DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

**RCRA Corrective Action**
**Environmental Indicator (EI) RCRAInfo code (CA725)**
**Current Human Exposures Under Control**

**Facility Name:** **Shell Chemical Yabucoa, Inc.**
**Facility Address:** **Route 901, Km 2.7, Camino Nuevo Ward, Yabucoa, Puerto Rico**
**Facility EPA ID #:** **PRD090074071**

1. Has **all** available relevant/significant information on known and reasonably suspected releases to soil, groundwater, surface water/sediments, and air, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMU), Regulated Units (RU), and Areas of Concern (AOC)), been **considered** in this EI determination?

__X__ If yes - check here and continue with #2 below.
_____ If no - re-evaluate existing data, or
_____ If data are not available skip to #6 and enter "IN" (more information needed) status code.

**BACKGROUND**

**Definition of Environmental Indicators (for the RCRA Corrective Action)**

Environmental Indicators (EI) are measures being used by the RCRA Corrective Action program to go beyond programmatic activity measures (e.g., reports received and approved, etc.) to track changes in the quality of the environment. The two EI developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater. An EI for non-human (ecological) receptors is intended to be developed in the future.

**Definition of "Current Human Exposures Under Control" EI**

A positive "Current Human Exposures Under Control" EI determination ("YE" status code) indicates that there are no "unacceptable" human exposures to "contamination" (i.e., contaminants in concentrations in excess of appropriate risk-based levels) that can be reasonably expected under current land- and groundwater-use conditions (for all "contamination" subject to RCRA corrective action at or from the identified facility (i.e., site-wide)).

**Relationship of EI to Final Remedies**

While Final remedies remain the long-term objective of the RCRA Corrective Action program the EI are near term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993, GPRA). The "Current Human Exposures Under Control" EI are for reasonably expected human exposures under current land- and groundwater-use conditions ONLY, and do not consider potential future land- or groundwater-use conditions or ecological receptors. The RCRA Corrective Action program's overall mission to protect human health and the environment requires that Final remedies address these issues (i.e., potential future human exposure scenarios, future land and groundwater uses, and ecological receptors).

**Duration / Applicability of EI Determinations**

EI Determinations status codes should remain in RCRAInfo national database ONLY as long as they remain true (i.e., RCRAInfo status codes must be changed when the regulatory authorities become aware of contrary information).

**Facility Description:**

Shell Chemical Yabucoa Inc. (SCYI) is a petroleum refining facility located in Yabucoa, Puerto Rico. A description of the facility is presented below.

Site Location and Setting

The SCYI facility is located on Route 901, Km 2.7, Camino Nuevo Ward, about 1.5 miles east of the town of Yabucoa, Puerto Rico. The facility occupies an area of approximately 252 acres which is sub-divided into three working areas: the Refinery Area, the Tank Farm Area, and the Dock Area. The Refinery Area is the most inland area of the facility; the Tank Farm Area is about 2,300 ft east toward the Caribbean Sea; and the Dock Area is further to the east and terminates at the Caribbean Sea. The Dock Area encloses a small man-made inlet (usually referred to as the Turning Basin), which the facility uses for sea transportation purposes.

Agricultural and sugar cane fields surround the facility to the north, east, and west. Route 901 borders the Refinery Area to the south. Route 53 traverses between the Refinery and Tank Farm Areas. Sugar cane fields are to the south of the Tank Farm Area and a palm tree grove and beach are to the south of the Dock Area. A mountainous area is situated further south of the facility.

The nearest populated area to the facility is the residential community of Camino Nuevo, which has a population of about 4,900, the center of which is located about 2,500 ft southeast of the Refinery Area. The city of Yabucoa is located about 1.5 miles west of the facility.

The nearest surface water features to the facility are Lajas Creek, which runs along the eastern border of the Refinery Area, and Santiago Creek, which runs along the northern border of the Refinery Area. Lajas Creek subsequently enters Santiago Creek about 300 feet north of the Refinery Area. Santiago Creek runs eastward along the northern part of the Refinery Area and discharges to the Caribbean Sea about 1.5 miles to the east and north of the Dock Area. A small unnamed creek runs generally east-west near the northern border of the Tank Farm Area. This creek is also a tributary to Santiago Creek. A second small unnamed creek runs in a northeasterly direction south of the Tank Farm Area. This creek discharges directly to the Caribbean Sea. None of the rivers or streams in the valley is navigable by large vessels.

The largest surface water body in the area is the Caribbean Sea which borders the Dock Area and is about 1.5 miles east of the Refinery Area. In the Dock Area, a man-made inlet from the Caribbean Sea is used by tanker ships for loading/unloading operations.

SCYI's current water well production field consists of four wells and extends from about 2300 to 7000 ft north to northwest of the Refinery Area. There are no on-site water supply wells. No water supply wells are located downgradient of the facility.

Facility Operations

Petroleum refining operations at the facility commenced in May 1971. Prior to the construction of the facility, the property was used as agricultural land. SCYI leases the property upon which the facility is constructed from the Commonwealth of Puerto Rico. SCYI purchased the facility on December 31, 2001 from Puerto Rico Sun Oil Company (an entity of Sunoco, Inc.), which was the prior operator. There have been no other owners of the facility.

The facility has the capacity to process 85,000 barrels per day of crude oil. Major products include gasoline, kerosene, light distillates, naphtha, jet fuel, diesel fuel, No. 6 fuel oil, heavy olefin feedstock, residual fuels, and sulfur. Operations at the SCYI facility are conducted at the three distinct areas interconnected by a series of above ground pipelines. Further information on each of the areas is provided below.

> Refinery Area - The Refinery Area includes SCYI's oil processing operations. The following process units are located at the Refinery Area: crude unit, gas oil desulfurizer, hydrogen unit, sulfur unit, hydrotreater

and feed preparation unit, UV stabilization and final distillation unit, gasoline reformer and utilities. The Refinery Area also includes tank storage facilities, administrative and maintenance operations and a waste storage and treatment facility. The Refinery Area Wastewater Treatment Plant is located in the northern portion of the Refinery Area.

Tank Farm - Raw materials and products manufactured by SCYI are stored in above ground steel tanks in the Tank Farm Area. The Tank Farm contains approximately 43 crude and product tanks, ranging in size from 500 to 375,000 barrels. A tanker truck loading rack is located near the southwestern corner of the Tank Farm. The Tank Farm Wastewater Treatment Plant is located in the southeast corner of the Tank Farm.

Dock Facility - SCYI operates a dock facility for the loading and unloading of crude oil and products. The facility includes a Main Dock which serves oil tankers and a Barge Dock which serves smaller vessels and barges. There is also a dock for the servicing of tugboats. Crude oil and products are transferred to and from the Dock Area via aboveground pipelines. There are no storage facilities or process units at the Dock Area.

The SCYI facility is served by several different wastewater collection and treatment systems. The systems are designed to reduce the volume of contaminated wastewater requiring treatment by segregating contaminated and uncontaminated wastewater to the maximum extent possible. At the Refinery Area, collection systems exist for contaminated process wastewater, contaminated storm water, uncontaminated storm water, and sanitary wastewater. At the Tank Farm, a collection system is provided for storm water and tank water drawoff. Collection systems are provided for storm water at both the Main Dock and the Barge Dock. SCYI has been issued a National Pollution Discharge Elimination System (NPDES) Permit for the discharge of wastewater and storm water into area surface waters. The Permit allows the discharge of treated process wastewater into the Caribbean Sea through Outfall 001 and the discharge of uncontaminated storm water into Santiago Creek through Outfall 002.

RCRA Hazardous Waste Management Program

SCYI generates a number of wastes regulated as hazardous under RCRA as part of its operation, primarily the following:

F037 - Petroleum Refinery Primary Oil/Water/Solid Separation Sludge
F038 - Petroleum Refinery Secondary Oil/Water/Solid Separation Sludge
K048 - Dissolved Air Flotation (DAF) Unit Float
K049 - Slop Oil Emulsion Solids
K050 - Heat Exchanger Bundle Solids
K051 - API Separator Sludge
K069 - Crude Oil Tank Sediment
K171 - Spent Hydrotreating Catalyst
K172 - Spent Hydrorefining Catalyst
D001 - Ignitable Waste
D002 – Spent Mercury Sulfate & Sulfuric Acid (COD vials)
D008 - Lead containing spent car batteries
D009 - Mercury containing fluorescent lamps
D001, D002, D005, D006, D007, D008 - Expired laboratory reagents (Labpacks)
D018 - Toxic (Benzene) Waste
U154 - Methanol Waste (Off-Specification)

SCYI operates a container storage area (CSA) under interim status for the storage of hazardous waste prior to off-site disposal. EPA has approved SCYI's RCRA Part B Permit Application for expansion of the CSA and has prepared a draft RCRA Permit for operation of the unit. Final issuance of the permit is pending public participation and final EPA approval.

Two regulated hazardous waste surface impoundments were formerly operated at the facility: the Equalization Basin at the Refinery Area and the New Oily Sludge Basin at the Tank Farm. The units have undergone RCRA closure. EPA approved clean closure of the units in June 2002. SCYI does not operate any other regulated hazardous waste management units.

<u>RCRA Corrective Action Program</u>

A RCRA Facility Investigation (RFI) has been completed at the SCYI facility. The RFI was implemented to satisfy the terms of the RCRA 3008(h) Corrective Action Order (Order) signed by PRSOC, the previous facility owner, and the United States Environmental Protection Agency (EPA) in June 1994.

The RFI was conducted in accordance with the terms of the RCRA Facility Investigation Work Plan, which was approved by EPA, with certain revisions, in April 1996. The RFI included the investigation of soil and/or groundwater at 16 solid waste management units (SWMUs) identified in the Order. A summary and description of the SWMUs subject to the RFI is presented in Attachment 1. Attachment 2 contains a list of SWMUs at the facility that were not subject to the RFI. A facility map depicting locations of SWMUs was presented as Figure 5-1 in the March 2005 Final RFI Report (Ref. 3), and is provided with this EI determination as Attachment 3. The objectives of the RFI were to identify hazardous constituents and their concentrations in soil and/or groundwater at the subject SWMUs, to determine the potential for contaminant migration, to acquire sufficient data to characterize environmental contamination at the SWMUs to support interim or long-term corrective measures, and to acquire sufficient data to assess any risk to human health and the environment

Initial RFI field activities were conducted between June and August 1996 with certain follow-on activities conducted in January 1997. A Draft RFI Report (Ref. 1) was submitted to EPA in June 1997. In response to EPA comments on the Draft RFI Report, PRSOC submitted a Supplemental RFI Work Plan in March 1999, with subsequent revisions. Supplemental RFI field activities were conducted between January and June 2003. A Supplemental RFI Report (Ref. 2), which presented the results of the supplemental investigation, was submitted to EPA in June 2003. Additional field sampling activities were conducted in 2004 and 2005 in response to EPA comments. A total of 91 soil samples were collected for VOC, BNA and/or metals analysis. Eight soil samples were collected for physiochemical analysis. The soil samples were collected from various depths at 68 locations. A total of 58 groundwater monitoring wells were installed. The wells were used for groundwater level observations, collection of groundwater samples, and/or free-phase hydrocarbon (FPH) delineation and thickness measurements.

