DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

RCRA Corrective Action
Environmental Indicator (EI) RCRIS code (CA750)
Migration of Contaminated Groundwater Under Control

Facility Name: PUMA Energy Caribe, LLC
Facility Address: Road PR-28, KM 2, Luchetti Industrial Park, Bayamon, Puerto Rico
Facility EPA ID#: PRD000632182

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 EIs 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 "Migration of Contaminated Groundwater Under Control" EI

A positive "Migration of Contaminated Groundwater Under Control" EI determination ("YE" status code) indicates that the migration of "contaminated" groundwater has stabilized, and that monitoring will be conducted to confirm that contaminated groundwater remains within the original "area of contaminated groundwater" (for all groundwater "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 objectives of the RCRA Corrective Action program, the EIs are near-term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993 (GPRA). The "Migration of Contaminated Groundwater Under Control" EI pertains ONLY to the physical migration (i.e., further spread) of contaminated groundwater and contaminants within groundwater (e.g., non-aqueous phase liquids or NAPLs). Achieving this EI does not substitute for achieving other stabilization or final remedy requirements and expectations associated with sources of contamination and the need to restore, wherever practicable, contaminated groundwater to be suitable for its designated current and future uses.

Duration / Applicability of EI Determinations

EI Determination status codes should remain in the 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 PUMA Energy Caribe, Inc. facility is located at Road PR-28, km 2, in the Luchetti Industrial Park in Bayamón, Puerto Rico. It is approximately 3 miles south of the Atlantic Ocean coast. The land use surrounding the site is primarily industrial and commercial (Ref. 5). Fort Buchanan is located to the east,

Highway PR-22 is to the north, and additional commercial and industrial properties are located south and west of the site (Ref. 5).

The site is located approximately 10 to 35 feet above Mean Sea Level (MSL) and generally slopes to the north. The area to the north is undeveloped and relatively flat, consisting primarily of wetlands. Las Lajas Creek originates south of the facility and flows through the wetlands and ultimately discharges to San Juan Bay. The facility is also bordered to the west by Diego Creek (100 meters west of the site) and 140 meters to the east by Santa Catalina Creek (Ref. 3).

Las Lajas Creek, which flows through the wetland areas, is a low-flow shallow perennial stream that discharges into San Juan Bay. The creek receives stormwater runoff from both the nearby residential and commercial areas. The water is channeled underground as it enters the PUMA facility and returns to open channels at the north of the facility's waste water treatment plant (WWTP). PUMA has a National Pollutant Discharge Elimination System (NPDES) permit for this discharge (Ref. 3).

The PUMA site is located on alluvium deposits of clay, sand, and sandy clay. The overburden thickness is approximately 90 feet at the northern perimeter and about 10 feet at the southern perimeter. A layer of carbonate sediments is located beneath the clay soils overlying the limestone bedrock. The regional topography includes mogotoes from the limestone formations in the area (Ref. 3).

Two general hydrogeologic units underlie the facility. The uppermost unit is a low permeability clay unit that contains a semi-perched layer and a permeable carbonate water bearing zone referred to as zone A. Groundwater flow direction in zone A is to the north, although some mounding does occur in the central portion of the site. Zone B, which underlies zone A, is a carbonate sediment layer that contains a water bearing zone which flows to the north northwest (Ref. 3). Groundwater in zone B is semi-confined, which often results in the potentiometric surface of groundwater wells completed in this zone having a higher water level than Zone A (Ref. 5). Due to the nature of the soils and geology in the area, water migration from surface soils is slow (Ref. 4).

Currently, the facility encompasses 179 acres, of which 115 acres are developed as a petroleum products storage facility that includes administrative offices, parking areas, and a wastewater treatment plant to the north (Ref. 5). The other 64 acres is the wetlands areas located to the north (Ref. 6). The facility has an aboveground pipeline for the transfer of fuel from loading docks on San Juan Bay and to customers at the Luis Munoz Marin Airport (LMMIA). A liquid propane gas storage and distribution area is also included as part of the facility. The rest of the property is undeveloped. Figure 1 shows the general location of the facility and surrounding areas (Ref. 6).

Initial petroleum refining operations first began at the site under the name of the Caribbean Refining Corporation (Ref. 1). In 1962, Gulf Oil purchased the site and changed the name to Caribbean Gulf Refining Corporation. Chevron acquired the site in 1984 and owned it until 1987 when First Oil Corporation purchased the site. The site operated until 2000, refining approximately 48,000 barrels of petroleum a day (Ref. 2).

While operating as a refinery, the facility imported crude oil and used it to produce petroleum distillates, leaded/unleaded gasoline, kerosene, and residual oils (Ref. 4). Hazardous wastes historically managed at the site also include primary oil/water/solids separation sludge (F037), secondary oil/water/solids separation sludge (F038), slop oil emulsion solids (K049), heat exchanger bundle solids (K050), API separator sludge (K051), ignitable waste (D001), and toxicity characteristic (benzene) wastewater (D018) (Ref. 2).

By 2008, both the CA725 and CA750 Environmental Indicator (EI) determinations were achieved (Refs. 1, 2). However, in October 2009 a series of explosions and fires damaged the site and destroyed many storage tanks. An unknown quantity of petroleum was released at the site and some of the materials were released to Las Lajas Creek and the associated wetlands areas to the north of the site. The fire occurred in the Tank Farm, which was comprised of 48 tanks used to store petroleum products (Ref. 1). Due to the explosions, a unilateral order was issued and EPA began conducting cleanup operations of the site. This included removal of contaminated soil tank bottoms and dismantling of damaged tanks (Ref. 3).

In 2010, the facility (named Caribbean Petroleum Refinery at the time) filed for bankruptcy and PUMA Energy Caribe acquired the site. In May 2011, PUMA entered into a RCRA Agreement to implement corrective action activities. This agreement was a modification to the October 1995 Administrative Order of Consent executed by EPA and Caribbean Petroleum Refinery (CPR) to investigate 35 Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs). The Order also required a site-wide hydrogeologic investigation. RCRA Facility Investigation (RFI) activities had been conducted at the site from 1998 until the explosions in 2009 (Ref. 2).

