk				5.0E-7

NOTES:
1. Emission rates are based on estimated design mass emissions from groundwater air stripper off gas and soil vapor extraction treated by catalytic oxidation.
2. Maximum long term impact at a height of 4 meters above the stack base and located 99 meters (325 ft) away from the stack based on a 1 g/s total chemical emission rate from the stack (10% of one hour value obtained using SCREEN2 program, Model No. 2, 1000 SCFM, simple terrain downwash from Antilles Auto Parts, Stack ht = 6.1 meters (20 ft))
3. Maximum ground concentration = estimated emission rate x maximum ground concentration for 1 g/s emission rate
4. Off-site exposure factors: inhalation factor = 0.83 m^3/hr for 24 hrs/day; exposure frequency = 350 days/year; averaging time = 70 years x 365 days/year = 25,550 days
5. Chronic Daily Intake = (maximum ground concentration x inhalation rate x exposure frequency x exposure duration)/ (averaging time x body weight of 70 kg)
6. Slope factors are converted from unit risk factors included in IRIS (1995).
7. Slope factors are converted from unit risk factors included in U.S. EPA Health Assesment documents.
8. Slope factors are converted from unit risk factors included in the U.S. EPA Health Effects Assessment Summary Tables, FY 1994 Annual.
9. Estimated Incremental Lifetime Cancer Risk Averaged over 70 years with 30 years of exposure = (chronic daily intake x slope factor)
10. Totals may be rounded.
11. Nearest residence is located 99 meters (325 ft) south of the stack.

TABLE B-3.8

TREATED AIR EMISSIONS - TEXACO SERVICE STATION LOCATION
HEALTH RISK ANALYSIS FOR EPA CARCINOGENS

Tutu Texaco Service Station
Off-Site School Student Health Risk Analysis
(EKI 940058.03)

Chemical of Concern	Estimated Emission Rate (g/s) (1)	Maximum Ground Concentration for 1g/s Emission Rate (ug/m^3) (2)	Maximum Ground Concentration for Estimated Emission Rate (ug/m^3) (3)	Chronic Daily Intake (mg/(kg -d)) (4,5)	Slope Factor (1/mg/(kg - d))	Estimated Incremental Lifetime Cancer Risk 8 Year Exposure (9)
Benzene	7.7E-4	170.0	1.31E-01	7.4E-7	2.9E-2 (6)	2.1E-8
1,2-Dichloroethane (DCA)	4.4E-5	170.0	7.49E-03	4.2E-8	9.1E-2 (6)	3.8E-9
Tetrachloroethene (PCE)	8.4E-6	170.0	1.43E-03	8.0E-9	2.0E-3 (7)	1.6E-11
Trichloroethene (TCE)	1.0E-5	170.0	1.78E-03	1.0E-8	6.0E-3 (8)	6.0E-11
Vinyl Chloride	3.4E-5	170.0	5.70E-03	3.2E-8	2.9E-1 (8)	9.5E-9
Methylene Chloride	7.1E-4	170.0	1.21E-01	6.8E-7	1.6E-3 (6)	1.1E-9
			Total Maximum Incremental Cancer Risk			4.0E-8

NOTES:
1. Emission rates are based on estimated design mass emissions from groundwater air stripper off gas and soil vapor extraction treated by catalytic oxidation.
2. Maximum long term impact at a height of 6 meters above the stack base and located 88 meters (290 ft) away from the stack based on a 1 g/s total chemical emission rate from the stack (10% of one hour value obtained using SCREEN2 program, Model No. 1, 1000 SCFM, simple terrain downwash from Antilles Auto Parts, Stack ht = 6.1 meters (20 ft))
3. Maximum ground concentration = estimated emission rate x maximum ground concentration for 1 g/s emission rate
4. Off-site student exposure factors: inhalation factor =3.2 m^3/hr for 6 hrs/day; exposure frequency = 270 days/year; averaging time = 70 years x 365 days/year = 25,550 days
5. Chronic Daily Intake = (maximum ground concentration x inhalation rate x exposure frequency x exposure duration)/ (averaging time x body weight of 36 kg)
6. Slope factors are converted from unit risk factors included in IRIS (1995).
7. Slope factors are converted from unit risk factors included in U.S. EPA Health Assesment documents.
8. Slope factors are converted from unit risk factors included in the U.S. EPA Health Effects Assessment Summary Tables, FY 1994 Annual.
9. Estimated Incremental Lifetime Cancer Risk Averaged over 70 years with 8 years of exposure = (chronic daily intake x slope factor)
10. Totals may be rounded.
11. Nearest school is located 88 meters (290 ft) southeast of the stack.

TUT 008 0345

EPA GUIDANCE FORMULAS AND BACK-UP CALCULATIONS

United States
Environmental Protection
Agency

Office of Emergency and
Remedial Response
Washington DC 20460

EPA/540/1-89/002
December 1989

Superfund

PB90-155581

EPA

Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A)

Interim Final

EXHIBIT 6-16

RESIDENTIAL EXPOSURE: INHALATION OF AIRBORNE (VAPOR PHASE) CHEMICALS[a b]

Equation:

$$\text{Intake (mg/kg-day)} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT}$$

Where:

CA = Contaminant Concentration in Air (mg/m^3)
IR = Inhalation Rate (m^3/hour)
ET = Exposure Time (hours/day)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged — days)

Variable Values:

CA: Site-specific measured or modeled value

IR: 30 m^3/day (adult, suggested upper bound value; EPA 1989d)
20 m^3/day (adult, average; EPA 1989d)
Hourly rates (EPA 1989d)
Age-specific values (EPA 1985a)
Age, sex, and activity based values (EPA 1985a)
0.6 m^3/hr — showering (all age groups; EPA 1989d)

ET: Pathway-specific values (dependent on duration of exposure-related activities)
12 minutes — showering (90th percentile; EPA 1989d)
7 minutes — showering (50th percentile; EPA 1989d)

EF: Pathway-specific value (dependent on frequency of showering or other exposure-related activities)

ED: 70 years (lifetime; by convention)
30 years (national upper-bound time (90th percentile) at one residence; EPA 1989d)
9 years (national median time (50th percentile) at one residence; EPA 1989d)

BW: 70 kg (adult, average; EPA 1989d)
Age-specific values (EPA 1985a, 1989d)

AT: Pathway-specific period of exposure for noncarcinogenic effects (i.e., ED x 365 days/year), and 70 year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year).

[a] *See Section 6.4.1 and 6.6.3 for a discussion of which variable values should be used to calculate the reasonable maximum exposure. In general, use 95th or 90th percentile values for contact rate and exposure frequency and duration variables.*

[b] *The equation and variable values for vapor phase exposure can be used with modification to calculate particulate exposure.. See text.*

OSWER DIRECTIVE: 9285.6-03

March 25, 1991

RISK ASSESSMENT GUIDANCE FOR SUPERFUND

VOLUME I: HUMAN HEALTH EVALUATION MANUAL

SUPPLEMENTAL GUIDANCE

"STANDARD DEFAULT EXPOSURE FACTORS"

INTERIM FINAL

Office of Emergency and Remedial Response
Toxics Integration Branch
U.S. Environmental Protection Agency
Washington, D.C. 20460
(202)475-9486

SUMMARY OF STANDARD DEFAULT EXPOSURE FACTORS (1)

Land Use	Exposure Pathway (2)	Daily Intake Rate	Exposure Frequency	Exposure Duration	Body Weight
Residential	Ingestion of Potable Water	2 liters	350 days/year	30 years	70 kg
	Ingestion of Soil and Dust	200 mg (child) 100 mg (adult)	350 days/year	6 years 24 years	15 kg (child) 70 kg (adult)
	Inhalation of Contaminants	20 cu.m (total) 15 cu.m (indoor)	350 days/year	30 years	70 kg
Commercial/ Industrial	Ingestion of Potable Water	1 liter	250 days/year	25 years	70 kg
	Ingestion of Soil and Dust	50 mg	250 days/year	25 years	70 kg
	Inhalation of Contaminants	20 cu.m/workday	250 days/year	25 years	70 kg
Agricultural	Ingestion of Potable Water	2 liters	350 days/year	30 years	70 kg
	Ingestion of Soil and Dust	200 mg (child) 100 mg (adult)	350 days/year	6 years 24 years	15 kg (child) 70 kg (adult)
	Inhalation of Contaminants	20 cu.m (total) 15 cu.m (indoor)	350 days/year	30 years	70 kg
	Consumption of Homegrown Produce	42 g (fruit) 80 g (veg.)	350 days/year	30 years	70 kg
Recreational	Consumption of Locally Caught Fish	54 g	350 days/year	30 years	70 kg

(1) - Factors presented are those that should generally be used to assess exposures associated with a designated land use. Site-specific data may warrant deviation from these values; however, use of alternate values should be justified and documented in the risk assessment report.

(2) - Listed pathways may not be relevant for all sites and, other exposure pathways may need to be evaluated due to site conditions. Additional pathways and applicable default values are provided in the text of this guidance.

United States
Environmental Protection
Agency

Office of Health and
Environmental Assessment
Washington DC 20460

EPA 600 8-89-043
July 1989

Research and Development

PB90-106774

EPA

Exposure Factors Handbook

Table 3-1. Summary of Human Inhalation Rates for Men, Women, and Children by Activity Level (m^3/hour)[a]

	Resting[b]	Light[c]	Moderate[d]	Heavy[e]
Adult male	0.7	0.8	2.5	4.8
Adult female	0.3	0.5	1.6	2.9
Average adult[f]	0.5	0.6	2.1	3.9
Child, age 6	0.4	0.8	2.0	2.4
STUDENT → Child, age 10	0.4	1.0	3.2	4.2

[a] Values of inhalation rates for males, females, and children presented in this table represent the mean of values reported for each activity level in USEPA (1985).

[b] Includes watching television, reading, and sleeping.

[c] Includes most domestic work, attending to personal needs and care, hobbies, and conducting minor indoor repairs and home improvements.

[d] Includes heavy indoor cleanup, performance of major indoor repairs and alterations, and climbing stairs.

[e] Includes vigorous physical exercise and climbing stairs carrying a load.

[f] Derived by taking the mean of the adult male and adult female values for each activity level.

Table 5-3. Body Weights of Children (kilograms)

Age	Boys Mean	Boys Std. error of mean	Girls Mean	Girls Std. error of mean	Boys and girls Mean	Boys and girls Std. error of mean
< 3	11.9	0.0016	11.2	0.0011	11.6	---
3 < 6	17.6	0.0014	17.1	0.0015	17.4	---
6 < 9	25.3	0.0023	24.6	0.0024	25.0	---
STUDENT → 9 < 12	35.7	0.0038	36.2	0.0043	36.0	---
12 < 15	50.5	0.0051	50.7	0.0049	50.6	---
15 < 18	64.9	0.0047	57.4	0.0042	61.2	---

Source: Adapted from USEPA (1985).

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TU-1 940053.00 | AIR EMISSIONS / RISK | 5/15/95 DAG

STANDARD DEFAULT FACTORS

BASIS: RISK ASSESSMENT GUIDANCE FOR SUPERFUND, VOL. I: HUMAN HEALTH EVALUATION MANUAL SUPPLEMENTAL GUIDANCE "STANDARD DEFAULT EXPOSURE FACTORS" INTERIM FINAL

RESIDENTIAL

INHALATION RATE (m^3/hr)
= INTAKE RATE

$$\frac{20\,m^3}{day} \times \frac{1\,day}{24\,hrs} = 0.83\,m^3/hr$$

COMMERCIAL

INHALATION RATE (m^3/hr)
= INTAKE RATE

$$\frac{20\,m^3}{workday} = \frac{20\,m^3}{8\,hr} = 2.5\,m^3/hr$$

ASSUME 8 hr WORKDAY

CHRONIC DAILY INTAKE
(COMMERCIAL/INDUSTRIAL - ON-SITE)

$$\frac{\text{Grnd Conc} \frac{\mu g}{m^3} \times \frac{mg}{10^3 \mu g} \times 2.5 \frac{m^3}{hr} \times 3 \frac{hr}{DAY} \times 250 \frac{days}{YR} \times 25 \text{ years}}{\left(70 \text{ kg} \times 365 \frac{\text{DAYS}}{\text{YEAR}} \times 70 \text{ years}\right)}$$

FOR BENZENE:

$$\frac{4.2 \times 10^{-1} \frac{\mu g}{m^3} \times \frac{1 \text{ mg}}{1000 \mu g} \times 2.5 \frac{m^3}{hr} \times \frac{3 \text{ hr}}{DAY} \times 250 \frac{\text{DAYS}}{YR} \times 25 \text{ YEARS}}{\left(70 \text{ kg} \times 365 \frac{\text{DAYS}}{\text{YEAR}} \times 70 \text{ years}\right)}$$

$$= 2.9 \times 10^{-5} \frac{mg}{kg \cdot d}$$

CHRONIC DAILY INTAKE
(OFF-SITE RESIDENTIAL)

$$\frac{\text{GRND CONC} \frac{\mu g}{m^3} \times \frac{mg}{10^3 \mu g} \times 0.83 \frac{m^3}{hr} \times \frac{24 \text{ hr}}{DAY} \times 350 \frac{days}{YR} \times 30 \text{ YEARS}}{\left(70 \text{ kg} \times 365 \frac{\text{DAYS}}{\text{YEAR}} \times 70 \text{ YEARS}\right)}$$

FOR BENZENE:

$$\frac{8.9 \times 10^{-2} \frac{\mu g}{m^3} \times \frac{1 \text{ mg}}{1000 \mu g} \times 0.83 \frac{m^3}{hr} \times \frac{24 \text{ hr}}{DAY} \times 350 \frac{\text{DAYS}}{YR} \times 30 \text{ YRS}}{\left(70 \text{ kg} \times 365 \frac{\text{DAYS}}{YR} \times 70 \text{ yrs}\right)}$$

$$= 1.0 \times 10^{-5} \frac{mg}{kg \cdot d}$$

CHRONIC DAILY INTAKE
(STUDENT)

$$\frac{\text{GRND CONC}\ \frac{\mu g}{m^3} \times \frac{mg}{10^3 \mu g} \times 3.2\frac{m^3}{hr} \times \frac{6\ hr}{DAY} \times 270\frac{DAYS}{YR} \times 8\ YEARS}{\left(36 kg \times 365\frac{DAYS}{YEAR} \times 70\ YEARS\right)}$$

$$\frac{1.31 \times 10^{-1}\frac{\mu g}{m^3} \times \frac{mg}{1000\mu g} \times 3.2\frac{m^3}{hr} \times \frac{6hr}{DAY} \times 270\frac{DAYS}{YR} \times 8\ YEARS}{\left(36 kg \times 365\frac{DAYS}{YR} \times 70\ YRS\right)}$$

$= 7.4 \times 10^{-7}$

AIR EMISSIONS - UNIT RISK FACTORS

CHEMICAL	UNIT RISK ug/m3	REFERENCE
Benzene	8.3E-06	Iris April 1995
1,2 - DCA	2.6E-05	Iris April 1995
PCE	5.8E-07	US EPA Health Effects Assessment Summary Tables
TCE	1.7E-06	US EPA Health Effects Assessment Summary Tables
Vinyl Chloride	8.40E-05	US EPA Health Effects Assessment Summary Tables
Methylene Chloride	4.7E-07	Iris April 1995

TUT 008 0357

TEXACO SERVICE STATION

SCREEN2 SIMULATION ASSUMPTIONS, RESULTS AND OUTPUT

TUT 008 0358

TEXACO SERVICE STATION LOCATION AIR MODELING

Five model runs using the Screen2 air dispersion model for air emissions emanating from the proposed caltalytic oxidizer treatment unit at the Texaco Tutu Service Station location, St. Thomas, U.S. Virgin Islands are described below. The five model runs were generated to determine the worst-case air emissions scenario in the vicinity of the catalytic oxidizer stack and resulting maximum chemical concentration for a 1 g/s emission rate. This concentration is used in the calculation for the incremental carcinogenic risk shown on Tables A1 through A3.

The worst-case scenario is Model No. 5, as described below, showing a maximum concentration of 5,436 ug/m^3 at a distance of 22 meters from the stack.

The assumptions of the five model runs are described below and the SCREEN2 printout results follow.

Model No. 1, "tex1":

Assumptions:

- The treatment system is located on flat terrain (approximate elevation 181 feet)

- Stack height = 6.1 meters above ground surface
  Stack diameter = 0.2 meters
  Stack velocity = 15 meters/second

- Air dispersion is toward the east of the treatment system, and up a hill. (The complex terrain and simple terrain inputs model this geography.)

Results:

- The maximum concentration (3,475 ug/m^3) occurred at a distance of 41 meters from the stack.

- The maximum concentration at the nearest school (1,673 ug/m^3) occurred at a distance of 88 meters from the stack.

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TEXACO SERVICE STATION LOCATION AIR MODELING

Model No. 2, "texsim2":

Assumptions:

- The treatment system is located on flat terrain (approximate elevation 181 feet)

- Stack height = 6.1 meters above ground surface
  Stack diameter = 0.2 meters
  Stack velocity = 15 meters/second

- Air dispersion is toward the south and southeast of the treatment system, and up a hill that is lower than the top of the stack. (The simple terrain input models this geography.)

- The maximum concentration at the nearest residence (1,150 ug/m^3) occurred at a distance of 99 meters from the stack.

Results:

- The maximum concentration (4,728 ug/m^3) occurred at a distance of 23 meters from the stack.

Model No. 3, "textflt2":

Assumptions:

- The treatment system is located on flat terrain (approximate elevation 181 feet)

- Stack height = 6.1 meters above ground surface
  Stack diameter = 0.2 meters
  Stack velocity = 15 meters/second

- Air dispersion is toward the southwest of the treatment system, and down a hill or across flat terrain. (The flat terrain input models this geography.)

Results:

- The maximum concentration (4,498 ug/m^3) occurred at a distance of 24 meters from the stack.

TEXACO SERVICE STATION LOCATION AIR MODELING

Model No. 4, "texnth":

Assumptions:

- The treatment system is located on flat terrain (approximate elevation 181 feet)
- Stack height = 6.1 meters above ground surface
  Stack diameter = 0.2 meters
  Stack velocity = 15 meters/second
- Air dispersion is toward the north of the treatment system, across flat terrain and toward lower elevations. (The flat terrain input models this geography.)

Results:

- The maximum concentration (4,914 ug/m^3) occurred at a distance of 22 meters from the stack.

Model No. 5, "texnth2":

Assumptions:

- The treatment system is located on flat terrain (approximate elevation 181 feet)
- Stack height = 6.1 meters above ground surface
  Stack diameter = 0.25 meters
  Stack velocity = 9.3 meters/second
- Air dispersion is toward the north of the treatment system, across flat terrain and toward lower elevations. (The flat terrain input models this geography.)

Results:

- The maximum concentration (5,436 ug/m^3) occurred at a distance of 22 meters from the stack.

TUT 008 0361

TEXACO SERVICE STATION LOCATION AIR MODELING

General Assumptions:

- Downwash from Antilles Auto Parts is included in all model runs.

- Background concentrations are not included in any of the model runs.

TEXACO TUTU SERVICE
STATION AIR DISPERSION
MODEL NO. 1

****** SCREEN2 MODEL ******
**** VERSION DATED 92245 ****

IBM-PC VERSION (1.01)

05/05/95
08:44:06

.ex1

COMPLEX TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.00000
STACK HT (M)	=	6.0957
STACK DIAMETER (M)	=	.2000
STACK VELOCITY (M/S)	=	15.0203
STACK GAS TEMP (K)	=	477.6000
AMBIENT AIR TEMP (K)	=	294.2600
RECEPTOR HEIGHT (M)	=	.0000
URBAN/RURAL OPTION	=	URBAN

BUOY. FLUX = .565 M**4/S**3; MOM. FLUX = 1.390 M**4/S**2.

FINAL STABLE PLUME HEIGHT (M) = 24.2
DISTANCE TO FINAL RISE (M) = 200.6

TERR HT (M)	DIST (M)	MAX 24-HR CONC (UG/M**3)	*VALLEY 24-HR CALCS* CONC (UG/M**3)	PLUME HT ABOVE STK BASE (M)	**SIMPLE TERRAIN 24-HR CALCS** CONC (UG/M**3)	PLUME HT ABOVE STK HGT (M)	SC	U10M (M/S)	USTK (M/S)
6.	117.	286.5	77.30	18.8	286.5	14.0	4	1.0	1.0
7.	122.	273.3	78.99	19.1	273.3	14.0	4	1.0	1.0
8.	137.	233.9	69.77	20.2	233.9	14.0	4	1.0	1.0
8.	145.	216.8	67.65	20.7	216.8	14.0	4	1.0	1.0
9.	152.	201.1	65.33	21.2	201.1	14.0	4	1.0	1.0
9.	158.	189.7	64.03	21.6	189.7	14.0	4	1.0	1.0

05/05/95
08:44:06

tex1

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.00000
STACK HEIGHT (M)	=	6.0957
STK INSIDE DIAM (M)	=	.2000
STK EXIT VELOCITY (M/S)	=	15.0203
STK GAS EXIT TEMP (K)	=	477.6000
AMBIENT AIR TEMP (K)	=	294.2600
RECEPTOR HEIGHT (M)	=	1.5000
URBAN/RURAL OPTION	=	URBAN
BUILDING HEIGHT (M)	=	7.3150
MIN HORIZ BLDG DIM (M)	=	17.6780
MAX HORIZ BLDG DIM (M)	=	23.7730

B . FLUX = .565 M**4/S**3; MOM. FLUX = 1.390 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
34.	3396.	6	2.0	2.0	10000.0	6.85	3.66	4.73	SS

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 1. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
38.	3369.	6	2.0	2.0	10000.0	6.51	4.16	4.98	SS

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 2. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
41.	3475. ← MAX.	6	2.0	2.0	10000.0	6.09	4.48	5.14	SS

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 2. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
46.	3348.	6	2.0	2.0	10000.0	5.79	4.98	5.39	SS

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 3. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST CONC U10M USTK MIX HT PLUME SIGMA SIGMA

(M)	(UG/M**3)	STAB	(M/S)	(M/S)	(M)	HT (M)	Y (M)	Z (M)	DWASH
61.	2322.	6	2.0	2.0	10000.0	6.28	6.63	6.21	SS

```
**********************************
*** SCREEN DISCRETE DISTANCES ***
**********************************
```

*** TERRAIN HEIGHT OF 3. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
67.	2148.	6	2.0	2.0	10000.0	6.13	7.28	6.53	SS

```
**********************************
*** SCREEN DISCRETE DISTANCES ***
**********************************
```

*** TERRAIN HEIGHT OF 4. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
76.	1826.	6	2.0	2.0	10000.0	6.23	8.26	7.26	SS

```
**********************************
*** SCREEN DISCRETE DISTANCES ***
**********************************
```

*** TERRAIN HEIGHT OF 5. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
78.	1878.	6	2.0	2.0	10000.0	5.74	8.42	7.36	SS

```
**********************************
*** SCREEN DISCRETE DISTANCES ***
**********************************
```

*** TERRAIN HEIGHT OF 5. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
79.	1921.	5	2.0	2.0	10000.0	5.25	8.58	7.46	SS

```
**********************************
*** SCREEN DISCRETE DISTANCES ***
**********************************
```

*** TERRAIN HEIGHT OF 6. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH

81.	1948.	5	2.0	2.0	10000.0	4.77	8.74	7.57	SS

```
*********************************
** SCREEN DISCRETE DISTANCES ***
*********************************
```

** TERRAIN HEIGHT OF 6. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
88.	1673. ← SCHOOL	5	2.0	2.0	10000.0	5.07	9.56	8.10	SS

```
*********************************
*** SCREEN DISCRETE DISTANCES ***
*********************************
```

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR   *
*     SIMPLE ELEVATED TERRAIN PROCEDURE     *
*********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	34.	--
1.	38.	--
2.	41.	--
2.	46.	--
3.	61.	--
3.	67.	--
4.	76.	--
5.	78.	--
5.	79.	--
6.	81.	--
6.	88.	--

*** CAVITY CALCULATION - 1 ***
CONC (UG/M**3) = 1723.
CRIT WS @10M (M/S) = 4.45
CRIT WS @ HS (M/S) = 4.45
DILUTION WS (M/S) = 2.23
CAVITY HT (M) = 7.82

*** CAVITY CALCULATION - 2 ***
CONC (UG/M**3) = 1853.
CRIT WS @10M (M/S) = 5.56
CRIT WS @ HS (M/S) = 5.56
DILUTION WS (M/S) = 2.78
CAVITY HT (M) = 7.49

CAVITY LENGTH (M)	=	22.95	CAVITY LENGTH (M)	=	19.29
ONGWIND DIM (M)	=	17.68	ALONGWIND DIM (M)	=	23.77

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)	
IMPLE TERRAIN	3475.	41.	2.	
COMPLEX TERRAIN	286.5	117.	6.	(24-HR CONC)
UILDING CAVITY-1	1723.	23.	--	(DIST = CAVITY LENGTH)
BUILDING CAVITY-2	1853.	19.	--	(DIST = CAVITY LENGTH)

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

UN ENDED ON 05/05/95 AT 08:44:06

TEXACO TUTU
SERVICE STATION AIR
DISPERSION MODEL NO. 2

****** SCREEN2 MODEL ******
**** VERSION DATED 92245 ****

IBM-PC VERSION (1.01)

05/05/95
09:24:36

exsim2

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.00000
STACK HEIGHT (M)	=	6.0957
STK INSIDE DIAM (M)	=	.2000
STK EXIT VELOCITY (M/S)	=	15.0203
STK GAS EXIT TEMP (K)	=	477.6000
AMBIENT AIR TEMP (K)	=	294.2600
RECEPTOR HEIGHT (M)	=	1.5000
URBAN/RURAL OPTION	=	URBAN
BUILDING HEIGHT (M)	=	7.3150
MIN HORIZ BLDG DIM (M)	=	17.6780
MAX HORIZ BLDG DIM (M)	=	23.7730

BUOY. FLUX = .565 M**4/S**3; MOM. FLUX = 1.390 M**4/S**2.