A Final RFI Report (Ref. 3), which consolidated the findings presented in the 1997 Draft RFI Report, the 2003 Supplemental RFI Report, and additional field investigation activities conducted in 2004, was submitted to EPA in March 2005. The report was reviewed by EPA and comments were issued in a letter dated August 17, 2005. SCYI is currently preparing responses to address EPA's comments.

In addition to the RFI, a Process Sewer Assessment was performed at the facility in accordance with the terms of the Order. The objective of the process sewer assessment, which consisted of a closed circuit television survey and soil sampling, was to determine whether hazardous constituents had been released from the sewer system. The study found no evidence of significant releases. The report for the Process Sewer Assessment (Ref. 4) was submitted to EPA in October 1997 and was subsequently approved by EPA.

A groundwater investigation of the Wastewater Treatment Plant/ Maintenance Building Area (Refinery Area) was performed during 2001 through 2004 for the purpose of investigating a dissolved-phase vinyl chloride plume of limited extent. The presence of vinyl chloride was attributed to it being a biodegradation product of trichloroethene. Groundwater sampling for VOCs was performed at 13 direct-push locations, at four existing wells, and at two wells installed for the investigation. The results, which were reported to EPA in March 2005 (Ref. 5), concluded the lack of significant contamination. In May 2005, EPA concurred and agreed to termination of the investigation (Ref. 6).

The current status of the Corrective Action Program can be summarized as follows:

- The RFI and Process Sewer Assessment as required by the Order have been completed. EPA has approved the Process Sewer Assessment Report. As discussed above, SCYI is currently preparing responses to EPA's recently received comments to the Final RFI Report submitted in March 2005.

- Recovery of light non-aqueous phase liquids and/or routine groundwater monitoring is ongoing at a six SWMUs as described further in the following sections.

- The need for further remediation at the site will be assessed as part of the Corrective Measure Study to be implemented after EPA approval of the Final RFI Report.

**References:**

1. Anderson, Mulholland & Associates, Inc. (AMAI), 1997. Draft RCRA Facility Investigation Report, Puerto Rico Sun Oil Company, Yabucoa, Puerto Rico.

2. Anderson, Mulholland & Associates, Inc. (AMAI), 2003. Supplemental RCRA Facility Investigation Report, Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

3. Anderson, Mulholland & Associates, Inc. (AMAI), March 2005. Final RCRA Facility Investigation Report. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

4. Anderson, Mulholland & Associates, Inc. (AMAI), 1997. Process Sewer Assessment Report, Puerto Rico Sun Oil Company, Yabucoa, Puerto Rico.

5. Letter from Sunoco Inc. to EPA dated March 28, 2005. (Sunoco Inc., as previous owner of the facility performed the Wastewater Treatment Plant/ Maintenance Building Area groundwater investigation on behalf of Shell Chemical Yabucoa, Inc.)

6. Letter from EPA to Shell Chemical Yabucoa, Inc. dated May 24, 2005.

2. Are groundwater, soil, surface water, sediments, or air **media** known or reasonably suspected to be **"contaminated"** [1] above appropriately protective risk-based "levels" (applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action (from SWMUs, RUs or AOCs)?

| Media | Yes | No | ? | Rationale / Key Contaminants |
|---|---|---|---|---|
| Groundwater | X | | | Benzene, naphthalene, 2-methylnaphthalene, arsenic, LNAPL |
| Air (indoors) [2] | | X | | See discussion below |
| Surface Soil (e.g., <2 ft) | X | | | Benzo(a)pyrene |
| Surface Water | | X | | See discussion below |
| Sediment | | X | | See discussion below |
| Subsurf. Soil (e.g., >2 ft) | X | | | Arsenic, benzo(a)pyrene |
| Air (outdoors) | | X | | See discussion below |

_____ If no (for all media) - skip to #6, and enter "YE," status code after providing or citing appropriate "levels," and referencing sufficient supporting documentation demonstrating that these "levels" are not exceeded.

__X__ If yes (for any media) - continue after identifying key contaminants in each "contaminated" medium, citing appropriate "levels" (or provide an explanation for the determination that the medium could pose an unacceptable risk), and referencing supporting documentation.

_____ If unknown (for any media) - skip to #6 and enter "IN" status code.

Rationale and Reference(s):

**Groundwater:**

Groundwater samples were collected and analyzed for VOCs, BNAs, and/or metals at 58 monitoring wells as part of the RFI work during 1996-1997 and Supplemental RFI work in 2003 and 2005 (Ref. 1). (Metals samples from 1996-1997 were analyzed for dissolved metals. Metals samples from 2003 and 2005 were for total and dissolved metals). Three of the wells are screened (10 ft screen length) in a deep water-bearing zone at the Refinery and Tank Farm areas at depths between 25 to 38 ft below ground level (bgl). All other wells are screened at or near the top of the water table.

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Footnotes:

[1] "Contamination" and "contaminated" describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriately protective risk-based "levels" (for the media, that identify risks within the acceptable risk range).

[2] Recent evidence (from the Colorado Dept. of Public Health and Environment, and others) suggest that unacceptable indoor air concentrations are more common in structures above groundwater with volatile contaminants than previously believed. This is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration necessary to be reasonably certain that indoor air (in structures located above (and adjacent to) groundwater with volatile contaminants) does not present unacceptable risks.

Quarterly groundwater sampling for VOCs has been performed at well MDS-4 of the Main Dock Sump (SWMU 33) since September 2003 as part of interim measures (Ref. 2). Groundwater sampling for VOCs was performed during December 2001 to December 2002 for the Wastewater Treatment Plant/Maintenance Building Area groundwater investigation (Ref. 3). Quarterly groundwater sampling from March through December 2004 (Ref. 4) was also performed for VOCs for the Wastewater Treatment Plant/Maintenance Building Area groundwater investigation.

Groundwater elevation and flow direction maps were constructed from synoptic water level measurements collected during the RFI in September 1996 and April 2003 (Ref. 1). The data show that the general groundwater flow direction is to the north and northeast within the Refinery Area; to the east and northeast within the Tank Farm Area; and to the east and southeast within the Dock Area. Groundwater elevations at the site varied from about 1 ft above mean sea level (amsl) at the Dock Area to over 21 ft amsl in the Refinery Area. The depth to groundwater, which is affected mainly by topographic relief, varied from about 2 to 15 ft below ground level (bgl). Seasonal water level variations at the Refinery Area are about 5 ft. The seasonal water level variation decreases in magnitude toward the Caribbean Sea where groundwater elevations are lower. The seasonal water level changes, which generally followed rainfall cycles, do not appear to significantly affect the groundwater flow direction. Average horizontal groundwater velocities were calculated to be about 0.01 ft/day in the Refinery Area, 0.07 ft/day in the Tank Farm Area, and 0.8 ft/day in the Dock Area.

The vertical hydraulic gradient at the Northeast Refinery Area (SWMU 40) varies seasonally between upward and downward, although the upward direction was more frequent (Ref. 1). In the Tank Farm Area, the vertical gradient at the East API Separator (SWMU 3) was downward. At the Watery Oil Separator (SWMU 43) also in the Tank Farm Area, the vertical gradient varied seasonally between upward and downward, although the downward direction was more frequent. Expected groundwater discharge to the Caribbean Sea suggests an upward vertical gradient in the Dock Area.

Measurements for groundwater and surface water interaction at the Northeast Refinery Area (SWMU 40) generally show that surface water from Santiago Creek recharges the groundwater and that groundwater discharges to Lajas Creek (Ref. 1).

The four production water wells for the facility are the most downgradient water supply wells in Yabucoa valley (Ref. 1). However, based on the groundwater flow direction data for the facility, none of the production wells are located downgradient of the site. The wells are located north and north-northwest of the Refinery Area. The production well closest to the facility is located about 2300 ft north of the Refinery Area. No apparent effect on groundwater levels at the facility from the production well pumping is observed (Ref. 1).

Groundwater results from the various phases of investigation were compared to groundwater screening levels. Groundwater screening levels were obtained from EPA Maximum Contaminant Levels (MCLs) and, where MCLs were not available, EPA Region 3 tap water RBCs (EPA Region 3, October 2004) were used. For MTBE, the acceptable drinking water guideline (20 to 40 ug/L) established by EPA (Ref. 5) was used. Texas Natural Resource Conservation Commission (TNRCC) protective concentration levels (PCLs)(TNRCC, March 2004) were used for groundwater screening levels for acenaphthylene (1500 ug/L), benzo(ghi)perylene (73 ug/L), and phenanthrene (73 ug/L), since MCLs and Region 3 tap water RBCs were not available for these three compounds. For lead, the EPA action level of 15 ug/L was used as a groundwater screening level. The constituents of concern that exceeded groundwater screening levels, their maximum concentrations, and the location of the maximums are shown in the table below.

| Groundwater Contaminant | Screening Levels (ug/L) | Maximum Concentration (ug/L) | Location of Maximum |
|---|---|---|---|
| Benzene | 5 | 5.1 | Well MDS-4 (SWMU 33) – Dock Area (Ref. 2) |
| Naphthalene | 6.5* | 26.4 | Well MDS-4 (SWMU 33) – Dock Area (Ref. 2) |
| 2-Methylnaphthalene | 24 | 60.1 | Well MDS-4 (SWMU 33) – Dock Area (Ref. 1) |
| 2-Methylnaphthalene | 24 | 36.9 | Well 40-21 (SWMU 40) – Refinery Area (Ref. 1) |

| Groundwater Contaminant | Screening Levels (ug/L) | Maximum Concentration (ug/L) | Location of Maximum |
|---|---|---|---|
| Arsenic | 10 | 34 | Well BDS-2 (SWMU 34) – Dock Area (Ref. 1) |
| Arsenic | 10 | 12.3 J | Well AB-1 (SWMU 17&18) – Refinery Area (Ref. 1) |
| Arsenic | 10 | 10 | Well WOS-5 (SWMU 43) – Tank Farm Area (Ref. 1) |

Notes: * - indicates an EPA Region 3 tap water RBC. All other screening levels are EPA MCLs. The 'J' data qualifier indicates an estimated concentration. Benzene and naphthalene results at well MDS-4 are the most recent quarterly results from February 2005; the 2-methylnaphthalene result is from June 2003. The benzene, naphthalene, and 2-methylnaphthalene results at well MDS-4 may be biased high due to the presence of a free phase hydrocarbon sheen in the well prior to sample collection. Although the sheen was removed prior to sampling, the elevated results may be attributed to cross-contamination and may not be representative of actual groundwater quality in the area. The 2-methylnaphthalene result at well 40-21 is from February 2005. Arsenic is reported as total arsenic at wells BDS-2 and WOS-5, and as dissolved arsenic at well AB-1. Total arsenic at well AB-1 is not available. Arsenic at wells BDS-2 and WOS-5 is from April 2003. Arsenic at well AB-1 is from August 1996.

