

## DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

### RCRA Corrective Action Environmental Indicator (EI) RCRIS code (CA725) Current Human Exposures Under Control

**Facility Name:** Bayway Refinery  
**Facility Address:** 1400 Park Avenue, Linden, New Jersey  
**Facility EPA ID #:** NJD062037031

## BACKGROUND

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

Environmental Indicators (EI) are measures being used by the Resource Conservation and Recovery Act (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 EIs developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater.

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

## **Facility Information**

The Bayway Refinery is an active, 1,300-acre industrial facility located in a heavily industrial area within the cities of Linden and Elizabeth, Union County, New Jersey (Figure 1). The facility has been in continuous operation since 1909. Exxon Mobil Corporation (ExxonMobil) owned and operated the refinery from 1909 until its sale to Tosco Refining Company in 1994. Phillips Petroleum Company bought Tosco Corporation in early 2001, and in 2002 merged with Conoco, Inc. to form ConocoPhillips Company. Currently owned and operated by ConocoPhillips, Bayway Refinery is the northernmost U.S. refinery on the eastern seaboard and, according to ConocoPhillips, features the largest fluid catalytic cracking unit in the world. The refinery receives crude oil via tanker primarily from fields in the Atlantic Basin. The facility distributes refined products to customers on the U.S. East Coast via barge, pipeline, truck and railcar. A 775 million-pound-per-year polypropylene plant became operational in the second quarter of 2003.

The facility is located in a low-lying area on New York Harbor adjacent to the Arthur Kill, with ground elevations generally less than 10 feet above mean sea level. Much of the area has been filled to current grade since the beginning of refinery operations in the early 1900s. The main refinery area is bounded to the north by U.S. Route 1, Interstate 278, and Park Avenue, to the west by two cemeteries and U.S. Route 1, and to the south by Wood Avenue (Figure 2). The New Jersey Turnpike passes through the site, separating the main refinery and process area from the waterfront area, which borders on the Arthur Kill. Two outlying tank fields (Rahway River Tankfield and 40-Acre Tankfield) are located southwest of the main refinery area. Morses Creek bisects the site along a southwest to northeast flow track, and has been classified by the State of New Jersey as an FW2-NT/SE3 surface water body. From No. 2 Dam to No. 1 Dam, Morses Creek measures approximately 7,500 feet in length, with an average width of approximately 150 feet. The creek discharges to the Arthur Kill below No. 1 Dam. Ground water at the facility is not used as a drinking water source, and some areas are saline due to naturally-occurring salt water intrusion. Pending final signatures and recording, ConocoPhillips has agreed to, and the New Jersey Department of Environmental Protection (NJDEP) has approved, a deed notice that will restrict the refinery property to only non-residential uses. Additionally, the refinery sales agreement limits the property to non-residential uses.

The facility consists of a main petroleum refining facility, a petrochemical manufacturing facility, several tankfields, a fuel distribution terminal, process areas, offices, chemical plants, mechanical shops, wastewater treatment units, tankfields, pipelines, railroad sidings, and tanker docks. Refinery products include motor gasoline, home heating oil, heavy fuel oil, jet fuel, diesel fuel, asphalt, and chemical feedstocks. Products associated with the West Side Chemical Plant include additives for motor oil and high purity propylene. Products associated with the former East Side Chemical Plant included lighter hydrocarbons for product alcohols, ketones, white oils, and other chemicals produced until 1988. The West Side Chemical Plant is currently owned and operated by Infineum USA LP.

The facility operates 24-hours a day, 365-days a year. The refinery maintains a comprehensive site security system that includes perimeter fencing with warning signs, controlled gate access and 24-hour security. The refinery also has a security policy establishing locations and procedures for admittance to the site, including maritime security. Employees and contractors are health and safety trained.

Site investigation and remediation activities have been and are being conducted pursuant to the Administrative Consent Order (ACO) entered into by ExxonMobil (EM) and the NJDEP on November 27, 1991, and amended April 8, 1993, and in accordance with the "Technical Requirements for Site Remediation" (N.J.A.C. 7:26E, *et seq.*). These activities include: the remedial investigation (RI); Interim Remedial Measures (IRMs); Construction Maintenance Emergency Repair Protocol (CMERP), and remedial action.

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.