FULL METEOROLOGY ***

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
3.	.0000	0	.0	.0	.0	.00	.00	.00	NA

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
8.	.0000	0	.0	.0	.0	.00	.00	.00	NA

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

TUT 008 0370

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
15.	.0000	0	.0	.0	.0	.00	.00	.00	NA

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
17.	.0000	0	.0	.0	.0	.00	.00	.00	NA

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
20.	.0000	0	.0	.0	.0	.00	.00	.00	NA

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
23.	4728. ← MAX.	6	2.0	2.0	10000.0	6.61	2.50	4.16	SS

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
25.	4312.	6	2.0	2.0	10000.0	6.71	2.74	4.27	SS

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST CONC U10M USTK MIX HT PLUME SIGMA SIGMA

(M)	(UG/M**3)	STAB	(M/S)	(M/S)	(M)	HT (M)	Y (M)	Z (M)	DWASH
28.	3819.	6	2.0	2.0	10000.0	6.86	3.06	4.43	SS

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
30.	3475.	6	2.0	2.0	10000.0	6.98	3.33	4.57	SS

****
** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
38.	2664.	6	2.0	2.0	10000.0	7.42	4.16	4.98	SS

****
** SCREEN DISCRETE DISTANCES ***
****

** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
47.	2064.	6	2.5	2.5	10000.0	7.06	5.15	5.81	SS

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
49.	2105.	6	2.5	2.5	10000.0	6.82	5.31	5.89	SS

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 1. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH

49.	2332.	6	2.0	2.0	10000.0	7.26	5.38	5.58	SS

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**********************************
*** SCREEN DISCRETE DISTANCES ***
**********************************
```

*** TERRAIN HEIGHT OF 2. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
50.	2573.	6	2.0	2.0	10000.0	6.71	5.48	5.63	SS

```
**********************************
*** SCREEN DISCRETE DISTANCES ***
**********************************
```

*** TERRAIN HEIGHT OF 2. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
52.	2752.	6	2.0	2.0	10000.0	6.21	5.64	5.71	SS

```
**********************************
*** SCREEN DISCRETE DISTANCES ***
**********************************
```

*** TERRAIN HEIGHT OF 3. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
55.	2776.	6	2.0	2.0	10000.0	5.82	5.97	5.88	SS

```
**********************************
*** SCREEN DISCRETE DISTANCES ***
**********************************
```

*** TERRAIN HEIGHT OF 3. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
58.	2774.	6	2.0	2.0	10000.0	5.43	6.30	6.04	SS

```
**********************************
*** SCREEN DISCRETE DISTANCES ***
**********************************
```

*** TERRAIN HEIGHT OF 4. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH

```
 99.   1150.← HOUSE 4     1.0     1.0    320.0     9.88    15.55    13.67     SS

DWASH=    MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	3.	--
0.	8.	--
0.	15.	--
0.	17.	--
0.	20.	--
0.	23.	--
0.	25.	--
0.	28.	--
0.	30.	--
0.	38.	--
0.	47.	--
0.	49.	--
1.	49.	--
2.	50.	--
2.	52.	--
3.	55.	--
3.	58.	--
4.	99.	--

```
*** CAVITY CALCULATION - 1 ***
 CONC (UG/M**3)       =    1723.
 CRIT WS @10M (M/S)   =     4.45
 CRIT WS @ HS (M/S)   =     4.45
 DILUTION WS (M/S)    =     2.23
 CAVITY HT (M)        =     7.82
 CAVITY LENGTH (M)    =    22.95
 ALONGWIND DIM (M)    =    17.68

*** CAVITY CALCULATION - 2 ***
 CONC (UG/M**3)       =    1853.
 CRIT WS @10M (M/S)   =     5.56
 CRIT WS @ HS (M/S)   =     5.56
 DILUTION WS (M/S)    =     2.78
 CAVITY HT (M)        =     7.49
 CAVITY LENGTH (M)    =    19.29
 ALONGWIND DIM (M)    =    23.77

    ***************************************
    *** SUMMARY OF SCREEN MODEL RESULTS ***
    ***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)	
PLE TERRAIN	4728.	23.	0.	
BUILDING CAVITY-1	1723.	23.	--	(DIST = CAVITY LENGTH)
BUILDING CAVITY-2	1853.	19.	--	(DIST = CAVITY LENGTH)

```
* ************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
*************************************************

UN ENDED ON 05/05/95 AT 09:24:37
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TEXACO TUTU SERVICE
STATION AIR DISPERSION
MODEL NO. 3

****** SCREEN2 MODEL ******
**** VERSION DATED 92245 ****

IBM-PC VERSION (1.01)

05/05/95
09:34:12

exflt2

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.00000
STACK HEIGHT (M)	=	6.0957
STK INSIDE DIAM (M)	=	.2000
STK EXIT VELOCITY (M/S)	=	15.0203
STK GAS EXIT TEMP (K)	=	477.6000
AMBIENT AIR TEMP (K)	=	294.2600
RECEPTOR HEIGHT (M)	=	1.5000
URBAN/RURAL OPTION	=	URBAN
BUILDING HEIGHT (M)	=	7.3150
MIN HORIZ BLDG DIM (M)	=	17.6780
MAX HORIZ BLDG DIM (M)	=	23.7730

UOY. FLUX = .565 M**4/S**3; MOM. FLUX = 1.390 M**4/S**2.

FULL METEOROLOGY ***

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
8.	.0000	0	.0	.0	.0	.00	.00	.00	NA
12.	.0000	0	.0	.0	.0	.00	.00	.00	NA
16.	.0000	0	.0	.0	.0	.00	.00	.00	NA
20.	.0000	0	.0	.0	.0	.00	.00	.00	NA
24.	4498. ← MAX.	6	2.0	2.0	10000.0	6.66	2.63	4.22	SS
27.	3906.	6	2.0	2.0	10000.0	6.83	3.00	4.40	SS
31.	3408.	6	2.0	2.0	10000.0	7.01	3.39	4.60	SS
35.	2956.	6	2.0	2.0	10000.0	7.24	3.82	4.81	SS
39.	2586.	6	2.0	2.0	10000.0	7.48	4.26	5.03	SS
43.	2300.	6	2.5	2.5	10000.0	6.91	4.69	5.56	SS
47.	2076.	6	2.5	2.5	10000.0	7.05	5.12	5.79	SS
51.	1884.	6	2.5	2.5	10000.0	7.21	5.55	6.02	SS
55.	1717.	6	2.5	2.5	10000.0	7.37	5.98	6.25	SS
59.	1577.	4	1.5	1.5	480.0	8.73	9.33	8.19	SS
64.	1457.	4	1.5	1.5	480.0	8.73	10.11	8.88	SS
107.	847.1	4	1.0	1.0	320.0	13.54	16.72	14.70	SS

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED

WASH=HS MEANS HUBER-SNYDER DOWNWASH USED
ASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*** CAVITY CALCULATION - 1 ***          *** CAVITY CALCULATION - 2 ***
CONC (UG/M**3)       =    1723.         CONC (UG/M**3)       =    1853.
CRIT WS @10M (M/S)   =     4.45         CRIT WS @10M (M/S)   =     5.56
CRIT WS @ HS (M/S)   =     4.45         CRIT WS @ HS (M/S)   =     5.56
DILUTION WS (M/S)    =     2.23         DILUTION WS (M/S)    =     2.78
CAVITY HT (M)        =     7.82         CAVITY HT (M)        =     7.49
CAVITY LENGTH (M)    =    22.95         CAVITY LENGTH (M)    =    19.29
ALONGWIND DIM (M)    =    17.68         ALONGWIND DIM (M)    =    23.77
```

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***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)	
IMPLE TERRAIN	4498.	24.	0.	
BUILDING CAVITY-1	1723.	23.	--	(DIST = CAVITY LENGTH)
UILDING CAVITY-2	1853.	19.	--	(DIST = CAVITY LENGTH)

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**************************************************
REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
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RUN ENDED ON 05/05/95 AT 09:34:15

TEXACO TUTU SERVICE
STATION AIR DISPERSION
MODEL NO. 4

```
******  SCREEN2 MODEL  ******
 **** VERSION DATED 92245 ****

IBM-PC VERSION (1.01)
(C) COPYRIGHT 1993, TRINITY CONSULTANTS, INC.
SERIAL NUMBER 6759  SOLD TO ERLER & KALINOWSKI

                                                  05/05/95
                                                  15:06:28
exnth

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE               =        POINT
   EMISSION RATE (G/S)       =      1.00000
   STACK HEIGHT (M)          =       6.0957
   STK INSIDE DIAM (M)       =        .2000
   STK EXIT VELOCITY (M/S)=          15.0203
   STK GAS EXIT TEMP (K)     =     477.6000
   AMBIENT AIR TEMP (K)      =     294.2600
   RECEPTOR HEIGHT (M)       =       1.5000
   URBAN/RURAL OPTION        =        URBAN
   BUILDING HEIGHT (M)       =       7.3150
   MIN HORIZ BLDG DIM (M)    =      17.6780
   MAX HORIZ BLDG DIM (M)    =      23.7730

_JOY. FLUX =      .565 M**4/S**3;  MOM. FLUX =     1.390 M**4/S**2.