Petroleum hydrocarbon LNAPL was detected during the RFI at six SWMUs (Ref. 1), which are the Northeast Refinery Area (SWMU 40), East API Separator (SWMU 3), Watery Oil Separator (SWMU 43), East Aisle Ditch (SWMU 45), Main Dock Sump (SWMU 33), and Barge Dock Sump (SWMU 34). In December 2004, the maximum apparent LNAPL thicknesses at the various SWMUs were: 0.30 ft at the Northeast Refinery Area (SWMU 40), a sheen at the East API Separator (SWMU 3), 1.00 ft at Watery Oil Separator (SWMU 43), a sheen at the East Aisle Ditch (SWMU 45), 0.04 ft at the Main Dock Sump (SWMU 33), and a sheen at the Barge Dock Sump (SWMU 34). Maps showing the areal distribution and thickness of LNAPL at the various units are presented in Reference 1. No impact to groundwater above screening levels was observed at the East API Separator (SWMU 3) and East Aisle Ditch (SWMU 45). The impact to groundwater at or above screening levels at the Northeast Refinery Area (SWMU 40), Main Dock Sump (SWMU 33), Barge Dock Sump (SWMU 34), and Main Dock Sump (SWMU 33) are summarized in the table above.

Visual observations have been performed on a weekly basis since April 2003 in the surface water at Lajas and Santiago Creeks, which are adjacent to the Northeast Refinery Area (SWMU 40). Visual observations have also been performed on a weekly basis since January 2001 at the shoreline opposite the Main Dock Sump (SWMU 33). No sheen has been observed at any of the surface water monitoring locations (Ref. 1).

EPA-approved interim measures consisting of LNAPL thickness measurement and recovery are ongoing at the affected areas. Groundwater sampling results from the Northeast Refinery Area (SWMU 40) showed only 2-methylnaphthalene above its screening level. Groundwater sampling results at the Main Dock Sump showed only benzene, naphthalene, and 2-methylnaphthalene above screening levels (the actual presence of these constituents in the groundwater is subject to the qualification discussed above). Arsenic occurred above its screening level at the Barge Dock Sump and equal to its screening level at the Watery Oil Separator (SWMU 43), which may be associated with the LNAPL. Groundwater sampling results from the East API Separator and East Aisle Ditch did not indicate any impact from LNAPL to groundwater.

None of the constituents (benzene, naphthalene, 2-methylnaphthalene) that were detected in the groundwater above screening levels at well MDS-4 of the Main Dock Sump (SWMU 33) were detected in the surface water adjacent to the unit (Ref. 1). Also, 2-methylnaphthalene, which was detected in the groundwater above its screening level at well 40-21 of the Northeast Refinery Area (SWMU 40), was not detected in the surface water or sediment (Lajas Creek) adjacent to the unit (Ref. 1). These results indicate that the surface water is not impacted from any contamination at these units.

**Soil Vapor/Indoor Air:**

An unoccupied building occurs north and upgradient of the Main Dock Sump (SWMU 33). This building was used in the past by Dock Area personnel for incidental purposes. This building was severely affected by Hurricane Georges in October 1998 and since then is no longer in use. The building is located about 100 ft upgradient of well MDS-4 at which volatile constituents (benzene, naphthalene, and 2-methylnaphthalene) were detected. Only benzene (5.1 ug/L) exceeded its groundwater to indoor air screening level of 5 ug/L (Table 2c of Ref. 6). (The actual presence of benzene is subject to the qualification discussed above). Naphthalene (26.4 ug/L) and 2-

methylnaphthalene (60.1 ug/L) at the Main Dock Sump were below their respective groundwater to indoor air screening levels of 150 and 3300 ug/L. Groundwater sampling results at well MDS-3, which is upgradient of well MDS-4 and closer to the building, showed non-detect for benzene, naphthalene, and 2-methylnaphthalene, however. Due to the distance between the groundwater plume and the building, and the absence of volatile constituents at well MDS-3, no impact to indoor air is indicated.

No other occupied buildings at the facility occur within 100 ft of a groundwater plume containing volatile constituents above groundwater to indoor air screening levels.

**Surface Soil (< 2 ft):**

A total of 91 soil samples were collected for VOC, BNA and/or metals analysis during the RFI work in 1996 and the Supplemental RFI in 2003 (Ref. 1). The soil samples were collected from various surface and subsurface depths at 68 locations.

Surface soil results were compared to soil ingestion/dermal risk-based screening levels (RBSLs)(Ref. 1). RBSLs were obtained for an industrial on-site worker exposure scenario from the lower of EPA Region 3 ingestion risk-based concentrations (RBCs)(EPA Region 3, October 2004) and ingestion/dermal soil screening levels (SSLs) from EPA's Supplemental Guidance for Developing Soil Screening Levels for Superfund (Ref. 7). EPA Region 3 RBCs and EPA SSLs were not available for the ingestion/dermal exposure pathway for several of the detected constituents in soil (benzo(ghi)perylene, dibenzofuran, 2-methylnaphthalene, and phenanthrene). Texas Natural Resource Conservation Commission (TNRCC) protective concentration levels (PCLs)(TNRCC, March 2004) were employed for these three constituents. A soil screening level of 400 mg/kg was used for lead (Ref. 8).

No VOCs were detected in the surface soil above screening levels. No BNAs were detected in surface soil above screening levels, except for benzo(a)pyrene at one SWMU. Benzo(a)pyrene exceeded its screening level of 200 ug/kg at the East API Separator (SWMU 3)(230 ug/kg) at one location.

Metals detected in surface soil above screening levels consisted only of arsenic. Arsenic exceeded its screening level of 1.9 mg/kg in surface soil at the following six SWMUs: Slop Oil Tank (SWMU 35), Northeast Refinery Area (SWMU 40), West API Separator (SWMU 2), East API Separator (SWMU 3), East Aisle Ditch (SWMU 45), and Barge Dock Sump (SWMU 34). The arsenic levels at these SWMUs ranged from 2.1 B to 7.3 mg/kg, which were below the background level of 8.7 mg/kg. Since the arsenic levels are below background no residual risk is indicated.

**Surface Water:**

The Northeast Refinery Area (SWMU 40), Main Dock Sump (SWMU 33), and Barge Dock Sump (SWMU 34) are the only units that are located adjacent to surface water bodies. The Northeast Refinery Area is situated adjacent to Santiago and Lajas Creeks. The Main Dock Sump and Barge Dock Sump are situated adjacent to a saltwater inlet of the Caribbean Sea. There is no surface soil contamination at these SWMUs, hence no surface soil runoff impact to surface water is indicated.

As part of the Supplemental RFI (Ref. 1), surface water samples were collected and analyzed from Lajas Creek, which is adjacent to the Northeast Refinery Area (SWMU 40), and from the shoreline adjacent to the Main Dock Sump (SWMU 33). No VOCs or BNAs were detected in the surface water samples.

Groundwater sampling results at the Northeast Refinery Area (SWMU 40) showed that screening levels were not exceeded, except for 2-methylnaphthalene at one well. The 2-methylnaphthalene was detected in the groundwater above its screening level at well 40-21. Surface water results from Lajas Creek adjacent to the unit did not detect 2-methylnaphthalene, however. Additionally, no VOCs or other BNAs were detected in the surface water sample. Hence, no impact to surface water is indicated from this area.

The East Aisle Ditch, located adjacent to SWMUs 3, 43, and 44, has been designated as SWMU 45 and was also thoroughly investigated as part of the Supplemental RFI (Ref. 1). No VOCs, BNAs, or metals were detected in soil or groundwater at concentrations exceeding risk-based screening levels and/or background concentrations.

As previously discussed, the groundwater sampling results at well MDS-4 of the Main Dock Sump (SWMU 33) showed benzene, naphthalene, and 2-methylnaphthalene above screening levels (the actual presence of these constituents is subject to the qualification discussed above). Surface water (seawater) results from the shoreline adjacent to the SWMU and downgradient of well MDS-4 did not detect any of these constituents. Additionally, no other VOCs or BNAs were detected in the surface water.

Arsenic (2.7 B ug/L) was detected in the surface water (seawater) adjacent to the Main Dock Sump (SWMU 33) at a level above the Puerto Water Quality Standard of 1.4 ug/L. However, arsenic was not detected in the duplicate sample. The detection of arsenic at the low level in the primary sample may be due to instrument noise near the detection limit of 2.2 ug/L. Also, arsenic occurs naturally in seawater in concentrations generally ranging up to 2.6 ug/L (Refs. 9 and 10). Therefore, the arsenic level detected at the Main Dock Sump appears to be due to naturally occurring background levels or to laboratory instrument noise.

Groundwater sampling results at the Barge Dock Sump (SWMU 34) show that the downgradient well closest to the surface water did not exceed screening levels, hence no impact to surface water is indicated from this unit.

LNAPL occurrence and plume stability at the units is discussed in detail below.

Northeast Refinery Area (SWMU 40)

The LNAPL at the Northeast Refinery Area is interpreted by fingerprint analysis to be severely degraded #4 fuel oil with a probable age of twenty years or more. In December 2004, LNAPL thickness occurred up to 0.30 ft in a limited area. No recent releases or continuing sources are indicated. An EPA approved interim measure consisting of LNAPL measurement and recovery is ongoing. Weekly visual inspections since April 2003 of the adjacent Santiago and Lajas Creeks demonstrate the absence of LNAPL release to the surface water.

The physical characteristics of the soil at the Northeast Refinery Area are summarized as follows: silty clay loam, hydraulic conductivity of 0.122 m/d, hydraulic gradient of 0.012, total porosity of 0.43, estimated residual water saturation of 0.21, and an estimated field residual LNAPL saturation of 0.20.

The physical characteristics and other observations for the LNAPL at the Northeast Refinery Area are as follows: s specific gravity of 0.92, viscosity of 70.03 cSt, and an oil-air surface tension of 31.7 dynes/cm.

The low hydraulic conductivity, the small difference between porosity and the combined residual water and LNAPL saturations of the soil, and the high viscosity and surface tension of the LNAPL, and the age of the plume with no continuing sources are indicative of a stable LNAPL plume (Ref. 11). The observation of a stable LNAPL plume is consistent with the field observation noted above concerning absence of LNAPL in the surface water. Therefore, no impact to the adjacent surface water from the LNAPL plume is indicated.

Main Dock Sump (SWMU 33)

LNAPL collected from the Main Dock Sump (SWMU 33) area during the RFI work in 1996 was interpreted by fingerprint analysis to be severely degraded #4 fuel oil or a topped fraction of crude oil with a probable age of greater than 20 years. Subsequent releases at the unit from an adjacent above ground pipeline, which were reported to EPA, occurred in January 2002 and October 2003.

In December 2004, LNAPL thickness occurred up to 0.04 ft. No continuing sources are indicated. The free product plume has been observed to be stable or decreasing in size, based on groundwater monitoring and LNAPL gauging. Weekly visual inspections since January 2001 along the tidal inlet have found no evidence of a release to the surface water.