### **Remedial Investigation**

In accordance with the Administrative Consent Order (ACO), ExxonMobil conducted a remedial investigation (RI) at the Bayway Refinery. To best accomplish the goals of the ACO, the RI was conducted in a phased manner. The Site History Report (Geraghty & Miller, 1993) is a compilation of the relevant history of the Site, including operations, spills and disposal history. The Phase 1A portion of the RI was completed in 1995, and the results are contained within the Phase 1A Remedial Investigation Interim Report (Geraghty & Miller, 1995). The Phase 1B portion of the RI was completed between 1996 and 2000, and was summarized in the Phase 1B Remedial Investigation Report (Arthur D. Little, 2000a).

During the Phase 1A and 1B portions of the RI, the refinery was divided into Investigative Units (A through H) based on hydrogeologic conditions and site use (Figure 3). Each Investigative Unit was further subdivided into Investigative Areas of Concern (IAOCs) based on operations and historical usage (Figure 4). Fifty-one (51) IAOCs have been identified at the Site (Table 1).

ExxonMobil received NJDEP comments on the Phase 1B RI Report for each Investigative Unit in letters from May 2001 through June 2002 (NJDEP 2001a – f, 2002a). The NJDEP letters identified data gaps that needed to be addressed in the Phase 2RI. The Phase 2 RI was performed in accordance with the procedures outlined in the Phase 2 RI Work Plans for individual Investigative Units submitted to the NJDEP during the period from August 2001 to October 2002 (DRAI, 2001 b-e; 2002a, b, d), and the NJDEP comments on the Work Plans (NJDEP, 2002c). The Phase 2 Remedial Investigation Report, which completed the delineation of contamination at the facility, was submitted in April 2004 (TRC Raviv, 2004b).

### **Interim Remedial Measures**

Interim Remedial Measure (IRM) activities, consisting of recovering free product and/or ground water from wells and sumps, are currently conducted at seven (7) areas within the refinery: Domestic Trade Truck Terminal; Caustic Tank No. 3; Spheroid No. 196; Cogen North Leasehold/Fuel Gas; No. 2 Dam Interceptor Trench; Tank No. 519; and the Waterfront Barge Pier. The purpose of the IRM program is to prevent off-site migration and impact to surface water (Figure 5). Over the years, the IRM activities have substantially diminished the free product thicknesses in monitoring wells. IRM activities are conducted on a regular schedule, and reported to the NJDEP on a quarterly basis (TRC Raviv, 2004d).

## **Remedial Action**

Conceptual Remedial Strategies for various waste management areas, free product, soil, and ground water were presented to the NJDEP in October 2000 at the completion of the Phase 1B remedial investigation (Arthur D. Little, 2000b).

The NJDEP comment letter on the Phase 1B RI Report for Unit A also required ExxonMobil to submit proposals for remedial action for certain areas within Unit A that were identified by NJDEP as a potential source of contamination, or as an area where free product or dissolved contamination may be flowing towards potential environmental receptors. The requirements for remedial action at these areas are being addressed through the submission of separate documents including six Remedial Action Selection Reports (RASRs), and the subsequent submission of Remedial Action Work Plans (RAWPs). RASRs were prepared for the following areas (Figure 6): East Side Chemical Plant (ESCP); the Domestic Trade Terminal Area; the Gasoline Blending Tankfield; the Gasoline Component Tankfield; the Pitch Area; and the Caverns Area (DRAI 2002c, 2002e, 2002f, and TRC Raviv 2003c, 2003d, 2004a).

The NJDEP approved the RASRs for the Domestic Trade Terminal Area, the Gasoline Blending Tankfield, the Gasoline Component Tankfield and the Caverns Area (NJDEP 2003a, 2003b, 2003c and 2004). The RAWP for the Domestic Trade Terminal was submitted to NJDEP in June 2004 (TRC Raviv 2004c). RAWPs are currently being prepared for the Gasoline Blending Tankfield, the Gasoline Component Tankfield and the Caverns Area.

Remedial action activities have been completed at the following areas (Figure 6): Greater Elizabeth Tankfield (TRC Raviv, 2003a) and the Sludge Lagoon Operable Unit (SLOU) (Shaw, 2003). Monitoring reports for these areas are submitted to the NJDEP on a quarterly basis. Remedial activities are currently being conducted at the Former Tank 510 Area (Figure 6), and monitoring reports are submitted to the NJDEP on a quarterly basis (DRAI, 2004e).