   FULL METEOROLOGY ***

**********************************
*** SCREEN DISCRETE DISTANCES ***
 **********************************

*** TERRAIN HEIGHT OF     0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
5.	.0000	0	.0	.0	.0	.00	.00	.00	NA
10.	.0000	0	.0	.0	.0	.00	.00	.00	NA
15.	.0000	0	.0	.0	.0	.00	.00	.00	NA
20.	.0000	0	.0	.0	.0	.00	.00	.00	NA
22.	4914. ← MAX.	6	2.0	2.0	10000.0	6.58	2.41	4.11	SS
24.	4498.	6	2.0	2.0	10000.0	6.66	2.63	4.22	SS
26.	4137.	6	2.0	2.0	10000.0	6.76	2.85	4.33	SS
28.	3819.	6	2.0	2.0	10000.0	6.86	3.06	4.43	SS
30.	3538.	6	2.0	2.0	10000.0	6.96	3.28	4.54	SS
32.	3286.	6	2.0	2.0	10000.0	7.07	3.50	4.65	SS
34.	3060.	6	2.0	2.0	10000.0	7.18	3.71	4.76	SS
36.	2857.	6	2.0	2.0	10000.0	7.30	3.93	4.86	SS
38.	2672.	6	2.0	2.0	10000.0	7.42	4.15	4.97	SS
40.	2505.	6	2.0	2.0	10000.0	7.54	4.37	5.08	SS
50.	1929.	6	2.5	2.5	10000.0	7.17	5.45	5.96	SS
60.	1553.	4	1.5	1.5	480.0	8.73	9.49	8.33	SS
70.	1318.	4	1.5	1.5	480.0	8.73	11.05	9.70	SS
80.	1111.	4	1.5	1.5	480.0	8.73	12.60	11.07	SS

```
 ASH=   MEANS NO CALC MADE (CONC = 0.0)
 ASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

*** CAVITY CALCULATION - 1 ***        *** CAVITY CALCULATION - 2 ***
 CONC (UG/M**3)      =    1723.        CONC (UG/M**3)      =    1853.
 CRIT WS @10M (M/S)  =     4.45        CRIT WS @10M (M/S)  =     5.56
 CRIT WS @ HS (M/S)  =     4.45        CRIT WS @ HS (M/S)  =     5.56
 DILUTION WS (M/S)   =     2.23        DILUTION WS (M/S)   =     2.78
 CAVITY HT (M)       =     7.82        CAVITY HT (M)       =     7.49
 CAVITY LENGTH (M)   =    22.95        CAVITY LENGTH (M)   =    19.29
 ALONGWIND DIM (M)   =    17.68        ALONGWIND DIM (M)   =    23.77

    ***************************************
    *** SUMMARY OF SCREEN MODEL RESULTS ***
    ***************************************

CALCULATION          MAX CONC     DIST TO    TERRAIN
 PROCEDURE          (UG/M**3)     MAX (M)     HT (M)
--------------     -----------    -------    -------
SIMPLE TERRAIN       4914.           22.         0.

BUILDING CAVITY-1    1723.           23.        --    (DIST = CAVITY LENGTH)
 LDING CAVITY-2      1853.           19.        --    (DIST = CAVITY LENGTH)

****************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****************************************************

RUN ENDED ON 05/05/95 AT 15:06:32
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TEXACO TUTU SERVICE STATION AIR DISPERSION MODEL NO. 5

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****** SCREEN2 MODEL ******
**** VERSION DATED 92245 ****

IBM-PC VERSION (1.01)
(C) COPYRIGHT 1993, TRINITY CONSULTANTS, INC.
SERIAL NUMBER 6759  SOLD TO ERLER & KALINOWSKI

                                                  05/09/95
                                                  08:53:45
exnth2

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE              =        POINT
   EMISSION RATE (G/S)      =      1.00000
   STACK HEIGHT (M)         =       6.0957
   STK INSIDE DIAM (M)      =        .2500
   STK EXIT VELOCITY (M/S)=         9.3210
   STK GAS EXIT TEMP (K)    =     477.6000
   AMBIENT AIR TEMP (K)     =     294.2600
   RECEPTOR HEIGHT (M)      =       1.5000
   URBAN/RURAL OPTION       =        URBAN
   BUILDING HEIGHT (M)      =       7.3150
   MIN HORIZ BLDG DIM (M) =        17.6780
   MAX HORIZ BLDG DIM (M) =        23.7730

BUOY. FLUX =      .548 M**4/S**3;  MOM. FLUX =      .836 M**4/S**2.

*** FULL METEOROLOGY ***

**********************************
*** SCREEN DISCRETE DISTANCES ***
**********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
5.	.0000	0	.0	.0	.0	.00	.00	.00	NA
10.	.0000	0	.0	.0	.0	.00	.00	.00	NA
15.	.0000	0	.0	.0	.0	.00	.00	.00	NA
20.	.0000	0	.0	.0	.0	.00	.00	.00	NA
22.	5436. MAX.	6	2.0	2.0	10000.0	6.50	2.41	4.46	SS
24.	4980.	6	2.0	2.0	10000.0	6.57	2.63	4.58	SS
26.	4584.	6	2.0	2.0	10000.0	6.65	2.85	4.69	SS
28.	4237.	6	2.0	2.0	10000.0	6.73	3.06	4.81	SS
30.	3931.	6	2.0	2.0	10000.0	6.82	3.28	4.93	SS
32.	3657.	6	2.0	2.0	10000.0	6.91	3.50	5.04	SS
34.	3412.	6	2.0	2.0	10000.0	7.01	3.71	5.16	SS
36.	3191.	6	2.0	2.0	10000.0	7.11	3.93	5.28	SS
38.	2991.	6	2.0	2.0	10000.0	7.22	4.15	5.39	SS
40.	2809.	6	2.0	2.0	10000.0	7.33	4.37	5.51	SS
50.	2103.	6	2.0	2.0	10000.0	7.92	5.45	6.09	SS
60.	1644.	4	1.5	1.5	480.0	8.25	9.49	8.33	SS
70.	1375.	4	1.5	1.5	480.0	8.25	11.05	9.70	SS
80.	1216.	4	1.0	1.0	320.0	12.44	12.60	11.07	SS

TUT 008 0383

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*** CAVITY CALCULATION - 1 ***           *** CAVITY CALCULATION - 2 ***
 CONC (UG/M**3)        =   2199.          CONC (UG/M**3)        =   2356.
 CRIT WS @10M (M/S)    =    3.49          CRIT WS @10M (M/S)    =    4.38
 CRIT WS @ HS (M/S)    =    3.49          CRIT WS @ HS (M/S)    =    4.38
 DILUTION WS (M/S)     =    1.74          DILUTION WS (M/S)     =    2.19
 CAVITY HT (M)         =    7.82          CAVITY HT (M)         =    7.49
 CAVITY LENGTH (M)     =   22.95          CAVITY LENGTH (M)     =   19.29
 ALONGWIND DIM (M)     =   17.68          ALONGWIND DIM (M)     =   23.77
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    ***************************************
    *** SUMMARY OF SCREEN MODEL RESULTS ***
    ***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)	
SIMPLE TERRAIN	5436.	22.	0.	
BUILDING CAVITY-1	2199.	23.	--	(DIST = CAVITY LENGTH)
BUILDING CAVITY-2	2356.	19.	--	(DIST = CAVITY LENGTH)

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***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
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RUN ENDED ON 05/09/95 AT 08:53:48

SPECIFICATION 13270 - CATALYTIC OXIDIZER

TUT 008 0385

SECTION 13270 - CATALYTIC OXIDIZER

PART 1 -- GENERAL

1.1 The Requirement

A. **General:** The EQUIPMENT SUPPLIER shall furnish a skid mounted catalytic oxidizer suitable for automatic operation, together with all necessary auxiliary equipment, including but not limited to: blowers, burner/gas train, reactor, catalyst, heat exchanger, exhaust stack, piping, valves, fittings, controls, gauges, supports, and appurtenances. EQUIPMENT SUPPLIER shall provide a complete and workable system as specified herein.

The catalytic oxidizer furnished by the EQUIPMENT SUPPLIER will become part of a treatment plant treating air discharged from an air stripper ("AS") and a soil vapor extraction ("SVE") system. The treatment plant will be assembled within an 8 foot by 40 foot shipping container at the facility of the CONTRACTOR in Campbell, CA and delivered to the site in St. Thomas, U.S. Virgin Islands for installation.

1.2 EQUIPMENT SUPPLIER Submittals

A. **Shop Drawings:** Furnish four copies of shop drawings for the total system including blowers, heat exchanger and controls. One copy shall be returned following review by ENGINEER. Shop drawings shall contain the following information:

1. Descriptive information and drawings including but not limited to:

    a. Destruction efficiencies.
    b. Preheater and catalyst bed temperatures.
    c. Materials of construction.
    d. Catalyst type, volume and expected life.
    e. Stack height and gas stack velocity.
    f. Temperature and other control mechanisms.
    g. System shutdowns.
    h. A process and instrumentation diagram.
    i. Operating characteristics of blowers.
    j. Utilities needed for operation of the unit.
    k. Footprint and height of the unit.
    l. Calculated weights and actual shipping.
    m. Locations of piping inlets and outlets.
    n. Delivery conditions and warranties.

2. Electrical and instrumentation information as follows:

    a. Materials list and catalog cuts for instruments and electrical components.
    b. Control panel elementary diagram.
    c. System interconnection diagram showing conduit sizes, wire gage and count.

d. Motor data sheets for air blowers to include manufacturer, full load amps, power factor, efficiency, horsepower, voltage, service factor, insulation class and temperature rating.
e. Interior and exterior control panel layouts showing component locations and nameplate inscriptions.
f. Normal start-up, shut down, and safety sequences.

3. Seismic calculations for the complete skid-mounted unit, verified and stamped by a registered civil or structural engineer, to demonstrate conformance with the seismic requirements of the Uniform Building Code, current edition, Section 2311, Earthquake Regulations.

4. Manuals: Furnish three copies each of manufacturer's installation, operation and maintenance manuals, bulletins, lubrication instructions, and spare parts lists.

5. Submittal Dates: By 23 June 1995, within approximately two weeks of receipt of letter of intent from Owner to purchase equipment, provide the following shop drawings:

   a. Footprint and height of unit.
   b. A draft process and instrumentation drawing.
   c. Locations of piping inlets and outlets.
   d. List of system shutdowns.

   Submit all remaining shop drawings within 4 weeks of receipt of purchase order of equipment. Submit manuals at the same time as delivery of the unit.

B. **Connections:** Use dimensional drawings to scale, clearly communicate the exact location, orientation, elevation, size, and type of all field connections required, including but not limited to the following.

   1. Anchor bolts.
   2. Process piping.
   3. Electrical Power.
   4. Propane.
   5. Instrumentation and controls.

Part 2 -- PRODUCTS

2.1 General Information

A. Process Air Composition (combined flow from the AS and SVE systems)

Component	Lb/day
Benzene	15
Toluene	15
Ethylbenzene	3
Xylene	12
Naphthalene	0.2
Methyl tert butyl ether (MTBE)	40
1,2-Dichloroethane (DCA)	0.2
1,2-Dichloroethene (DCE)	0.5
tetrachloroethene (PCE)	0.04
Trichloroethene (TCE)	0.05
Vinyl Chloride	0.2
Methylene Chloride	3

2.2 Performance and Capacity Requirements

A. Air streams from the AS and SVE shall be treated to remove organic compounds. The catalytic oxidizer shall meet or exceed the following performance and capacity requirements:

Air Stripper capacity	900 scfm
SVE system capacity	100 scfm
Total capacity (scfm)	1,000 scfm

Preheater Propane

Heat Exchanger Efficiency 50%

Destruction Efficiency

Component	Destruction Efficiency %
Benzene	99
Toluene	99
Ethylbenzene	99
Xylene	99
Naphthalene	95
Methyl tert butyl ether (MTBE)	95
1,2-Dichloroethane (DCA)	96
1,2-Dichloroethene (DCE)	96
tetrachloroethene (PCE)	96
Trichloroethene (TCE)	96
Vinyl Chloride	96
Methylene Chloride	96

2.3 Design and Construction

A. Skid Mounted Unit: Equipment supplier shall furnish a complete skid-mounted catalytic oxidizer unit suitable for placement within an 8 foot by 40 foot by 8 foot high container. This container will be used for shipping and for permanent housing. Provide a unit footprint with adequate operation and maintenance access from one side of the unit.

B. **Corrosion Protection:** Due to proximity of the ocean and a warm and humid climate, **conditions at the site are extremely favorable for corrosion of exposed parts.** Whenever possible, external parts and controls shall be constructed with corrosion resistant materials. Electrical enclosures shall be constructed of plastic.

C. **Vacuum Blower System:** The vacuum blower system shall consist of two blowers, a vacuum blower on the SVE inlet and a second vacuum blower on the AS inlet. These two blower systems shall have the following characteristics and components.

1. The vacuum blower on the SVE inlet shall be sufficient to produce 100 scfm of airflow at a system inlet pressure of 6 inches Hg below atmospheric pressure.

2. The vacuum blower on the AS inlet shall be sufficient to produce 900 scfm of airflow at a system inlet pressure of 25 inches of water below atmospheric pressure.

3. The two blowers shall have outlet pressures sufficient to pass the combined airstream through the catalytic oxidizer system.

4. The blowers shall operate on three phase 230 volt power.

5. Ambient air inlet piping and valves shall be sized for 100 scfm on the SVE process inlet and 900 scfm on the AS process inlet.

6. Vacuum blowers shall have an inlet particulate filter, vibration isolation and recycle piping (i.e., piping from discharge to inlet) with a gate valve to allow the total system throughput to be decreased by partially opening the valve in the recycle piping.

7. Each blower shall have a flow sensor located near the blower discharge.

8. Vacuum and pressure gages, sample ports, and safety switches shall be provided as necessary to monitor performance and protect equipment. This shall include, at a minimum, a vacuum relief valve with an adjustable set point preset to 6 inches of Hg on the SVE process inlet and a vacuum relief valve with an adjustable set point preset to 2 inches of Hg on the AR process inlet.

9. The blowers and motor shall be housed in a ventilated noise abatement box. The box shall be designed with sufficient noise-abatement material to limit the noise to 80 dBA maximum, measured at three feet from the box.

The walls of the box shall be removable as needed to provide sufficient access for blower and motor maintenance. Ventilation shall be sufficient for motor cooling.

D. **Vapor/Liquid Separators:** The system shall have vapor/liquid separators, with secondary containment, located upstream of both vacuum blowers. The vapor/liquid separators shall be sized to handle the quantity of air and the type of contaminants moving through the inlets, and they shall remove entrained water droplets.

The system shall have automatic water pumps to transfer water from the vapor/liquid separators to the air stripper inlet. The pumps shall provide a discharge pressure of 40 psi (minimum) and a flow of 5 gpm at the air stripper inlet tie-in location. Pump motors shall be rated for DIV I, Class 2 service. Vapor/liquid separators and pumps shall be remote mounted.

E. **Burner/Gas Train:** The gas train shall be fabricated to Factory Mutual ("FM") specifications. The burner shall be a propane type with an integral combustion air fan, as required. The combustion shall utilize process air, when possible, instead of fresh air to keep the overall system size and operating cost to a minimum. Complete FM approval is required.

The burner shall be mounted in the horizontal plane to allow the flame to fire in the direction of airflow. Uniform temperature entering the catalyst shall be achieved by proper air distribution over the burner and mixing plates located downstream of the burner.

The burner shall be selected to bring the reactor up to catalyst ready temperature with ambient air during startup. The burner shall have the capacity to maintain system operating temperatures during VOC free, full air flow conditions. The expected system heat-up time shall be approximately 15 to 80 minutes from cold start.

F. **Reactor:** The catalytic oxidizer reactor interior shall be constructed of 300 series stainless steel. The exterior shell shall be designed to resist corrosion. High density insulating board shall be placed between the inner and outer shells to maintain external skin temperature at safe levels. The catalyst shall be contained in a fully welded 300 series stainless steel bed configuration with high temperature gasketing to ensure no VOC bypass. A door allowing access to the reactor shall be supplied for ease of servicing and inspection of the catalyst and the interior of the reactor. Temperature sensors shall be located before and after the catalyst bed for proper control of temperature within the reactor.

G. **Catalyst:** The catalyst shall be suitable for chlorinated hydrocarbon reaction and to achieve the destruction efficiency as specified in 2.2.A. The catalyst shall be positioned to maintain uniform airflow and temperature throughout the catalyst bed.

H. **Heat Exchanger:** A shell and tube type heat exchanger (50 percent efficient) shall be supplied to preheat the incoming air stream and reduce auxiliary fuel consumption. The heat exchanger shall be constructed of 300 series stainless steel and be continuously welded around all seams. Each weld shall be leak tested for assurance of no cross contamination. The air containing VOCs shall pass through the tube side of the exchanger and the hot purified air shall pass through the shell side. Multiple passes on the shell side shall be designed to approach true counter flow conditions within the exchanger.

I. **Exhaust Stack:** A no-loss type exhaust stack with easily accessible sampling ports shall be provided. EQUIPMENT SUPPLIER shall design the catalytic oxidizer unit to support the weight of the exhaust stack. The height of the exhaust stack shall be 20 feet above ground surface. The diameter of the exhaust stack shall be 10-inches. Within the container, the exhaust stack shall be insulated.

J. **System Controls and Safety Shutdowns:** The fully automatic controls of the system shall be divided into the following categories:

1. **Start-up Mode With Fresh Air Damper:** The start-up sequence shall be as follows:

   a. The oxidizer shall be brought up to reactor temperature independent of the process using outside air via the fresh air inlet damper. This ensures the system will be cleansed of any residual VOC hydrocarbon vapors.
   b. Only when the reactor is brought up to operating temperature can the process inlet damper be opened, allowing VOC vapors into the system for destruction.

2. **Burner and Flame Safety Supervision:** The flame safeguard control shall monitor the pilot so that the primary gas valves cannot open until the pilot flame has been established and proven. The gas burner piping system shall consist of an IRI rated gas pipe train including the following components:

a. Main gas valve.
b. Vent valve.
c. Blocking valve.
d. High and low gas pressure switches with shutdown interlocks.
e. Gas regulator (vented to outside of the container for release of gas or vapors).
f. Spark arrestor with shutdown interlock.

An electronic flame safeguard control of the flame rod type shall monitor the flame during the entire burning cycle. This control shall provide the following sequence:

a. A prepurge of 90 seconds.
b. Pilot proving prior to the energizing of the main valve.
c. Trial for ignition of main flame for 10 seconds.

In the event of flame failure during a firing period, the main fuel valves shall be deenergized and signal a shutdown interlock. Manual reset shall be required at the flame supervision control located in the main control cabinet.

3. **System Safety Controls:** The following shall be a typical control safety sequence for vapor processing, as VOC load increases.

   a. The inlet temperature controller shall reduce the burning firing rate.
   b. If the concentration continues to produce an exotherm that exceeds the preset high limit temperature, a signal shall be sent to a controller to initiate the bypass of the heat exchanger.
   c. A sustained outlet temperature above the high preset limit shall initiate a system shutdown. During a shutdown an alarm signal shall be sent to the main system control panel. Operator start-up sequence must then be reinstituted.

4. **Safety Shut-Down Controls:** A number of safety features shall be an integral part of the system controls design as standard equipment. In addition to FM-approved gas trains, airflow switches, high limits and safety shutdowns shall protect the system. Any safety shutdown shall initiate an alarm and send the signal to the main system control panel. The shutdowns shall include:

a. Low air flow.
b. High catalyst exit temperature.
c. High liquid level in vapor/liquid separator.
d. High temperature in sound enclosure.
e. Loss of Power.
f. Flame out of the burner.

5. **Normal Shut-Down Controls:** Provide a 5-minute adjustable time delay on any normal shut-down of the catalytic oxidizer so that the catalytic oxidizer will remain operating until other treatment units are shut-down.

6. **Recording:** Standard controls shall consist of state-of-the-art digital temperature and pressure controllers, timers, relays, and switches in a NEMA 3R enclosure (plastic). The control panel shall include necessary displays for system status indication. A hard copy temperature and flow recorder/controller shall be supplied to control and monitor the inlet and outlet temperatures and flow of the oxidizer.

7. **Sample Ports:** Provide a minimum of four easibly accessible sample ports: 1) one on the AS inlet; 2) one on the SVE inlet; 3) one on the exhaust stack; and 4)one on the dilution air line.

K. **System Testing:**

The EQUIPMENT SUPPLIER shall test the catalytic oxidizer at their facility to ensure that all equipment functions properly. The test shall be witnessed by the ENGINEER.

L. **Manufacturer's Service Representative:**

1. **Shop Testing:** Once the catalytic oxidizer is connected to the rest of the treatment plant, the complete treatment plant will be tested at the shop where it has been assembled. At the option of the Owner, a factory trained service technician shall be supplied for one day to provide assistance for this shop test. The shop test will be conducted in Campbell, California.

2. **Start-Up Assistance:** A factory trained service technician shall be supplied for five days to startup and balance the catalytic oxidizer system at the Texaco Tutu Service Station in St. Thomas, U.S. Virgin Islands. Also included is the confirmation testing as described in 3.2.A.

3. **Instruction of OWNER's Personnel:** The EQUIPMENT SUPPLIER shall provide for the services of a factory service representative for one day to instruct the OWNER's personnel in the operation and maintenance of the

equipment. This shall be included in the five day startup service above.

M. **Field Procedures:** Instructions for field procedures for erection, adjustments, inspection, and testing shall be provided prior to installation of each piece of equipment.

2.4 Guarantees, Warranties

A. A 2-year warranty shall be provided for the catalytic oxidizer unit and its components. It shall warrant the unit from the date of receipt of equipment at CONTRACTORS shop (1) to be free of any defects in materials and/or workmanship at the time of sale, and (2) to satisfy the catalytic oxidizer performance criteria included in these specifications.

B. The expected catalyst life shall be approximately 18,000 hours of operation with minimal catalyst addition.

2.5 Manufacturers, or Equal

A. King, Buck & Associates, Inc., San Diego, California.

PART 3 -- EXECUTION

3.1 Delivery

A. Deliver the skid-mounted catalytic oxidizer to Campbell, California within 10 weeks of receipt of purchase order of equipment (assume shop drawings will be reviewed by ENGINEER within 5 days).

3.2 Confirmation Testing

B. Provide confirmation testing (EPA Method 8015 with BTEX and MTBE distinction and EPA Method 8010 modified) at start-up to demonstrate compliance with performance requirements described in these specifications.

4

B-4. Performance Monitoring

Monitoring of SVE system performance will begin during the start-up of the system. The following monitoring will be performed during the first six months of operations:

1) Soil vapor sampling at the SVE wellheads, the groundwater air stripper exhaust, the combined catalytic oxidizer influent, and the combined catalytic oxidizer effluent.

2) A one-time radius of influence test for each SVE well.

Proposed monitoring parameters and monitoring frequency for the start-up and shakedown period, i.e. the first six months of system operation, are discussed below. A long term monitoring plan will be submitted to regulatory agencies within 45 days of the end of six months of full time system operation.

B-4.1 Soil Vapor Sampling

At system start-up, soil vapor at each SVE wellhead, exhaust gas from the groundwater air stripper (discussed in Section C), and the combined catalytic oxidizer influent and effluent vapor streams will be sampled. The soil vapor samples will be collected in "Summa" vacuum canisters or Tedlar bags and analyzed for petroleum hydrocarbons, BTEX, and MTBE by EPA Method 8015/8020 (modified) and for chlorinated VOCs by EPA Method 8010. This initial sampling will determine initial SVE well vapor-phase concentrations and confirm that the catalytic oxidizer meets specified destruction efficiencies.

Following system start-up, monthly sampling at the same locations will be performed with a PID for the first six months of system operation. Data generated during monthly sampling will be used to monitor the effectiveness of the SVE system and catalytic oxidizer.

B-4.2 SVE Well Vacuum Testing

Once equilibrium operating conditions have been established, the radius of influence of each SVE well will be determined by performing a vacuum influence test. The radius of influence will be determined by creating about 6 inches of mercury vacuum at each extraction well and measuring the amount of vacuum at monitoring points located around 10 to 30 feet from each of the three vapor extraction wells. If there is no influence at the monitoring points with a vacuum of 6 inches of mercury, the vacuum will be increased to 8 inches of mercury. If increasing the vacuum to 8 inches of mercury does not result in an adequate radius of influence, then additional SVE well installation will be evaluated. This evaluation will consider: (1) the radius of influence for each well, (2) the mass of chemicals of concern being extracted from the vadose zone from each well, (3) any additional soil data for the site, and (4) capital and operation costs.

B-4.3 Completion of SVE Remedial Action

The mass removal rate of chemicals of concern will be considered no longer significant and the remedial action of a particular SVE well complete when any one of the three following alternative performance standards is satisfied:

1) Three sets of extracted gas concentration monitoring results show that all of the three following criteria are met:

a) the extracted gas concentration of volatile petroleum hydrocarbons (including BTEX) is less than ten (10%) of its value at the time of startup or less than the Practical Quantitation Limit ("PQL"), whichever is greater; and

b) the extracted gas concentration of petroleum hydrocarbons, in the most recent year of operation, has been reduced by less than ten percent (10%) of its value at the start of the year, or is less than the PQL, whichever is greater; and

c) the total aggregate removal rate for the petroleum hydrocarbons is less than three (3) pounds per day per 100 standard cubic feet per minute ("SCFM") of vapor removed.

2) Three sets of extracted gas concentration monitoring results, at intervals established in the approved Monitoring Plan, show that the extracted gas concentration of petroleum hydrocarbons is less than one percent (1%) of its value at the time of startup or less than the PQL, whichever is greater.

3) Three years of SVE system operation have been completed and three sets of extracted gas concentration monitoring results, at intervals established in the approved Monitoring Plan, show that the extracted gas concentration of petroleum hydrocarbons is less than ten percent (10%) of its value at the time of startup or less than the PQL, whichever is greater.

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B-5. System Operation

B-5.1 Expected Operations Schedule

The SVE system, as part of the overall remediation system at the Service Station Site, will be operated on a 24-hour basis. Based on experience with similar systems, system up-time is expected to be in the range of 90%-95%, or from 328 to 347 days per year. It is expected that operational difficulties will most likely be experienced at the beginning of system operation. As the system is adjusted, increased up-time is anticipated.

B-5.2 Instrumentation and Control

The SVE system, together with the groundwater extraction system, will be automatically controlled. The SVE system is designed with shutdowns and interlocks to prevent the discharge of untreated vapor to the atmosphere. As an example, if the catalytic oxidizer is not operating within specified parameters, the entire extraction system will be shut down and the operations personnel will be automatically notified of the shutdown by an autodialer system. It is anticipated that the O&M personnel will respond to the signal within a few hours.

The Service Station Site control description and equipment list are given in Table B-5.1. The control system shows the shutdowns and interlocks for the SVE system as well as the groundwater extraction system.

During the final design a complete Process and Instrumentation Diagram (P&ID) will be prepared that will show the complete instrumentation of the SVE system.

TABLE B-5.1

TEXACO TUTU SERVICE STATION CONTROL DESCRIPTION & EQUIPMENT LIST

Texaco Tutu, U.S. Virgin Islands

(EKI 940058.05)

EQUIPMENT	POWER REQMTS	OPTIONS BY MFR (1)		INTERLOCKS (2)	OPTIONS BY CONTR (3)		FIRST OUT PANEL (4)	AUTODIALER AUTODIALER (5)
ELECTRICAL GROUNDWATER PUMPS (To be supplied by Contractor)	230V 1 Phase 60 Hz			Shutdown	<=	Current sensor type protection device	YES	YES
CHEMICAL FEED SYSTEM (To be supplied by Contractor)	230V 1 Phase 60 Hz			Shutdown	<=	Power loss at chemical feed pump	YES	YES
AIR STRIPPER (Owner furnished)	230V 3 Phase 60 Hz	Remote panel						
		Power loss at panel	=>	Shutdown			YES	YES
		Air Flow Meter						
		Temperature gauges						
		Air Blower Silencer						
		Line Sample Ports						
		Low Air Pressure Alarm (w/adjustable time delay)	=>	Shutdown			YES	YES
		High Water level Alarm	=>	Shutdown			YES	YES

TABLE B-5.1

TEXACO TUTU SERVICE STATION CONTROL DESCRIPTION & EQUIPMENT LIST

Texaco Tutu, U.S. Virgin Islands

(EKI 940058.05)

EQUIPMENT	POWER REQMTS	OPTIONS BY MFR (1)		INTERLOCKS (2)	OPTIONS BY CONTR (3)	FIRST OUT PANEL (4)	AUTODIALER AUTODIALER (5)
CATALYTIC OXIDIZER (Owner furnished)	230V 3 Phase 60 Hz						
		Low air flow	=>	Shutdown		YES	YES
		High catalyst exit temperature	=>	Shutdown		YES	YES
		Liquid Level Switch if high liquid in V/L separator	=>	Shutdown		YES	YES
		High temperature in sound enclosure	=>	Shutdown		YES	YES
		Power loss at panel	=>	Shutdown		YES	YES
		High or low gas pressure	=>	Shutdown		YES	YES
		Flame failure	=>	Shutdown		YES	YES
		Spark arrestor	=>	Shutdown		YES	YES

NOTES:

1. These are the control options that are included by the manufacturer with the equipment. If any one of these alarm conditions occurs, a signal will be sent from that piece of equipment that an alarm condition has been detected.
2. This indicates what should occur if the indicated alarm condition is detected.
3. These are the control options that shall be designed and installed by the CONTRACTOR.
4. A Yes indicates that if the indicated alarm condition is detected, it should be indicated on a First Out Panel.
5. A Yes indicates that if the alarm condition is detected, it should activate the autodialer.

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B-6. Contingencies

Assumptions used in the design of the SVE system, with respect to vacuum rate and the number of SVE wells, may be revised based on observed conditions and/or vacuum influence testing. Possible contingency plans are summarized below.

B-6.1 Vacuum Adjustment / Additional Wells

Based on prior experience with SVE systems in this type of soil, it is estimated that a vacuum of six (6) inches of mercury at a given well will result in a radius of influence of approximately 20 feet. If the results of the vacuum influence test (to be performed during system startup) indicate that the radius of influence is less than 20 feet, the vacuum will be increased to as much as 8 inches of mercury. If increasing the vacuum to 8 inches of mercury does not result in an adequate radius of influence, then installation of additional SVE wells will be evaluated.

C

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SECTION C - GROUNDWATER EXTRACTION SYSTEMS

C-1. Remedial Goals

The proposed groundwater remediation systems are designed to capture groundwater impacted by petroleum hydrocarbons at the down-gradient property line of the Service Station Site and near the northern boundary of the Vitelco Site (Figure C-1.1).

Based on a review of available analytical data, the occurrence of benzene in groundwater can be used as an indicator of impact by petroleum hydrocarbons. The distribution of benzene detected in groundwater samples (collected between May and June 1994) is presented on Figure C-1.2. The analytical data for benzene are also presented on cross sections (Figures C-1.3 and C-1.4) to illustrate the vertical distribution of benzene in the petroleum hydrocarbon plume.

The remedial goal for operation of the groundwater system is to reduce concentrations of chemicals of concern detected in groundwater from monitoring wells, located within the petroleum hydrocarbon plume, to achieve compliance with Federal Drinking Water Maximum Contaminant Levels (MCLs). The chemicals of concern and the corresponding federal MCLs are presented in Table C-1.1.

For chlorinated VOCs, achievement of the remedial goals may be difficult, however. For example, if groundwater migrating onto the Texaco Property contains concentrations of chlorinated VOCs above MCLs, the remedial goals for these chemicals may not be achievable. If this is the case, the remedial goals for chlorinated VOCs may need to be modified to take into account upgradient chemical concentrations. (For additional discussion, please see Section B-6.2).