As part of the 2011 agreement with EPA, PUMA prepared a Current Conditions Report (CCR). Based on the CCR, PUMA prepared and submitted the 2013 RFI Work Plan to EPA. The RFI Work Plan focused on expediting the investigation of the site and employed a holistic approach to the remediation of the facility as opposed to a SWMU by SWMU approach. Once the RFI Work Plan was approved and implemented, the 2015 RFI Report (Ref. 6) was prepared. Upon review of the RFI Report, EPA requested a supplemental sampling investigation to address a few outstanding concerns (Ref. 7). The supplemental sampling investigation was approved and implemented in 2016 (Ref. 8). In addition to the supplemental sampling, EPA requested that PUMA prepare an updated screening evaluation (Ref. 9) using 2016 risk-based screening values to evaluate the 2015 RFI Report. The RFI was approved in January 2017. Based on this approval of the RFI, it was recommended that the new CA725 and CA750 EI determinations be prepared based on current conditions, as the CA725 and CA750 EIs on file were for the site prior to the explosions and fires which impacted site conditions.

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 (SWMUs), regulated units (RUs), and areas of concern (AOCs)), 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 #8 and enter "IN" (more information needed) status code.

Summary of Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs):

An Administrative Order on Consent was executed by EPA and CPR in October 1995 to investigate 32 SWMUs/AOCs, Las Lajas Creek Sediment, the facility Process Sewer, and the groundwater beneath the site (Ref. 2). The following is a list of the original SWMUs and AOCs, as well as the current status of the SWMUs and AOCs. The attached Figure 6 from the RFI depicts the original location of the SWMUs and AOCs, and Figure 7 from the RFI includes the status of the SWMUs and AOCs as presented in the 2015 RFI Report (Ref. 6).

SWMU 1: Container Storage Area
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

SWMU 2: Slop Oil Tank 1000
Cleaned and demolished in 2014 under the Work-Plan Decommission and Demolition of the Industrial Wastewater Treatment Plant, approved by EPA on June 17, 2014.

SWMU 3: Slop Oil Tank 1001
Cleaned and demolished in 2014 under the Work-Plan Decommission and Demolition of the Industrial Wastewater Treatment Plant, approved by EPA on June 17, 2014.

SWMU 4: Solids Knockout Pit
Cleaned and demolished in 2014 under the Work-Plan Decommission and Demolition of the Industrial Wastewater Treatment Plant, approved by EPA on June 17, 2014.

SWMU 5: Surge Tank ET-1
Cleaned and demolished in 2014 under the Work-Plan Decommission and Demolition of the Industrial Wastewater Treatment Plant, approved by EPA on June 17, 2014.

SWMU 6: API Separator
Cleaned and demolished in 2014 under the Work-Plan Decommission and Demolition of the Industrial Wastewater Treatment Plant, approved by EPA on June 17, 2014.

SWMU 7: Corrugated Plate Interceptor
Cleaned and demolished in 2014 under the Work-Plan Decommission and Demolition of the Industrial Wastewater Treatment Plant, approved by EPA on June 17, 2014.

SWMU 8: Equalization Basin
Closed RCRA unit that operated as an unlined surface impoundment that managed D018 and F038 wastes until ceasing operation in 1993. The unit was RCRA closed and approved by EPA in 1999. Closure activities consisted of dewatering the basin, stabilizing the residual sludge, backfilling the basin, installing an impermeable clay and flexible membrane liner cap, installing a drainage layer, and installing a vegetative cover. In 1991, six wells were installed as part of a groundwater monitoring program for the unit. The monitoring system was integrated into the Site Wide Groundwater Monitoring Plan (SWGMP) as part of corrective action in 2002 (Ref. 2). Historically, benzene had been detected in groundwater, but as of March 2009, no constituents were detected in monitoring wells associated with the basin (CCR).

SWMU 9: Inlet basin to Biological Reactor #1
Cleaned and demolished in 2014 under the Work-Plan Decommission and Demolition of the Industrial Wastewater Treatment Plant, approved by EPA on June 17, 2014.

SWMU 10: Digester
Cleaned and demolished in 2014 under the Work- Plan Decommission and Demolition of the Industrial Wastewater Treatment Plant, approved by EPA on June 17, 2014.

SWMU 11: Old Oil Lagoons area
ICM implemented in December 2006, which involved removal of and off-site disposal of impacted soil (CCR). Soil sampling conducted during RFI and Supplemental RFI, approved January 2016.

SWMU 12: Old East Separator
Previously removed by CPR prior to the explosion of October 2009.

SWMU 13: Slop Oil Tank 452
Cleaned and demolished in 2014 under the Work-Plan Decommission and Demolition of the Industrial Wastewater Treatment Plant, approved by EPA on June 17, 2014.

SWMU 19: Natural Aeration Basins
Cleaned and demolished in 2015 under the Work-Plan Decommission and Demolition of the Industrial Wastewater Treatment Plant, approved by EPA on June 17, 2014.

SWMU 21: IAF Unit
Cleaned and demolished in 2014 under the Work-Plan Decommission and Demolition of the Industrial Wastewater Treatment Plant, approved by EPA on June 17, 2014.

SWMU 22: Process Sewer
Flushed and manholes sealed in 2014 in accordance with the Final RFI Work Plan, approved on March 19, 2013. Letter Report submitted to EPA on February 17, 2014.

SWMU 23: Crude Oil 101
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

SWMU 24: Sulphur Pit
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

SWMU 26: Sulphur Recycling Plant
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

SWMU 27: Tank 481
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

SWMU 29: Storage Area – Particulate
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

SWMU 31: Flare
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

SWMU 32: Old Landfill Area
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

SWMU 33: Non-Hazardous Disposal
Soil sampling conducted during RFI and Supplemental RFI. Approved January 2016.

SWMU 34: Sulphur Lagoon
Soil sampling conducted during RFI and Supplemental RFI. Approved January 2016.

SWMU 35: Catalytic Waste Pond
Soil sampling conducted during RFI and Supplemental RFI. Approved January 2016.

SWMU 37: Sulphur Drum Storage Area
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

SWMU 38: Centrifuge
Cleaned and demolished in 2014 under the Work-Plan Decommission and Demolition of the Industrial Wastewater Treatment Plant, approved by EPA on June 17, 2014.

SWMU 39: Gravity Thickener Yard
Cleaned and demolished in 2014 as part of the CWA, RCRA orders, and under the Phase I of the Decommissioning and Demolition of the Industrial Wastewater and Treatment Plant. Approved October 13, 2013.

SWMU 40: Scrap Metal
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

AOC 1: Crude Unit Charge Pump Area
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

AOC 2: Fuel Oil Transfer Pump (Cummins) Area
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

AOC 3: Fuel Oil Transfer Pump Area near Tank 603
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

AOC 4: Asphalt Heater Unit
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

AOC 5: Fuel Oil Loading Rack Pump Area
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

AOC 6: Debutanizer Re-Boiler Area
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

AOC 7: FCC Unit Compressor Lube System Area
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

AOC 8: Heat Exchanger Bundles at Heavy Cycle Steam Generator
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

AOC 9: Crude Unit Num. 1 Area
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

AOC 10: Crude Unit Num. 1 near Heat Exchanger Bundle Area
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

AOC 11: Fuel Oil Pipeline Spill Areas
Removed and demolished during demolition of the refinery in 2012 under the CERCLA Order. This work was summarized in The Final Completion Report, dated October 18, 2013, and approved by EPA on September 15, 2014.