In accordance with the ACO, remedial action selection reports which include conceptual proposals for final remedial actions have been prepared for six areas and remedial action workplans have been submitted for four of these areas. Remedial action workplans for the remaining two areas are currently being prepared.

In summary, the site consists of 52 IAOCs which have been investigated by ExxonMobil with NJDEP oversight. Since 1993, over 4,000 groundwater samples have been collected from approximately 224 RI monitoring wells, 340 temporary well points and 39 quarterly sampled ExxonMobil NJPDES monitoring wells. Additionally, over 2200 soil and sediment samples have been analyzed. For EI purposes, all of the IAOCs have been adequately characterized and delineated through environmental investigations conducted under the ACO with NJDEP. There is one area—a Public Service Electric and Gas (PSE&G) right-of-way transecting a portion of the site adjacent to the SLOU, IAOC D5--where contamination off-site is considered to be from ExxonMobil. This area has been investigated under the ACO and engineering controls (i.e., a fenced, gated and locked area) at the PSE&G right-of-way are adequate to be protective of human exposure (DRAI, 2001b and TRC Raviv, 2004b). The investigations of all of the IAOCs have provided sufficient data to characterize and evaluate potential impacts on human exposure for the purpose of this EI evaluation. It has been determined that the existing engineering and institutional controls are adequate to control human exposure while final remedies are being developed. Active remediation of higher priority areas has already begun. (For example, remedial activity at the most significant IAOC at the site--the SLOU--has been completed in 2003.)

## **References**

References reviewed to prepare this EI determination are identified in the appendices that follow Question 6.

2. Are groundwater, soil, surface water, sediments, or air **media** known or reasonably suspected to be **“contaminated”**<sup>1</sup> 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   |    |   | See Table 2                              |
| Air (indoors) <sup>2</sup>    |     | x  |   |  |
| Surface Soil (e.g., <2 ft)    | x   |    |   | See Table 2                              |
| Surface Water                 |     | x  |   |  |
| Sediment                      | x   |    |   | SVOC, Inorganics, Pesticides and Xylenes |
| Subsurface Soil (e.g., >2 ft) | x   |    |   | See Table 2                              |
| Air (Outdoor)                 |     | x  |   |  |

\_\_\_\_\_ 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:**

The purpose of the RI being conducted at the Bayway Refinery (see Question 1 for more information) is to delineate contamination exceeding applicable criteria. The RI is also performed to characterize the subsurface conditions (geologic and hydrogeologic) at the site. The majority of the RI at the Bayway Refinery was completed during Phase 1A and Phase 1B. The Phase 2 RI was more limited in scope, focusing on addressing final data gaps.

The data from the all phases of the RI (as well as miscellaneous CMERP and IRM investigations) has been loaded into a database. Most of the figures and tables discussed below were drawn directly from this database and include the data from the Phase 1A, Phase 1B, and Phase 2 RIs, as well as additional sampling.

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Footnotes:

<sup>1</sup> “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).

<sup>2</sup> 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.

Contaminants of Concern (COCs) were identified in the Phase 1B RI Report (Arthur D. Little, 2000a) as primary contaminants within an IAOC. Contaminants that were low level, isolated occurrences, or if the exceedances appeared spurious, were not designated as COCs. Table 2 lists the COCs identified for soil and ground water at the Bayway Refinery.

### **Groundwater**

The Bayway Refinery is situated in the Newark Basin physiographic province. Approximately 5 to 10 feet of fill material is present throughout the refinery. The fill material consists of reworked clays and silts, as well as heterogeneous mixtures of gravel and sand, with lesser amounts of cinders, construction debris, and wood. In the eastern portion of the facility, the fill is underlain by meadow mat at approximately 5 feet below ground surface (ft-bgs). Glacial till underlies the site at approximately 5 to 10 ft-bgs. The glacial till acts as a confining layer. The bedrock formation beneath the site consists of sedimentary and igneous rocks of the Newark Basin Supergroup. The sedimentary rocks also known as the Passaic Formation consists of reddish-brown thin-bedded shales, siltstones, and sandstones.

According to the City of Linden Health Department, there are no current or planned uses of the ground water in the Bayway Refinery area. All residents of Linden and Elizabeth, NJ are on a municipal water supply system (TRC Raviv, 2003b).