The physical characteristics of the soil and groundwater at the Main Dock Sump area are summarized as follows: medium to coarse sand, mean tidal elevation of 0.5 ft, hydraulic conductivity of 76.2 m/day, hydraulic gradient of about 0.0001, total porosity of 0.30, estimated residual water saturation of 0.09, and an estimated field residual LNAPL saturation of 0.12.

The physical characteristics and other observations for the LNAPL at the Main Dock Sump are summarized as follows: specific gravity of 0.87, estimated viscosity of 60 cSt, and an oil-air surface tension of 25 dynes/cm.

The flat hydraulic gradient, 0.5 ft mean tidal elevation, the high LNAPL viscosity, and the age of the plume and absence of continuing sources indicate that the LNAPL plume is stable (Ref. 11). A stable plume is confirmed since there has been no evidence of a release to the surface water during the RFI interim measures period. Therefore, no impact to the adjacent surface water from the LNAPL plume is indicated.

<u>Barge Dock Sump (SWMU 34)</u>

Monitoring wells at the Barge Dock Sump (SWMU 34) show that the LNAPL plume is limited to the area in the immediate vicinity of the unit. LNAPL measurements are performed at the unit on a quarterly basis as part of ongoing interim measures. Measurements in December 2004 at the unit show only sheen. LNAPL has not been detected at any of the downgradient wells between the unit and the inlet to the Caribbean Sea. Therefore, the plume is stable and no impact to the nearby surface water is indicated.

**<u>Sediment:</u>**

The Northeast Refinery Area (SWMU 40), Main Dock Sump (SWMU 33), and Barge Dock Sump (SWMU 34) are the only units that are located adjacent to surface water bodies. The Northeast Refinery Area is situated adjacent to Santiago and Lajas Creeks. The Main Dock Sump and Barge Dock Sump are situated adjacent to a saltwater inlet of the Caribbean Sea. There is no surface soil contamination at these SWMUs, hence no surface soil runoff impact to sediment is indicated.

To determine whether groundwater discharges may be impacting the sediments in the Caribbean Sea inlet adjacent to the Main Dock and Barge Dock Sumps, reported contaminant concentrations upgradient of this inlet were compared to screening criteria based on established surface water standards. In this case, contaminant concentrations potentially discharging to the Caribbean Sea were compared to the relevant Puerto Rico Water Quality Standards (PRWQS) for SB water bodies or, for contaminants lacking PRWQS, EPA Region 4 Saltwater Screening Levels. To account for dilution, dispersion, and other mitigating factors that have the effect of reducing groundwater contaminant concentrations at the point of discharge to surface water, the screening levels are increased by a factor of ten prior to comparison against field data. Arsenic was the only contaminant detected in applicable wells (i.e., MDS-8, MDS-9R, MDS-10R, and BDS-1) at concentrations exceeding its PRWQS. The maximum detected arsenic concentration in these wells, however, was 9.9 ug/L, which is less than 10.4 ug/L (i.e., the PRWQS of 1.4 ug/L times a factor of 10). Based on this analysis, sediments in the Caribbean Sea inlet are not expected to be contaminated.

Sediment samples were collected from Lajas Creek adjacent to the Northeast Refinery Area (SWMU 40) during the Supplemental RFI work in February 2005 and analyzed for VOCs and BNAs (Ref. 1). No VOCs or BNAs were detected in the sediment, which indicates that there is no impact from the unit.

As discussed above, the East Aisle Ditch, located adjacent to SWMUs 3, 43, and 44, was thoroughly investigated as SWMU 45 during the Supplemental RFI (Ref. 1). No VOCs, BNAs, or metals were detected in soil or groundwater at concentrations exceeding risk-based screening levels and/or background concentrations.

As discussed above, the LNAPL plumes at the Northeast Refinery Area, Main Dock Sump, and Barge Dock Sump areas are stable and no impact to sediment is indicated.

As discussed above, surface soil contamination (benzo(a)pyrene) occurs at one location at the East API Separator (SWMU 3). Any surface water runoff from this SWMU discharges to the adjacent East Aisle Ditch (SWMU 45). Material from the East Aisle Ditch is conveyed to the Tank Farm wastewater treatment plant.

**<u>Subsurface Soil (> 2 ft):</u>**

A total of 91 soil samples were collected for VOC, BNA and/or metals analysis during the RFI work in 1996 and the Supplemental RFI in 2003 (Ref. 1). The soil samples were collected from various surface and subsurface depths at 68 locations.

Subsurface soil results were compared to soil ingestion/dermal risk-based screening levels (RBSLs)(Ref. 1). RBSLs were obtained for an industrial on-site worker exposure scenario from the lower of EPA Region 3 ingestion risk-based concentrations (RBCs)(EPA Region 3, October 2004) and ingestion/dermal soil screening levels (SSLs) from EPA's Supplemental Guidance for Developing Soil Screening Levels for Superfund (Ref. 7). EPA Region 3 RBCs and EPA SSLs were not available for the ingestion/dermal exposure pathway for three of the detected constituents in soil (benzo(ghi)perylene, dibenzofuran, 2-methylnaphthalene, and phenanthrene). Texas Natural Resource Conservation Commission (TNRCC) protective concentration levels (PCLs)(TNRCC, March 2004) were employed for these three constituents. A soil screening level of 400 mg/kg was used for lead (Ref. 8).

No VOCs were detected in the subsurface soil above screening levels. No BNAs were detected in subsurface soil above screening levels, except for benzo(a)pyrene at one location each at three SWMUs. The table below summarizes the results.

| Subsurface soil contaminant | Risk-based screening level (ug/kg) | Maximum detected (ug/kg) | Location |
|---|---|---|---|
| Benzo(a)pyrene | 200 | 400 | Location 36-02 at the Dissolved Air Flotation Unit (SWMU 36) |
| Benzo(a)pyrene | 200 | 2600 | Location 40-03 at Northeast Refinery Area (SWMU 40) |
| Benzo(a)pyrene | 200 | 1000 | Location 3-01 at East API Separator (SWMU 3) |

Arsenic exceeded its direct-contact RBSL of 1.9 mg/kg in subsurface soil at the following seven SWMUs: Northeast Refinery Area (SWMU 40), West API Separator (SWMU 2), East API Separator (SWMU 3), Watery Oil Separator (SWMU 43), Ballast Basin Skimmer Area (SWMU 44), East Aisle Ditch (SWMU 45), and Barge Dock Sump (SWMU 34). With the exception of the Watery Oil Separator (SWMU 43), the arsenic levels at these SWMUs ranged from 2.1 B to 6.1 mg/kg, which were below the background level of 8.7 mg/kg. Therefore, no residual risk from arsenic is indicated at these SWMUs. The arsenic level at the Watery Oil Separator (SWMU 43) was 11 mg/kg at one location at a depth of 7-7.5 ft, which only slightly exceeded background.

**<u>Air (outdoors):</u>**

A total of 91 soil samples were collected for VOC, BNA and/or metals analysis during the RFI work in 1996 and the Supplemental RFI in 2003 (Ref. 1). The soil samples were collected from various surface and subsurface depths at 68 locations.

The surface and subsurface soil results were compared to risk-based screening levels (RBSLs) for the inhalation of volatile/particulates in outdoor air exposure pathway (Ref. 1). Screening levels were obtained from EPA SSLs (Ref. 7) for an industrial exposure scenario. EPA SSLs were not available for the outdoor air exposure pathway for two of the detected constituents in soil (acetone or 2-butanone). EPA Region 9 preliminary remediation goals (PRGs) (EPA, Region 9, October 2004b) were employed for these two constituents.

No constituents were detected in surface or subsurface soil above the outdoor air screening levels.

**<u>References:</u>**

1. Anderson, Mulholland & Associates, Inc. (AMAI), March 2005. Final RCRA Facility Investigation Report. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

2. RFI Quarterly Progress Reports 38 through 44, for the quarterly periods corresponding to September-December 2003 through January-March 2005. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

3. Anderson, Mulholland & Associates, Inc. (AMAI), 2003. Groundwater Investigation Report, Wastewater Treatment Plant and Service Building Areas, SCYI Facility. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

4. RFI Quarterly Progress Reports 40 through 43, for the quarterly periods corresponding to January-March 2004 through October-December 2004. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

5. U.S. Environmental Protection Agency (EPA), 1997. Drinking Water Advisory: Consumer Acceptability Advice and Health Effects Analysis on Methyl Tertiary-Butyl Ether (MTBE). Office of Water. EPA-833-F-97-009.

6. U.S. Environmental Protection Agency (EPA), 2002. Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. OSWER, EPA-530F-02-052

7. U.S. Environmental Protection Agency (EPA), 2001. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

8. U.S. Environmental Protection Agency (EPA), 1994, OSWER Directive #9355.4-12.

9. World Health Organization (WHO), 2001, Arsenic and Arsenic Compounds, 2nd Edition, Geneva.

10. Turekian, K.K., 1968, Oceans, Prentice Hall, New York.

11. Huntley, D., and G.D. Beckett, (2002), Evaluating Hydrocarbon Removal from Source Zones and its Effect on Dissolved Plume Longevity and Concentration, American Petroleum Institute, API Publication 4715, September.

3. Are there **complete pathways** between "contamination" and human receptors such that exposures can be reasonably expected under the current (land- and groundwater-use) conditions?

Summary Exposure Pathway Evaluation Table

Potential **Human Receptors** (Under Current Conditions)

| **"Contaminated" Media** | Residents | Workers | Day-Care | Construction | Trespassers | Recreation | Food |
|---|---|---|---|---|---|---|---|
| Groundwater | NO | NO | NO | YES | ___ | ___ | NO |
| ~~Air (indoors)~~ | ___ | ___ | ___ | | | | |
| Soil (surface, e.g., <2 ft) | NO | YES | NO | YES | NO | NO | NO |
| ~~Surface Water~~ | ___ | ___ | | | ___ | ___ | ___ |
| ~~Sediment~~ | ___ | ___ | | | ___ | ___ | ___ |
| Soil (subsurface e.g., >2 ft) | ___ | ___ | ___ | YES | ___ | ___ | NO |
| ~~Air (outdoors)~~ | ___ | ___ | ___ | ___ | ___ | | |

Instructions for Summary Exposure Pathway Evaluation Table:

1. Strike-out specific Media including Human Receptors' spaces for Media which are not "contaminated") as identified in 2 above.

2. Enter "yes" or "no" for potential "completeness" under each "Contaminated" Media – Human Receptor combination (Pathway).

Note: In order to focus the evaluation to the most probable combinations some potential "Contaminated" Media - Human Receptor combinations (Pathways) do not have check spaces ("___"). While these combinations may not be probable in most situations they may be possible in some settings and should be added as necessary.

____ If no (pathways are not complete for any contaminated media-receptor combination) - skip to #6, and enter "YE" status code, after explaining and/or referencing condition(s) in-place, whether natural or man-made, preventing a complete exposure pathway from each contaminated medium (e.g., use optional pathway Evaluation Work Sheet to analyze major pathways).