The remedial goals for inorganic compounds detected in groundwater are also Federal Drinking Water MCLs. Nevertheless, if groundwater migrating onto the Texaco Property contains concentrations of inorganic compounds above MCLs, these remedial goals also may need to be modified to take into account upgradient and background chemical concentrations.

TABLE C-1.1

Chemicals of Concern and Maximum Contaminant Levels

Texaco Tutu, U.S. Virgin Islands
(EKI 940058.03)

Parameter	Current Federal MCLs (1,2)
Benzene	5
Toluene	1000
Ethylbenzene	700
Xylenes (Total)	10 ppm
1,2-Dichloroethane (DCA)	5
1,2-Dichloroethene (DCE)	70
Tetrachloroethene (PCE)	5
Trichloroethene (TCE)	5
Vinyl chloride	2
Methylene Chloride	5

NOTES:
1. MCL values shown are from EPA Region IX, "Drinking Water Standards and Health Advisories Table", January 1995.
2. All concentrations are in ppb unless noted otherwise.

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TUTU WELLS SUPERFUND SITE
FIGURE C-1.1
CONCEPTUAL SITE LAYOUT FOR TEXACO AND VITELCO PROPERTIES
(Page: TUT 008 0409)

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TUTU WELLS SUPERFUND SITE
FIGURE C-1.2
CONCENTRATIONS OF BENZENE (UG/L)
DETECTED IN GROUNDWATER MAY – JUNE
1994 (Page: TUT 008 0410)

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TUTU WELLS SUPERFUND SITE
FIGURE C-1.3
BENZENE CONCENTRATIONS (UG/L) IN GROUNDWATER ALONG SECTION A-A' (UG/L)
(Page: TUT 008 0411)

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TUTU WELLS SUPERFUND SITE
FIGURE C-1.4
BENZENE CONCENTRATIONS (UG/L)
DETECTED IN GROUNDWATER ALONG
SECTION B-B' (UG/L) (Page: TUT 008 0412)

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C-2. Volume of Groundwater to be Remediated

Based on the delineation of the plume presented on Figure C-1.2 in Sub Section C-1, an area of approximately 70,000 square feet is impacted by petroleum hydrocarbons.

Because gasoline is less dense than water, dissolved chemical plumes down-gradient of gasoline releases are typically shallow and do not commonly extend to great depths. At the Texaco Tutu Station, however, BTEX compounds have been detected at elevated concentrations in water from the deep monitoring well TT-1D. In addition, such compounds have been detected in groundwater from the Tillett well. This vertical distribution suggests that chemicals of concern may have been drawn downward, possibly under the influence of pumping from the Tillett well. Assuming this is the case, the vertical extent of chemicals which emanate from the Texaco Tutu Station is assumed to be as much as 100 feet deep, the depth of the bottom of the Tillett well (Figure C-1.3) in Sub Section C-1.

Assuming that petroleum hydrocarbons are present to a depth of 100 feet below ground surface (bgs), that groundwater is encountered at a depth of 15 feet bgs, and that the porosity of the water-bearing zone is 0.1, the volume of groundwater potentially impacted by petroleum hydrocarbons is approximately 52 million gallons.

EKI has estimated the groundwater extraction volumes required to capture the petroleum hydrocarbon plume using a simple hydrogeological computer model of the Service Station Site and surrounding areas. The required extraction volumes are estimated to be approximately 20 to 50 gallons per minute ("gpm") at the Texaco Site and 5 to 20 gpm at the Vitelco Site. Groundwater at both locations will be extracted from well pairs consisting of a shallow extraction well screened from an elevation of approximately 140 to 170 feet mean sea level ("msl"), and a deep extraction well screened from approximately 90 to 130 feet msl.

The estimated zone of capture for the proposed system with extraction at 20 gpm from a single well pair at the Texaco Site and 10 gpm from a single well pair at the Vitelco Site is presented on Figure C-2.1. A schematic of the zone of capture in vertical cross section is presented on Figures C-2.2 and C-2.3. At the present time, extraction from a second well pair at the Service Station Site is also planned. However, if site access makes installation of these additional wells impossible, the system may be installed with a single well pair.

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TUTU WELLS SUPERFUND SITE
FIGURE C-2.1
ESTIMATED ZONE OF CAPTURE
(Page: TUT 008 0415)

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FIGURE C-2.2
SCHEMATIC OF GROUNDWATER ZONE OF CAPTURE ALONG SECTION A-A' (UG/L)
(Page: TUT 008 0416)

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TUTU WELLS SUPERFUND SITE
FIGURE C-2.3
SCHEMATIC OF GROUNDWATER ZONE OF CAPTURE ALONG SECTION B-B'
(Page: TUT 008 0417)

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C-3. Treatment Criteria

C-3.1 Assumed Groundwater Influent Concentrations

Assumed groundwater influent concentrations are given in Table 1 of the April Report. 1. The back-up spreadsheets used to calculate the concentrations shown in Table 1 of the April Report are included as Table C-3.1, C-3.1A, C-3.2, C-3.2A, C-3.3, and C-3.3A. In addition to showing the backup calculations for the concentrations in Table 1 of the April Report, these tables show the percent removal of each chemical of concern at the Service Station Site and the Vitelco Site by the air-stripping process, the chemical concentrations and mass remaining in the water, and the calculated mass in the air discharged from the air stripper.

C-3.2 TPDES Discharge Requirements

Texaco submitted an application to DPNR for a Territorial Pollutant Discharge Elimination System ("TPDES") permit in May 1995. This TPDES permit application requests that DPNR allow discharge of the treated groundwater from the Service Station Site and the Vitelco Site to the existing St. Thomas storm sewer system. This storm sewer system discharges to territorial receiving waters of the U.S., specifically to Turpentine Run and Jersey Bay. The treated water discharge will meet current Federal MCLs. Table 3 of the April Report shows the range of typical expected effluent concentrations and expected maximum effluent concentrations for chemicals of concern. The concentrations shown in Table 3 are the same as those submitted in the TPDES permit application. The treatment system is designed to produce treated water within the typical expected effluent concentrations.

C-3.3 Treatment of Air Discharged from the Air-Stripper by the Catalytic Oxidizer

Extracted groundwater will be treated at both the Service Station Site and the Vitelco Site by an air-stripper. At the Service Station Site, the air stripper air flow rate of 900 scfm will be produced by the catalytic oxidizer blower. The catalytic oxidizer blower will induce the air flow by creating a 6-inch Hg vacuum at the air stripper. The catalytic oxidizer will treat both the air discharged form the air stripper and the vapor from the SVE system. The catalytic oxidizer is described in Section B-3.3.

At the Vitelco Site, the air stripper blower will produce a 150 scfm air flow rate. The air emissions at this location will be discharged directly to the atmosphere.

The air stripper specifications follow. The catalytic oxidizer specifications are included in Section B-3.

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C-3.4 Estimated Air Emissions

Based on discussions with the DPNR, air discharge limits or permitting requirements have not been promulgated for remediation facilities for the U.S. Virgin Islands. Air emissions of benzene, 1,2-dichloroethane, trichloroethene, tetrachloroethene, vinyl chloride and methylene chloride are of potential concern because these chemicals have been identified as human carcinogens (Class A) or probable human carcinogens (Class B2) (EPA, 1994). EPA uses a general risk range of 10^{-4} to 10^{-6} (the probability that an individual will contract cancer over a 70 year lifetime due to exposure to chemicals of concern) as an acceptable "target range" for cleanup (EPA, 1990). Table C-3.4 (revised from Table 5, page 1, in the April Report) shows estimated air emissions of these chemicals of concern, catalytic oxidation destruction efficiencies, estimated treated air emissions and estimated hydrochloric acid emissions following catalytic oxidation destruction at the Service Station Site. Table C-3.5 (revised from Table 5, page 2, of the April Report) shows estimated air emissions of the chemicals of concern at the Vitelco Site.

The catalytic oxidizer destruction efficiencies specified for the unit that will be manufactured specifically for the Service Station Site are based on typical, achievable destruction efficiencies for catalytic oxidizers. (The catalytic oxidizer specifications are included in the back of Sub Section B-3.) As discussed below, the air emissions from the catalytic oxidizer at the Service Station Site and the Vitelco Site air stripper are expected to be within the risk range of 10^{-6}.

HCl will be formed as a result of the destruction of chlorinated VOCs. Estimated emissions of HCl are calculated to be on the order of 3 lb/day.

The risk screening analysis method used for both the Service Station Site and the Vitelco Site is based on the EPA Risk Assessment Guidance for Superfund (EPA, 1989) and EPA's Supplemental Guidance entitled "Standard Default Exposure Factors" (EPA, 1991). Three populations are considered in the evaluation of estimated incremental lifetime cancer risk due to inhalation of chemicals of concern emitted from the remediation system: 1) on-site employee risk; 2) off-site resident risk; and 3) off-site school student risk. Summary Table C-3.6 for both Sites, Detailed Risk Analysis Tables C-3.7 through C-3.9 for the Vitelco Property, and SCREEN2 simulation results for the Vitelco Property are included at the end of this Sub Section. Results of the risk analysis for EPA carcinogens are described below. Service Station Site detailed risk analysis tables, EPA guidance formulas, back-up calculations, air model assumptions, and SCREEN2 simulation results are included in the back of Sub Section B-3.

Texaco Service Station:

At the Service Station Site, benzene emissions from the soil vapor extraction system and the groundwater treatment system, without emissions control, are estimated to be on the order of up to 15 lb/day. Due to this potentially significant mass, air emissions treatment by catalytic oxidation has been included in the remedial design for this location.

A risk screening analysis was completed to estimate the incremental potential lifetime cancer risk due to exposure to treated air emissions from the Service Station Site remediation system. Based on estimated air emission rates and the results of emission scenarios calculated from an EPA approved air dispersion model (SCREEN2 ,1993), health risk analyses were completed for on-site employees, off-site residents, and off-site school students due to exposure to the maximum calculated concentration at ground level. The results are summarized in Table C-3.6.

The estimated incremental lifetime cancer risk for on-site employees at the Service Station Site, assuming a 25 year exposure duration, is estimated to be 1.0×10^{-6}. For off-site residents, the incremental lifetime cancer risk, assuming a 30 year exposure, is estimated to be 5.0×10^{-7}. The estimated incremental lifetime cancer risk for off-site students, assuming an 8 year exposure, is estimated to be 4.0×10^{-8}.

The risks are weighted toward the assumed benzene and vinyl chloride emissions. In response to a comment from EPA, an additional analysis was completed to look at the potential effects on risk due to hypothetical higher, simultaneous vinyl chloride and benzene levels. If the vinyl chloride emission rate increased to 2.7×10^{-4} g/s (increasing the influent concentration to approximately 2 ppm from the assumed 100 ppb) and the benzene emission rate increased to 1.3×10^{-3} g/s (doubling the groundwater influent concentration to 34 ppm from the assumed 17 ppm) the estimated incremental lifetime cancer risk would be 5.0×10^{-6} for on-site employees assuming a 25 year exposure duration and 2.0×10^{-6} for on-site employees assuming a 10 year exposure duration.

The long term analyses may be conservative inasmuch as the exposure durations of 25 years for on-site employees, and 30 years for off-site residents are likely two to three times the probable operational life of the remediation system. In addition, the chemical concentrations for the soil vapor extraction are expected to significantly decline within a few years.

Therefore, it can be assumed that with the specified catalytic oxidizer destruction efficiencies, the conservative exposure durations used, and the expected reduction of chemicals from the soil vapor extraction sytem, there is adequate flexibility in the system to treat higher than assumed influent concentrations without increasing the estimated incremental lifetime cancer risk above 10^{-6}.

Vitelco Site:

A risk screening analysis was also completed to estimate the incremental lifetime cancer risk due to air emissions directly to the atmosphere from the remediation system at the Vitelco Site. This system is not planned to have air emissions treatment. Based on estimated air emission rates and air concentrations calculated from two simulations performed using SCREEN2, health risk analyses were completed for on-site employees and off-site school students due to exposure to the calculated maximum air ground concentration. Results of the SCREEN2 simulation indicates that there would be no detectable air concentration of chemicals of concern at ground level at a distance of 24 meters (80 feet) from the site, the location of the nearest residence.

The estimated incremental lifetime cancer risk for on-site employees at the Vitelco property location, assuming a 25 year exposure duration, is estimated to be 7.0×10^{-7}. The estimated incremental lifetime cancer risk for off-site school students, assuming an 8 year exposure duration, is estimated to be 1.0×10^{-7}.

The risks are weighted toward the vinyl chloride emission. The vinyl chloride emission rate shown in Table C-3.7, 5.2×10^{-5} g/s, is based on the assumed design influent groundwater concentration of 10 ppb. Vinyl chloride has not been detected to date in groundwater monitoring well MW-7 at the Vitelco Site. In response to a comment from EPA, we looked at the potential effects on risk due to hypothetical high vinyl chloride concentrations. Table C-3.8 shows that if the vinyl chloride emission rate increased to 1.2×10^{-4} g/s (increasing the influent concentration to approximately 100 ppb from the assumed 10 ppb) then the estimated incremental lifetime cancer risk would be 2.0×10^{-6} for on-site employees assuming a 25 year exposure duration and 6.0×10^{-7} assuming a 10 year exposure duration.

In addition, the long term analyses, at least for on-site employees, may be conservative inasmuch as the exposure durations are likely two to three times the probable operational life of the system.

Based on the estimated incremental lifetime cancer risks and the conservative exposure durations used, it is assumed that emissions control will not be required at the Vitelco Site. However, if actual air emissions differ significantly from the estimated emission rates, further risk screening analysis will be conducted. If required, a catalytic oxidizer or other appropriate air emissions treatment unit will be added to treatment process.

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TUTU WELLS SUPERFUND SITE
TABLE C-3.1
TEXACO SERVICE STATION ORGANIC CONCENTRATIONS: GROUNDWATER & VAPOR PHASE (1) (Page: TUT 008 0423)

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TABLE C-3.1A
TEXACO SERVICE STATION ORGANIC CONCENTRATIONS: GROUNDWATER & VAPOR PHASE (1) (Page: TUT 008 0424)

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TABLE C-3.2
VITELCO PROPERTY ORGANIC CONCENTRATIONS: GROUNDWATER & VAPOR PHASE (1) (Page: TUT 008 0425)

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TABLE C-3.2A
VITELCO PROPERTY ORGANIC CONCENTRATIONS: GROUNDWATER & VAPOR PHASE (1) (Page: TUT 008 0426)

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TABLE C-3.3
TEXACO SERVICE STATION & VITELCO PROPERTY INORGANIC CONCENTRATIONS: GROUNDWATER (Page: TUT 008 0427)

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TABLE C-3.3A
TEXACO SERVICE STATION & VITELCO PROPERTY INORGANIC CONCENTRATIONS: GROUNDWATER (1) (Page: TUT 008 0428)

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TABLE C-3.4

ESTIMATED AIR EMISSIONS

Texaco Tutu, U.S. Virgin Islands
(EKI 940058.03)

CHEMICALS OF CONCERN	TEXACO TUTU SERVICE STATION with Emissions Control (1)						
	Mass in Air Air Stripper lb/day (2)	Mass in Air SVE lb/day (3)	Total Mass in Air lb/day	Cat-Ox Destruction % (4)	Treated Air Emissions lb/day	Treated Air Emissions g/s	HCl Emissions (5)
Benzene	10	5	15	99	0.15	7.7E-04	-
Toluene	9	6	15	99	0.15	8.0E-04	-
Ethylbenzene	2	1	3	99	0.03	1.7E-04	-
Xylenes	8	4	12	99	0.12	6.4E-04	-
1,2-Dichloroethane (DCA)	0.2	0.01	0.21	96	0.01	4.4E-05	0.1
1,2-Dichloroethene (DCE)	0.3	0.25	0.55	96	0.02	1.2E-04	0.4
Tetrachloroethene (PCE)	0.03	0.01	0.04	96	0.002	8.4E-06	0.05
Trichloroethene (TCE)	0.03	0.02	0.05	96	0.002	1.0E-05	0.05
Vinyl Chloride	0.06	0.1	0.16	96	0.01	3.4E-05	0.2
Methylene Chloride	2	1	3	96	0.14	7.1E-04	2.2
SUM HCl (pounds per day)							3.0

NOTES:

1. Off-gas from the air stripper and SVE will be treated by catalytic oxidation.
2. Assumed air mass is based on estimated removal rates of chemicals by air stripping as shown on Table C-3.1
3. Assumed SVE air mass is estimated from groundwater data as shown on Table B-4.1. Levels are expected to decrease with time.
4. Catalytic Oxidizer destruction efficiencies are specified in equipment Specification Section 13270.
5. Assumed hydrochloric acid (HCl) emitted to the atmosphere after air treatment by catalytic oxidation, in pounds per day.
6. Totals may be rounded.
7. This table is a revision of Table 5 included in the Groundwater and Soils Remediation Program Report dated 13 April 1995.

TABLE C-3.5

ESTIMATED AIR EMISSIONS
Vitelco Property
Texaco Tutu, U.S. Virgin Islands
(EKI 940058.03)

CHEMICALS OF CONCERN	VITELCO PROPERTY without Emissions Control (5)	
	Air Emissions lb/day (2)	Air Emissions g/s
Benzene	0.007	3.7E-05
Toluene	0.002	1.3E-05
Ethylbenzene	0.002	1.3E-05
Xylenes	0.002	1.3E-05
1,2-Dichloroethane (DCA)	0.001	5.2E-06
1,2-Dichloroethene (DCE)	0.10	5.0E-04
Tetrachloroethene (PCE)	0.03	1.6E-04
Trichloroethene (TCE)	0.01	4.7E-05
Vinyl chloride	0.01	5.2E-05
Methylene Chloride	0.002	1.0E-05

NOTES:

1. Off-gas vapors from the air stripper will be vented directly to the atmosphere.
2. Assumed air mass is based on removal rates by air stripping.
3. This table is a revision of Table 5, page 2, included in the Groundwater and Soils Remediation Program Report dated 13 April 1995.

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TABLE C-3.6

AIR EMISSIONS
SUMMARY OF HEALTH RISK ANALYSIS FOR EPA CARCINOGENS
Tutu Texaco Service Station
(EKI 940058.03)

LOCATION	ESTIMATED INCREMENTAL LIFETIME CANCER RISK		
	On-Site Employees 25 Year Exposure	Off-Site Residents 30 Year Exposure	Off-site Students 8 Year Exposure
Texaco Service Station	1.0E-06 5.0E-06 (1)	5.0E-07	4.0E-08
Vitelco Property	7.0E-07 2.0E-06 (2)	(3)	1.0E-07

NOTES:

1. Increased risk based on vinyl chloride and benzene concentrations greater than design concentrations.
2. Increased risk based on vinyl chloride concentrations greater than design concentrations.
3. Vitelco property air modeling indicates that air emission concentrations are not detectable at the nearest residence located approximately 24 meters (80 feet) from the emission stack location.

TUT 008 0431

RISK ANALYSIS TABLES

TUT 008 0432

TABLE C-3.7

AIR EMISSIONS - VITELCO SITE
HEALTH RISK ANALYSIS FOR EPA CARCINOGENS

Tutu Texaco Service Station
On-Site Employees Health Risk Analysis
(EKI 940058.03)

Chemical of Concern	Estimated Emission Rate (g/s) (1)	Maximum Ground Concentration for 1g/s Emission Rate (ug/m^3) (2)	Maximum Ground Concentration for Estimated Emission Rate (ug/m^3) (3)	Chronic Daily Intake (mg/(kg -d)) (4,5)	Slope Factor (1/mg/(kg - d))		Estimated Incremental Lifetime Cancer Risk (25 Year Exposure) (9)	Estimated Incremental Lifetime Cancer Risk (10 Year Exposure) (9)
Benzene	3.7E-5	606.5	2.2E-2	1.6E-6	2.9E-2	(6)	4.5E-8	1.8E-8
1,2-Dichloroethane (DCA)	5.2E-6	606.5	3.2E-3	2.2E-7	9.1E-2	(6)	2.0E-8	8.1E-9
Tetrachloroethene (PCE)	1.6E-4	606.5	9.5E-2	6.7E-6	2.0E-3	(7)	1.4E-8	5.4E-9
Trichloroethene (TCE)	4.7E-5	606.5	2.9E-2	2.0E-6	6.0E-3	(8)	1.2E-8	4.8E-9
Vinyl chloride	5.2E-5	606.5	3.2E-2	2.2E-6	2.9E-1	(8)	6.5E-7	2.6E-7
Methylene Chloride	1.0E-5	606.5	6.4E-3	4.4E-7	1.6E-3	(6)	7.3E-10	2.9E-10
			Total Maximum Incremental Cancer Risk				7.0E-7	3.0E-7

NOTES:
1. Emission rates are based on estimated design mass emissions from groundwater air stripper off gas and soil vapor extraction treated by catalytic oxidation.
2. Maximum long term impact at a height of 4 meters above the stack base and located 29 meters (95 ft) away from the stack based on a 1 g/s total chemical emission rate from the stack (10% of one hour value obtained using SCREEN2 program, Model No. 1, 150 SCFM, simple terrain downwash from Mike's Paints, Stack ht =4.9 meters (16 ft))
3. Maximum ground concentration = estimated emission rate x maximum ground concentration for 1 g/s emission rate
4. On-site exposure factors: inhalation Rate = 2.5 m^3/hr for 8 hours/day; exposure frequency = 250 days/year; averaging time = 70 years x 365 days/year
5. Chronic Daily Intake = (maximum ground concentration x inhalation rate x exposure frequency x exposure duration)/ (averaging time x body weight of 70 kg)
6. Slope factors are converted from unit risk factors included in IRIS (1995).
7. Slope factors are converted from unit risk factors included in U.S. EPA Health Assesment documents.
8. Slope factors are converted from unit risk factors included in the U.S. EPA Health Effects Assessment Summary Tables, FY 1994 Annual.
9. Estimated Incremental Lifetime Cancer Risk Averaged over 70 years with 25 years of exposure = (chronic daily intake x slope factor)
10. Estimated Incremental Lifetime Cancer Risk Averaged over 70 years with 10 years of exposure = Estimated Incremental Lifetime Cancer Risk (25 Year Exposure) x (10/25)
11. Totals may be rounded.

TUT 008 0433

TABLE C-3.8

AIR EMISSIONS - VITELCO SITE
HEALTH RISK ANALYSIS FOR EPA CARCINOGENS

Hypothetical Increase in Vinyl Chloride Emission Rate
Tutu Texaco Service Station
On-Site Employees Health Risk Analysis
(EKI 940058.03)

Chemical of Concern	Estimated Emission Rate (g/s) (1)	Maximum Ground Concentration for 1g/s Emission Rate (ug/m^3) (2)	Maximum Ground Concentration for Estimated Emission Rate (ug/m^3) (3)	Chronic Daily Intake (mg/(kg -d)) (4,5)	Slope Factor (1/mg/(kg - d))		Estimated Incremental Lifetime Cancer Risk (25 Year Exposure) (9)	Estimated Incremental Lifetime Cancer Risk (10 Year Exposure) (9)
Benzene	3.7E-5	606.5	2.2E-2	1.6E-6	2.9E-2	(6)	4.5E-8	1.8E-8
1,2-Dichloroethane (DCA)	5.2E-6	606.5	3.2E-3	2.2E-7	9.1E-2	(6)	2.0E-8	8.1E-9
Tetrachloroethene (PCE)	1.6E-4	606.5	9.5E-2	6.7E-6	2.0E-3	(7)	1.4E-8	5.4E-9
Trichloroethene (TCE)	4.7E-5	606.5	2.9E-2	2.0E-6	6.0E-3	(8)	1.2E-8	4.8E-9
Vinyl chloride	1.2E-4	606.5	7.3E-2	5.1E-6	2.9E-1	(8)	1.5E-6	6.0E-7
Methylene Chloride	1.0E-5	606.5	6.4E-3	4.4E-7	1.6E-3	(6)	7.3E-10	2.9E-10
			Total Maximum Incremental Cancer Risk				2.0E-6	6.0E-7

NOTES:
1. Emission rates are based on estimated design mass emissions from groundwater air stripper off gas and soil vapor extraction treated by catalytic oxidation.
2. Maximum long term impact at a height of 4 meters above the stack base and located 29 meters (95 ft) away from the stack based on a 1 g/s total chemical emission rate from the stack (10% of one hour value obtained using SCREEN2 program, Model No. 1, 150 SCFM, simple terrain downwash from Mike's Paints, Stack ht =4.9 meters (16 ft))
3. Maximum ground concentration = estimated emission rate x maximum ground concentration for 1 g/s emission rate
4. On-site exposure factors: inhalation Rate = 2.5 m^3/hr for 8 hours/day; exposure frequency = 250 days/year; averaging time = 70 years x 365 days/year
5. Chronic Daily Intake = (maximum ground concentration x inhalation rate x exposure frequency x exposure duration)/ (averaging time x body weight of 70 kg)
6. Slope factors are converted from unit risk factors included in IRIS (1995).
7. Slope factors are converted from unit risk factors included in U.S. EPA Health Assesment documents.
8. Slope factors are converted from unit risk factors included in the U.S. EPA Health Effects Assessment Summary Tables, FY 1994 Annual.
9. Estimated Incremental Lifetime Cancer Risk Averaged over 70 years with 25 years of exposure = (chronic daily intake x slope factor)
10. Estimated Incremental Lifetime Cancer Risk Averaged over 70 years with 10 years of exposure = Estimated Incremental Lifetime Cancer Risk (25 Year Exposure) x (10/25)
11. Totals may be rounded.

TABLE C-3.9

AIR EMISSIONS - VITELCO SITE
HEALTH RISK ANALYSIS FOR EPA CARCINOGENS

Tutu Texaco Service Station
Off-Site Student Health Risk Analysis
(EKI 940058.03)

Chemical of Concern	Estimated Emission Rate (g/s) (1)	Maximum Ground Concentration for 1g/s Emission Rate (ug/m^3) (2)	Maximum Ground Concentration for Estimated Emission Rate (ug/m^3) (3)	Chronic Daily Intake (mg/(kg -d)) (4,5)	Slope Factor (1/mg/(kg - d))		Estimated Incremental Lifetime Cancer Risk 8 Year Exposure (9)
Benzene	3.7E-5	85.3	3.1E-3	1.4E-7	2.9E-2	(6)	4.1E-9
1,2-Dichloroethane (DCA)	5.2E-6	85.3	4.5E-4	2.0E-8	9.1E-2	(6)	1.8E-9
Tetrachloroethene (PCE)	1.6E-4	85.3	1.3E-2	6.0E-7	2.0E-3	(7)	1.2E-9
Trichloroethene (TCE)	4.7E-5	85.3	4.0E-3	1.8E-7	6.0E-3	(8)	1.1E-9
Vinyl chloride	5.2E-5	85.3	4.5E-3	2.0E-7	2.9E-1	(8)	5.9E-8
Methylene Chloride	1.0E-5	85.3	8.9E-4	4.0E-8	1.6E-3	(6)	6.6E-11
			Total Maximum Incremental Cancer Risk				1.0E-7

NOTES:
1. Emission rates are based on estimated design mass emissions from groundwater air stripper off gas and soil vapor extraction treated by catalytic oxidation.
2. Maximum long term impact at a height of 6.9 meters (22 ft) above the stack base and located 134 meters (440 ft) northeast from the stack based on a 1 g/s total chemical emission rate from the stack (10% of one hour value obtained using SCREEN2 program, Model No. 1, 150 SCFM, complex terrain downwash from Mike's Paints, Stack ht = 4.9 meters (16 ft)
3. Maximum ground concentration = estimated emission rate x maximum ground concentration for 1 g/s emission rate
4. Student exposure factors: inhalation factor =3.2 m^3/hr for 6 hours/day; exposure frequency = 270 days/year; averaging time = 70 years x 365 days/year
5. Chronic Daily Intake = (maximum ground concentration x inhalation rate x exposure frequency x exposure duration)/ (averaging time x body weight of 36 kg)
6. Slope factors are converted from unit risk factors included in IRIS (1995).
7. Slope factors are converted from unit risk factors included in U.S. EPA Health Assesment documents.
8. Slope factors are converted from unit risk factors included in the U.S. EPA Health Effects Assessment Summary Tables, FY 1994 Annual.
9. Estimated Incremental Lifetime Cancer Risk Averaged over 70 years with 8 years of exposure = (chronic daily intake x slope factor)
10. Totals may be rounded.

TUT 008 0435

VITELCO PROPERTY

SCREEN2 SIMULATION ASSUMPTIONS, RESULTS AND OUTPUT

TUT 008 0436

VITELCO PROPERTY LOCATION AIR MODELING

Two model runs using the Screen2 air dispersion model for air emissions emanating from the proposed groundwater treatment system at the Vitelco Property location, St. Thomas, U.S. Virgin Islands are described below. The two model runs were generated to determine the worst-case air emissions scenario and resulting maximum chemical concentration for a 1 g/s emission rate. This concentration is used in the calculation for the incremental carcinogenic risk shown on Tables A4 through A5.

The worst-case scenario is Model No. 1, as described below, showing a maximum concentration of 6,065 ug/m^3 at a distance of 29 meters from the stack.

The assumptions of the two model runs are described below and the SCREEN2 printout results follow.

Model No. 1, "tutu5":

Assumptions:

- The treatment system is located on flat terrain (approximate elevation 180 feet)

- Stack height = 4.9 meters above ground surface
  Stack diameter = 0.09 meters
  Stack velocity = 12.7 meters/second

- Air dispersion is toward the east and northeast of the treatment system, and up a hill. (The complex terrain and simple terrain inputs model this geography.)

Results:

- The maximum concentration (6,065 ug/m^3) occurred at a distance of 29 meters from the stack.

- The maximum concentration at the nearest school (853 ug/m^3) occurred at a distance of 134 meters from the stack.

TUT 008 0437

VITELCO PROPERTY LOCATION AIR MODELING

Model No. 2, "tutuflt2":

Assumptions:

- The treatment system is located on flat terrain (approximate elevation 180 feet)

- Stack height = 4.9 meters above ground surface
  Stack diameter = 0.09 meters
  Stack velocity = 12.7 meters/second

- Air dispersion is toward the north, west, and south of the treatment system, down a hill or across flat terrain. (The flat terrain input models this geography.)

Results:

- The maximum concentration (4,660 ug/m^3) occurred at a distance of 29 meters from the stack.

General Assumptions:

- Downwash from Mike's Paints is included in all model runs.

- Background concentrations are not included in any of the model runs.

VITELCO PROPERTY

AIR DISPERSION

MODEL NO. 1

****** SCREEN2 MODEL ******
**** VERSION DATED 92245 ****

IBM-PC VERSION (1.01)

04/12/95
12:01:46

ıtu5

COMPLEX TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.00000
STACK HT (M)	=	4.8766
STACK DIAMETER (M)	=	.0914
STACK VELOCITY (M/S)	=	12.6994
STACK GAS TEMP (K)	=	296.1500
AMBIENT AIR TEMP (K)	=	294.2600
RECEPTOR HEIGHT (M)	=	.0000
URBAN/RURAL OPTION	=	URBAN

UOY. FLUX = .002 M**4/S**3; MOM. FLUX = .335 M**4/S**2.

INAL STABLE PLUME HEIGHT (M) = 7.5
DISTANCE TO FINAL RISE (M) = 200.6

			VALLEY 24-HR CALCS		**SIMPLE TERRAIN 24-HR CALCS**				
TERR HT (M)	DIST (M)	MAX 24-HR CONC (UG/M**3)	CONC (UG/M**3)	PLUME HT ABOVE STK BASE (M)	CONC (UG/M**3)	PLUME HT ABOVE STK HGT (M)	SC	U10M (M/S)	USTK (M/S)
5.	53.	3909.	46.86	6.3	3909.	3.2	6	1.0	1.0
6.	57.	3511.	60.93	6.3	3511.	3.2	6	1.0	1.0
6.	61.	3164.	73.78	6.3	3164.	3.2	6	1.0	1.0
7.	82.	108.7	108.7	6.3	.0000	.0	0	.0	.0
7.	102.	110.4	110.4	6.5	.0000	.0	0	.0	.0
8.	116.	103.6	103.6	6.7	.0000	.0	0	.0	.0
9.	126.	97.49	97.49	6.8	.0000	.0	0	.0	.0
6.	134.	852.6	91.87	6.9	852.6	3.2	6	1.0	1.0
9.	139.	88.86	88.86	6.9	.0000	.0	0	.0	.0
10.	148.	82.81	82.81	7.0	.0000	.0	0	.0	.0

OFF-SITE STUDENT MAXIMUM

04/12/95
12:01:46

tutu5

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.00000
STACK HEIGHT (M)	=	4.8766
STK INSIDE DIAM (M)	=	.0914
STK EXIT VELOCITY (M/S)	=	12.6994
STK GAS EXIT TEMP (K)	=	296.1500
AMBIENT AIR TEMP (K)	=	294.2600
RECEPTOR HEIGHT (M)	=	1.5000
URBAN/RURAL OPTION	=	URBAN

BUILDING HEIGHT (M) = 9.1435
IN HORIZ BLDG DIM (M) = 12.1914
AX HORIZ BLDG DIM (M) = 18.2870

BUOY. FLUX = .002 M**4/S**3; MOM. FLUX = .335 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 1. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
4.	.0000	0	.0	.0	.0	.00	.00	.00	NA

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 1. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
11.	.0000	0	.0	.0	.0	.00	.00	.00	NA

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 2. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
15.	.0000	0	.0	.0	.0	.00	.00	.00	NA

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 2. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
16.	.0000	0	.0	.0	.0	.00	.00	.00	NA

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 3. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
19.	.0000	0	.0	.0	.0	.00	.00	.00	NA

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 4. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
24.	.0000	0	.0	.0	.0	.00	.00	.00	NA

OFF-SITE RESIDENCE

****
** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 4. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
25.	.0000	0	.0	.0	.0	.00	.00	.00	NA

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 4. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

ON-SITE EMPLOYEE

DIST (M)	CONC (UG/M**3)	STAB	U1 (M/			PLUME T (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
27.	.0000	0	.			.00	.00	.00	NA

****
*** SCREEN DISCRETE DISTANCES *
****

*** TERRAIN HEIGHT OF 4. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES **

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
29.	6065.	3	1.0	1.0	320.0	.86	7.79	6.50	SS

ON-SITE EMPLOYEE MAXIMUM

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 4. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
32.	5792.	3	1.0	1.0	320.0	.66	7.98	6.69	SS