As discussed in the “Verification of Class III-B Groundwaters” report (DRAI, 2000), ground water in the eastern portion of the refinery has characteristics typical of the New Jersey Department of Environmental Protection (NJDEP) Class III-B (non-potable) designation – brackish with naturally occurring iron, sodium, manganese, and aluminum concentrations in excess of Class II-A ground water quality standards (GWQS). In the “Proposed Alternative, Site-Specific Ground Water Quality Criteria for the Class III-B Area” report (DRAI, 2001a), ExxonMobil proposed site-specific GWQS for ground waters with the Class III-B designation. The NJDEP conditionally approved the Class III-B reclassification and site-specific Class III-B GWQS in December 2002 (NJDEP 2002b). Ground water quality results are discussed in the context of the appropriate designation, either Class II-A or Class III-B.

In general, shallow groundwater at the facility flows towards surface water bodies. At the southern parts of the facility (e.g., Units F and G), shallow groundwater flows towards the Rahway River and in the northern parts, ground water flow towards Moses Creek and the Arthur Kill. (Moses Creek traverses the site from west boundary and flows easterly into Arthur Kill.) Secondary features, such as partings, fractures, and joints, influence ground water flow in the Passaic Formation. In refinery areas, bedrock is generally covered by low-permeability glacial till or alluvium; a confined condition generally exists at shallow depths.

Groundwater investigations have been conducted at the Bayway Refinery as part of the RI and IRM programs discussed in response to Question 1, above. Since 1993, over 1,000 ground water samples have been collected from approximately 190 monitoring wells and approximately 735 temporary well points. Contaminants of Concern (COCs) identified in ground water during the RI are listed in Table 2. (Refer to Attachment 1 for maps and tables showing all exceedances of applicable NJDEP’s GWQC--either Class II-A or Class III-B--in groundwater.)

Consistent with the historic use of the facility, the dissolved phase groundwater contamination plumes (consisting primarily of benzene) have been identified and delineated at the facility. Vertically, the plumes primarily exist within the shallow water bearing zone. The groundwater plumes are in the northern and interior portions of the site and migrate towards Moses Creek and Arthur Kill. There is no groundwater contamination that is expected to migrate to the Rahway River. Other than the previously discussed Public Service Property, the groundwater plumes do not extend off-site. Based on the results of the extensive groundwater studies conducted at the site it is reasonable to conclude that groundwater is not adversely impacting human receptors. The only potential human receptors

identified, construction workers who may need to complete excavations below the water table, are adequately protected through the refinery's excavation permitting process. The permitting process ensures that only trained workers are allowed to perform excavations and that they are notified of potential contaminants and adequate protective measures are taken.

### **Indoor-Air**

For occupational settings where persons are in a working situation (e.g., workplaces where workers are handling hazardous chemicals, manufacturing facilities similar to or different from those in the subsurface contamination, as well as other workplaces, such as administrative and other office buildings where chemicals are not routinely handled in daily activities), the Occupational Safety and Health Administration (OSHA) and US EPA have agreed that OSHA generally will take the lead role in addressing occupational exposures (US EPA, 2003). ConocoPhillips, the current owner and operator of the refinery, regularly monitors their workers and contractors in accordance with OSHA requirements. Therefore, indoor-air in this facility is not reasonably suspected to be contaminated above OSHA levels as a result of releases from the facility (ConocoPhillips, 2003).

In addition, there are two office buildings on-site -- the refinery office building located in IAOC A-20 and the chemicals office building located in IAOC A-19 -- where administrative personnel routinely work. These are located in the northern portion of the Refinery and hydraulically up-gradient of any groundwater plumes. Groundwater beneath these buildings is not contaminated and therefore the indoor-air pathway is not a reasonable concern for office workers.