AOC 12: Old Loading Rack
Soil sampling conducted during RFI and Supplemental RFI. Approved January 2016.

Groundwater Investigations
Contaminants of concern identified at the AOCs and SWMUs are primarily total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), and metals (e.g., arsenic, vanadium, lead) (Ref. 5). Numerous groundwater investigations have also been conducted at the site. A comprehensive groundwater sampling event was conducted in 2003. At that time, groundwater samples were collected from 51 monitoring wells and 11 direct-push locations (Ref. 2).

Petroleum hydrocarbons are present in upper clayey sediment and carbonate sediment water-bearing zones at concentrations high enough to create light non-aqueous phase liquids (LNAPLs) (Ref. 2). Interim activities at the site have consisted of measurement and recovery of petroleum hydrocarbon LNAPL and groundwater monitoring. LNAPL measurements were performed at 129 monitoring wells situated throughout the facility. Groundwater sampling (VOCs, arsenic, lead, and/or mercury) was performed on a semi-annual basis. Semi-annual groundwater sampling (BTEX) was also performed at 6 wells at the former facility equalization basin. Historical groundwater contamination identified at the site prior to the fire includes:

- LNAPL in the upper clayey sediment (Zone A) and carbonate sediment (Zone B) water-bearing zones. Reportedly five LNAPL bodies existed, generally within the tank farm and WWTP areas (Ref. 5). Figure 6 from the RFI (Ref. 6) presents the pre-fire locations of the LNAPL plume.

- Dissolved groundwater constituents above the applicable screening criteria:
    - Zone A: benzene, toluene, xylenes, 1,2-dichloroethane (1,2-DCA), 2 -methylnaphthalene, naphthalene, methyl-tert-butyl-ether (MTBE), benzo(a)pyrene, chrysene, fluorene, total and dissolved arsenic, total barium, total beryllium, total chromium, total and dissolved lead, dissolved mercury, total vanadium

    - Zone B: trichloroethene (TCE), tetrachloroethene (PCE), vinyl chloride (VC), cis/trans-1,2-dichloroethene (1,2-DCE), 1,2-dichloropropane, benzene, ethylbenzene, arsenic.

Prior to the 2009 fire, 16 monitoring wells were sampled annually (Ref. 5). These wells were selected to provide information for evaluating downgradient migration. Five of the wells were located in the upper clayey sediment (Zone A), and 11 wells monitored conditions in the carbonate zone (Zone B; Ref. 5). These 16 wells selected were intended to provide information for evaluating potential downgradient migration of dissolved constituents from the LNAPL plume at the facility. Historically, the following areas of the facility were considered contaminated with dissolved constituents (Ref. 5):

- SWMU 22, Process Sewer Area – Zone A has reported detections of benzene, 1,2-DCA,

2-methyl-naphthalene, and naphthalene

- AOC 12, Old Loading Rack – Zone A has reported detections of benzene, naphthalene, and arsenic
- Wastewater Treatment Plant – Zone A has reported benzene, 2-methylnapthalene, chrysene, arsenic, chromium, and vanadium
- SWMU 11, Old Oil Lagoons – Zone A has reported detections of benzene, naphthalene, arsenic, and benzo(a)pyrene
- SWMU 34, Sulfur Lagoon – Zone A has reported detections of arsenic
- Northeast facility – TCE and degradation products in Zone B
- Area M, Northern Tank Farm – Arsenic plume in Zone B

Historically, LNAPL has also existed at the terminal floating both in the clay soil layer and from the carbonate layer. No off-site groundwater contamination had been identified historically as a result of the site contamination (Ref. 6).

Interim measure activities consisted of measurement and recovery of petroleum hydrocarbon LNAPL and groundwater monitoring. The groundwater recovery monitoring system consisted of 131 groundwater monitoring wells, 16 of which were sampled in March and 10 of which were sampled in September of every year to assess the downgradient migration of dissolved constituents from the LNAPL plumes. In addition, quarterly water level and/or product thickness measurements were also collected at the 131 monitoring wells. Monthly measurements were made at 63 of the wells (Ref. 2). LNAPL was routinely recovered at 60 wells. Twenty-two of the 60 recovery wells were equipped with pneumatic ejector pumps. Additional product was recovered from the remaining 38 wells by manual bailing. For the reporting period of October through December 2007, 873 gallons of product were recovered, and for the reporting period of January through March 2008, 265 gallons of product were recovered. As of March 2008, the total amount of product recovered since October 1991 was 80,368 gallons (Ref. 2).

Post 2009 Investigations

In 2009 at the time of the explosion, the site consisted of 42 aboveground storage tanks (ASTs). Areas specifically impacted or suspected of impact from the fire were:

- Northern Tank Farm
- Vicinity of WWTP
- Stormwater channels with the active portion of the facility
- Portions of the undeveloped area (e.g., wetlands).

Immediately following the 2009 explosions, EPA began recovering free product and contaminated soil. This included two areas with LNAPL that were excavated to water table depth, and both contaminated soil and water were removed. Several removal actions were also conducted by EPA during 2010. See attached Tables 9 and 10 from the CCR (Ref. 4) that summarize the activities conducted by EPA and contractors. After the fire, EPA also constructed a gabion retaining wall and earthen berm containing a flow control structure (underflow dam) across Las Lajas Creek to help restrict potential downgradient migration of released petroleum products (RFI Work Plan). Note that in 2014 the gabions were removed by PUMA (Ref. 5).

In May 2011, PUMA (with concurrence from EPA) began assessing site conditions holistically rather than on a SWMU by SWMU approach (Ref. 6), as many of the SWMUs and AOCs had been addressed (Ref. 4). In 2013, PUMA conducted underground storage tank (UST) investigations and removal of a 7,000-gallon diesel UST, a former 4,000-gallon gasoline UST, and a 6,000-gallon gasoline UST located on Avenue B south of the site and north of a former warehouse building. Note that both the 7,000-gallon

and the 4,000-gallon USTs were not found. The 7,000-gallon UST was reportedly already removed in April 1993 and the 4,000-gallon was not found. The 6,000-gallon UST was removed and excavation was conducted in January 2014. Groundwater was not detected in the excavation and the post-excavation samples were not detectable or below applicable screening levels for petroleum products (Ref. 6). Note that lead was detected at concentrations of 3.32 parts per million (ppm) and 13.5 ppm.