__X__ If yes (pathways are complete for any "Contaminated" Media - Human Receptor combination) - continue after providing supporting explanation.

_____ If unknown (for any "Contaminated" Media - Human Receptor combination) - skip to #6 and enter "IN" status code

Rationale and Reference(s):

**Residents, Day Care, Trespassers, Recreation via "contaminated":**

The SCYI facility site is currently utilized for industrial purposes only, thus no residents or day-care receptors are exposed to site contaminants. There is no recreational or agricultural use of the site. Therefore, there are no completed pathways for surface soil exposure for these receptors.

Access to the SCYI facility is limited to employees, contractors, and visitors. The perimeter of the facility is fenced and guarded 24 hours a day. Therefore, trespassers are not expected to gain access to the facility and are not expected to become exposed to impacted on-site surface soil.

There are no water supply wells used for public or private drinking water supplies that are located downgradient of the SCYI facility. Additionally, groundwater impact at the facility is limited to shallow depths, whereas potable water is typically withdrawn from greater depths. Hence, there is no completed exposure pathway to residents or day care receptors from groundwater exposure.

**Workers via "contaminated":**

Groundwater – Contaminated groundwater occurs only in the shallow water-bearing zone and not in the deeper water-bearing zone. The groundwater impact is described in the response to Question 2. There are no on-site wells for production or water supply. Therefore, there is no completed pathway for worker exposure.

The four production water wells for the facility are the most downgradient water supply wells in Yabucoa valley (Ref. 1). Based on the groundwater flow direction data for the facility (see the discussion in Question 2 for groundwater flow), the production wells are located upgradient of the site. The wells are located north and north-northwest of the Refinery Area. The production well closest to the facility is located about 2300 ft north of the Refinery Area. No apparent effect on groundwater levels at the facility from the production well pumping is observed. Since there is no indication of contamination at the production wells and the wells are upgradient of the facility, there is no potential for a completed pathway for worker exposure to groundwater from the production wells.

Surface Soil - Exposure to contaminated surface soil may occur to workers from benzo(a)pyrene at the East API Separator (SWMU 3). As discussed in the response to Question 2, benzo(a)pyrene exceeded its soil screening level of 200 ug/kg at the East API Separator (SWMU 3)(230 ug/kg) at one location.

**Construction Workers via "contaminated":**

Groundwater - Construction workers may potentially come in direct contact with contaminated groundwater during intrusive activities. As discussed in the response to Question 2, benzene, naphthalene, and 2-methylnaphthalene exceed groundwater-screening levels at the Main Dock Sump (SWMU 33). Arsenic exceeds groundwater-screening levels at well AB-1 of the North Aeration Basin (SWMU 17) and Barge Dock Sump (SWMU 34).

Surface Soil - Exposure to contaminated surface soil may occur to construction workers from benzo(a)pyrene at the East API Separator (SWMU 3). As discussed in the response to Question 2, benzo(a)pyrene exceeded its soil screening level of 200 ug/kg at the East API Separator (SWMU 3)(230 ug/kg) at one location.

Subsurface Soil – Exposure to contaminated subsurface soil may occur to construction workers during intrusive activities. As discussed in the response to Question 2, benzo(a)pyrene exceeded its soil screening level of 200 ug/kg at one location each at three SWMUs: the Dissolved Air Flotation Unit (SWMU 36), the Northeast Refinery Area (SWMU 40), and the East API Separator (SWMU 3). Concentrations ranged from 400 to 2600 ug/kg. The arsenic level at the Watery Oil Separator (SWMU 43) was 11 mg/kg at one location at a depth of 7-7.5 ft, which only slightly exceeded background level of 8.6 mg/kg.

Exposure to LNAPL in shallow plumes may also occur to construction workers.

**Food via "contaminated":**

Exposure pathways to food via contaminated soil and/or groundwater are not complete because no crops are grown in the areas where soil and groundwater contamination occur. Additionally, surface water and sediment were determined to be uncontaminated in Question 2 above and, therefore, uptake to fish or shellfish is not expected.

**References:**

1. Anderson, Mulholland & Associates, Inc. (AMAI), March 2005. Final RCRA Facility Investigation Report, March 2005. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

4. Can the **exposures** from any of the complete pathways identified in #3 be reasonably expected to be **"significant"**[4] (i.e., potentially "unacceptable" because exposures can be reasonably expected to be: 1) greater in magnitude (intensity, frequency and/or duration) than assumed in the derivation of the acceptable "levels" (used to identify the "contamination"); or 2) the combination of exposure magnitude (perhaps even though low) and contaminant concentrations (which may be substantially above the acceptable "levels") could result in greater than acceptable risks)?

__X__ If no (exposures can not be reasonably expected to be significant (i.e., potentially "unacceptable") for any complete exposure pathway) - skip to #6 and enter "YE" status code after explaining and/or referencing documentation justifying why the exposures (from each of the complete pathways) to contamination" (identified in #3) are not expected to be "significant."

_____ If yes (exposures could be reasonably expected to be "significant" (i.e., potentially "unacceptable") for any complete exposure pathway) - continue after providing a description (of each potentially "unacceptable" exposure pathway) and explaining and/or referencing documentation justifying why the exposures (from each of the remaining complete pathways) to "contamination" (identified in #3) are not expected to be "significant."

_____ If unknown (for any complete pathway) - skip to #6 and enter "IN" status code

Rationale and Reference(s):

Benzo(a)pyrene exceeded its screening level (200 ug/kg) in surface soil at the East API Separator (SWMU 3). Exposure to surface soil may occur for on-site and construction workers. The exceedance occurred at one location at a level of 230 ug/kg. The maximum estimated risk to on-site workers is estimated to be $1.2 \times 10^{-6}$. (The risk estimate was obtained by proportioning the EPA risk-based SSL of 200 ug/kg for industrial workers, which is based on a risk of $1 \times 10^{-6}$.) The risk estimate is conservative as it is unlikely that worker exposure would occur only at the area of maximum concentration. Actual worker exposure to benzo(a)pyrene in the surface soil would be less since a worker would be exposed to average soil concentrations, which are less than the maximum. The risk to construction workers is less since exposure assumptions for construction workers are less stringent that for on-site workers. Nevertheless, the conservative risk estimate of $1.2 \times 10^{-6}$ is within the USEPA acceptable target cancer risk range of $1 \times 10^{-4}$ to $1 \times 10^{-6}$. Therefore, the risk to on-site industrial workers and construction workers from exposure to benzo(a)pyrene in the surface soil is not expected to be significant.

Benzo(a)pyrene exceeded its screening level (200 ug/kg) in subsurface soil at one location each at the Dissolved Air Flotation Unit (SWMU 36) (400 ug/kg), the Northeast Refinery Area (SWMU 40) (2,600 ug/kg), and East API Separator (SWMU 3) (1,000 ug/kg). Exposure to subsurface soil may occur for construction workers. The maximum total excess lifetime cancer risk to construction workers from exposure to subsurface soil contaminated with benzo(a)pyrene is estimated to be less than $1.3 \times 10^{-5}$. This estimate is based on exposure to the maximum detected benzo(a)pyrene concentration of 2600 ug/kg. (The risk estimate was obtained by proportioning the EPA risk-based SSL of 200 ug/kg for industrial workers, which is based on a risk of $1 \times 10^{-6}$.) Therefore, the risk to construction workers from exposure to benzo(a)pyrene in the subsurface soil is not expected to be significant.

The screening level for arsenic (1.9 mg/kg) was exceeded in subsurface soil for arsenic at seven SWMUs, as discussed in the response to Question 2. Exposure to subsurface soil may occur for construction workers. With the exception of the Watery Oil Separator (SWMU 43), none of the arsenic levels exceeded the background level of 8.7 mg/kg, however. At the Watery Oil Separator (SWMU 43) the arsenic level of 11 mg/kg only slightly exceeded the background level. The maximum total excess lifetime cancer risk to construction workers from exposure to subsurface soil contaminated with arsenic is estimated to be less than $6.0 \times 10^{-6}$. (The risk estimate was obtained by proportioning the EPA Region 3 RBC of 1.9 mg/kg for industrial workers, which is based on a risk of $1 \times 10^{-6}$.) Therefore, the risk to construction workers from exposure to arsenic in the subsurface soil is not expected to be significant.

The risk estimates for construction workers discussed above for exposure to surface and subsurface soil contaminated with benzo(a)pyrene and arsenic are conservative as they are based on exposure factors for on-site industrial workers, which are more stringent than for construction workers. Consequently, the risk to construction workers is less than for on-site industrial workers. Also, it is unlikely that construction worker exposure would occur only at the area of maximum concentration. Actual construction worker exposure would be less since a worker would be exposed to average soil concentrations, which are less than the maximum.

All individuals conducting intrusive activities conducted at the SCYI facility must first obtain a permit from the facility, which is reviewed by facility Health and Safety personnel. At SWMUs with contamination above relevant screening criteria, this process provides for protection of construction workers through adherence to applicable OSHA regulations (e.g., PPE use) or by not allowing intrusive activities or disturbances to occur. Additionally, no construction activities are currently planned in the areas of concern. Therefore, construction worker exposure to groundwater contamination is not currently expected to be significant.

5. Can the "significant" **exposures** (identified in #4) be shown to be within **acceptable** limits?

_____ If yes (all "significant" exposures have been shown to be within acceptable limits) - continue and enter "YE" after summarizing and referencing documentation justifying why all "significant" exposures to "contamination" are within acceptable limits (e.g., a site-specific Human Health Risk Assessment).

_____ If no (there are current exposures that can be reasonably expected to be "unacceptable")- continue and enter "NO" status code after providing a description of each potentially "unacceptable" exposure.

_____ If unknown (for any potentially "unacceptable" exposure) - continue and enter "IN" status code.

Rationale and Reference(s):

Not applicable. See the response to Question 4.

6. Check the appropriate RCRIS status codes for the Current Human Exposures Under Control EI event code (CA725), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (and attach appropriate supporting documentation as well as a map of the facility):

_X__ YE - Yes, "Current Human Exposures Under Control" has been verified. Based on a review of the information contained in this EI Determination, "Current Human Exposures" are expected to be "Under Control" at the **Shell Chemical Yabucoa, Inc**. facility, EPA ID # PRD090074071, located in Yabucoa, Puerto Rico under current and reasonably expected conditions. This determination will be re-evaluated when the Agency/State becomes aware of significant changes at the facility.

____ NO - "Current Human Exposures" are NOT "Under Control."

____ IN - More information is needed to make a determination.

Completed by ____________________________________ Date __________
Shell Chemical Yabucoa Inc.