```
*********************************
*** SCREEN DISCRETE DISTANCES ***
*********************************
```

*** TERRAIN HEIGHT OF 4. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
34.	5561.	3	1.0	1.0	320.0	.46	8.14	6.85	SS

```
*********************************
*** SCREEN DISCRETE DISTANCES ***
*********************************
```

*** TERRAIN HEIGHT OF 5. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
37.	5310.	4	1.0	1.0	320.0	.25	8.33	7.03	SS

```
*********************************
*** SCREEN DISCRETE DISTANCES ***
*********************************
```

*** TERRAIN HEIGHT OF 5. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
42.	4871.	4	1.0	1.0	320.0	.05	8.67	7.38	SS

```
DWASH=   MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
```

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*     SIMPLE ELEVATED TERRAIN PROCEDURE    *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
1.	4.	--
1.	11.	--

2.	15.	--
2.	16.	--
3.	19.	--
4.	24.	--
4.	25.	--
4.	27.	--
4.	29.	--
4.	32.	--
4.	34.	--
5.	37.	--
5.	42.	--

*** CAVITY CALCULATION - 1 ***

CONC (UG/M**3)	=	3987.
CRIT WS @10M (M/S)	=	1.00
CRIT WS @ HS (M/S)	=	1.00
DILUTION WS (M/S)	=	1.00
CAVITY HT (M)	=	11.73
CAVITY LENGTH (M)	=	19.85
ALONGWIND DIM (M)	=	12.19

*** CAVITY CALCULATION - 2 ***

CONC (UG/M**3)	=	5981.
CRIT WS @10M (M/S)	=	1.00
CRIT WS @ HS (M/S)	=	1.00
DILUTION WS (M/S)	=	1.00
CAVITY HT (M)	=	10.23
CAVITY LENGTH (M)	=	10.17
ALONGWIND DIM (M)	=	18.29

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)	
SIMPLE TERRAIN	6065.	29.	4.	
COMPLEX TERRAIN	3909.	53.	5.	(24-HR CONC)
BUILDING CAVITY-1	3987.	20.	--	(DIST = CAVITY LENGTH)
BUILDING CAVITY-2	5981.	10.	--	(DIST = CAVITY LENGTH)

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

RUN ENDED ON 04/12/95 AT 12:01:48

VITELCO PROPERTY

AIR DISPERSION

MODEL NO. 2

****** SCREEN2 MODEL ******
**** VERSION DATED 92245 ****

IBM-PC VERSION (1.01)

04/13/95
13:08:33

ıtuflt2

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.00000
STACK HEIGHT (M)	=	4.8766
STK INSIDE DIAM (M)	=	.0914
STK EXIT VELOCITY (M/S)	=	12.6994
STK GAS EXIT TEMP (K)	=	296.1500
AMBIENT AIR TEMP (K)	=	294.2610
RECEPTOR HEIGHT (M)	=	1.5000
URBAN/RURAL OPTION	=	URBAN
BUILDING HEIGHT (M)	=	9.1435
MIN HORIZ BLDG DIM (M)	=	12.1914
MAX HORIZ BLDG DIM (M)	=	18.2870

JOY. FLUX = .002 M**4/S**3; MOM. FLUX = .335 M**4/S**2.

FULL METEOROLOGY ***

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
2.	.0000	0	.0	.0	.0	.00	.00	.00	NA
3.	.0000	0	.0	.0	.0	.00	.00	.00	NA
5.	.0000	0	.0	.0	.0	.00	.00	.00	NA
6.	.0000	0	.0	.0	.0	.00	.00	.00	NA
8.	.0000	0	.0	.0	.0	.00	.00	.00	NA
9.	.0000	0	.0	.0	.0	.00	.00	.00	NA
11.	.0000	0	.0	.0	.0	.00	.00	.00	NA
12.	.0000	0	.0	.0	.0	.00	.00	.00	NA
14.	.0000	0	.0	.0	.0	.00	.00	.00	NA
15.	.0000	0	.0	.0	.0	.00	.00	.00	NA
18.	.0000	0	.0	.0	.0	.00	.00	.00	NA
21.	.0000	0	.0	.0	.0	.00	.00	.00	NA
24.	.0000	0	.0	.0	.0	.00	.00	.00	NA
27.	.0000	0	.0	.0	.0	.00	.00	.00	NA
29.	4660.	3	1.0	1.0	320.0	4.93	7.79	6.50	SS
30.	4568.	3	1.0	1.0	320.0	4.93	7.90	6.60	SS
33.	4420.	3	1.0	1.0	320.0	4.93	8.07	6.77	SS
36.	4277.	4	1.0	1.0	320.0	4.93	8.24	6.95	SS
38.	4139.	4	1.0	1.0	320.0	4.93	8.41	7.12	SS

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46.	3757.	4	1.0	1.0	320.0	4.93	8.92	7.63	SS
53.	3417.	4	1.0	1.0	320.0	4.93	9.43	8.14	SS
61.	3117.	4	1.0	1.0	320.0	4.93	9.94	8.65	SS
69.	2851.	5	1.0	1.0	10000.0	4.93	10.45	9.16	SS
76.	2615.	5	1.0	1.0	10000.0	4.93	10.96	9.67	SS
84.	2405.	5	1.0	1.0	10000.0	4.93	11.47	10.18	SS
91.	2123.	5	1.0	1.0	10000.0	4.93	12.26	10.97	SS
99.	1924.	5	1.0	1.0	10000.0	4.93	13.06	11.47	SS
107.	1752.	5	1.0	1.0	10000.0	4.93	13.86	11.96	SS
114.	1603.	5	1.0	1.0	10000.0	4.93	14.66	12.45	SS
122.	1473.	5	1.0	1.0	10000.0	4.93	15.45	12.93	SS

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

*** CAVITY CALCULATION - 1 ***			*** CAVITY CALCULATION - 2 ***		
CONC (UG/M**3)	=	3987.	CONC (UG/M**3)	=	5981.
CRIT WS @10M (M/S)	=	1.00	CRIT WS @10M (M/S)	=	1.00
CRIT WS @ HS (M/S)	=	1.00	CRIT WS @ HS (M/S)	=	1.00
DILUTION WS (M/S)	=	1.00	DILUTION WS (M/S)	=	1.00
CAVITY HT (M)	=	11.73	CAVITY HT (M)	=	10.23
CAVITY LENGTH (M)	=	19.85	CAVITY LENGTH (M)	=	10.17
ALONGWIND DIM (M)	=	12.19	ALONGWIND DIM (M)	=	18.29

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)	
IMPLE TERRAIN	4660.	29.	0.	
BUILDING CAVITY-1	3987.	20.	--	(DIST = CAVITY LENGTH)
UILDING CAVITY-2	5981.	10.	--	(DIST = CAVITY LENGTH)

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

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SPECIFICATION 13720 - AIR STRIPPER

SECTION 13720 - AIR STRIPPER

PART 1 -- GENERAL

1.1 The Requirement

A. **General:** The EQUIPMENT SUPPLIER shall furnish two skid-mounted low-profile air strippers suitable for automatic operation, together with all necessary blowers, piping, valves, fittings, controls, gauges, supports, and appurtenances to provide two complete and workable systems as specified herein.

The EQUIPMENT SUPPLIER shall furnish (1) an air stripper without a blower for the Texaco Service Station location ("Location No. 1") that will be connected with an OWNER furnished catalytic oxidizer and other system equipment, and (2) an air stripper with a blower for the Vitelco Property location ("Location No. 2") site that will be connected with other system equipment. The air strippers furnished by EQUIPMENT SUPPLIER will become part of two separate treatment plants. The treatment plants will be assembled within separate shipping containers at the facility of the CONTRACTOR at Campbell, CA and delivered to each location in St. Thomas, U.S. Virgin Islands for installation.

1.2 EQUIPMENT SUPPLIER Submittals

A. **Shop Drawings:** Furnish four copies of shop drawings for the air strippers. One copy shall be returned following review by ENGINEER. At a minimum provide descriptive information and drawings showing the system footprint, layout of the air stripper, water inlet and outlet, blower, baffled trays, and air outlet.

1. Descriptive information and drawings including but not limited to:
   a. Removal efficiencies.
   b. Materials of construction.
   c. System safety shutdowns.
   d. A process and instrumentation diagram.
   e. Operating characteristics of blower.
   f. Utilities needed for operation of the unit.
   g. Footprint and height of the unit.
   h. Locations of piping inlets and outlets.
   i. Delivery conditions and warranties.

2. Electrical and instrumentation information as follows:
   a. Materials list and catalog cuts for instruments and electrical components.
   b. Control panel elementary diagram.
   c. System interconnection diagram showing conduit sizes, wire gage and count.

d. Motor data sheets for air blower to include manufacturer, full load amps, power factor, efficiency, horsepower, voltage, service factor, insulation class, and temperature rating.

e. Interior and exterior control panel layouts showing component locations and nameplate inscriptions.

f. Calculated weights and actual shipping.

3. Seismic Calculations: Seismic calculations for the complete skid-mounted unit shall be verified and stamped by a registered Civil or Structural Engineer, to demonstrate conformance with the seismic requirements of the Uniform Building Code, 1994 edition.

4. Manuals: Furnish three copies each of manufacturer's installation, operation and maintenance manuals, bulletins, lubrication instructions, and spare parts lists.

5. Submittal Dates: Within 1 week of receipt of letter of intent to purchase equipment, provide all of the shop drawings for each unit. Provide manuals at time of shipment of units to Campbell, CA.

B. **Connections:** EQUIPMENT SUPPLIER shall use dimensional drawings to scale clearly communicating the exact location, orientation, elevation, size, and type of all field connections required, including but not limited to the following:

1. Process piping.
2. Anchor bolts.
3. Electrical power.
4. Instrumentation and controls.

Part 2 -- PRODUCTS

2.1 General Information and Performance Requirements

A. Groundwater from extraction wells shall be treated to remove organic compounds. The flow-rate, water temperature, ambient air temperature, and anticipated influent organic compound concentrations for each location are listed below. The air stripper shall remove the organic compounds to levels at or below the listed discharge limits (Federal Maximum Contaminant Limits).

minimum water temperature 65°F

maximum flow-rate:

Location No. 1	55 gallons/minute
Location No. 2	20 gallons/minute

Compound	Location No. 1 Influent Concentrations (µg/L)	Location No. 2 Influent Concentrations (µg/L)	Discharge Limits (µg/L)
Benzene	17,000	30	5
Toluene	15,000	10	1,000
Ethylbenzene	3,000	10	700
Xylene	13,000	10	10,000
Naphthalene	500	10	NA
Methyl tert butyl ether (MTBE)	46,000	500	NA
1,2-Dichloroethane (DCA)	300	10	5
1,2-Dichloroethene (DCE)	500	400	70
Tetrachloroethene (PCE)	50	200	5
Trichloroethene (TCE)	50	40	5
Vinyl Chloride	100	10	2
Methylene Chloride	4,000	10	5
Acetone	1,000	10	NA

2.2 Design and Construction

A. **Corrosion Protection:** Due to proximity of the ocean and the warm and humid climate, **conditions at both locations are extremely favorable for corrosion of exposed parts.** Whenever possible, external parts and controls shall be constructed with corrosion resistant materials. Electrical enclosures shall be constructed of plastic.

B. **Reactors:** The air stripper reactors shall be constructed of a corrosion resistant material. The air strippers shall provide sufficient air to water contact to reduce the levels of organic compounds in water to those listed in Section 2.1.

C. **Blower Systems:** Air flow through the low profile air stripper at Location No. 1 will be induced by a vacuum blower provided with the OWNER furnished catalytic oxidizer. The supplied vacuum blower will create a maximum vacuum of 25 inches of water. Therefore, 25 inches of water shall induce a sufficient air flow through the low profile air stripper to reduce the levels of organic compounds in water at location No. 1 to those listed in Section 2.1.

A blower provided by the EQUIPMENT SUPPLIER shall induce air flow through the low profile air stripper at Location No. 2. The blower system for Location No. 2 shall consist of the following characteristics and components.

1. The blower shall provide sufficient air flow to reduce the levels of organic compounds in water to those listed in Section 2.1.
2. The blower shall operate on three phase 230 volt power.

E. **System Requirements and Appurtenances:** The two air stripping systems shall include the following:

1. Location No. 1

    a. Sump Tank
    b. Stripper Trays
    c. Air pressure Gauge
    d. Mist Eliminator
    e. Piping
    f. Spray Nozzle
    g. Water Level Sight Tube
    h. Gaskets
    i. Latches
    j. Frame
    k. Explosion-Proof Motors
    l. NEMA 3R - Remote Mounted Control Panel
    m. Main Disconnect Switch
    n. Intermittent Operation
    o. Power Loss Indicator
    p. Low Air Pressure Alarm Switch
    q. High Water Level Alarm Switch
    r. Water Pressure Gage
    s. Digital Water Flow Indicator
    t. Air Flow Meter
    u. Temperature Gauge
    v. Line Sampling Ports
    w. Washer Wand

2. Location No. 2

    a. Sump Tank
    b. Stripper Trays
    c. Blower
    d. Air pressure Gauge
    e. Mist Eliminator
    f. Piping
    g. Spray Nozzle
    h. Water Level Sight Tube
    i. Gaskets
    j. Latches
    k. Frame
    l. Discharge Pump
    m. Explosion-Proof Motors
    n. NEMA 3R Control Panel - Remote Mounted
    o. Main Disconnect Switch
    p. Intermittent Operation
    q. Power Loss Indicator
    r. Low Air Pressure Alarm Switch
    s. High Water Level Alarm Switch
    t. Discharge Pump Level Switch
    u. Water Pressure Gauge
    v. Digital Water Flow Indicator
    w. Air Flow Meter
    x. Temperature Gauge

y. Line Sampling Ports
z. Air Blower Silencer
aa. Washer Wand

E. **Safety Shut-Down Controls:** Shutdowns shall include:

1. Low air pressure.
2. High water level.
3. Power loss to unit.

Any safety shutdown shall initiate an alarm and send the signal to the main system control panel.

F. **Normal System Start-up and Shut-down Operations:** Provide adjustable 5-minute time delays on all normal start-up and shut-down operations.

G. **System Testing:**

The EQUIPMENT SUPPLIER shall test the air stripper at their facility to ensure that all equipment functions properly.

H. **Manufacturer's Service Representative:**

1. **Shop Testing:** Once the air strippers are installed in containers and the rest of the treatment plant has been assembled, the complete system will be tested at the shop where the treatment plant has been assembled. At the option of the OWNER, a factory trained service technician shall be supplied for one day to provide assistance for this shop test. The shop test will be conducted in Campbell, California.

2. **Start-Up Assistance:** A factory trained service technician shall be supplied for five days to startup and balance the air stripper system at the site in St. Thomas, U.S. Virgin Islands.

3. **Instruction of OWNER's Personnel:** The EQUIPMENT SUPPLIER shall provide for the services of a factory service representative for one day to instruct the OWNER's personnel in the operation and maintenance of the equipment. This shall be included with the five day startup service above.

I. **Field Procedures:** Instructions for field procedures for erection, adjustments, inspection, and testing shall be provided prior to installation of each piece of equipment.

2.3 Guarantees, Warranties

A. A 2-year warranty shall be provided for the air stripping units and their components. It shall warrant the unit from the first date of operation (1) to be free of any defects in materials and/or workmanship, and (2) to satisfy air stripper performance criteria included in these specifications.

2.4 Manufacturers, or Equal

A. North East Environmental Products, Inc., West Lebanon, New Hampshire, Shallow Tray Model 3641 (Location No. 1) and Shallow Tray Model 1341 (Location No. 2).

PART 3 -- EXECUTION

3.1 Delivery

A. Deliver the skid-mounted air stripper to Campbell, California within 7 weeks of receipt of purchase order of equipment (assume shop drawings will be reviewed by ENGINEER within 5 days).

4

C-4. Performance Monitoring

A regular monitoring program will be implemented to evaluate the performance of the groundwater remediation system. The purpose of the program is to evaluate:

- hydraulic capture,
- potential hydraulic impacts to nearby properties,
- the concentration of chemicals of concern in groundwater over time, and
- the concentration of chemicals of concern in air

The monitoring program will consist of:

- quarterly measurement of groundwater levels in selected wells to evaluate groundwater capture,
- quarterly collection and analysis (by EPA Method 8240) of groundwater samples from selected wells to monitor changes in concentrations of chemicals of concern, and
- monthly collection and analysis (by EPA Method 8240) of influent vapor and treated vapor samples from the catalytic oxidizer to monitor compliance with air permit requirements.
- monthly collection and analysis of treated groundwater samples in accordance with the TPDES application, currently under review.

Proposed monitoring parameters and monitoring frequency for the start-up and shakedown period, i.e. the first six months of system operation, are discussed below. All air samples will be analyzed by EPA Method 8015/8020 (modified) for petroleum hydrocarbons, BTEX, and MTBE and by EPA Method 8010 for chlorinated VOCs. The long term monitoring plan will be developed during the start-up and shakedown period and will be submitted to regulatory agencies following the first six months of operation.

C-4.1 Groundwater Monitoring

The wells to be included in the monitoring program are summarized in Table C-4.1. They include most of the existing wells in the vicinity of the Service Station and Vitelco Sites. Collection of groundwater levels in the selected wells will allow evaluation of regional hydraulic effects. Analysis of groundwater samples from the selected wells will provide ongoing characterization of groundwater upgradient of the Service Station Site, at the Service Station Site, at the Vitelco Site, and downgradient of both sites. In the event that Tutu Envinronmental Investigation Committee ("TEIC") or other parties monitor groundwater wells in the valley, Texaco proposes to utilize data generated from such efforts to supplement or replace elements of the Texaco monitoring program.

C-4.2 Influent and Treated Vapor Monitoring at the Service Station Site

At system start-up, soil vapor at each SVE wellhead, exhaust gas from the groundwater air stripper (discussed in Section B), and the combined catalytic oxidizer influent and effluent vapor streams will be sampled. The soil vapor samples will be collected in "Summa" vacuum canisters or Tedlar bags and analyzed for petroleum hydrocarbons, BTEX, and MTBE by EPA Method 8015/8020 (modified) and for chlorinated VOCs by EPA Method 8010. This initial sampling will determine initial SVE well vapor-phase concentrations and confirm that the catalytic oxidizer meets specified destruction efficiencies.

Following system start-up, monthly sampling at the same locations will be performed with a PID for the first six months of system operation. Data generated during monthly sampling will be used to monitor the effectiveness of the SVE system and catalytic oxidizer.

C-4.3 Air Stripper Air Emissions at the Vitelco Site

Off-gas vapor from the groundwater air stripper will be released directly to the atmosphere as discussed in Section C-3. At system start-up, an air sample will be collected at the exhaust stack and analyzed to determine initial concentrations of chemicals of concern. On a monthly basis, an air sample from the same sample port will be taken and analyzed to monitor air emissions for compliance with the DPNR issued air permit.

TABLE C-4.1

WELLS INCLUDED IN GROUNDWATER SYSTEM
QUARTERLY MONITORING PROGRAM
Texaco Tutu, U.S. Virgin Islands
(EKI 940058.03)

Groundwater Level Measurement	
Shallow Wells	MW-16, MW-17, MW-15, MW-1, MW-2, TT-2, MW-3, MW-4, TT-4, TT-5, TT-1, MW-5, MW-6R, TT-6, MW-7, CHT-4, CHT-1