Between October and November 2013, soil sampling was also conducted in Area M. Area M consisted of soils piled up about 30 feet (approximately 168,000 cubic yards) which were a result of construction activities at the site. Sampling of the soils identified metals (aluminum, barium, chromium, iron, lead magnesium, manganese, and zinc) in concentrations below background. Soil was recommended for reuse at the terminal (Ref. 6).

In 2013, the RFI Work plan (Ref. 5) was scoped to assess the most current SWMUs and AOCs with documented contamination. Soil sampling was conducted in the following areas:

- Southern and eastern perimeter areas – 18 soil samples were collected to determine the extent of soil contamination in and along the facility boundary in the southern and eastern part of the site
- Avenue D – five soil borings were collected in the central portion of the facility, as this was the area identified to have the highest contamination prior to fire
- Undeveloped wetland areas – four sediment samples collected to address possible contamination in wetlands
- Las Lajas Creek – three sediment samples collected from the creek in northern portion of the facility.

Soil sampling results for Avenue D and the southern/eastern perimeter area identified primarily metals. Sediment samples in wetland areas and Las Lajas Creek also identified metals and TPH. Site-wide groundwater results identified VOCs and metals. In addition to dissolved constituents, LNAPL was detected in three monitoring wells, two of which were located in the tank farm area and one of which was located west in the area of Avenue D (Ref. 5).

Soil sampling results identified metals (e.g., lead, vanadium, chromium) in the vicinity of the southern and eastern perimeter areas. Additionally, TPH-diesel range organics (DRO) and TPH-oil range organics (ORO) were identified in some samples. Similar constituents were reported for Avenue D soil samples and the wetland and Las Lajas Creek sediment sample results (Ref. 5).

After completion of the RFI in 2015, based on historical soil results and the RFI results, an additional supplemental sampling investigation was conducted to address data gaps identified by EPA in and around SWMUs 11, 33, 34, 35. Specifically, two soil samples were collected at SWMU 11 and four samples were collected at SWMUs 33, 34 and 35 (Ref. 8). TPH-gasoline range organics (GRO), TPH-DRO, and TPH-ORO were identified in several of the samples surrounding these SWMUs.

The 2015 RFI also investigated groundwater conditions at the site. Dissolved constituents and LNAPL have been present in groundwater at the site since before the 2009 fire and explosion (Ref. 5). The 2015 RFI evaluated the current condition of the groundwater. Seventy groundwater samples were collected (Ref. 5). VOCs (e.g., benzene, ethyl benzene, MTBE, TCE, naphthalene) were detected along with metals (arsenic, chromium, lead and vanadium).

In addition to the LNAPL plumes and site-related contamination, there is information that a groundwater plume from the nearby Fort Buchanan site may be contributing to contamination (Ref. 5). Specifically, TCE and vinyl chloride have been identified along the eastern boundary of the PUMA site, but is believed

to be part of a larger plume located on Fort Buchanan property (Refs. 2 and 5). Figure 18 of the RFI (Ref. 5) is attached, which depicts the plume maps for the site. Additional details regarding site-wide groundwater contamination are discussed in Question No. 2. However, the 2015 RFI concludes that dissolved constituents are not migrating significantly in groundwater, and that LNAPL is not anticipated to migrate in groundwater based on hydrogeologic conditions. The RFI also indicates that semi-annual and annual groundwater monitoring will be conducted over the next three years to ensure that migration is not occurring.

EPA approved the RFI and supplemental RFI in 2016, indicating that site characterization was complete. EPA also concurred with PUMA's recommendation to conduct periodic groundwater sampling to demonstrate that the EIs had been achieved (Ref. 5). Additional details regarding site-wide contamination are discussed in Question No. 2.

2. Is **groundwater** known or reasonably suspected to be "**contaminated**"[1] above appropriately protective "levels" (i.e., applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action, anywhere at, or from, the facility?

   _X_ If yes - continue after identifying key contaminants, citing appropriate "levels," and referencing supporting documentation.

   ___ If no - skip to #8 and enter "YE" status code, after citing appropriate "levels," and referencing supporting documentation to demonstrate that groundwater is not "contaminated."

   ___ If unknown - skip to #8 and enter "IN" status code.

Rationale:
The PUMA facility is located on alluvium deposits that consist of sand, clay, and sandy clay (Ref. 5). Overburden thickness varies from 10 feet in the southern portion of the facility to about 90 feet in the northern portion (Ref. 5). A layer of carbonate sediments is located beneath the clay soils overlying the limestone bedrock. Undulation of the carbonate layer results in natural domes covered by clay soils (Ref. 5).

Two general water-bearing units are present beneath the PUMA facility: an upper overburden clay unit that is a low permeability semi-perched layer (Zone A) and an underlying permeable carbonate water-bearing sediment unit (Zone B). Groundwater flow in Zone A is to the north, and in Zone B flows to the north to northwest. Well yields in the overburden (Zone A) are generally less than in the carbonate sediment, as observed during well development and groundwater sampling activities. Groundwater in the overburden varies from unconfined to semi-confined. Groundwater in the carbonate sediment (Zone B) varies from semi-confined (Ref. 5). The groundwater gradient at the facility is generally to the north (Ref. 5). Figures 3 and 4 from the December 2016 groundwater monitoring report depict the most recent groundwater flow data.

Prior to the 2009 fire, 16 monitoring wells were sampled annually (Ref. 5). These wells were selected to provide information for evaluating downgradient migration. Five of the wells were located in the upper clayey sediment (Zone A), and 11 wells monitored conditions in the carbonate zone (Zone B; Ref. 5). These 16 wells were intended to provide information for evaluating potential downgradient migration of dissolved constituents from the LNAPL plume at the facility. Historically, the following areas of the facility were considered contaminated with dissolved constituents (Ref. 5):

- SWMU 22, Process Sewer Area – Zone A has reported detections of benzene, 1,2-DCA, 2-methyl-naphthalene, and naphthalene
- AOC 12, Old Loading Rack – Zone A has reported detections of benzene, naphthalene, and arsenic
- Wastewater Treatment Plant – Zone A has reported benzene, 2-methylnapthalene, chrysene, arsenic, chromium, and vanadium
- SWMU 11, Old Oil Lagoons – Zone A has reported detections of benzene, naphthalene, arsenic,

[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 appropriate "levels" (appropriate for the protection of the groundwater resource and its beneficial uses).

and benzo(a)pyrene

- SWMU 34, Sulfur Lagoon – Zone A has reported detections of arsenic
- Northeast facility – TCE and degradation products in Zone B
- Area M, Northern Tank Farm – Arsenic plume in Zone B

Historically, LNAPL has also existed at the terminal floating on both the clay soil layer and the carbonate layer. No off-site groundwater contamination had been identified historically as a result of the site contamination (Ref. 6).