Reviewed and
Revised by ____________________________________ Date __________
Jennifer Nystrom, Risk Assessor
Booz Allen Hamilton (for EPA Region 2)

Reviewed by ____________________________________ Date __________
Ernst Jabouin, Project Manager
RCRA Programs Branch
EPA Region 2

____________________________________ Date __________
Dale J. Carpenter, Section Chief
RCRA Programs Branch
EPA Region 2

Approved by Original signed by: Date: September 28, 2005
Adolph Everett, Chief
RCRA Programs Branch
EPA Region 2

**Locations where References may be found:**
U.S. Environmental Protection Agency - Region 2
RCRA File Room
290 Broadway - 15th Floor
New York, New York 10007

**Contact telephone and e-mail numbers:**
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**FINAL NOTE: THE HUMAN EXPOSURES EI IS A QUALITATIVE SCREENING OF EXPOSURES AND THE DETERMINATIONS WITHIN THIS DOCUMENT SHOULD NOT BE USED AS THE SOLE BASIS FOR RESTRICTING THE SCOPE OF MORE DETAILED (E.G., SITE-SPECIFIC) ASSESSMENTS OF RISK.**

<u>Attachments</u>

The following attachments have been provided to support this EI determination.

Attachment 1 - Summary and Description of the SWMUs Subject to the RFI
Attachment 2 - List of SWMUs at the Facility Not Subject to the RFI
Attachment 3 – Locations of SWMUs

**Attachment 1**
**SWMU Description Document**

## West API Separator – SWMU 2

The West API Separator is an in-ground, reinforced concrete tank that provides primary oil/water/solids separation to stormwater and any potential tank water draw-off handled within the western portion of the Tank Farm. Accumulated stormwater is discharged to the West Aisle Ditch from within product tank diked areas and from the Truck Loading Rack. The West Aisle Ditch discharges this stormwater by gravity into the West API Separator. The separator does not receive stormwater runoff from process areas. Therefore, only a minimum amount of oil is expected to be contained in the stormwater.

Oily emulsion recovered from the separator is discharged to the Watery Oil Separator for further separation. Recovered oil is ultimately conveyed to the Crude Tanks for reprocessing. Water from the separator is discharged to the Ballast Basin to be rerouted to the refinery wastewater treatment system and is ultimately discharged into the Caribbean Sea through NPDES Outfall 001. API separator sludge is periodically removed from the unit and processed in a plate and frame filter press for dewatering. The residual solids are sent to Norco Refinery, a subsidiary of Shell Company in Louisiana, to be recycled for energy recovery in an FCC unit as a non-hazardous waste. The West API Separator was placed in service in 1971 and is currently operational.

The West API Separator is designed and operated to prevent releases of hazardous constituents to the environment. The unit is 79' long x 20'8" wide x 8'6" deep. Exterior walls of the separator are constructed of 10" thick reinforced concrete. Walls are connected to the 12" thick reinforced concrete tank bottom using steel reinforcement tying and a 3 5/8" concrete shear key with a 4" PVC waterstop. A sludge collector located near the southern end of the unit consists of four triangular collection trenches. The trenches are constructed of 12" thick reinforced concrete.

Stormwater enters the separator through a 3' wide x 50' long x 3'10" deep in-ground trench. This trench receives flow from the West Aisle Ditch. The trench discharges into the separator through a 4' x 13' x 3'10" deep diversion box, which is attached to the southern wall of the separator. Both the diversion box and the trench are constructed of reinforced concrete with 10" thick walls and base, and are covered with steel grating. The concrete base of the diversion box and trench area is set on well-compacted subgrade. The connection of the exterior wall to the diversion box walls, and the diversion box and trench exterior walls to the concrete base, is accomplished with reinforced steel bars and the shear key.

The northern section of the West API Separator measures 11' 6" x 20' 8" x 11'6" deep and contains the pumps and stilling wells. The area is constructed with the same exterior walls and base as the center of the separator, however, it is partially covered by a 6' long, 12" thick reinforced concrete slab which provides support to the effluent pumps.

The oil sump is located on the northeast corner of the separator and measures 8' x 4' x 11'6" deep. Its base is 12" thick reinforced concrete and the walls are 10" thick reinforced concrete. The sump is connected to the separator's exterior walls via steel reinforcing bars.

*Quantities of Solid and Hazardous Waste*

The West API Separator has a design capacity of 750 gallons per minute and could accumulate approximately 75 tons of oily bottom sludges on a yearly basis, which as discussed below, are not considered a solid waste.

*Hazardous Wastes or Constituents*

The stormwater that is conveyed to the West API Separator may contain low levels of petroleum hydrocarbons and metals. The slop oil generated in the unit is not a solid waste since it is recycled. The bottom sludge generated in the unit is no longer classified as a hazardous waste (K051), since now it is recycled (it was listed due to the potential presence of chromium and lead). Actually, this material, which is now exempted due to the secondary oil-bearing recycling exclusion, is dewatered and sent to an FCC unit for energy recovery. TCLP analysis of separator sludge conducted in 1990 detected benzene at 261 ppb and barium at 950 ppb. No other TCLP parameters were detected.

**EAST API SEPARATOR - (SWMU 3)**

*Location*

The East API Separator is located within the eastern portion of the Tank Farm Area.

*Description*

The East API Separator is an in-ground, reinforced concrete tank which provides primary oil/water/solids separation to tank water draw-offs, pipelines relief valve popping, and any stormwater collected within the eastern portion of the Tank Farm. Accumulated stormwater is discharged to the East Aisle Ditch from within crude and product tank diked areas. The East Aisle Ditch discharges those materials by gravity into the East API Separator. The East API Separator does not receive stormwater runoff from process areas. Therefore, only a minimum amount of oil is expected to be contained in the stormwater. Oily emulsion recovered from the separator is discharged to the Watery Oil Separator for further separation. Recovered oil is ultimately conveyed to the crude tanks for reprocessing. Water from the separator is discharged to the Ballast Basin to be rerouted to the refinery wastewater treatment system and is ultimately discharged into the Caribbean Sea through NPDES Outfall 001. API separator sludge is periodically removed from the unit and processed in a plate and frame filter press for dewatering. The residual solids are sent to Norco Refinery, a subsidiary of Shell Company in Louisiana, to be recycled for energy recovery in an FCC unit as a non-hazardous waste The Separator was placed in service in 1971 and is currently operational.

The East API Separator is designed and operated to prevent releases of hazardous constituents to the environment. The unit is 79' long x 20'8" wide x 8'6" deep. Exterior walls of the separator are constructed of 10" thick reinforced concrete. Walls are connected to the 12" thick reinforced concrete tank bottom using steel reinforcement tying and a 3 5/8" concrete shear key with a 4" PVC waterstop. A sludge collector located near the northern end of the unit, consists of four triangular collection trenches. The trenches are constructed of 12" thick reinforced concrete. Stormwater enters the separator through a 3' wide x 50' long x 3'10" deep in-ground trench. This trench receives flow from the East Aisle Ditch. The trench discharges into the separator through a 4' x 13' x 3'10" deep diversion box, which is attached to the northern wall of the separator. Both the diversion box and the trench are constructed of reinforced concrete with 10" thick walls and base, and are covered with steel grating. The concrete base of the diversion box and trench area are set on well compacted subgrade. The connection of the northern most exterior wall to the diversion box walls, and the diversion box and trench exterior walls to the concrete base, is accomplished with reinforced steel bars and the shear key (with PVC waterstop). The southern northern section of the East API Separator measures 11' 6" x 20' 8" x 11'6" deep and contains the pumps and stilling wells. The area is constructed with the same exterior walls and base as the center of the separator, however, it is partially covered by a 6' long, 12" thick reinforced concrete slab which provides support to the effluent pumps.

The oil sump is located on the southeast corner of the separator and measures 8' x 4' x 11'6" deep. Its base is 12" thick reinforced concrete and the walls are 10" thick reinforced concrete. The sump is connected to the separator's exterior walls via steel reinforcing bars.

*Quantities of Solid and Hazardous Waste*

The design capacity of the East API Separator is 750 gallons per minute and could accumulate approximately 75 tons of oily bottom sludges on a yearly basis, which as discussed below, are not considered a solid waste.

*Hazardous Wastes or Constituents*

Stormwater conveyed to the East API Separator may contain low levels petroleum hydrocarbons and metals. The slop oil generated in the unit is not a solid waste since it is recycled. The bottom sludge generated in the unit is no longer classified as a hazardous waste (K051), since now it is recycled (it was listed due to the potential presence of chromium and lead). Actually, this material, which is now exempted due to the secondary oil-bearing recycling exclusion, is dewatered and sent to an FCC unit for energy recovery. TCLP analysis of separator sludge was conducted in 1990. Benzene was detected at 214 ppb, MEK at 85 ppb and barium at 850 ppb. No other TCLP parameters were detected.

## FINAL RETENTION BASIN - (SWMU 14)

*Location*

The former Final Retention Basin was located in the southern portion of the refinery wastewater treatment area.

*Description*

The Final Retention Basin was an in-ground earthen surface impoundment which received boiler blowdown and off-specification water from sour water strippers at the Hydrotreater Unit. The basin also received wastewater from any process unit in which there was an upset condition which may have caused a shock load to the wastewater treatment system. The Final Retention Basin was used to store and regulate flow of these high ammonia and other wastestreams prior to discharge to the Equalization Basin and to the North and South Aeration Basins. The Final Retention Basin was approximately 360' long x 120' wide x 10' deep. The unit was provided with a 24" thick compacted clay liner which was designed to prevent migration of impounded liquids into the subsurface. The basin was placed in service in 1971 and ceased operation in 1991. Liquids, sludge and the clay liner were removed.

The excavation was then backfilled to within four feet of grade. Equalization Tanks W7 and W8 have been constructed on the site of the former basin.

*Volume of Wastes Managed*

Prior to its closure, the Final Retention Basin provided a 2.25 million gallon capacity, or one day's storage at the design flow.

*Hazardous Wastes or Constituents*

The Final Retention Basin did not manage hazardous waste. Wastewater received in the basin may have contained low levels of petroleum hydrocarbons.

## NORTH AERATION BASIN - (SWMU 17)

*Location*

The North Aeration Basin is located within the central portion of the refinery wastewater treatment area.

*Description*

The North Aeration Basin is an in-ground earthen surface impoundment which receives wastewater effluent from the Equalization Tanks. The North Aeration Basin is equipped with four mechanical aerators which provide aggressive biological treatment to the wastewater. Effluent enter by gravity to the Clarifier through a gate valve. A portion of the sludge collected in the Clarifier is returned to the North Aeration Basin as activated sludge. The North Aeration Basin is approximately 250' long x 82' wide x 12'6" deep. The unit is designed to prevent migration of impounded liquids into the subsurface. The sloped sides and bottom of the basin are constructed with 3" of shotcrete. The shotcrete layer is underlain with a 24" thick layer of compacted clay. The basin was placed in service in 1971 and is currently operational.

*Volume of Wastes Managed*

The volume of the North Aeration Basin is approximately 1.2 million gallons.

*Hazardous Wastes or Constituents*

The North Aeration Basin does not manage hazardous waste. Wastewaters and sludge may contain low levels of petroleum hydrocarbons and metals.

**SOUTH AERATION BASIN - (SWMU 18)**

*Location*

The South Aeration Basin is located within the central portion of the refinery wastewater treatment area.