Deep Wells	MW-1D,*TT-3D, MW-4D, TT-1D, CHT-6D, MW-6D, Tillett, Four Winds III, Four Winds II, Four Winds I
Quarterly Groundwater Sampling	
Up-Gradient Wells	MW-16, MW-15, MW-1, MW-1D
On-Site Wells	TT-2, TT-3D, MW-3, MW-4, MW-4D, TT-5, TT-1, TT-1D
Down-Gradient Wells	MW-5, Tillett, MW-7

* Note: TT-1 and TT-1D may be sacrificed for installation of groundwater extraction wells TEW-1 and TEW-1D given the severly limited access at the Texaco Service Station Site.

5

C-5. System Operation

C-5.1 Expected Operations Schedule

The groundwater extraction system, together with the SVE system at the Service Station Site, will operate on a 24-hour basis. The groundwater extraction system at the Vitelco Site will also operate on a 24-hour basis. Based on experience with similar types of remediation systems, system up-time at both locations is expected to be in the range of 90%-95%, or from 328 to 347 days per year. It is expected that operational difficulties will most likely be experienced at the beginning of system operation. As the system is adjusted, increased up-time is anticipated.

C-5.2 Instrumentation and Control

The groundwater extraction system, together with the SVE system, will be automatically controlled. The Vitelco Site system will also be automatically controlled. Each location will be controlled separately. Each system is designed with shutdowns and interlocks to prevent the operation of the groundwater pumps if the air stripper is not operating within specified parameters or if the groundwater pumps are not operating properly. Similarly there are internal controls on the catalytic oxidizer at the Texaco site to shut down if it is not operating within specified parameters. In the case of a system shutdown at either location, an auto-dialer will signal the shutdown to O&M personnel. It is anticipated that the O&M personnel will respond to the signal within a few hours. Control descriptions and equipment lists for the Texaco Site and the Vitelco Sites are given on Table C-5.1.

During the final design a complete Process and Instrumentation Diagram (P&ID) will be prepared that will show the complete instrumentation of the groundwater extraction system.

TABLE C-5.1

TEXACO TUTU SERVICE STATION CONTROL DESCRIPTION & EQUIPMENT LIST

Texaco Tutu, U.S. Virgin Islands

(EKI 940058.05)

EQUIPMENT	POWER REQMTS	OPTIONS BY MFR (1)	INTERLOCKS (2)	OPTIONS BY CONTR (3)	FIRST OUT PANEL (4)	AUTODIALER AUTODIALER (5)
ELECTRICAL GROUNDWATER PUMPS (To be supplied by Contractor)	230V 1 Phase 60 Hz		Shutdown	Current sensor type <= protection device	YES	YES
CHEMICAL FEED SYSTEM (To be supplied by Contractor)	230V 1 Phase 60 Hz		Shutdown	Power loss at <= chemical feed pump	YES	YES
AIR STRIPPER (Owner furnished)	230V 3 Phase 60 Hz	Remote panel				
		Power loss at panel =>	Shutdown		YES	YES
		Air Flow Meter				
		Temperature gauges				
		Air Blower Silencer				
		Line Sample Ports				
		Low Air Pressure Alarm => (w/adjustable time delay)	Shutdown		YES	YES
		High Water level Alarm =>	Shutdown		YES	YES

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TABLE C-5.1

TEXACO TUTU SERVICE STATION CONTROL DESCRIPTION & EQUIPMENT LIST

Texaco Tutu, U.S. Virgin Islands

(EKI 940058.05)

EQUIPMENT	POWER REQMTS	OPTIONS BY MFR (1)		INTERLOCKS (2)	OPTIONS BY CONTR (3)	FIRST OUT PANEL (4)	AUTODIALER AUTODIALER (5)
CATALYTIC OXIDIZER (Owner furnished)	230V 3 Phase 60 Hz						
		Low air flow	=>	Shutdown		YES	YES
		High catalyst exit temperature	=>	Shutdown		YES	YES
		Liquid Level Switch if high liquid in V/L separator	=>	Shutdown		YES	YES
		High temperature in sound enclosure	=>	Shutdown		YES	YES
		Power loss at panel	=>	Shutdown		YES	YES
		High or low gas pressure	=>	Shutdown		YES	YES
		Flame failure	=>	Shutdown		YES	YES
		Spark arrestor	=>	Shutdown		YES	YES

NOTES:

1. These are the control options that are included by the manufacturer with the equipment. If any one of these alarm conditions occurs, a signal will be sent from that piece of equipment that an alarm condition has been detected.
2. This indicates what should occur if the indicated alarm condition is detected.
3. These are the control options that shall be designed and installed by the CONTRACTOR.
4. A Yes indicates that if the indicated alarm condition is detected, it should be indicated on a First Out Panel.
5. A Yes indicates that if the alarm condition is detected, it should activate the autodialer.

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TABLE C-5.1

VITELCO PROPERTY CONTROL DESCRIPTION & EQUIPMENT LIST

Texaco Tutu, U.S. Virgin Islands

(EKI 940058.05)

EQUIPMENT	POWER REQMTS	OPTIONS BY MFR (1)	INTERLOCKS (2)	OPTIONS BY CONTR (3)	FIRST OUT PANEL (4)	AUTODIALER AUTODIALER (5)
ELECTRICAL GROUNDWATER PUMPS (To be supplied by Contractor)	230V 1 Phase 60 Hz		Shutdown	<= Current sensor type protection device	YES	YES
CHEMICAL FEED SYSTEM (To be supplied by Contractor)	230V 1 Phase 60 Hz		Shutdown	<= Power loss at chemical feed pump	YES	YES
AIR STRIPPER (Owner furnished)	230V 3 Phase 60 Hz	Remote panel				
		Power loss at panel =>	Shutdown		YES	YES
		Air Flow Meter Temperature gauges Air Blower Silencer Line Sample Ports				
		Low Air Pressure Alarm => (w/adjustable time delay)	Shutdown		YES	YES
		High Water level Alarm =>	Shutdown		YES	YES

NOTES:

1. These are the control options that are included by the manufacturer with the equipment. If any one of these alarm conditions occurs, a signal will be sent from that piece of equipment that an alarm condition has been detected.
2. This indicates what should occur if the indicated alarm condition is detected.
3. These are the control options that shall be designed and installed by the CONTRACTOR.
4. A Yes indicates that if the indicated alarm condition is detected, it should be indicated on a First Out Panel.
5. A Yes indicates that if the alarm condition is detected, it should activate the autodialer.

6

C-6. Contingencies

Assumptions used in the design of the groundwater system may be revised based on observed field conditions. Possible contingency plans are summarized below.

C-6.1 Achievement of Hydraulic Capture

Extraction rates will be adjusted within the design range of the treatment system (20 to 50 gpm) to achieve groundwater capture. If groundwater capture is not achievable within this range, modifications to the groundwater remediation system will be evaluated. These modifications could include the construction of additional extraction wells as well as additional treatment capacity (e.g., an additional air stripper and catalytic oxidizer).

C-6.2 Achievement of Remedial Goals

Federal MCLs have been established as the remedial goal for operation of the groundwater system. If upgradient groundwater quality makes these goals unachievable, however, modified goals may be established. Modified remedial goals would be based on reducing concentrations of chemicals of concern in onsite and downgradient monitoring wells to levels found in upgradient monitoring wells.

C-6.3 Limiting Perturbation of Suspected DNAPL Near the Curriculum Center

Preliminary groundwater modeling indicates that groundwater pumping at the Texaco property may result in a drawdown of approximately 3 to 5 feet near the Curriculum Center where DNAPL may be present. It is possible that excessive drawdown near the Curriculum Center could mobilize DNAPL if present. If excessive drawdown is detected during performance monitoring, extraction rates from the existing wells will be decreased. Installation of additional extraction wells needed to maintain hydraulic capture will be evaluated. Should LNAPL need to be recovered, a selective oil skimmer will be installed in the well. A selective oil skimmer is designed to skim LNAPL from the surface of the groundwater. An air operated bladder pump, located at the surface, lifts the LNAPL from the skimmer and discharges the LNAPL into a storage tank.

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D

SECTION D - ADDITIONAL INVESTIGATIONS

D-1. Chemical Data for Soil on the Service Station Site

As discussed in EKI (1995), there are limited chemical data for soil at the Service Station Site. To augment these data and to assure that the SVE system is remediating the soil impacted by the petroleum hydrocarbons, additional soil samples will be collected and analyzed during installation of the system. Soil samples will be collected at the capillary fringe from the borings for the 2 new SVE wells and both shallow groundwater wells. Any soil samples obtained will be analyzed using EPA Method 8240 for volatile organic compounds and 8015 for petroleum hydrocarbon compounds.

D-2. LNAPL Evaluation

As described in EKI (1995), provision for LNAPL recovery is part of the design for the groundwater extraction system at the Service Station Site. At the time the remediation system is installed, existing wells TT - 1 and TT - 2 will be surveyed to determine if free product is present in either or both wells. In addition, during the installation of the two new SVE wells and the new shallow groundwater extraction well, observations will be made to determine if LNAPL is present. The results of the LNAPL survey will be used as the basis for system modifications, if needed.

E

1

SECTION E - IMPLEMENTATION AND SCHEDULE

E-1 Conceptual Design

EKI, on behalf of TCI, has prepared a conceptual design for the remediation systems at the Service Station Site and at the Vitelco Site. This design was described in the April Report. In addition, this conceptual design was also included in the request for proposal documents prepared by EKI that were sent to prospective contractors for contract bidding. The technical portions of the request for proposal are included in this section and are listed below.

- Technical Specifications:

  Section 01010: Summary of Work

  Section 01901: Phase I - Design

  Section 01902: Phase 2 - Assembly of Treatment Plants

  Section 01903: Phase 3 - On Site Construction and Start-Up

- Alarms & Interlocks (Attachment A of Technical Specifications)
- Assumed Water Quality (Attachment A of Technical Specifications)
- Existing Monitoring Well Construction Logs - TT-4 and TT-1 (Attachment A of Technical Specifications)
- Owner Furnished Equipment, Catalytic Oxidizer and Air Strippers (Attachment B of Technical Specifications)

SECTION 01010
SUMMARY OF WORK

PART I -- GENERAL

1.01 General

The WORK to be performed shall consist of the design, construction, and start-up of a groundwater extraction and treatment system and a soil vapor extraction and treatment system at the Texaco Service Station in the Tutu Area of St. Thomas ("Location 1") and the design, construction, and start-up of a groundwater extraction and treatment system at the Vitelco Property ("Location 2"). Location 1 and Location 2 are collectively called the "Site". Both systems shall use certain OWNER furnished major equipment. It is the intent of the Contract Documents that the CONTRACTOR provide complete and fully functional systems conforming to all applicable Laws and Regulations, including all codes and local requirements.

The OWNER furnished major equipment will consist of 1) air strippers for Locations 1 and 2 and 2) A catalytic oxidizer for Location 1. All other materials, appurtenances, and equipment shall be supplied by CONTRACTOR so as to provide complete and functional systems. Since the Site is in the U.S. Virgin Islands and therefore remote, it is intended that the treatment plants each be assembled in a container at CONTRACTOR's shop, tested in the shop, and shipped to the Site. It is also intended that the containers become the permanent housing for the treatment plants at the Site.

CONTRACTOR shall perform the WORK in three phases generally described as: 1) design, 2) assembly and testing of treatment plants in containers at CONTRACTOR's shop, 3) construction of the well heads, groundwater extraction and vapor extraction conveyance piping, conduits, installation of pumps, and connection of the treatment plants at both locations on the Site, and startup and testing of both the systems. Each of the three phases is described in more detail in the following Sections 01901, 01902, 01903 and the remainder of the Contract Documents.

1.02 General System Description

A plan view showing the two locations on the Site is included in the Drawings. Plan views and schematics of the systems are also shown on the Drawings. Included in Attachment A is a table in which is summarized the alarms and interlocks for each system, the assumed water quality and flowrates, and existing monitoring well construction logs. Included in Attachment B are catalog cuts of the air strippers and the catalytic oxidizer or similar units that are being furnished by the OWNER. Presented below is a general description of each of the systems:

Location 1. At Location 1 there are planned to be four groundwater extraction wells and three soil vapor extraction wells. Pumps furnished by the CONTRACTOR shall be installed in each of the groundwater extraction wells. The anticipated groundwater extraction rate is 8 to 15 gallons per minute ("gpm") per well. The anticipated influent concentration of the chemicals of concern and inorganic water quality parameters are included in Attachment A.

The extracted groundwater will be treated by an air stripper furnished by the OWNER and installed by CONTRACTOR. The treated groundwater will be discharged into an existing storm drain catch basin at the location shown on the Drawings via a pipeline constructed by CONTRACTOR.

The air stripper will have a hydraulic capacity of 50 gpm and an air flow rate of 900 standard cubic feet per minute ("scfm"). The air flow from the discharge of the air stripper will be treated by a catalytic oxidizer furnished by the OWNER and installed by CONTRACTOR. The catalytic oxidizer will have an air flow capacity of 1,000 scfm. The air flow through the air stripper will be created by one of two blowers that will be furnished by the OWNER with the catalytic oxidizer. The blower will create a vacuum of approximately 18 inches of water at the air stripper.

The soil vapor extraction ("SVE") system will consist of three extraction wells. The vacuum at each of the SVE wells will be induced by the second blower furnished with the catalytic oxidizer. The second blower will be capable of creating a vacuum of six inches of mercury at an air flow rate of 100 scfm. The discharge from this blower will be combined with the air flow from the air stripper and also treated by the catalytic oxidizer before it is discharged to the atmosphere.

Location 2. At Location 2 there are planned to be two groundwater extraction wells. Pumps furnished by the CONTRACTOR shall be installed in each well. It is anticipated that the groundwater extraction rate from each well will be between 5 and 10 gpm. The anticipated influent concentration of the chemicals of concern and inorganic water quality parameters are included in Attachment A.

The extracted groundwater will be treated by an air stripper furnished by the OWNER and installed by CONTRACTOR. The treated extracted groundwater will be discharged into an existing storm drain catch basin at the location shown on the Drawings via a pipeline constructed by the CONTRACTOR.

The air stripper will have a hydraulic capacity of 20 gpm and an air flow rate of approximately 150 scfm. The air from the air stripper will be discharged directly to the atmosphere without further treatment via a stack provided by CONTRACTOR.

1.03 General Design Criteria

The groundwater extraction and treatment systems and SVE system at both locations shall conform to the following criteria:

1) The treatment plant containers shall be lighted to permit maintenance and easy monitoring of gauges, equipment, and other instruments during night time hours.

2) The treatment plant containers shall be ventilated such that the temperature inside is compatible with the equipment and controls housed in the container, and such that it is reasonably comfortable for a person to work inside of the container. The containers shall be ventilated such that the portion of the container or containers that house equipment and or piping containing untreated water or air will be classified as a Class I Division 2 space and the portion that will house the electrical enclosures will be unclassified

3) The materials of construction of CONTRACTOR furnished equipment, piping, wire, and conduit shall be appropriate for the hot, humid, salt air environment at the Site.

4) The treatment plants shall be suitably designed to withstand code-specified wind and seismic events.

5) The treatment plants and other appurtenances shall be secure, but easily accessible, especially critical components of the treatment plants, for operation and maintenance activities.

6) Spare parts for CONTRACTOR furnished equipment and materials shall be readily available.

END OF SECTION

TUT 008 0473

SECTION 01901
PHASE 1 - DESIGN

PART I -- GENERAL

1.01 General

CONTRACTOR shall develop the Assembly Drawings. The Assembly Drawings shall be based on the information contained herein and as necessary for complete and functional systems.

1.02 Schedule

CONTRACTOR shall prepare and submit to ENGINEER a preliminary schedule for the performance of the WORK within 14 days from the Notice to Proceed. This schedule shall be based on the schedule included in Attachment C ("Schedule"). CONTRACTOR's schedule shall show the completion date to be on or before the completion date shown on the Schedule. CONTRACTOR shall make every effort to comply with the schedule.

If the ENGINEER or OWNER is unable to substantially complete a task assigned to either of them in the time allocated on the Schedule, it will be considered a changed condition and the CONTRACTOR's time to perform the WORK will be extended in accordance with the General Conditions and Supplementary General Conditions. No additional compensation to CONTRACTOR will be made for such changed condition beyond such time extension.

1.03 Design Meeting