After the fire, PUMA conducted a site-wide well survey as many of the wells were damaged or were no longer functional (Ref. 5). As such, 121 of the 195 existing wells on site had to be decommissioned. Figures 11 and 12 of the RFI (Ref. 6) depict the remaining wells after closure and the newly installed wells. Also during the reconstruction activities, PUMA removed soil and LNAPL from AOCs 2, 3 and SWMU 13, as well as other areas where previously identified LNAPL was present (Figures 17 and 18 of the RFI; Ref. 6). Figures 20-28 depict detections during RFI sampling of the 70 wells. Note that as part of the 2015 RFI activities, nine new monitoring wells were installed along the eastern and southern perimeters. Three were installed in Zone A (PMW-116, 117, and 118) and six in Zone B (PMW-119, PMW-120, PMW-121, PMW-122, PMW -123, and PMW-124).

During the 2015 RFI, all monitoring wells were sampled. Results indicated that groundwater is contaminated above the EPA 2016 Regional Screening Levels (Ref. 9) for several dissolved VOC and inorganic constituents. Additionally, LNAPL has existed in different portions of the terminal, both in groundwater and in the clay soil layer and from the carbonate sediment layer (Refs. 2 and 5). The LNAPL is pushed upward against the overlying clay soils due to undulations of the carbonate sediment layer (Ref. 5). It is believed that the floating free product in the carbonate sediments is unable to migrate (Refs. 2 and 5).

Numerous groundwater investigations have been conducted at the facility since 1980. Approximately 1,000,000 gallons of petroleum product and/or groundwater has been removed from the site (Ref. 4). Beginning in 1988, a groundwater assessment was initiated to delineate the extent of LNAPL at the site.

In 2003, groundwater samples were collected and analyzed for VOCs, base neutral acids (BNAs), and/or metals at 51 monitoring wells and at 11 direct-push locations. VOCs, BNAs, and metals were detected in both zones A and B. No off-site migration was identified. Table 1 below compares the historical maximum contaminant concentrations detected during this event and presented in the 2008 EI (Ref. 2) to the 2016 screening groundwater levels identified in the PUMA Energy Caribe, LLC, Updated Site Screening Evaluation (Ref. 9). As shown in Table 1, constituents exceeded at least one of the applicable screening levels: 2016 EPA Vapor Intrusion Screening Level (VISL), 2016 EPA Maximum Contaminant Level (MCL), or 2016 EPA tap water Regional Screening Level (RSL).

Table 1. Historical Groundwater Data from 2008 Environmental Indicator CA725

Groundwater Contaminant	2016 Tap Water RSL (µg/L)	2016 EPA MCL (µg/L)	2016 EPA Commercial VISL (µg/L)	Maximum Concentration (µg/L)	Monitoring well Or Direct Push Location
Benzene	0.46	5	6.9	2910	Well MW-91A
1,2-DCA	17	5	9.8	6.9 J	DP location PS-15G
Methyl Tertiary-Butyl Ether	14	-	200	652	Well B-2
Naphthalene	0.017	-	20	358 J	Direct-push location PS-16G
cis-1,2-DCE	3.6	70	-	71.7	Well MW-75B
TCE	28	5	2.2	154 J	Well MW-83B1
Vinyl Chloride	0.019	2	2.5	5.8	Well MW-75B
Arsenic	0.052	10	-	121	Well MW-110B
Chromium	2200	100	-	248	Well MW-110B
Mercury	0.57	2	-	3.4	Well MW-21B
Vanadium	6.6	-	-	408	Well MW-110B

J = Estimated value
- = Not available

After the 2009 fire, as mentioned above, PUMA conducted a groundwater sampling investigation at the site. Groundwater results from the 2016 Dec. Ground Water Monitoring Report (GWMR; Ref. 11) and the 2015 RFI (Ref. 5) are compared to EPA RSLs in Table 2 below. Table 2 identifies the maximum detected concentrations of constituents that exceed relevant screening levels for groundwater and lists the well in which it was detected.

Table 2. December 2016 Groundwater Monitoring Results

Constituent	2016 EPA Tap Water RSL (µg/L)	2016 EPA MCL (µg/L)	2016 EPA Commercial VISL (µg/L)	Maximum Detection in December 2016 GWMR (µg/L)	Location of 2016 Maximum Detection (µg/L)
Arsenic	0.052	10	-	9.6	MW-MP3
Lead	15	15	-	31	MW-48A
Mercury	0.57	2	-	22	MW-MP3
Vanadium	6.6	-	-	56	MW-B1
Naphthalene	0.017	-	20	210	MW-91A
Benzene	0.46	5	6.9	1080	MW-91A
Chloroform	0.22	80	3.6	0.56	MW-118
Cis-1,2 DCE	3.6	70	-	8	MW-118
Ethyl benzene	1.5	700	15	690	MW-91A
MTBE	14	-	200	61.2	MW- EB104
TCE	28	5	2.2	72.3	MW-118
m/p xylenes	19	10,000	160	63.6	MW-91A
O xylene	19	10,000	210	16.7	MW-91A

- = Not available

In addition to dissolved constituents, LNAPL is still present and has been detected in monitoring wells MW-42B, MW-40B, MW-T9, and MW-114A. The maximum LNAPL detected during the December 2016 monitoring event was 1.41 feet of LNAPL in monitoring well MW-40B. Figures 15 and 16 from the RFI Report (Ref. 6) depict the monitoring well locations.

In addition, there is information that contamination from Fort Buchanan property may have impacted the facility. The 2008 EI (Ref. 2) notes that TCE and vinyl chloride were detected along the eastern boundary of the facility and these constituents are believed to be from a larger plume on the property of Fort Buchanan to the east. Fort Buchanan is working to identify the source of the plume (Refs. 2 and 6).

3. Has the **migration** of contaminated groundwater **stabilized** (such that contaminated groundwater is expected to remain within "existing area of contaminated groundwater"[2] as defined by the monitoring locations designated at the time of this determination)?

_X_ If yes - continue, after presenting or referencing the physical evidence (e.g., groundwater sampling/measurement/migration barrier data) and rationale why contaminated groundwater is expected to remain within the (horizontal or vertical) dimensions of the "existing area of groundwater contamination"[2].

___ If no (contaminated groundwater is observed or expected to migrate beyond the designated locations defining the "existing area of groundwater contamination"[2]) - skip to #8 and enter "NO" status code, after providing an explanation.