Two residential areas are located adjacent to the Bayway Refinery (Figure 2). The first residential area is located adjacent to the southwest corner of the Tremley Tankfield. The second residential area is located east of the Former 40-Acre Tankfield Separator (across Lower Avenue) and south of the Tremley Tankfield (across Wood Avenue). As part of the Phase 2 RI, four new off-site wells (GMW-171, GMW-172, GMW-173, and GMW-174) were installed in the park across Wood Avenue and opposite Tremley Tankfield (TRC Raviv, 2004b). All four of these wells along with a new onsite well (GMW-175) showed no off-site migration and were less than the reporting limit (RL) (1 ug/l) for benzene, which was the contaminant of concern in the Tankfield. A new well (GMW-183) was also installed off-site in the park across Lower Road and opposite 40-Acre Tankfield (TRC Raviv, 2004b). It also showed no off-site contamination, and the results for benzene were also below the RL (1ug/l). This well, along with wells (GMW-117, GMW-118, and GMW-119) installed earlier in the RI, demonstrate no off-site migration from 40-Acre Tankfield. Based on the data for both Tankfields, there is no off-site migration in these areas and that for purposes of CA725 there is no potential exposure and no need for an indoor-air vapor inhalation assessment.

In summary, the groundwater plumes associated with the IAOCs are limited to within the site boundaries and do not extend off-site with the exception of the Public Service Property discussed above. For the most part, the plumes exist under unoccupied areas of the site. The two office buildings at the site do not have groundwater plumes beneath them. For the reasons discussed above, the indoor-air exposure pathway is considered under control for the purpose of this EI evaluation. The groundwater plumes eventually discharge to on-site saline surface water bodies (e.g., Morses Creek, which discharges to the Arthur Kill), which are not used as sources of drinking water or for recreational fishing.

### **Surface and Subsurface Soil**

Portions of the refinery contain surface and subsurface soils that have concentrations of volatile organic compounds (VOCs), semi-VOCs, petroleum hydrocarbons, pesticides, and metals that exceed the New Jersey Non-Residential Direct Contact Soil Cleanup Criteria (NRDCSCC).



Contaminants of Concern (COCs) identified in soil during the RI are listed in Table 2. Refer to Attachment 1 for maps and tables showing all exceedances of NJDEP's NRDCSCC in surface and subsurface soil.

In summary, both surface and subsurface soil contaminated areas have been adequately characterized and delineated. Over 2000 soil samples have been collected as part of the site investigation. Soil contamination does not extend off-site with the exception of the Public Service Property discussed above. Potential human impacts from on-site contaminated soil areas are controlled through engineering and institutional controls. Access to any area on-site is controlled by a 24 hour a day, seven day a week guarded access system and fencing. Process areas are largely covered with concrete, asphalt or crushed stone. Tankfields are bermed and all areas, including idle outlining areas are subject to a detailed access permitting system which ensures that only OSHA trained and protected personnel are allowed to excavate within contaminated areas.

### **Surface Water and Sediment**

Surface water bodies are present both within and adjacent to the Bayway Refinery. Morses Creek runs through the site and flows to the east towards the Arthur Kill. Piles Creek is located east and adjacent to the Sludge Lagoon Operable Unit and discharges to the Arthur Kill. Morses Creek has been classified by the State of New Jersey as an FW2-NT/SE3 (brackish) surface water body.

The two main surface water bodies at the site are Morses Creek, which runs through the site and to the adjacent Arthur Kill. These surface water bodies are not used as actual or potential drinking water sources. Additionally, they are not used for recreational purposes. Their use at and adjacent to the site is for commercial ship transportation and refinery process water intakes. At the site, Morses Creek has several dams located and operated by the Refinery. These dams, along with fences and 24-hour seven days a week security patrols, prevent any unauthorized access to Morses Creek at the Refinery. Refinery permits are required to enter Morses Creek. Entrance is only allowed for Refinery purposes or environmental sampling. As part of the Refinery permit process strict health and safety requirements must be followed to ensure worker protection from exposure to potential contaminants as well as general water safety. Similar requirements also exist for those portions of the Arthur Kill adjacent to the Refinery. Only approved commercial vessels may enter the docks or shoreline. Only trained personnel, wearing appropriate protective equipment may enter the shore adjacent to the Refinery. All vessels are subject to the Refinery permit procedures. Both Refinery security personnel and the US Coast Guard patrol the dock and adjacent shoreline.

Additionally, there are a series of booms located along the Refinery dock area at the Arthur Kill. These are for contingency purposes in case of a spill during vessel loading and unloading activities.