*Description*

The South Aeration Basin is an in-ground earthen surface impoundment which receives wastewater effluent from the Equalization Tanks. The South Aeration Basin is equipped with four mechanical aerators which provide aggressive biological treatment to the wastewater. This unit operates in parallel with the North Aeration Basin (NAB). Effluent from this unit is mixed with the effluent coming from the NAB and then enters into the Clarifier. A portion of the sludge collected in the Clarifier is returned to the South Aeration Basin as activated sludge. The South Aeration Basin is approximately 250' long x 82' wide x 12'6" deep. The unit is designed to prevent migration of impounded liquids into the subsurface. The sloped sides and bottom of the basin are constructed with 3" of shotcrete. The shotcrete layer is underlain with a 24" thick layer of compacted clay. The basin was placed in service in 1971 and is currently operational.

*Volume of Wastes Managed*

The volume of the South Aeration Basin is approximately 1.2 million gallons.

*Hazardous Wastes or Constituents*

The South Aeration Basin does not manage hazardous waste. Wastewater and sludge may contain low levels of petroleum hydrocarbons and metals.

**MAIN DOCK SUMP AREA - (SWMU 33)**

*Location*

The Main Dock Sump Area is located adjacent to the Main Dock catwalk at SCYI's Dock facility.

*Description*

The Main Dock Sump Area consists of two adjacent in-ground concrete tanks - the Main Dock Oil Drainage Sump ("Oil Sump") and the Main Dock Stormwater Sump ("Stormwater Sump").

Oil Drainage Sump

The Oil Sump collects crude and product drainage from the pipelines servicing the main dock and hoses used for loading and unloading vessels. Collected oil flows by gravity from the dock facility into the sump. Oil is then pumped directly to a crude tank and is ultimately returned to the crude unit for processing. The Oil Sump is 39' long x 16'6" wide x 7' deep. The north, south and west walls of the tank slope at 1:1 to the bottom of the tank. These walls, as well as the 28' x 5' tank bottom, are constructed of 4" thick reinforced concrete. The inside of the tank is lined with 1/4-inch steel plating. The upper 18" of the walls are vertical and are constructed of 9" thick reinforced concrete. The eastern wall is also constructed of 9" thick reinforced concrete. A 5' x 6' control sump is situated in the southeast corner of the tank. The walls of the sump are 9" thick reinforced concrete. The floor of the sump is 12" thick reinforced concrete. The Oil Sump was constructed in 1972 and is currently operational.

Stormwater Sump

The Stormwater Sump collects precipitation runoff from the Main Dock facility. Stormwater flows by gravity from the dock facility into the sump. Stormwater is then pumped back to the tank farm where it is discharged into the wastewater treatment system.

The Stormwater Sump is 42' long x 17' wide x 5'6" deep. The walls of the tank are constructed of 12" thick reinforced concrete. The floor of the tank is constructed of 24" thick reinforced concrete and is underlain by a 3" sand layer and a layer of 40 mil High Density Polyethylene (HDPE). A 5' x 5' control sump is situated in the southeast corner of the tank. The Stormwater Sump was constructed in 1992.

Both the Oil Sump and the Stormwater Sump are surrounded by a contiguous 4" thick bermed slab designed to contain spilled material.

*Volume of Wastes Managed*

The Oil Sump does not manage waste since all material is recovered. The capacity of the Stormwater Sump is approximately 700 barrels.

*Hazardous Wastes or Constituents*

The Oil Sump does not manage waste. Hazardous constituents that may be present in the Oil Sump include petroleum hydrocarbons. Stormwater entering the Stormwater Sump may contain low concentrations of petroleum hydrocarbons.

**BARGE DOCK SUMP AREA - (SWMU 34)**

*Location*

The Barge Dock Sump Area is located adjacent to the Barge Dock catwalk at SCYI's Dock facility.

*Description*

The Barge Dock Sump Area consists of two adjacent in-ground concrete tanks - the Barge Dock Oil Drainage Sump ("Oil Sump") and the Barge Dock Stormwater Sump ("Stormwater Sump").

Oil Drainage Sump

The Oil Sump collects product drainage from the pipelines servicing the barge dock and hoses used for loading and unloading barges. Collected oil flows by gravity from the dock facility into the sump. Oil is then pumped directly to a crude tank and is ultimately returned to the crude unit for processing. The Oil Sump is 43'8" long x 15' wide x 7' deep. The east, west and south walls of the tank slope at 1:1 to the bottom of the tank. These walls, as well as the tank bottom, are constructed of 4" thick reinforced concrete. The inside of the tank is lined with 1/4-inch steel plating. The northern wall is constructed of 9" thick reinforced concrete. A 6' x 6' control sump is situated in the northwest corner of the tank. The walls of the sump are 9" thick reinforced concrete. The floor of the sump is 12" thick reinforced concrete. The Oil Sump was constructed in 1972 and is currently operational.

Stormwater Sump

The Stormwater Sump collects precipitation runoff from the Barge Dock facility. Stormwater flows by gravity from the dock facility into the sump. Stormwater is then pumped back to the tank farm where it is discharged into the wastewater treatment system.

The Stormwater Sump is 15' long x 10' wide x 5'6" deep. The walls of the tank are constructed of 12" thick reinforced concrete. The floor of the tank is constructed of 18" thick reinforced concrete and is underlain by a 3" sand layer and a layer of 40 mil High Density Polyethylene (HDPE). A 5' x 5' control sump is situated in the northeast corner of the tank. The Stormwater Sump was constructed in 1992.

Both the Oil Sump and the Stormwater Sump are surrounded by a contiguous 4" thick bermed slab designed to contain spilled material.

*Volume of Wastes Managed*

The Oil Sump does not manage waste since all material is recovered. The capacity of the Stormwater Sump is approximately 150 barrels.

*Hazardous Wastes or Constituents*

The Oil Sump does not manage waste. Hazardous constituents that may be present in the Oil Sump include petroleum hydrocarbons. Stormwater entering the Stormwater Sump may contain low concentrations of petroleum hydrocarbons.

**SLOP OIL TANK 103 - (SWMU 35)**

*Location*

Slop Oil Tank 103 is located in the northern portion of the refinery process area.

*Description*

Slop Oil Tank 103 receives recovered oil from Slop Oil Tanks W5 and W6. The tank also receives slop oil from the flare knockout drum, the naphtha line relief valve and other process units. Recovered oil is pumped to the crude unit for recovery. Water is conveyed to the 2-Cell API Separator. Slop Oil Tank 103 is a fixed roof steel tank with a diameter of 42' 6" and a height of 40'. The tank is constructed on an asphalt/gravel foundation, which extends out 5 feet from the wall of the tank. The area surrounding Tank 103 and its asphalt foundation has been lined with a 5" thick slab of concrete. Tank 103, along with two adjacent tanks, is surrounded by a 48" high concrete wall which provides secondary containment. The containment area is equipped with a concrete channel to collect stormwater. Tank 103 was placed in service in 1971 and is currently operational.

*Volume of Wastes Managed*

All oil received in the tank is returned to the refinery process and recovered. The tank has a capacity of 10,000 barrels. The quantity of slop oil typically stored in the unit is approximately 3,000 barrels. Bottom sludge is considered F037 and is disposed as that when removed during clean ups.

*Hazardous Wastes or Constituents*

Slop oil entering the tank may contain petroleum hydrocarbons and metals. Bottom sludge is considered F037 and is disposed as that when removed during clean ups.

**DISSOLVED AIR FLOTATION UNIT - (SWMU 36)**

*Location*

The Dissolved Air Flotation (DAF) Unit is located adjacent to the southwest corner of the Equalization Basin within the refinery wastewater treatment area.

*Description*

The DAF Unit is an above ground, concrete tank which provides secondary oil/water/solids separation to process wastewater. The unit receives wastewater from the 2-Cell API Separator and discharges to the Equalization Tanks. Float drawn off the DAF unit is pumped to Slop Oil Tanks W5 and W6 and is ultimately returned to the refinery process for recovery. The DAF Unit is approximately 82' long x 23' wide x 8' deep and is constructed of reinforced concrete. Exterior walls are constructed of 12" thick reinforced concrete and are connected to the 15" thick reinforced concrete base via a shear key with PVC waterstops. An 8' x 5' x 8'6" deep concrete sump is located at the northwest corner of the DAF Unit. The sump is covered by a 1-3/4" steel grate.

*Volume of Wastes Managed*

Average flow through the DAF Unit is between 800 to 1500 gallons per minute.

*Hazardous Wastes or Constituents*

The DAF Unit receives wastewater which periodically exhibits elevated levels of benzene. In 1990, this wastewater became subject to RCRA regulation and was classified as D018 (TCLP-benzene). Float generated in the DAF Unit is classified as a hazardous waste (K048) when it is removed from the unit. DAF float is listed as a hazardous waste due to the potential presence of chromium and lead. Oily bottoms generated in the DAF Unit are classified as a hazardous waste (F038) when it is removed from the unit. DAF sludge bottom residues are listed as a hazardous waste due to the presence of benzene, benzo(a)pyrene chrysene, lead, and chromium. TCLP analysis of DAF float was conducted in 1990. Barium was detected at 1.1 parts per million. No other TCLP parameters were detected.

**DEWATERING CHAMBER - (SWMU 38)**

*Location*

The Dewatering Chamber is located within the Refinery Area, immediately west of the Equalization Tanks.

*Description*

The Dewatering Chamber is a part of the refinery wastewater treatment system and consists of a partially in-ground concrete box on a concrete pad. The unit was used in the past to thicken API separator sludge (K051) from the refinery 2 and 3-Cell API Separators as well as the tank farm East and West API Separators. Dewatering in the unit occurred by gravity separation of oil, water and solids. Oily water was decanted from the unit and flowed by gravity through an 8-inch pipe back into the 2-Cell Separator. Solids were removed from the tank, placed in the former Hazardous Waste Mixing Box and mixed with cement kiln dust to ensure that the material contained no free liquids. The solidified sludge was placed in appropriate containers and moved to the Hazardous Waste Storage Building. The Dewatering Chamber is a 24' long x 10' wide x 7' deep structure constructed of reinforced concrete. The bottom of the unit is lined with one quarter inch thick steel sheeting. The unit is surrounded by a 4" thick reinforced concrete pad. The chamber was placed in service in 1971. The unit has not been used for the management of hazardous waste since 1993.

*Volume of Wastes Managed*

The Dewatering Chamber has a capacity of approximately 50 cubic yards. The unit was used only when API sludge was removed from the separators.

*Hazardous Wastes or Constituents*

The dewatering chamber managed API separator sludge (K051), which is a listed hazardous waste due to the potential presence of chromium and lead. In addition, the waste may have contained petroleum hydrocarbons.

**HAZARDOUS WASTE MIXING BOX - (SWMU 39)**

*Location*

This unit was located within the outdoor storage pad located to the rear of the Hazardous Waste Storage Building.