___ If unknown - skip to #8 and enter "IN" status code.

Rationale:

The original 2008 CA750 EI Determination (Ref. 2) considered migration of contaminated groundwater stabilized. The EI (Ref. 2) states that petroleum hydrocarbon LNAPL is detected in five plumes contained within the facility. The plume locations are generally within the Tank Farm and WWTP areas of the facility. Interim measures consisting of LNAPL measurement and recovery within the plumes were conducted on an ongoing basis since 1990. Wells downgradient of the LNAPL plumes have been monitored for the presence of LNAPL since about 1991. All of the five plumes have remained stable with negligible migration. Additional discussion regarding LNAPL is provided below.

Implemented Remedial Actions for Groundwater

Interim measure activities conducted at the site consist of measurement and recovery of petroleum hydrocarbon LNAPL and groundwater monitoring. Historically, the groundwater recovery monitoring system consisted of 131 groundwater monitoring wells, 26 of which were sampled every year to assess the downgradient migration of dissolved constituents from the LNAPL plumes. In addition, quarterly water level and/or product thickness measurements were collected at the 131 monitoring wells. LNAPL was routinely recovered at 60 wells. Twenty-two of the 60 recovery wells were equipped with pneumatic ejector pumps. Additional product was recovered from the remaining 38 wells by manual bailing. For the reporting period of October through December 2007, 873 gallons of product were recovered and for the reporting period of January through March 2008, 265 gallons of product were recovered. As of March 2008, the total amount of product recovered since October 1991 was 80,368 gallons (Ref. 2).

Current Groundwater Conditions at the Site

As indicated previously, the groundwater gradient is predominantly to the north and northeast (Ref. 6). Figures 3 and 4 from the December 2016 groundwater monitoring report (Ref. 11) depict groundwater flow in Zone A and B respectively. Figure 31 from the RFI Report (Ref. 6) depicts perimeter wells and cross sections along the facility boundaries. Figure 18 from the RFI Report depicts the LNAPL distribution at the site. The RFI Report (Ref. 6) indicates the extent of LNAPL in monitoring wells has

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[2] "Existing area of contaminated groundwater" is an area (with horizontal and vertical dimensions) that has been verifiably demonstrated to contain all relevant groundwater contamination for this determination, and is defined by designated (monitoring) locations proximate to the outer perimeter of "contamination" that can and will be sampled/tested in the future to physically verify that all "contaminated" groundwater remains within this area, and that the further migration of "contaminated" groundwater is not occurring. Reasonable allowances in the proximity of the monitoring locations are permissible to incorporate formal remedy decisions (i.e., including public participation) allowing a limited area for natural attenuation.

decreased since 2009, and that hydrogeologic conditions at the site have not changed significantly since the 2008 EI (Ref. 2). The results of the 2016 groundwater sampling Semi-Annual events indicate that only three wells have reported LNAPL and that free product thickness is decreasing over time (Ref. 11).

As such, based on all available information, contaminated groundwater at the PUMA facility should be considered stabilized. The primary source of contamination at the site is the LNAPL that is present in the subsurface. Based on the RFI Report and the groundwater monitoring results in 2016, the occurrence of LNAPL is extremely limited. Four monitoring wells (MWT-9, MW-40, MW-42B, and AD-2) out of 73 reported detections of LNAPL, ranging in thickness from a 0.01 inches in AD-2, to 1.41 inches in MW-40B (Ref. 11). Historically, as many as 60 monitoring wells have reported LNAPL (Ref. 6). Furthermore, the EPA approved RFI Report (Ref. 6) provides historical comparison (see Table 5 of the RFI Report) of LNAPL thicknesses detected in monitoring wells between 2009 to 2014 and concludes that the free phase product data revealed an overall decrease in thickness in wells located in the WWTP area as well as in the Tank Farm. Finally, as the LNAPL is the primary source of groundwater contamination at the site and it is believed to be trapped and unable to migrate, the source should be considered controlled (Refs. 2 and 6). Additional evidence includes:

1. Contaminant concentrations have decreased or remained stable in monitoring wells over time. Comparison of historical data (Tables 3a/3b and 4 below) from 2014 to 2016 indicates a decreasing or stable trend in all monitoring wells with the exception of the eastern perimeter wells PMW-118 and PMW-119 (see Figure 15 of the RFI for well locations). These wells do show some increasing chlorinated VOC contamination; however, this is believed to be a result of the TCE plume from Fort Buchanan (Refs. 2 and 6).

Table 3a. Comparison of Historical Monitoring Well Data (in µg/L)

Constituent	Date	MW-13A	MW-30 A	MW-33A	MW-37A	MW-57A	MW-83A	MW-83B	MW-91A
Benzene	12/2016	0.50 U	0.50 U	0.50 U	2.3	0.50 U	0.50 U	0.50 U	1080
	6/2016	1.4	--	0.50 U	67.4	0.50 U	0.50 U	0.50 U	1940
	9/2014	ND	ND	ND	ND	ND	ND	ND	2430
Ethylbenzene	12/2016	0.10 U	0.50 U	0.50 U	72.9	0.50 U	5.0 U	5.0 U	690
	6/2016	0.10 U	--	0.50 U	52.4	0.50 U	5.0 U	5.0 U	1020
	9/2014	ND	ND	ND	ND	ND	--	ND	767
Arsenic – Total	12/2016	5.7	1.0 U	0.013	1.4	3.1	1.0 U	1.9	4.1
	6/2016	4.9	--	0.0091	1.8	6.9	1.7	1.0 U	4.6
	9/2014	ND	14.8	12.7	25.3	ND	ND	ND	16.9
Lead – Total	12/2016	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.3	1.2
	6/2016	1.0 U	--	1.0 U	1.3	1.0 U	1.0 U	1.0 U	1.5
	9/2014	ND	ND	ND	ND	ND	ND	ND	ND
Chromium - Total	12/2016	1.0 U	4.0	1.0 U	1.0 U	1.0 U	1.0 U	5.6	1.0 U
	6/2016	1.0 U	--	1.0 U	1.0 U	1.0 U	0.0014	1.0 U	1.0 U
	9/2014	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	12/2016	1.0 U	0.10 U	1.5	41.4	1.1	1.0 U	1.0 U	21.0
	6/2016	3.6	--	2.3	140	1.1	0.10 U	0.10 U	180
	9/2014	0.67	0.47	0.74	940	0.7	ND	ND	59.5
Isopropylbenzene	12/2016	1.0 U	1.0 U	1.0 U	7.9	1.0 U	0.0010 U	1.0 U	18.0
	6/2016	2.8	--	2.9	13.1	2.0	0.0010 U	1.0 U	28.7
	9/2014	ND	ND	ND	21.2	ND	ND	ND	ND
2-methylnaphthalene	12/2016	ND	ND	ND	ND	--	ND	ND	87.2
	6/2016	--	--	--	--	--	--	--	--
	9/2014	ND	0.13	ND	0.53	ND	ND	ND	22.9
MTBE	12/2016	1.9	2.8	8.4	1.2	7.9	0.50 U	0.00050 U	0.50 U
	6/2016	20.5	--	8.6	6.6	4.3	0.50 U	0.0017	0.50 U
	9/2014	30.7	ND	5.5	29.8	9.2	ND	ND	ND