Surface water samples were collected during the Phase 1A and Phase 1B RI, and evaluated as part of the Baseline Ecological Evaluation (BEE). Data gathered from the BEE indicates that potential human health exposure scenarios are under control. Media-specific benchmarks were used to identify and assess potential risks (Arthur D. Little, 2000a). The lower of EPA's chronic Federal ambient water quality (AWQC) or New Jersey surface water quality criteria (NJSWQC) was used to calculate surface water chemical-specific hazard quotients (HQs) and chemical group hazard indices (HIs). The study concluded that there are no significant surface water potential risks for direct human exposure given current water use and potential exposure pathways.

Sediment samples were collected as part of the Phase 1A, the Phase 1B RI, and the Phase 2 RI and evaluated as part of the BEE. The sediment samples were collected from tidally-influenced creeks (Morses Creek and Piles Creek), three reservoirs that impound water from two urban streams and a number of small ponds. The results are presented in the Phase 1B Remedial Investigation Report, Appendix R (Arthur D. Little, 2000b) and the Supplemental BEE (AMEC Earth & Environmental, Inc., 2004). VOCs, metals, SVOCs, and pesticides were detected at concentrations which exceed the New

Jersey Sediment Quality Evaluation (NJSQE) benchmark and reference HQs and HIs (Arthur D. Little, 2000a). ExxonMobil is in the process of obtaining additional data to complete its evaluation of potential ecological impacts within sediment areas. As stated above, access to these areas is restricted by dams, fences and security patrols.

### **Outdoor Air**

For occupational settings where persons are in a working situation (e.g., workplaces where workers are handling hazardous chemicals, manufacturing facilities similar to or different from those in the subsurface contamination, as well as other workplaces, such as administrative and other office buildings where chemicals are not routinely handled in daily activities), the Occupational Safety and Health Administration (OSHA) and US EPA have agreed that OSHA generally will take the lead role in addressing occupational exposures (US EPA, 2003). ConocoPhillips, the current owner and operator of the refinery, regularly monitors their workers and contractors in accordance with OSHA requirements. Therefore, outdoor air in this facility is not reasonably suspected to be contaminated above OSHA levels as a result of releases from the facility (ConocoPhillips, 2003).

### **References**

References reviewed to prepare this EI determination are identified in the appendices that follow Question 6.

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)*

| <b>Contaminated Media</b>       | <b>Residents</b> | <b>Workers</b> | <b>Day Care</b> | <b>Construction</b> | <b>Trespassers</b> | <b>Recreation</b> | <b>Food<sup>3</sup></b> |
|---------------------------------|------------------|----------------|-----------------|---------------------|--------------------|-------------------|-------------------------|
| Groundwater                     | No               | No             | No              | Yes                 | --                 | --                | No                      |
| <del>Air (indoors)</del>        |                  |                |                 |                     |                    |                   |                         |
| Soil (surface, e.g., <2 ft)     | No               | Yes            | No              | Yes                 | No                 | No                | No                      |
| <del>Surface Water</del>        |                  |                |                 |                     |                    |                   |                         |
| Sediment                        | No               | No             | --              | No                  | No                 | No                | No                      |
| Soil (subsurface, e.g., > 2 ft) | --               | Yes            | --              | Yes                 | --                 | --                | No                      |
| <del>Air (outdoors)</del>       |                  |                |                 |                     |                    |                   |                         |

Instructions for Summary Exposure Pathway Evaluation Table:

1. Strike-out specific Media including Human Receptors’ spaces for Media that 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. These spaces instead have dashes (“--”). While these combinations may not be probable in most situations they may be possible in some settings and should be added as necessary.

**Please Note: evaluations were added for the following Pathways: 1) Subsurface Soil – Workers; and 2) Sediment – Construction.**

\_\_\_\_\_ 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

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Footnotes:

<sup>3</sup> Indirect Pathway/Receptor (e.g., vegetables, fruits, crops, meat and dairy products, fish, shellfish, etc.)

## **RATIONALE:**

Supporting explanation is provided below for the Exposure Pathway Evaluation to determine if complete pathways exist between contamination and potential human receptors, and if exposures can be reasonably expected under the current (land- and ground water-use) conditions.

### **Residents**

There are no residences within the refinery property boundary. Both the property owner (ConocoPhillips) and the NJDEP have agreed to a deed notice to restrict to non-residential. According to the City of Linden Health Department, there are no current or planned uses of the ground water in the Bayway Refinery area. All residents of Linden and Elizabeth, NJ are on a municipal water supply system (TRC Raviv, 2003b). Therefore, all exposure pathways for residents are not complete.