*Description*

The Hazardous Waste Mixing Box was used in the past to mix hazardous waste (K051) with cement kiln dust in order to solidify the waste and render it suitable (i.e., no free liquids) for off-site transportation and disposal. After the sludge was solidified, it was placed in suitable containers, labeled, and transferred to the Hazardous Waste Storage Building prior to off-site disposal. The above ground steel box was approximately 20' long x 15' wide x 3' deep and was situated on top of a asphalt pad. This unit began operation in 1987 and was taken out of service in 1991.

*Volume of Wastes Managed*

The Hazardous Waste Mixing Box had a capacity of approximately 30 cubic yards. The unit was used only when API sludge was removed from the separators.

*Hazardous Wastes or Constituents*

The Hazardous Waste Mixing Box managed API separator sludge (K051), which is a listed hazardous waste due to the potential presence of chromium and lead. In addition, the waste may have contained contain petroleum hydrocarbons.

**DISPOSAL AREA BEHIND HAZARDOUS WASTE STORAGE BUILDING - (SWMU 40)**

*Location*

The Disposal Area Behind the Hazardous Waste Storage Building was located in the northeastern corner of the refinery wastewater treatment area. The area has been expanded and is now referred to as the Northeast Refinery Area.

*Description*

This area had been used for the temporary staging of non-hazardous waste material prior to off-site disposal. The area was not used for disposal of waste. This area included three small piles of waste material on the soil surface. One pile consisted of debris associated with cleaning of tank farm dikes. Two piles contained soil stained with blue and red colored contents of spent fire extinguishers. The three piles have been removed from the area. The area has not been otherwise used for placement of waste materials on the ground.

As a result of detection of petroleum LNAPL at the northern part of the area, the investigation area was expanded and is now referred to as the Northeast Refinery Area.

*Volume of Wastes Managed*

It is estimated that each pile contained less than one cubic yard of waste material.

*Hazardous Wastes or Constituents*

Hazardous waste was not placed in this area. There is no indication that materials managed in this area contained hazardous constituents.

**WATERY OIL SEPARATOR - (SWMU 43)**

*Location*

The Watery Oil Separator is located in the Tank Farm Area immediately west of Ballast Water Tanks W1 and W2.

*Description*

This unit is an in-ground concrete tank which provides oil/water separation to oily emulsions received from the East and West API Separators, and Ballast Water Tanks W1 and W2. (Note: As of 2002, ballast water is no longer handled by the facility. Hence, Tanks W1 and W2 are no longer used to receive ballast water). The separator also receives water drawoffs from the crude oil tanks that reach the East API Separator. Recovered oil is contained in the oily sump and is ultimately returned to the crude unit for processing. Water is returned to the East API Separator.

The Watery Oil Separator is a 28' long x 12' wide x 5'6" deep tank with an attached 8' x 4' x 5'6" deep sump for the collection of skimmed oil. The unit has a 12" thick reinforced concrete base. The exterior walls 8" thick reinforced concrete and are connected to the base with steel reinforcing bars and a 1 5/8" concrete shear key and 4" x 3/16" PVC water stops. The unit was placed in service in 1971 and is currently operational. In 1989, a concrete slab was installed around the Watery Oil Separator. The concrete slab is constructed with a 10" thick reinforced concrete base surrounded by a 12" high reinforced concrete berm. The base sits on well compacted crushed stone and fine gravel. This concrete slab, which encompasses the Watery Oil Separator as well as the Induced Air Flotation Unit and associated equipment, is referred to as the "General Pit Area.

*Volume of Wastes Managed*

The capacity of the Watery Oil Separator is approximately 500 barrels of slop oil.

*Hazardous Wastes or Constituents*

Oil collected in this unit is recovered. Material managed in the unit contains petroleum hydrocarbons and may contain low levels of metals. Oil/water/solids and oily bottoms from this unit are classified as F038.

## BALLAST BASIN - (SWMU 44)

*Location*

The Ballast Basin is located within the tank farm wastewater treatment area. It is situated immediately north of the Firewater Basin.

*Description*

This unit received ballast water and off-specification wastewater from the tank farm Induced Air Flotation (IAF) Unit. (The IAF is also known as the WEMCO unit). Effluent from the Ballast Basin was recirculated back to the head of the IAF Unit for further treatment. Periodically, off-specification effluent from the basin is conveyed to the 2-Cell Separator in the Refinery Area. (Note: As of 2002, ballast water is no longer handled by the facility. Also, as of 2005, the IAF is no longer used. Currently, the Ballast Basin is used for transfer of wastewater to the WWTP at the refinery area).

The Ballast Basin is an in-ground surface impoundment surrounded by earthen dikes. The basin is approximately 275' long x 125' wide x 8' deep. The dikes and the bottom of the basin are lined with a low permeability Dacron polyester liner which is constructed on top of a 24 inch sand layer. The unit is equipped with three mechanical surface aerators which provide aggressive biological treatment to the basin contents. The basin is underlain by a leachate collection system which consists of a series of 4-inch perforated PVC pipe. The collector pipe discharges liquids by gravity into the leachate collector tank which is located adjacent to the northeast corner of the basin. A 10' wide by 21' long by 14' deep reinforced concrete effluent pump sump is built into the western end of the north dike of the basin. The Ballast Basin is equipped with a rope mop oil skimmer system designed to remove floating oil from the surface of the basin. The skimmer unit is situated on a 10' x 10' x 6" thick reinforced concrete pad which is constructed on top of the north dike adjacent to the pump sump. The concrete pad is constructed upon a reinforced concrete block foundation. The foundation is filled to the level of the concrete pad with river sand. There is no sump associated with the oil recovery system. Recovered oil is discharged directly into a vacuum truck and transferred to the Watery Oil Separator.

*Volume of Wastes Managed*

The Ballast Basin has a capacity of 2.1 million gallons.

*Hazardous Wastes or Constituents*

The Ballast Basin does not manage hazardous waste. EP Toxicity analyses conducted on basin sludge between 1980 and 1982 detected all EP Toxicity metals at levels well below regulatory limitations. Organic EP Toxicity parameters were not detected. Low concentrations of petroleum hydrocarbons may be found in the Ballast Basin.

## BALLAST BASIN LEACHATE COLLECTOR TANK - (SWMU 44A)

*Location*

The Ballast Basin Leachate Collector Tank is located within the diked area of Ballast Water Tanks W1 and W2 in the tank farm. The tank is situated adjacent to the northeast corner of the Ballast Basin.

*Description*

This tank serves as the leachate collector tank for the Ballast Basin leachate collection system. Leachate flows by gravity into the tank from the 4" PVC collector pipes underlying the Ballast Basin. The tank consists of a 10 ft section of 42" diameter concrete pipe placed vertically into the ground to a depth of 9 feet. The upper 12 inches of the tank is above ground. The tank is constructed on a 4'9" square, 6" thick slab of concrete reinforced with 6”x6” wire mesh. The tank is sealed at the base by 1 inch of grout. The collector pipe enters the tank at a point 12 inches from the tank bottom. The tank is covered by a hinged, 1/4-inch thick circular steel plate. The tank is periodically inspected by operations personnel. Standing water is vacuumed from the tank and discharged into the wastewater treatment plant. The tank was installed in 1982 at the time the leachate collection system was installed at the Ballast Basin.

*Volume of Waste Managed*

The volume of liquid managed in the Collector Tank does not exceed 60 gallons.

*Hazardous Wastes or Constituents*

The Leachate Collector Tank does not manage hazardous waste. Since the Ballast Basin is not a regulated hazardous waste management unit, leachate collected from the unit is not classified as a hazardous waste. A sample of the leachate was analyzed for Target Compound and Skinner List parameters in 1993. Acetone and carbon disulfide were found at concentrations below method detection limits. No other constituents were detected.

## EAST AISLE DITCH - (SWMU 45)

*Location*

This unit is located in the eastern part of the Tank Farm Area.

*Description*

The East Aisle Ditch is an in ground, lined channel which carries stormwater runoff from diked tank areas and concrete pads from the eastern part of the Tank Farm Area. The ditch discharges by gravity into the East API Separator.

The East Aisle Ditch has a length of approximately 1550 feet. The ditch slopes gradually toward the East API Separator which is located near the midpoint of the ditch. The ditch is constructed on a well compacted subgrade with 1:1 1/2 sloped walls and a 1' wide flat base. The walls and base of the ditch are constructed with 2" thick shotcrete reinforced with 2" x 2" steel wire mesh. The 2" thick shotcrete extends outward 1 foot from the top of the sloped walls, where a 4" wide by 4" thick shotcrete footing is constructed. All joints between adjacent wall sections are constructed with PVC waterstops to prevent the unit from leaking. The East Aisle Ditch is routinely cleaned by maintenance personnel and inspected by operations personnel. The Ditch is cleaned at least once per year. The ditch was placed in service in 1971 and is currently operational.

*Volume of Wastes Managed*

The volume of stormwater managed in this unit varies. However, the ditch is designed to handle all anticipated stormwater events.

*Hazardous Wastes or Constituents*

The East Aisle Ditch does not manage hazardous waste. Stormwater entering the East Aisle Ditch may contain low levels of petroleum hydrocarbons.

## Attachment 2

## Solid Waste Management Units Not Subject to the RCRA Facility Investigation

| Number | Description |
|---|---|
| SWMU 1 | Tug Boat Dock Sump |
| SWMU 4 | West Aisle Ditch |
| SWMU 5 | Firewater Basin |
| SWMU 6 | Outfall Basin |
| SWMU 7 | 3-Cell API Separator |
| SWMU 8 | 2-Cell API Separator |
| SWMU 9 | Flood Surge Pond |
| SWMU 10 | Lime Pits |
| SWMU 11 | Sulfur Pit |
| SWMU 12 | Slop Tank W5 |
| SWMU 13 | Slop Tank W6 |
| SWMU 15 | Equalization Basin |
| SWMU 16 | Sludge Digester |
| SWMU 19 | Clarifier |
| SWMU 20 | Float Oil Basin |
| SWMU 21 | Old Oily Sludge Basin |
| SWMU 22 | Hazardous Waste Storage Area (HWSA) |
| SWMU 23 | Asbestos Boxes |
| SWMU 24 | Asbestos Box Van |
| SWMU 25 | Nonhazardous Waste Mixing Box |
| SWMU 26 | Davco Unit |
| SWMU 27 | Heat Exchanger Bundle Cleaning Area |
| SWMU 28 | Nonhazardous Waste Disposal Area |
| SWMU 29 | Spent Catalyst Area |
| SWMU 30 | Asbestos Disposal Area |
| SWMU 31 | Perimeter Ditch |
| SWMU 37 | Sand Drying Beds |
| SWMU 41 | Ballast Tank W1 |
| SWMU 42 | Ballast Tank W2 |
| SWMU 46 | New Oily Sludge Basin |
| SWMU 47 | Nonhazardous Waste Storage Area |
| SWMU 48 | Induced Air Flotation Unit |
| SWMU 49 | Equalization Tank W7 |
| SWMU 50 | Equalization Tank W8 |
| SWMU 51 | Sludge Processing Facility |