ND = Not detected
U = Undetected above the detection limit
-- = Not available

Table 3b. Comparison of Historical Monitoring Well Data (in µg/L)

Constituent	Date	AD-1	AD-2	AD-3	AD-4	MW-48A	MW-48B	EB-104	MP3
Benzene	**12/2016**	0.50 U	--	0.50 U	0.00050 U	0.50 U	--	0.50 U	0.50 U
	6/2016	0.50 U	0.50 U	0.50 U	0.00050 U	--	0.50 U	0.50 U	0.50 U
	9/2014	ND	ND	ND	23.8	--	ND	ND	ND
cis-1,2-DCE	**12/2016**	1.0 U	--	1.0 U	1.0 U	1.0 U	--	1.0 U	1.0 U
	6/2016	1.0 U	1.0 U	1.0 U	1.0 U	--	0.0010 U	1.0 U	1.0 U
	9/2014	ND	ND	ND	ND	--	ND	ND	ND
Ethylbenzene	**12/2016**	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
	6/2016	1.4	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
	9/2014	ND	ND	ND	8.2	--	ND	ND	ND
1,1,2-trichloroethane	**12/2016**	0.50 U	--	0.50 U	0.0019	0.00050 U	--	0.50 U	0.50 U
	6/2016	0.50 U	0.50 U	0.50 U	0.50 U	--	0.50 U	0.50 U	0.50 U
	9/2014	ND	ND	ND	22.7	--	ND	ND	ND
TCE	**12/2016**	0.50 U	--	0.50 U	0.50 U	0.50 U	--	0.50 U	0.50 U
	6/2016	0.50 U	0.50 U	0.50 U	0.50 U	--	0.50 U	0.50 U	0.50 U
	9/2014	ND	ND	ND	ND	--	ND	ND	ND
Arsenic – total	**12/2016**	1.0 U	--	1.0 U	2.8	1.0 U	--	1.0 U	9.6
	6/2016	2.7	1.0 U	1.0 U	1.0 U	--	4.0	1.2	8.4
	9/2014	59.5	276	33	273	--	ND	ND	ND
Lead – Total	**12/2016**	1.0 U	--	1.0 U	1.0 U	31	--	1.0 U	22
	6/2016	1.0 U	1.0 U	1.0 U	1.0 U	--	33	1.0 U	28
	9/2014	14.1	41.3	ND	29	--	17.8	ND	35.7
Chromium - Total	**12/2016**	1.1	--	1.0 U	1.0 U	15	--	1.7	3.6
	6/2016	1.0 U	1.0 U	1.0 U	1.0 U	--	15	20	3.8
	9/2014	121	630	47.4	521	--	ND	ND	11.2
Naphthalene	**12/2016**	15	--	1.0 U	0.92	1.0 U	--	1.0 U	1.0 U
	6/2016	15	1.0 U	1.0 U	3.3	--	1.0 U	1.0 U	1.0 U
	9/2014	16	12	11	22.9	--	ND	ND	ND
Isopropylbenzene	**12/2016**	1.0 U	--	1.0 U	1.0 U	1.0 U	--	1.0 U	1.0 U
	6/2016	13.1	0.0010 U	1.0 U	2.8	--	1.0 U	1.0 U	1.0 U
	9/2014	6.6	ND	ND	65.5	--	ND	ND	ND
MTBE	**12/2016**	0.50 U	--	0.50 U	1.4	0.50 U	--	61.2	0.50 U
	6/2016	1.8	0.50 U	0.50 U	0.50 U	--	0.50 U	76.4	0.50 U
	9/2014	ND	9.7	ND	9.5	--	ND	62.4	ND
2-methylnaphthalene	**12/2016**	--	--	--	0.20	ND	--	ND	ND
	6/2016	--	--	--	--	--	--	--	--
	9/2014	ND	ND	ND	11.2	--	ND	ND	ND

NA = not analyzed -- = not available
ND = Not detected U = not detected above the detection limit

Table 4. Historical Data for Northern and Eastern Boundary Monitoring Wells (in µg/L)

Constituent	Date	MW-20B	MW-21B	MW-75B2	MW-76B2	MW-77B	MW-78B	PMW-116	PMW-117	PMW-118	PMW-119	PMW-121	PMW-122	PMW-123
Benzene	12/2016	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
	6/2016	0.50 U	0.50 U	--	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
	9/2014	ND	ND	ND	ND	ND	--	ND	ND	ND	ND	ND	ND	ND
cis-1,2-DCE	12/2016	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
	6/2016	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	6.9	1.0 U	1.0 U	1.0 U	1.0 U
	9/2014	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	12/2016	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
	6/2016	0.50 U	0.50 U	--	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
	9/2014	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-trichloroethane	12/2016	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
	6/2016	0.50 U	0.50 U	--	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
	9/2014	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TCE	12/2016	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	72.3	7.4	1.7	0.50 U	0.50 U
	6/2016	0.50 U	0.50 U	--	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	61.9	4.5	0.50 U	0.50 U	0.50 U
	9/2014	ND	ND	ND	ND	ND	ND	ND	ND	14.7	10.6	ND	ND	ND
Arsenic – total	12/2016	1.0 U	1.0 U	1.0 U	1.0 U	1.5	1.0 U	1.7	1.0 U	1.0 U	1.0 U	3.4	1.0 U	1.0 U
	6/2016	1.7	1.0 U	--	1.0 U	1.1	1.0 U	6.2	1.0 U	1.0 U	1.0 U	3.7	1.0 U	1.0 U
	9/2014	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead – Total	12/2016	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
	6/2016	1.0 U	3.9	--	1.0 U	2.6	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	3.4	1.0 U	1.0 U
	9/2014	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium – Total	12/2016	4	4	460	1.0 U	7.2	7.4	1.1	1.0 U	1.1	1.0 U	5.8	1.0 U	1.0 U
	6/2016	11	2.8	--	1.0 U	4.4	1.6	1.7	1.1	1.0 U	1.0 U	9.8	1.5	2.1
	9/2014	ND	ND	41.7	ND	ND	--	ND	ND	ND	ND	ND	ND	ND
Naphthalene	12/2016 (mg/l)	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
	6/2016 (mg/l)	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
	9/2014	ND	ND	ND	ND	ND	--	ND	ND	ND	ND	ND	ND	ND
Isopropylbenzene	12/2016	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	18.0	18.0	18.0	1.0 U	1.0 U	1.0 U	1.0 U
	6/2016	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
	9/2014	ND	ND	ND	ND	ND	--	ND	ND	ND	ND	ND	ND	ND
MTBE	12/2016	0.50 U	2.8	4.7	0.50 U	0.50 U	0.50 U	0.50 U	1.5	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
	6/2016	0.50 U	3.5	--	0.50 U	0.50 U	0.50 U	0.50 U	1.0	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
	9/2014	ND	ND	ND	ND	ND	--	5.5	ND	ND	ND	ND	ND	ND
2-methylnaphthalene	12/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/2016	--	--	--	--	--	--	--	--	--	--	--	--	--
	9/2014	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