### **Day Care**

There are no day care facilities within the refinery property boundary. Therefore, all day care exposure pathways are not complete.

### **Workers and Construction**

Some classes of on-site refinery workers (employees) and construction workers (contractors) are expected to encounter contaminated surface soil and subsurface soil. Therefore, these pathways (worker–surface soil; worker–subsurface soil; construction–surface soil; and construction–subsurface soil) are potentially complete in the absence of protective controls. Adequate protective controls have been implemented to bring potential exposure scenarios to within acceptable limits, and are discussed further in Question 4, below.

Because the water table at the facility is shallow, construction workers have the added potential to be exposed to contaminated ground water during excavation and remediation activities. Therefore, the construction–ground water pathway is potentially complete in the absence of protective controls. Adequate protective controls have been implemented to bring potential exposure scenarios to within acceptable limits, and are discussed further in Question 4, below.

Refinery workers do not regularly enter excavations or directly contact ground water; therefore, the worker–ground water exposure pathway is not complete.

Exposure to contaminants in sediments is not expected for refinery or construction workers at this site under current conditions. Therefore, the workers–sediment and construction–sediment pathways are not complete.

The Arthur Kill borders the Refinery to the east of the waterfront. Sediment contamination within the Arthur Kill, if present, would likely be related to a variety of sources which may or may not include the Refinery. This is due to the highly industrialized area in which it is located. If off-site sediment contamination exists within the Arthur Kill, the only off-site construction worker exposure scenario which may occur is during dredging operations. No other off-site exposure scenarios are reasonably expected. Refinery personnel or trained refinery dredging sub-contractors conduct any dredging operations. Dredging occurs infrequently and is highly regulated. Dredging requires not only refinery permits but permits from the Army Corps of Engineers and the NJDEP. As part of the permit process sediment samples are analyzed for pollutants and an appropriate health and safety plan must be prepared. All workers who may come in contact with potentially contaminated sediments are required to wear appropriate personnel protective equipment.

### **Trespassers and Recreation**

The Bayway Refinery is an active industrial facility, and operates 24-hours a day, 365-days a year. The refinery maintains a comprehensive site security system that includes perimeter fencing with warning signs, controlled gate access and 24-hour on-site security. The refinery also has a security policy establishing locations and procedures for admittance to the site, including maritime security. Because of these measures, trespassers and/or recreators do not have access to the facility. Since access is prevented, human exposure to any contaminants in surface soil and sediments is not possible. Therefore, the trespasser and recreation exposure pathways are not complete.

### **Food**

There are no food crops (e.g., vegetables, fruits, crops, meat and dairy products) grown within the refinery property boundary. Therefore, the food exposure pathways for groundwater, surface soil and subsurface soil are not complete.

Crabs have been noted in the lower section of Morses Creek, adjacent to the Arthur Kill, and are the only organisms that could be potentially consumed (Woodard & Curran, 2001). The NJDEP and Department of Health and Senior Services (DHSS) have issued an advisory prohibiting taking, eating or harvesting blue crab from the Newark Bay Complex. The Newark Bay Complex includes the Arthur Kill and tidal portions of all rivers and streams that feed into the Arthur Kill; all tidal surface water bodies located within and adjacent to the Bayway Refinery are located in the Newark Bay Complex. This advisory also includes striped bass, American eel, white perch and white catfish from the Newark Bay Complex. NJDEP and DHSS have issued statewide advisories against eating American lobster, American eel, bluefish, and striped bass. Therefore, the food exposure pathway for sediment is not considered complete.

### **References**

References reviewed to prepare this EI determination are identified in the appendices that follow Question 6.

4. Can the **exposures** from any of the complete pathways identified in #3 be reasonably expected to be **“significant”**<sup>4</sup> (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)?

\_\_\_\_\_ 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.”

  X   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):**

### **Workers and Construction Exposure Pathways**

As discussed in Question 3, above, exposure of on-site workers (employees) to contaminated surface soil and subsurface soil, and exposure of construction workers (contractors) to contaminated ground water, surface soil and subsurface soil is expected in the absence of protective controls. However, protective controls have been implemented to bring potential exposure scenarios to within acceptable limits.