CONTRACTOR shall schedule qualified employees to attend a three day Design Meeting at the Site with the OWNER and ENGINEER. The primary goal of the meeting will be to review and confirm field details of: 1) the Process and Instrumentation Diagrams ("P&ID"), 2) the electrical single line and schematic diagrams, 3) the Materials List (list of materials, other than OWNER Supplied Equipment, to be used by CONTRACTOR in the construction of the WORK, 4) the piping layout and conduit runs, 5) miscellaneous electrical, control system, alarm, structural, and mechanical details, 6) permit and property access status, and 7) shop and startup testing and monitoring requirements.

In preparation for the Design Meeting, CONTRACTOR shall prepare a preliminary draft of the P&ID, preliminary electrical single line and schematic diagrams, preliminary plan layout drawings for the treatment plant for both Location 1 and Location 2 including preliminary piping layout and conduit run locations, and any details that the CONTRACTOR determines are important to the construction of the WORK. These submittals shall be based on the information included in the Contract Documents and as necessary for a complete and satisfactory installation.

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Drafts of the above documents shall be submitted to the ENGINEER three working days prior to the Design Meeting.

At the Design Meeting, ENGINEER will furnish to the CONTRACTOR the draft shop drawings for the owner furnished equipment and shop testing and start-up testing and monitoring requirements to enable the CONTRACTOR to prepare its bid price for Phase 2 and 3 of the WORK.

1.04 Assembly Drawings

On the basis of the information contained in the Contract Documents and developed at the Design Meeting, CONTRACTOR shall prepare the Assembly Drawings. The Assembly Drawings shall include P&ID, electrical single line diagram, electrical schematic diagrams, plan layout drawings for each treatment plant, and a comprehensive Materials List for both Locations 1 and 2. The plan layout drawings shall be prepared in enough detail to clearly show how the equipment will be installed in the containers.

The ENGINEER'S review of the Assembly Drawings does not relieve the CONTRACTOR of its responsibility to perform in accordance with the Contract Documents. The Assembly Drawings shall be subject to the provisions of Article 9, Paragraph 9.7, Contractor Submittals, Change Orders, and Payments, and Paragraph 9.9, Limitations on ENGINEER's Responsibilities. The adequacy of the Assembly Drawings is solely the responsibility of the CONTRACTOR. Errors or omissions in the Assembly Drawings shall be subject to, without limitation, the provisions of Article 13 of the General Conditions, WARRANTY AND GUARANTEE; TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK.

CONTRACTOR shall submit the draft Assembly Drawings to the ENGINEER for review. ENGINEER will furnish comments to CONTRACTOR within five (5) working days of receipt of a clear and complete set of draft Assembly Drawings. CONTRACTOR shall incorporate ENGINEER's comments on the draft Assembly Drawings in the final Assembly Drawings and submit final Assembly Drawings to ENGINEER within five (5) working days of receipt of ENGINEER's comments on draft Assembly Drawings. Upon favorable review by the ENGINEER, the final Assembly Drawings shall become the basis for the construction of the treatment plants.

The final Assembly Drawings shall become the property of the OWNER. CONTRACTOR may retain copies for its records of the final Assembly Drawings. OWNER, at its option, may use these documents for construction of the WORK by others.

1.05 Site Civil Drawings

ENGINEER will prepare schematic and plan view drawings for the construction of the piping and conduit from the wells to the treatment plants and the site grading at both Location 1 and Location 2. These drawings will be prepared based on information developed during the Design Meeting. These drawings will include plans and details. OWNER will construct wells without pumps or surface improvements.

ENGINEER will submit a draft of Site Civil Drawings to CONTRACTOR for review. CONTRACTOR shall submit its comments on draft Site Civil Drawings to ENGINEER within three (3) working days of receipt of draft Site Civil Drawings. ENGINEER will consider CONTRACTOR's comments on draft Site Civil Drawings in the preparation of final Site Civil Drawings. ENGINEER will furnish to CONTRACTOR three sets of the final Site Civil Drawings to CONTRACTOR within five (5) working days of receipt of CONTRACTOR's comments on draft Site Civil drawings. The final Site Civil Drawings shall be the basis for the construction of the extraction and treatment systems at both locations on the Site.

1.06 Phase 2 and Phase 3 Cost Proposal

CONTRACTOR shall submit a lump sum cost proposal for the performance of Phase 2 and Phase 3 of the WORK at the time CONTRACTOR submits the draft Assembly Drawings. The cost proposals shall be based on the draft Assembly Drawings. CONTRACTOR shall provide backup spread sheets demonstrating how the lump sum was developed using the unit costs in CONTRACTOR's Bid.

OWNER and CONTRACTOR will attempt, diligently and in good faith, to reach agreement concerning appropriate compensation. If a satisfactory lump sum cannot be agreed to, OWNER may elect to terminate the Contract in accordance with General Conditions and Supplementary General Conditions Article 14.

The lump sum cost proposal shall be itemized to facilitate the determination of monthly progress payments. The itemization shall be grouped by location, treatment plant, and elements of work that are readily measurable. Mobilization costs, insurance costs, and overhead costs shall not be considered an item of cost but shall be prorated over items of work. In the event the cost itemization is not favorably reviewed by ENGINEER, another itemization shall be submitted until the cost itemization is acceptable to CONTRACTOR and ENGINEER.

1.07 Payment

Payment for work performed in this section shall be at the unit rates indicated in Bid Items 1a and 1b. Total payment shall not exceed the budget in CONTRACTOR's Bid.

END OF SECTION

SECTION 01902
PHASE 2 - ASSEMBLY OF TREATMENT PLANTS

PART I -- GENERAL

1.01 General

CONTRACTOR shall assemble a groundwater and soil vapor treatment plant for Location 1 and a groundwater treatment plant for Location 2 on the Site. The treatment plants shall be assembled in a container suitable for both shipping to St. Thomas, U.S. Virgin Islands and as permanent enclosures for the treatment plants once they are installed on the Site. The treatment plants shall be assembled using a combination of OWNER furnished equipment and CONTRACTOR supplied equipment, materials, and labor. The treatment plants shall be assembled as detailed in the favorably reviewed Assembly Drawings. CONTRACTOR shall be responsible for providing complete and satisfactorily functioning systems meeting all applicable Laws and Regulations, including local codes and requirements.

1.02 OWNER Furnished Equipment

CONTRACTOR shall provide all equipment and manpower necessary to receive OWNER supplied equipment from the manufacturer. The equipment shall be stored according to manufacturer's instructions. Once the OWNER furnished equipment arrives at the CONTRACTOR's shop, CONTRACTOR shall be responsible for the equipment. For purposes of this project, the equipment shall be considered as having arrived at CONTRACTOR's shop once the CONTRACTOR has begun unloading equipment from the transportation vehicle. CONTRACTOR shall inform ENGINEER immediately if equipment is not received in satisfactory condition.

The equipment to be furnished by the OWNER to the CONTRACTOR for each location is listed below:

Texaco Service Station (Location 1)	**Vitelco Site (Location 2)**
1 - Air Stripper	1 - Air Stripper
1 - Catalytic Oxidizer	

Included in Attachment B is manufacturer's information for the OWNER furnished equipment. The manufacturer's information furnished is for a typical air stripper and catalytic oxidizer.

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The actual equipment furnished may be different than that included in Attachment B.

If OWNER furnished equipment requires modification after delivery to the CONTRACTOR's shop and the equipment supplier is unable to modify the equipment or it causes a schedule delay beyond CONTRACTOR's reasonable control, it shall be considered a changed condition and CONTRACTOR shall be reimbursed according to Article 11 and the schedule shall be modified according to Article 12 of the General Conditions and Supplementary General Conditions.

ENGINEER will arrange with the suppliers of the OWNER furnished equipment to submit to CONTRACTOR shop drawings showing the details of the OWNER furnished equipment.

1.03 Materials and Containers

CONTRACTOR shall furnish all the containers within which the treatment plants are installed and shipped. The containers shall be modified to be ventilated such that the portion of the container or containers that house equipment and/or piping containing untreated water or air will be classified as a Class I Division 2 space and the portion that will house the electrical enclosures will be unclassified. CONTRACTOR shall also furnish all materials on the favorably reviewed Materials List and all other materials, labor, and appurtenances necessary for the complete assembly of the treatment plants in the containers.

1.04 Treatment Plant Assembly

CONTRACTOR shall furnish and install all equipment, materials, and manpower necessary to assemble the treatment plants in containers as shown on the Assembly Drawings favorably reviewed by ENGINEER. CONTRACTOR shall use OWNER furnished equipment and materials from the favorably reviewed Materials List for the assembly of the treatment plants. No materials other than those on the Materials List shall be used in the assembly of treatment plant unless favorably reviewed by ENGINEER.

1.05 Coordination with ENGINEER

CONTRACTOR shall notify ENGINEER, three working days in advance, of when CONTRACTOR will reach a milestone in the assembly of the treatment plant. Treatment plant assembly milestones will be established by ENGINEER with the CONTRACTOR at the Design Meeting.

1.06 Shop Test

Prior to shipping the treatment plants to the Site, CONTRACTOR shall demonstrate that the treatment plants perform in accordance with the Contract Documents. The ENGINEER, at its option, may witness this testing. In general, CONTRACTOR shall:

1) Pressure test all the water piping by applying a pressure, using water, equal to one and one half times the working pressure for a period of four hours without leakage. Air piping under vacuum shall be tested both at 10 psi and at a vacuum equal to one and one half times the maximum applied vacuum for a period of four hours without leakage.

2) Demonstrate that each of the interlocks, alarm and shut down conditions performs as specified in the Contract Documents.

3) Simulate the actual operation of the treatment plants using potable water.

More detailed shop testing procedures will be developed by ENGINEER and given to CONTRACTOR at the Design Meeting.

1.07 Treatment Unit Shipping

After favorable review of the shop test results by ENGINEER, CONTRACTOR shall securely ship treatment plants to Site in accordance with the project schedule.

1.08 Payment

Payment for the work performed in this section shall be at the lump sum submitted during Phase 1, which lump sum was based on the favorably reviewed unit costs of Bid Items 2a and 2b as shown in CONTRACTOR's Proposal.

END OF SECTION

SECTION 01903
PHASE 3 -
ON-SITE CONSTRUCTION AND START-UP

PART I -- GENERAL

1.01 General

CONTRACTOR shall construct a groundwater extraction system and a soil vapor extraction system and a treatment plant at Location 1 and a groundwater extraction system and treatment plant at the Location 2 on the Site. The construction shall include the installation of pumps in the groundwater wells, construction of well heads, piping, conduit, and treatment plants in accordance with the Contract Documents. Construction shall be in accordance with the Department of Public Works ("DPW") Earth Change permit. Also included is the start-up of the system in accordance with the requirements of the Territorial Pollutant Discharge Elimination System ("TPDES") permit and the Department of Planning and Natural Resources ("DPNR") Air Quality permit. OWNER will obtain the Earth Change permit, the TPDES, and the DPNR Air Quality permits and furnish copies to the CONTRACTOR at Design Meeting. CONTRACTOR shall obtain all other permits, including building permits.

1.02 Health and Safety Plan

Twenty one days prior to mobilization at the Site, CONTRACTOR shall prepare and submit to ENGINEER a health and safety plan in accordance with applicable occupational health and safety standards and other applicable laws. The plan shall include, at a minimum, the following items: level of personal protection that shall be used; definition of exclusion, contamination reduction, and clean zones; and any required personnel air monitoring. The CONTRACTOR's health and safety plan shall be prepared and signed by a certified industrial hygienist and shall at a minimum conform to 29 CFR 1910.120.

1.03 Access

OWNER will make arrangements for CONTRACTOR's access to Location 1, Location 2, and the storm drain catch basins. OWNER will provide copies of the access agreements to CONTRACTOR at the Design Meeting.

1.04 Well Pumps

CONTRACTOR shall provide the pumps and all materials, equipment, appurtenances, and manpower for the construction of pumps and valves, meters, and boxes at each groundwater well and valves, meters, and boxes at each soil vapor extraction well, at both Locations on the Site. Provide the pumps, valves, meters, and boxes as shown on the Site Civil Drawings prepared by ENGINEER and reviewed by CONTRACTOR.

1.05 Piping, Conduit, and Wire

Provide piping, conduit, and wire as shown on the Assembly Drawings and the Site Civil Drawings.

1.06 Treatment Plants

Provide all materials, equipment, and manpower necessary to install the treatment plants at the locations shown on the Site Civil Drawings. CONTRACTOR shall connect treatment plants to the wells, the power supplies, and discharge points at both locations on the Site as shown on the Assembly Drawings and the Site Civil Drawings, and provide testing and start up services in accordance with the Contract Documents and applicable Laws and regulations, including local codes.

1.07 As-Built Drawings

CONTRACTOR shall maintain As-Built drawings during the performance of the WORK. CONTRACTOR shall prepare and submit complete As-Built Drawings (D Size) for each location on the Site. The As-Built Drawings shall include, at a minimum, P&ID, electrical single line, electrical schematic, plan layout, Site Civil Drawings (ENGINEER will furnish CONTRACTOR one original copy of Site Civil Drawings prepared by ENGINEER). Complete Record Drawings shall be furnished to ENGINEER within 30 days after the completion of the startup of the treatment systems at both locations on the Site.

1.08 Start-up

CONTRACTOR shall perform the following start-up procedures:

1) Pressure test all the groundwater piping by applying a pressure using water equal to one and one half times the working pressure for a period of four hours without leakage. Air piping under vacuum shall be tested both at 10 psi and at one and one half the maximum design vacuum for a period of four hours without leakage,

2) Demonstrate that each of the alarm and shut down conditions perform as defined in the Final Design of the WORK,

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3) Operate both systems for 24 hours per day for a continuous two week period in accordance with the requirements of the Territorial Pollutant Discharge Elimination System ("TPDES") permit and the Department of Planning and Natural Resources ("DPNR") Air permit. This snall include all sampling and analysis of treated groundwater required by the TPDES permits. Air sampling and analysis will be performed by the equipment supplier.

More specific start-up procedures will be developed at the Design Meeting.

1.09 Payment

Payment for the work performed in this section shall be at the lump sum submitted during Phase 1, which lump sum was based on the favorably reviewed unit costs of Bid Items 3a, 3b, and 3c as shown in CONTRACTOR's Proposal.

END OF SECTION

TUT 008 0482

Attachment A

Alarms & Interlocks
Assumed Water Quality
Existing Monitoring Well Construction Logs

ATTACHMENT A
TEXACO TUTU SERVICE STATION CONTROL DESCRIPTION & EQUIPMENT LIST

EQUIPMENT	POWER REQMTS	OPTIONS BY MFR (1)	INTERLOCKS (2)	OPTIONS BY CONTR (3)	FIRST OUT PANEL (4)	AUTODIALER AUTODIALER (5)
ELECTRICAL GROUNDWATER PUMPS (To be supplied by Contractor)	230V 1 Phase 60 Hz		Shutdown	Current sensor type <= protection device	YES	YES
CHEMICAL FEED SYSTEM (To be supplied by Contractor)	230V 1 Phase 60 Hz		Shutdown	Power loss at <= chemical feed pump	YES	YES
AIR STRIPPER (Owner furnished)	230V 3 Phase 60 Hz	Remote panel				
		Power loss at panel =>	Shutdown		YES	YES
		Air Flow Meter				
		Temperature gauges				
		Air Blower Silencer				
		Line Sample Ports				
		Low Air Pressure Alarm => (w/adjustable time delay)	Shutdown		YES	YES
		High Water level Alarm =>	Shutdown		YES	YES
CATALYTIC OXIDIZER (Owner furnished)	230V 3 Phase 60 Hz	Low air flow =>	Shutdown		YES	YES
		High catalyst exit temperature =>	Shutdown		YES	YES
		Liquid Level Switch if high liquid in V/L separator =>	Shutdown		YES	YES
		High temperature in sound enclosure =>	Shutdown		YES	YES
		Power loss at panel =>	Shutdown		YES	YES
		High or low gas pressure =>	Shutdown			YES
					YES	
		Flame failure =>	Shutdown		YES	YES
		Spark arrestor =>	Shutdown		YES	YES

NOTES:
1. These are the control options that are included by the manufacturer with the equipment. If any one of these alarm conditions occurs, . a signal will be sent from that piece of equipment that an alarm condition has been detected.
2. This indicates what should occur if the indicated alarm condition is detected.
3. These are the control options that shall be designed and installed by the CONTRACTOR.