Extensive training programs and detailed safety and work practices have been implemented at the Bayway Refinery. OSHA health and safety training is required for employees and contractors at the facility. Employees and contractors receive an initial training and annual refresher training thereafter. Appropriate personal protection equipment (PPE) is utilized by employees and contractors when working at the refinery.

Work permits are required before any work is conducted at the facility. Work permits are only obtained from the lead Unit Operator, and must be obtained daily. An additional permit is required for excavations that are greater than 6 inches below ground surface (bgs).

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#### Footnotes:

<sup>4</sup> If there is any question on whether the identified exposures are “significant” (i.e., potentially “unacceptable”) consult a human health Risk Assessment specialist with appropriate education, training and experience.

Conceptual Remedial Strategies for free product, soil, and ground water were presented to the NJDEP in October 2000 at the completion of the Phase 1B remedial investigation (Arthur D. Little, 2000b). Remedial solutions, which include in-situ biodegradation, containment, ground cover, and hot spot removal, have been proposed and/or implemented for several areas at the site (DRAI, 2002e, 2002f and TRC Raviv 2003a, 2003c, 2003d, 2004a, 2004c, 2004e, and Shaw 2003). Until these permanent remedial measures are implemented, several interim measures have been taken to bring any exposures to within acceptable limits.

For example, signs have been posted throughout the refinery to identify areas with exceedances in soil of NJDEP's NRDCSCC (Figure 6). Additionally, maps and tables showing exceedances of NJDEP's NRDCSCC in surface and subsurface soil, and exceedances of applicable NJDEP's GWQC (either Class II-A or Class III-B) in ground water (Attachment 1) have been distributed to the property owners (ConocoPhillips and Infineum). These maps and tables can be used by ConocoPhillips and Infineum when issuing a work permit to identify areas where additional PPE may be required.

Therefore, exposure of on-site workers to contaminated surface and subsurface soil, and exposure of construction workers to contaminated ground water, surface and subsurface soil is expected to be within acceptable limits.

### **References**

References reviewed to prepare this EI determination are identified in the appendices that follow Question 6.

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):**

This question is not applicable. See response to Question 4.

**References**

References reviewed to prepare this EI determination are identified in the appendices that follow Question 6.



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):

- 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 **Bayway Refinery** facility, EPA ID # **NJD06203703**, located at **1400 Park Avenue, Linden, New Jersey 07036** 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.

### References

References reviewed to prepare this EI determination are identified in the appendices that follow Question 6.

**Completed by:** \_\_\_\_\_ Date \_\_\_\_\_  
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TRC Raviv Associates, Inc.

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**Also Reviewed by:** \_\_\_\_\_ Date \_\_\_\_\_  
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\_\_\_\_\_ Date \_\_\_\_\_  
Barry Tornick, Section Chief  
RCRA Programs Branch  
EPA Region 2

**Approved by:** Original signed by: \_\_\_\_\_ Date: July 6, 2005  
Adolph Everett, Chief  
RCRA Programs Branch  
EPA Region 2

**Locations where References may be found:**

References reviewed to prepare this EI determination are identified in the appendices that follow Question 6. Reference materials are available at the USEPA Region 2, RCRA Records Center, located at 290 Broadway, 15<sup>th</sup> Floor, New York, New York, and the New Jersey Department of Environmental Protection Office located at 401 East State Street, Records Center, 6<sup>th</sup> Floor, Trenton, New Jersey.

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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.**

## APPENDICES

### Figures, Tables and Attachments

The following figures, tables and attachments have been provided to support this EI determination:

- Figure 1 – Site Location Map
- Figure 2 – Aerial Photograph
- Figure 3 – Investigative Units
- Figure 4 – Investigative Areas of Concern (IAOCs)
- Figure 5 – Locations of Interim Remedial Measures (IRMs)
- Figure 6 – Locations of Remedial Actions
- Figure 7 – Example of Sign (posted to identify areas with exceedances in soil of NJDEP's NRDCSCC)

Table 1 – Investigative Areas of Concern (IAOCs)

Table 2 – Site-Wide List of Contaminants of Concern (COCs)

Attachment 1 – Maps and Tables Showing Exceedances of NJDEP's NRDCSCC in Surface and Subsurface Soil, and Exceedances of NJDEP's GWQC in Ground Water (Distributed to ConocoPhillips). (Included in Volume 2 of 2)

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