4. A Yes indicates that, if the indicated alarm condition is detected, it should be indicated on a First Out Panel.
5. A Yes indicates that, if the alarm condition is detected, it should activate the autodialer.

ATTACHMENT A

VITELCO PROPERTY CONTROL DESCRIPTION & EQUIPMENT LIST

EQUIPMENT	POWER REQMTS	OPTIONS BY MFR (1)	INTERLOCKS (2)	OPTIONS BY CONTR (3)	FIRST OUT PANEL (4)	AUTODIALER AUTODIALER (5)
ELECTRICAL GROUNDWATER PUMPS (To be supplied by Contractor)	230V 1 Phase 60 Hz		Shutdown	Current sensor type <= protection device	YES	YES
CHEMICAL FEED SYSTEM (To be supplied by Contractor)	230V 1 Phase 60 Hz		Shutdown	Power loss at <= chemical feed pump	YES	YES
AIR STRIPPER (Owner furnished)	230V 3 Phase 60 Hz	Remote panel				
		Power loss at panel =>	Shutdown		YES	YES
		Air Flow Meter Temperature gauges Air Blower Silencer Line Sample Ports				
		Low Air Pressure Alarm => (w/adjustable time delay)	Shutdown		YES	YES
		High Water level Alarm =>	Shutdown		YES	YES

NOTES:

1. These are the control options that are included by the manufacturer with the equipment. If any one of these alarm conditions occurs, . a signal will be sent from that piece of equipment that an alarm condition has been detected.
2. This indicates what should occur if the indicated alarm condition is detected.
3. These are the control options that shall be designed and installed by the CONTRACTOR.
4. A Yes indicates that, if the indicated alarm condition is detected, it should be indicated on a First Out Panel.
5. A Yes indicates that, if the alarm condition is detected, it should activate the autodialer.

TUT 008 0485

TABLE 1

ASSUMED INFLUENT ORGANIC WATER QUALITY AND FLOWRATE

Texaco Tutu, U.S. Virgin Islands

(EKI 940058.00)

Parameter	Texaco Tutu Service Station					Vitelco Property	
	Shallow Max (1)	Deep Max (1)	Shallow Max (2)	Deep Max (2)	Design (3)	MW-7 (2)	Design
Design Flowrate	-	-	-	-	50	-	20
Benzene	23	1.6	21	1.7	17	0.021	0.03
Toluene	25	0.26	17	0.048	15	<0.01	0.01
Ethylbenzene	3	0.065	3.7	0.063	3	<0.01	0.01
Xylenes (Total)	17	0.62	18	0.062	13	<0.01	0.01
Naphthalene	-	-	0.76	0.016	0.5	0.01	0.01
Methyl tert butyl ether (MTBE)	52	1.5	56	1.9	46	0.42	0.5
1,2-Dichloroethane (DCA)	NR	0.033	0.29	<0.02	0.3	<0.01	0.01
1,2-Dichloroethene (DCE)	0.28	0.52	0.44	0.28	0.5	0.18	0.4
Tetrachloroethene (PCE)	0.031	0.058	0.056	0.023	0.05	0.13	0.2
Trichloroethene (TCE)	0.047	0.033	0.02	0.017	0.05	0.027	0.04
Vinyl chloride	0.056	0.15	<5	0.009	0.1	<0.01	0.01
Acetone	1.7	0.2	<5	<0.02	1	<0.01	0.01
Methylene Chloride	7	0.16	<5	<0.02	4	<0.01	0.01

NOTES:

1. Maximum concentrations shown are from the GCL Phase I RI dated 10 June 1994 for monitoring wells between MW-3 and TT-1.
2. Maximum concentrations shown are from the Geraghty & Miller Phase II report dated January 1995 for monitoring wells between MW-3 and TT-1.
3. Design concentrations for the Texaco Tutu Service Station are based on a weighted average of the deep and shallow wells. at a combined flowrate of 50 gpm plus a safety factor. In addition, chlorinated VOC concentrations have been increased to allow for possible concentration increase over time.
4. All concentrations are in parts per million.
5. < Indicates reported laboratory analytical result is below detection limit.

TUT 008 0486

TABLE 2

ASSUMED INFLUENT INORGANIC WATER QUALITY AND FLOWRATE

Texaco Tutu, U.S. Virgin Islands
(EKI 940058.00)

Parameter	TEXACO TUTU SERVICE STATION								
	TT1				TT1-D				Design (3)
	Shallow (1) Indicator Parameter	Unfiltered Metals	Filtered Metals	Estimated Concentration	Deep (1) Indicator Parameter	Unfiltered Metals	Filtered Metals	Estimated Concentration	
Assumed Flowrate (gallons per minute)	-	-	-	30	-	-	-	20	50
Arsenic		2.9	4.6	4		2	2	2	3
Cadmium		3	3	3		3	3	3	3
Chromium		4.8	3	3		3	3	3	3
Copper		30.2	3	5		3	3	3	4
Cyanide	<10			10	<10			10	0.01
Lead		9.5	2	3		2.2	2	2	3
Mercury		0.1	0.1	0.10		0.1	0.1	0.10	0.10
Nickel		16.5	10	12		10	10	10	11
Nitrate (as N)	0.05 ppm			0.00005	2.1 ppm			0.002	0.0008
Nitrite (as N)	0.05 ppm			0.00005	0.1 ppm			0.0001	0.0001
Selenium		2	10	10		2	2	2	6

NOTES:

1. Concentrations shown are from the Geraghty & Miller Phase II report dated January 1995 for monitoring wells TTI (shallow) and TT-1D (deep).
2. All concentrations are in ppb unless noted otherwise.
3. Design concentrations are based on a weighted average of the estimated concentrations for TT1 and TT1-D.
4. < Indicates reported laboratory analytical result is below detection limit.

TABLE 2

ASSUMED INFLUENT INORGANIC WATER QUALITY AND FLOWRATE

Texaco Tutu, U.S. Virgin Islands

(EKI 940058.00)

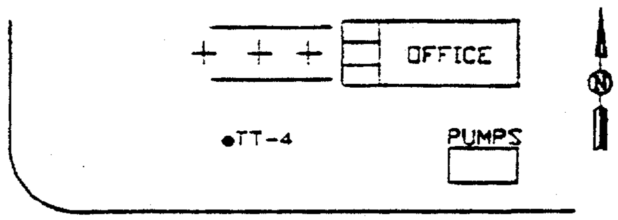
Parameter	VITELCO PROPERTY			
	MW-7 (2) Indicator Parameter	MW-7 (2) Unfiltered Metals	MW-7 (2) Filtered Metals	Design
Assumed Flowrate (gallons per minute)	-	-	-	20
Arsenic		9.2	2	2
Cadmium		3	3	3
Chromium		1050	3	5
Copper		3	3	3
Cyanide	<10			10
Lead		4.8	2	3
Mercury		1	0.1	0.1
Nickel		445	15	15
Nitrate (as N)	3.2 ppm			3 ppm
Nitrite (as N)	0.25 ppm			0.25 ppm
Selenium		2	2	2

NOTES
1. All concentrations are in ppb unless noted otherwise.
2. Concentrations shown are from the Geraghty & Miller Phase II report dated January 1995 for monitoring well MW-7.
3. < Indicates reported laboratory analytical result is below detection limit.

EXISTING MONITORING WELL CONSTRUCTION LOGS

LITHOLOGIC LOG (CUTTINGS)

LOCATION MAP:



__1/4 __1/4 __1/4 __1/4 S__ T__ R__

LOCATION No. 1

SITE ID: TEXACO TUTU LOCATION ID: TT-4

SITE COORDINATES (ft.):

N ______ E ______

GROUND ELEVATION (ft. MSL):

STATE: ST. THOMAS COUNTY: U.S.V.I.

DRILLING METHOD: AIR ROTARY/HAMMER

DRILLING CONTR.: CARRIBBEAN HYDRO-TECH

DATE STARTED: 12/2/93 DATE COMPLETED: 12/3/93

FIELD REP.: MAZZULLO/MONTANO

COMMENTS:

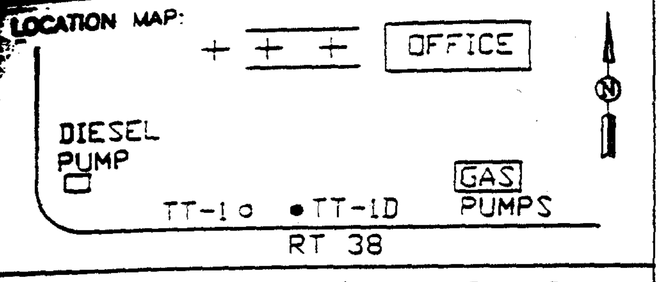
LOCATION DESCRIPTION: CENTER OF UST PIT AREA

DEPTH	WELL CONST.	LITH.	VISUAL %	SAMPLE TYPE	SAMPLE INTERVAL	LITHOLOGIC DESCRIPTION (LITH., GRAIN SIZE PROPORTIONS, WET COLOR, RNDG., SRTG., CONSOL., DIST. FEATURES)
				HEAD-SPACE	8.3 ppm	0.0–0.5 CONCRETE
5	4" PVC BLANK			PID	30.0 ppm	0.5–9.0 CLAYEY FILL = DARK GRAY TO GREENISH-GRAY (5G 4/1), GRAVELLY (UP TO 40%), MODERATELY PLASTIC CLAY, WITH LOCALLY MODERATE HEAVY-OIL ODOR.
				HEAD-SPACE	22.0 ppm	
10				PID	16.0 ppm	9.0–16.5 WEATHERED BEDROCK = DARK GREENISH-GRAY (5G 4/1) ANDESITE BRECCIA, WITH DARK GREENISH-GRAY CLAY FILLING INTERSTICES.
15						
20	4" .020-SLOT PVC					16.5–36.0 VOLCANIC BRECCIA = DARK GREENISH-GRAY (5G 4/1) AUGITE-ANDESITE BRECCIA, WITH SPORADIC DIKES OR INCLUSIONS OF BLACK (5G 2/1) BASALT BRECCIA. FRACTURES NOTEABLE NEAR 26-27 FT. AND SOFT WEATHERED ZONE NEAR 33 FT.
25						
30						
35						TD = 36.0 FT. B/SCREEN = 28.5 FT. INITIAL WATER LEVEL = 13.73 FT. BGL
40						
45						
50						

EXISTING MONITORING WELL CONSTRUCTION LOGS

LITHOLOGIC LOG (CUTTINGS)

LOCATION MAP:



__1/4 __1/4 __1/4 __1/4 S__ T__ R__

Location No. 1

SITE ID: TEXACO TUTU LOCATION ID: TT-1
SITE COORDINATES (ft.):
: ____ E ____
GROUND ELEVATION (ft. MSL):
STATE: ST. THOMAS COUNTY: U.S.V.I.
DRILLING METHOD: AIR ROTARY/HAMMER
DRILLING CONTR.: CARRIBEAN HYDRO-TECH
DATE STARTED: 12/8/93 DATE COMPLETED: 12/8/93
FIELD REP.: MAZZULLO/MONTANO
COMMENTS:

LOCATION DESCRIPTION: SOUTH END OF STATION ALONG CURB, 5 FT. WEST OF TT-1D

DEPTH	WELL CONST.	SAMPLE TYPE	SAMPLE INTERVAL	LITHOLOGIC DESCRIPTION (LITH., GRAIN SIZE PROPORTIONS, WET COLOR, RNDG., SRTG., CONSOL., DIST. FEATURES)
				0.0–0.5 CEMENT
		PID	5 ppm	0.5–5.0 CLAY = MODERATE GREENISH-GRAY (5B 5/1), MODERATE PLASTICITY, SANDY TO PEBBLY (20-25%), WITH MILD WASTE OIL ODOR.
5	4" PVC BLANK	HEAD-SPACE	94 ppm	5.0–7.5 CLAY = OLIVE-GRAY (5Y 4/1), MODERATE PLASTICITY, SANDY (10-15%) WITH SOME LARGER ROCKS AND TREE ROOTS.
		HEAD-SPACE	48 ppm	7.5–15.0 PEBBLY CLAY = GRAY-GREEN (5G 4/1), MODERATE PLASTICITY, 15-20% PEBBLES (LOCALLY HIGHER PROPORTION).
10		HEAD-SPACE	19 ppm	
15		PID	7 ppm	15.0–21.0 WEATHERED BEDROCK = DARK GREENISH-GRAY (5G 4/1), ALTERED ANDESITE AND BASALT BRECCIA, WITH INTERSTITIAL CLAY.
20		PID	16 ppm	21.0–36.3 VOLCANIC BRECCIA = FRACTURED, BLACK (5G 2/1), BASALT BRECCIA, DOWN TO FRACTURED, DARK GREENISH-GRAY (5G 4/1), AUGITE-ANDESITE BRECCIA. SLIGHT GASOLINE ODOR TOWARDS BOTTOM.
25	4" .010-SLOT PVC	PID	121 ppm	
30		PID	24 ppm	TD = 36.3 FT. B/SCREEN = 30 FT. INITIAL WATER LEVEL = 12.45 FT. BGL
		PID	6 ppm	
35		PID	5 ppm	
40				
45				
50				

LITH. | VISUAL %

Attachment B

OWNER Furnished Equipment

KING, BUCK & ASSOCIATES, INC.

FOR THE JOINT VENTURE KING,BUCK/CATALYTIC

Specializing in the energy and chemical processing industries

HD CatOx™

Halocarbon Destruct Catalytic Oxidation System

Pictured below is a King,Buck/Catalytic HD CatOx system. This system, with a capacity of 200 scfm, is one of the several HD CatOx systems that have been permitted by the South Coast Air Quality Management District. The HD CatOx was designed and constructed by King,Buck/Catalytic and utilizes an Allied Signal Purzaust® HDC catalyst selected for its effectiveness with chlorinated organic compounds.

This HD CatOx system is being used in a soil remediation project in which both hydrocarbons and chlorinated hydrocarbons are present. The system was compactly packaged so that it would occupy one parking space on the top floor of a multi-story parking garage. It consists of a vacuum/compressor, heat exchanger, process heater, fixed bed catalytic reactor, neutralizing scrubber, and self contained cooling system. The by-products of this remediation system are carbon dioxide, water and a solution of sodium chloride and sodium bicarbonate. Since start-up in 1991, its on-stream operating record has been nearly perfect.

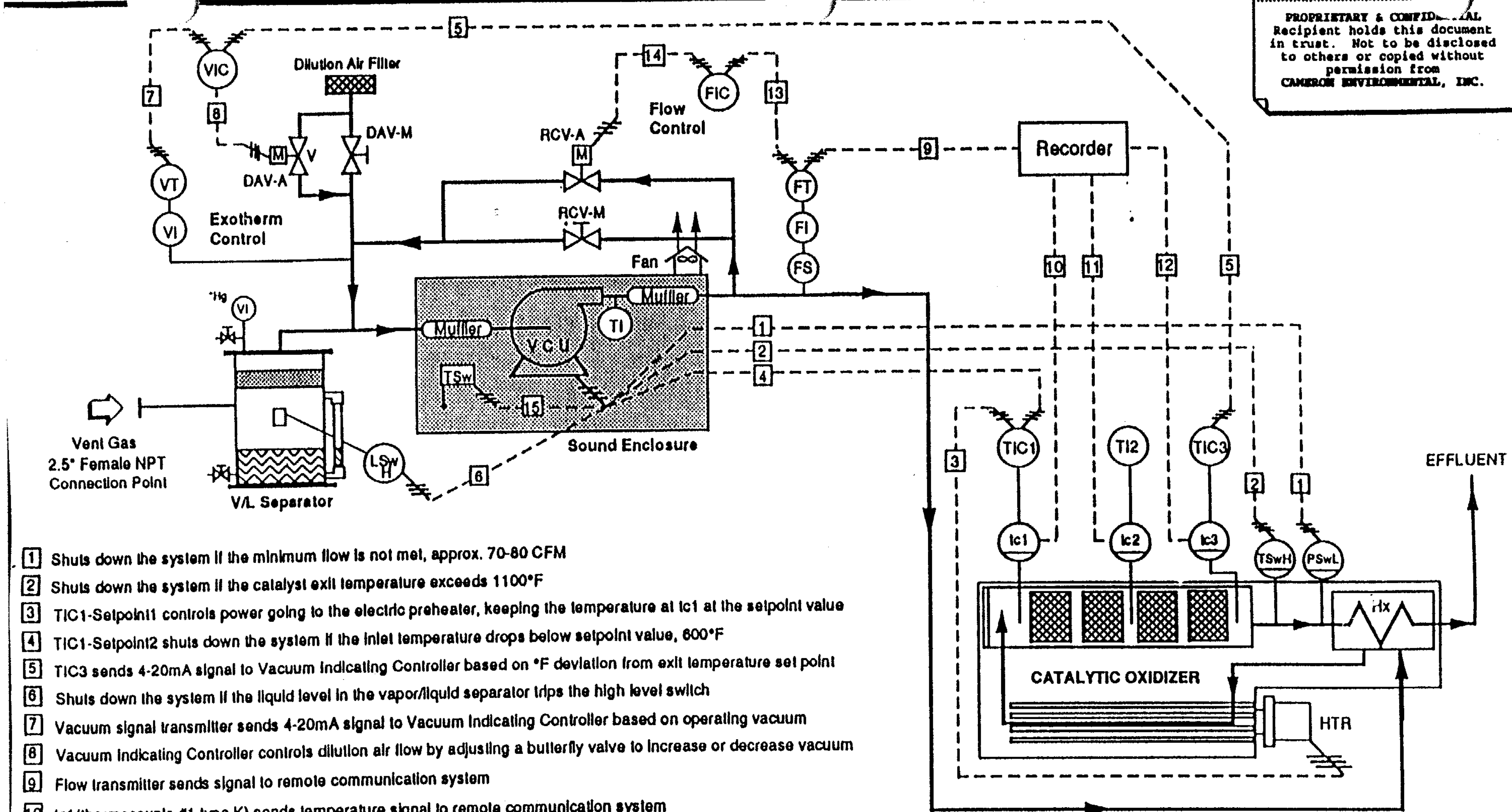
For more information on how the HD CatOx can economically solve soil remediation projects, please contact us.

TYPICAL LAYOUT

TUT 008 0492

2356 Moore Street, Suite 102 • San Diego, California 92110 • Telephone (619) 299-8431 • Fax (619) 299-8437

Final P&ID



[1] Shuts down the system if the minimum flow is not met, approx. 70-80 CFM
[2] Shuts down the system if the catalyst exit temperature exceeds 1100°F
[3] TIC1-Setpoint1 controls power going to the electric preheater, keeping the temperature at tc1 at the setpoint value
[4] TIC1-Setpoint2 shuts down the system if the inlet temperature drops below setpoint value, 600°F
[5] TIC3 sends 4-20mA signal to Vacuum Indicating Controller based on °F deviation from exit temperature set point
[6] Shuts down the system if the liquid level in the vapor/liquid separator trips the high level switch
[7] Vacuum signal transmitter sends 4-20mA signal to Vacuum Indicating Controller based on operating vacuum
[8] Vacuum Indicating Controller controls dilution air flow by adjusting a butterfly valve to increase or decrease vacuum
[9] Flow transmitter sends signal to remote communication system
[10] tc1(thermocouple #1,type K) sends temperature signal to remote communication system
[11] tc2(thermocouple #2,type K) sends temperature signal to remote communication system
[12] tc3(thermocouple #3,type K) sends temperature signal to remote communication system
[13] Flow signal transmitter sends 4-20mA signal to Flow Indicating Controller based on operating flow
[14] Flow Indicating Controller controls flow by regulating the recycle flow around the compressor
[15] Shuts down the system if the air temperature in the sound enclosure exceeds 210°F

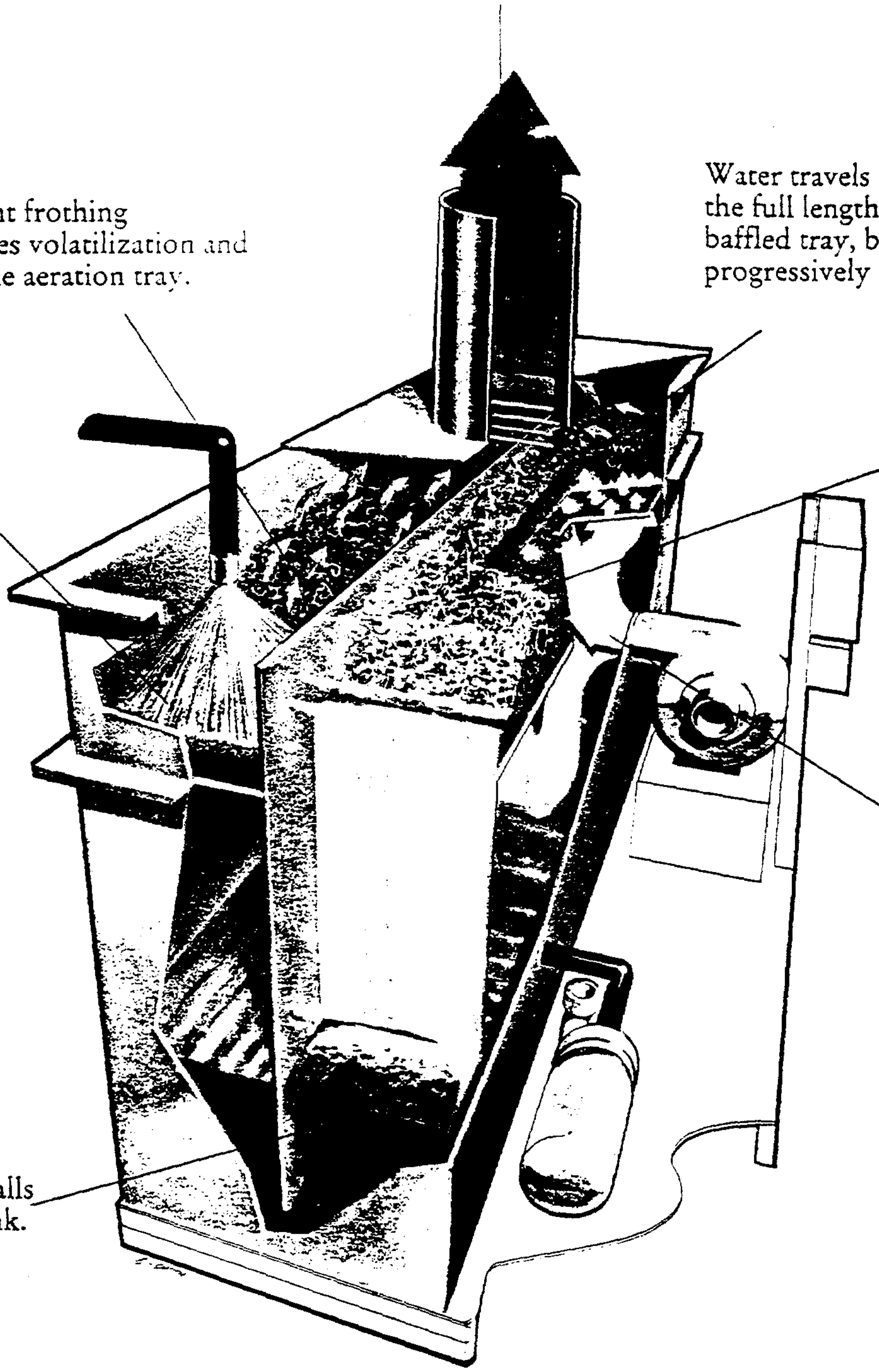
Legend:

Electrical Control Signal
DAV-A Dilution Air Control Valve - Automatic
DAV-M Dilution Air Control Valve - Manual
FI Flow Indicator
FIC Flow Indicating Controller
FS Flow Sensor
FT Flow Transmitter
HTR Heater
Hx Heat Exchanger
LSwH Liquid Level Switch
M Dilution Air Control Actuator Motor
PSwL Low Flow Limit Pressure Switch
RCV-A Recirculation Control Valve - Automatic
RCV-M Recirculation Control Valve - Manual
tc Thermocouple
TI Temperature Indicator
TIC Temperature Indicating Controller
TSwH High Limit Temperature Switch
TSw Temperature Switch
V/L Vapor/Liquid Separator
VCU Vacuum Compressor Unit
VI Vacuum Indicator
VIC Vacuum Indicating Controller
VT Vacuum Transmitter

P & I D	
CatOx-200 with Options	
CAMERON ENVIRONMENTAL, INC.	
MMC-6AE (electric preheater)	
P40015.1	3-30-94
Drwn. By:	Inspec. By:

TUT 008 0493

The ShallowTray Process



This illustration is representative of the ShallowTray® Model 2611.

Protected under U.S. Patent Nos. 5,045,215 and 5,240,595. Other International Patents Pending.

TUT 008 0494

Photo on front cover: top view of 2300 Series aeration tray in action.
Photo on back cover: cross section of a ShallowTray in action.

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51294

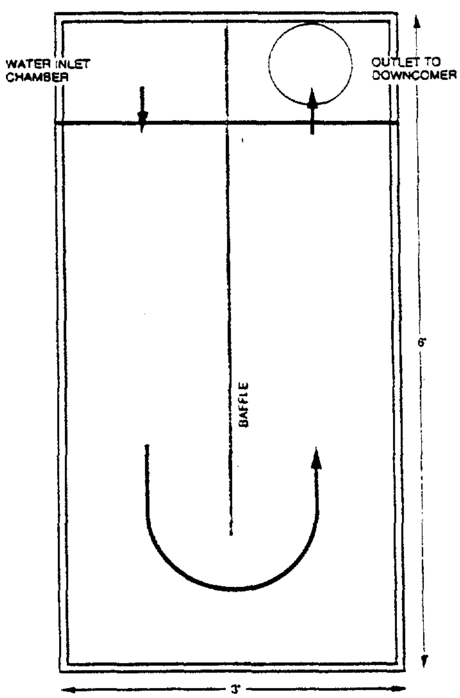
The graphs represent approximate removal efficiencies at 50°F. Use the ShallowTray® Modeler™ software to calculate expected performance.

odels	flow rate	# trays	width	length	height	min. cfm	approx. lbs.
3611	3-135gpm	1	5'0"	6'2"	5'0"	900	1240
621	3-135gpm	2	5'0"	6'2"	5'9"	900	1440
3631	3-135gpm	3	5'0"	6'2"	6'6"	900	1640
641	3-135gpm	4	5'0"	6'2"	7'3"	900	1840
3651	3-135gpm	5	5'0"	6'2"	8'0"	900	2040

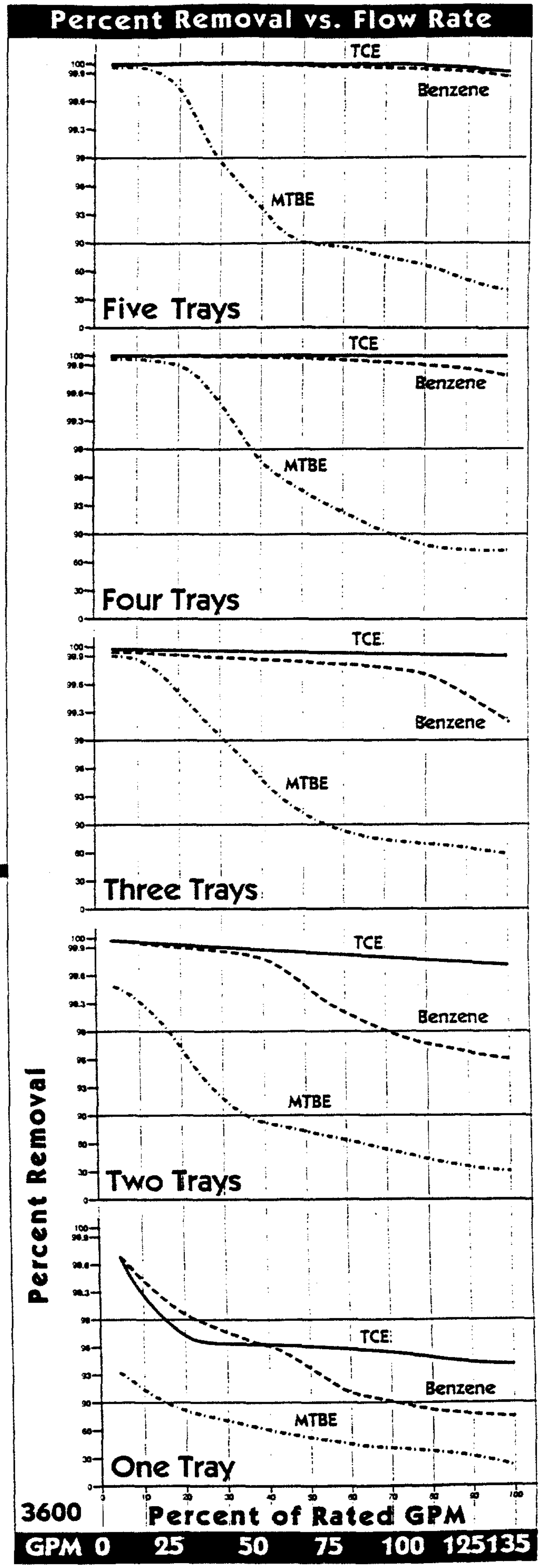
LOCATION 1 - TEXACO SERVICE STATION

hallowTray®
.ow profile air strippers

3600 AERATION TRAY

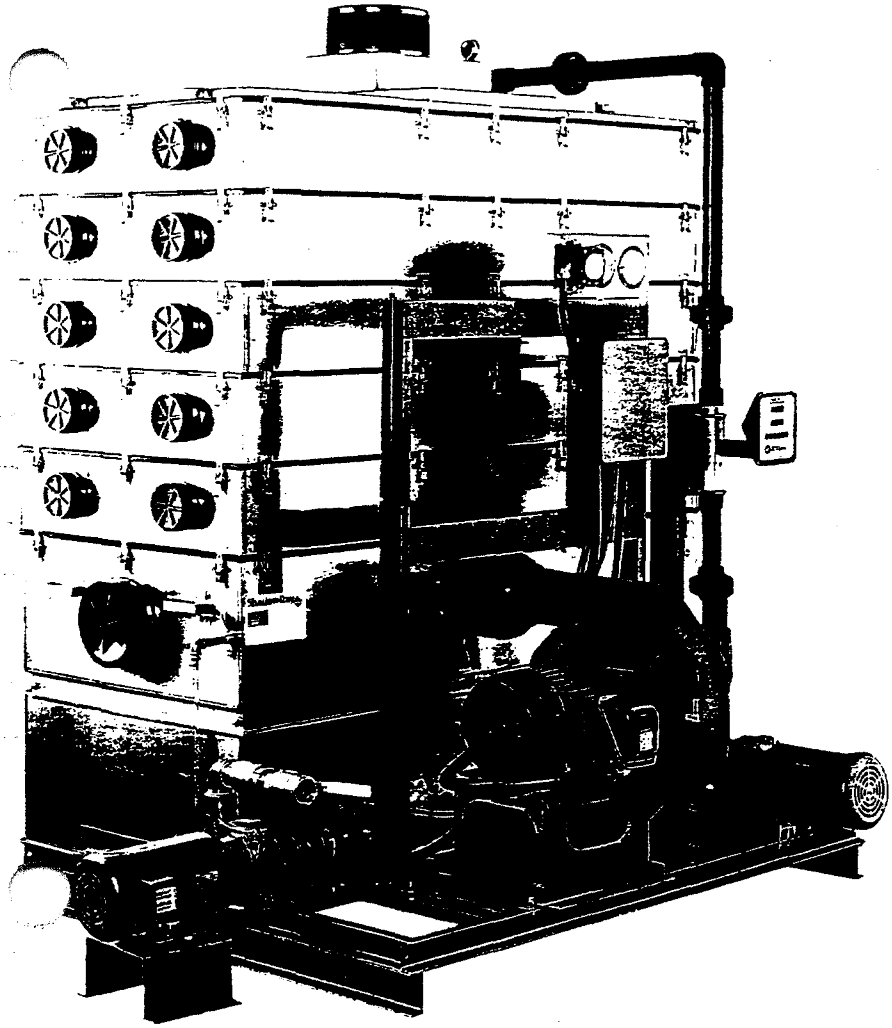


TOP VIEW



TUT 008 0495

3600 Series

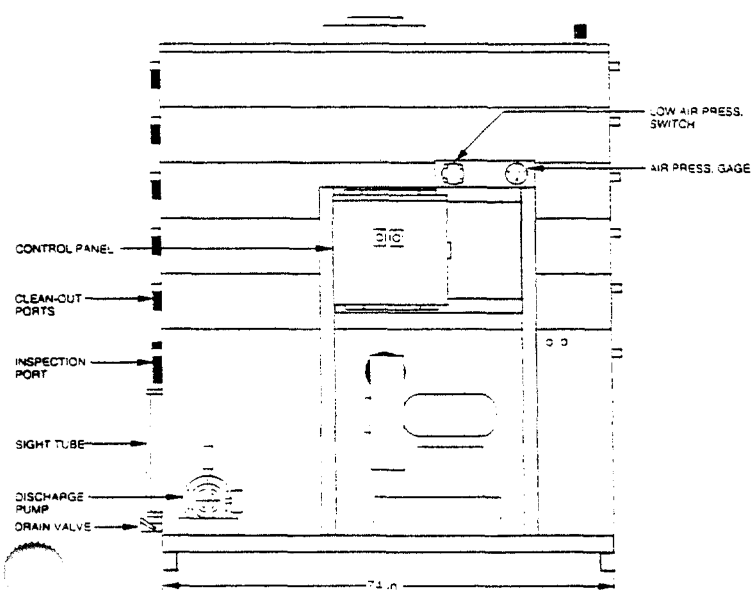


Model Pictured: 3651

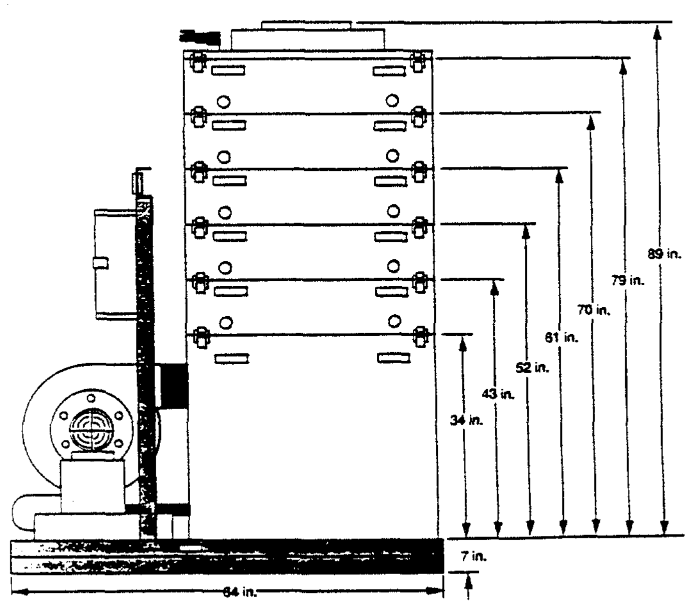
Options chosen for system pictured:

- ☑ EXP Feed and Discharge pumps
- ☑ NEMA 3R main disconnect switch
- ☑ Low air pressure alarm switch
- ☑ High water level alarm switch
- ☑ Discharge pump level switch
- ☑ Water pressure gauges
- ☑ Digital water flow indicator and totalizer

Typical 3651 Configuration*



FRONT VIEW



RIGHT SIDE VIEW

*Use these drawings as a guideline only. Systems are built to your project's specifications.

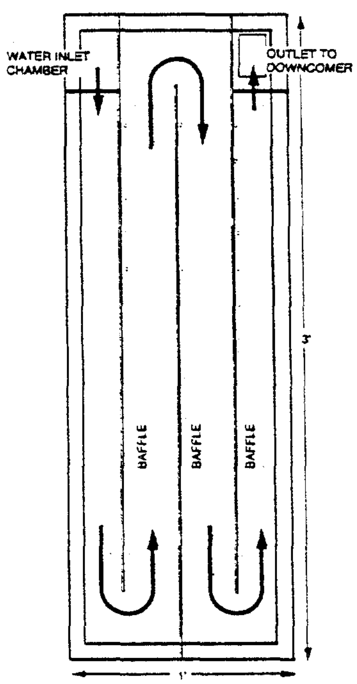
The graphs represent approximate removal efficiencies at 50°F. Use the ShallowTray® Modeler™ software to calculate expected performance.

Models	flow rate	# trays	width	length	height	min. cfm	approx. lbs.
1311	0.5-22.5gpm	1	3'0"	3'2"	5'0"	150	700
1321	0.5-22.5gpm	2	3'0"	3'2"	5'9"	150	760
1331	0.5-22.5gpm	3	3'0"	3'2"	6'6"	150	820
1341	0.5-22.5gpm	4	3'0"	3'2"	7'3"	150	880
1351	0.5-22.5gpm	5	3'0"	3'2"	8'0"	150	940

LOCATION 2 - VITELCO PROPERTY

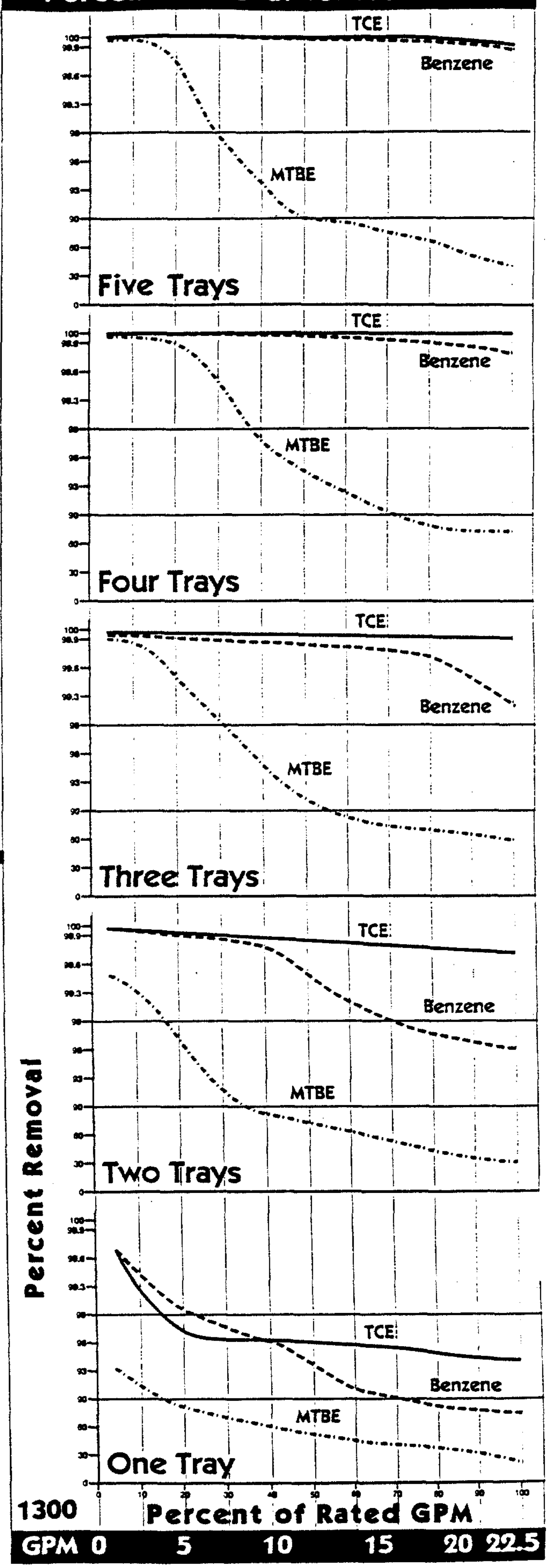
ShallowTray®
low profile air strippers

1300 AERATION TRAY



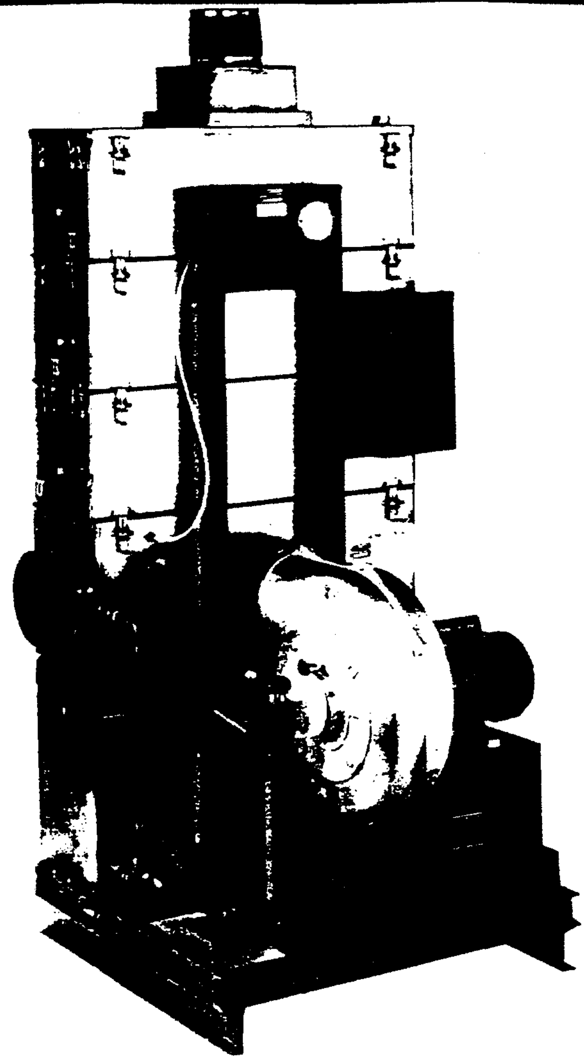
TOP VIEW

Percent Removal vs. Flow Rate



TUT 008 0497

1300 Series

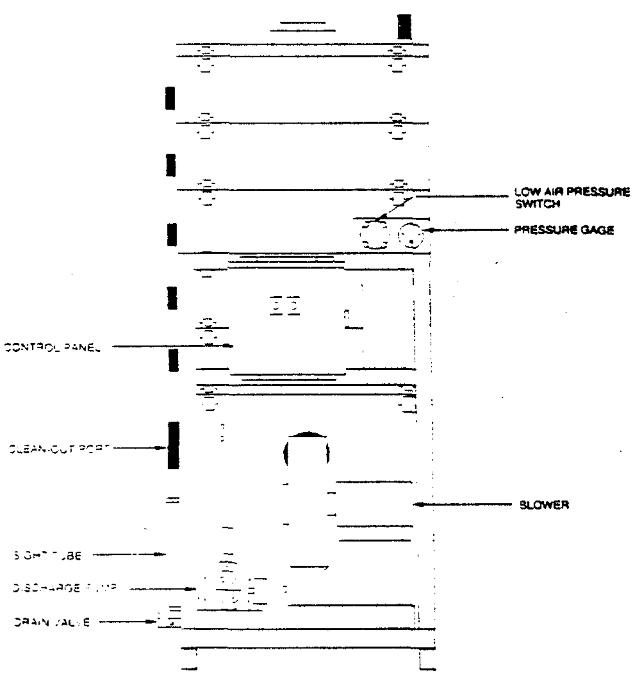


Model Pictured: 1331

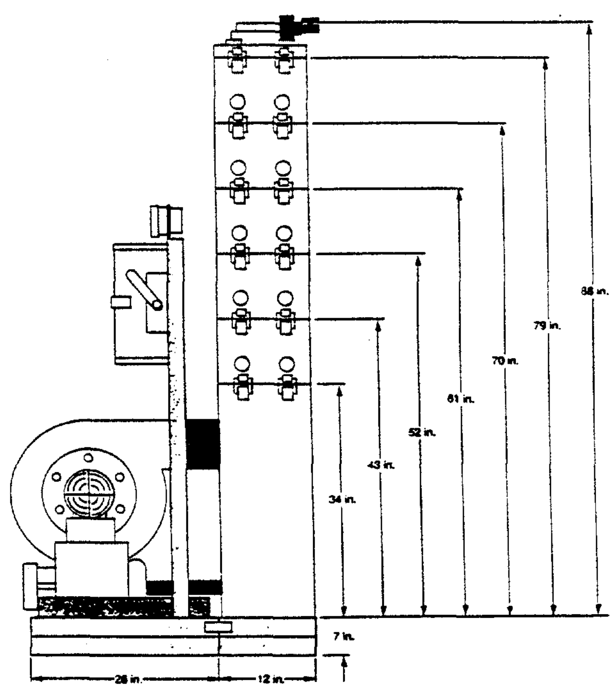
Options chosen for system pictured:

☑ None

Typical 1351 Configuration*



FRONT VIEW



RIGHT SIDE VIEW

*Use these drawings as a guideline only. Systems are built to your project's specifications.

TUT 008 0498

2

E-2 Design and Construction Concept

The two remedial systems proposed to remediate groundwater and soil at the Service Station Site and groundwater at the Vitelco Site include the following:

1) a groundwater extraction and treatment system and a soil vapor extraction and treatment system at the Service Station Site (described as Location 1 in the plans and specifications) and

2) a groundwater extraction and treatment system at the Vitelco Site (described as Location 2 in the plans and specifications).

TCI has selected Aqua Design, Inc. based in Campbell, California to perform the design and construction of the remedial systems. TCI has also selected Global Technologies, Inc. based in Milwaukee, Wisconsin to supply the catalytic oxidation equipment and Northeast Environmental Products, Inc. based in West Lebanon, New Hampshire to supply the air stripper equipment for the remedial systems.

The design and construction phase of the proposed groundwater and soil remedial systems will consist of three phases. The three phases will include design, assembly of treatment plants, and on-site construction as summarized below.

1) Design - Aqua Design will develop the design based on the information contained in the information itemized above and as developed at the Design Meeting with TCI and EKI (See specification "Section 01901 - Phase 1 - Design" included with this section for a definition of the Design Meeting).

2) Assembly of Treatment Plants - The two treatment plants will be assembled and tested by Aqua Design at their facility in Campbell, California. The catalytic oxidizer and air stripper for the Service Station Site and the air stripper for the Vitelco Site will be supplied by TCI for Aqua Design's installation and testing. The treatment plants will be assembled within a container that is suitable for shipping the treatment plants to St. Thomas, U.S. Virgin Islands and suitable as permanent housing for the treatment plants once they are installed at each location at the Site.

3) On-Site Construction - Aqua Design will construct the extraction systems and install the treatment plants at the Service Station Site and the Vitelco Site. Aqua Design will then test and start-up the remedial systems at both sites under the supervision of EKI.

3

E-3 Documents to be Transmitted to EPA and DPNR

The following documents will be transmitted to EPA and DPNR for review after completion of the construction and start-up of the remedial systems.

- System "As-Builts"
- Long Term Monitoring Plan
- Results of Start-Up and Vacuum Influence Testing
- Systems Operations and Maintenance Manual

4

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EPA REGION II
SCANNING TRACKING SHEET

DOC ID # 65038

DOC TITLE/SUBJECT:

TUTU WELLS SUPERFUND SITE

PRELIMINARY ACCELERATED SCHEDULE FOR PLANNING, DESIGN, AND CONSTRUCTION OF GROUNDWATER AND SOIL REMEDIATION SYSTEMS AT TUTU TEXACO SERVICE STATION
(Page: TUT 008 0505)

THIS DOCUMENT IS OVERSIZED AND CAN BE LOCATED IN THE ADMINISTRATIVE RECORD FILE AT THE

SUPERFUND RECORDS CENTER
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NEW YORK, NY 10007

E-4 Schedule

The design and construction of the remedial systems for the Service Station Site and the Vitelco Site are scheduled to be completed by 29 November 1995. The proposed schedule is included at the end of this Sub Section.