NA = not analyzed -- = not available
ND = Not detected U = not detected above the detection limit

2. Additionally historical data for site boundary wells continue to remain unimpacted.

A comparison of data from perimeter wells indicate that migration is not occurring off site and that concentrations of site-related contaminants have not been detected. It is noted that TCE and vinyl chloride have been detected in monitoring wells along the eastern boundary of PUMA. This plume is considered part of a larger plume located primarily on the property of Fort Buchanan. The highest concentration of TCE was found in monitoring wells (e.g., MW-18D) located upgradient of the facility (Ref. 6) and is migrating towards PMW-118 and PMW-119. Note that TCE is not a compound that has been used at the facility, and because hydrocarbon compounds are not present along with the

chlorinated compounds, these detections are not considered site related (Ref. 6). Fort Buchanan is currently in the process of identifying the source and evaluating the need for remedial actions for this plume.

4. Does "contaminated" groundwater **discharge** into **surface water** bodies?

_X_ If yes - continue after identifying potentially affected surface water bodies.

___ If no - skip to #7 (and enter a "YE" status code in #8, if #7 = yes) after providing an explanation and/or referencing documentation supporting that groundwater "contamination" does not enter surface water bodies.

___ If unknown - skip to #8 and enter "IN" status code.

Rationale:

It is believed that contaminated groundwater may discharge into surface water bodies. Several recent and historical assessments of potential impact to surface water from the PUMA facility have been conducted (Ref. 6). The wetlands area and Las Lajas Creek are considered the primary surface water bodies present at the PUMA facility. Groundwater discharge from the overburden water-bearing Zone A to Las Lajas Creek was identified in the 2008 EI (Ref. 2). Las Lajas Creek is a low-flow, shallow stream that originates in the hills south of the facility, traverses through the north-central part of the facility, and eventually discharges into San Juan Bay, located about 1.75 miles north of the facility. Las Lajas Creek is channeled underground as it enters the facility and returns to an open channel north of the facility's WWTP area. Once Las Lajas Creek has passed through the facility proper, much of the flow is outfall discharge (Refs. 1 and 2).

5. Is the **discharge** of "contaminated" groundwater into surface water likely to be **"insignificant"** (i.e., the maximum concentration[3] of each contaminant discharging into surface water is less than 10 times their appropriate groundwater "level," and there are no other conditions (e.g., the nature, and number, of discharging contaminants, or environmental setting), which significantly increase the potential for unacceptable impacts to surface water, sediments, or ecosystems at these concentrations)?

_X_ If yes - skip to #7 (and enter "YE" status code in #8 if #7 = yes), after documenting: 1) the maximum known or reasonably suspected concentration[3] of key contaminants discharged above their groundwater "level," the value of the appropriate "level(s)," and if there is evidence that the concentrations are increasing; and 2) provide a statement of professional judgment/explanation (or reference documentation) supporting that the discharge of groundwater contaminants into the surface water is not anticipated to have unacceptable impacts to the receiving surface water, sediments, or ecosystem.

___ If no - (the discharge of "contaminated" groundwater into surface water is potentially significant) - continue after documenting: 1) the maximum known or reasonably suspected concentration[3] of each contaminant discharged above its groundwater "level," the value of the appropriate "level(s)," and if there is evidence that the concentrations are increasing; and 2) for any contaminants discharging into surface water in concentrations[3] greater than 100 times their appropriate groundwater "levels," the estimated total amount (mass in kg/yr) of each of these contaminants that are being discharged (loaded) into the surface water body (at the time of the determination), and identify if there is evidence that the amount of discharging contaminants is increasing.

___ If unknown - enter "IN" status code in #8.

Rationale:

Several recent and historical assessments of potential impact to surface water from the PUMA facility have been conducted. Groundwater discharge from the overburden water-bearing zone to Las Lajas Creek was identified in the 2008 EI (Ref. 2). Historically, groundwater sampling results from shallow wells nearby and adjacent to the creek (monitoring wells MP-1, MP-5A, MP-9, MP-10, MW-86A, MW-110A, and MW- 111A) were used to demonstrate that discharge to surface water was acceptable. Historic results from these wells did show some constituents of concern above groundwater screening levels. Total arsenic and vanadium were detected above screening levels at monitoring well MW-110A during the July 2004 sampling event; however, the dissolved metals results were below screening levels. High turbidity occurred in the groundwater sample, which biased the total metals results high. Therefore, the dissolved arsenic and vanadium results were considered to be more representative than the total metals result for this sampling event. Resampling of monitoring well MW-111A in September of 2004 showed that both total and dissolved metals were below screening levels, which confirmed the dissolved metals results from July 2004. Therefore, no impact to surface water due to groundwater was indicated (Ref. 2).

Historically, LNAPL plumes have not been present adjacent to Las Lajas Creek; hence, no impact to surface water from the LNAPL plumes was indicated prior to the fire (Ref. 2). After the 2009 fire, additional assessments and evaluation of the surface water was conducted to ensure that no impacts to the surface water bodies had occurred. Immediately after the fire, visual impacts were observed in the

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[3] As measured in groundwater prior to entry to the groundwater-surface water/sediment interaction (e.g., hyporheic) zone.

Las Lajas Creek and the wetlands areas. However, after removal actions conducted by EPA and PUMA in 2011, no visual impacts were observed. In 2011, a hydrogeomorphic assessment of the wetlands did not find residual oil in wetlands or creeks (Ref. 6). Furthermore, no odors, sheens, staining, or discoloration were observed in surface waters, vegetation, or soil profiles (Ref. 6).

In 2015, as part of the RFI, surface water sampling was also conducted in Las Lajas Creek and the wetland areas to assess potential contamination (Ref. 6). The only constituent detected in surface water samples collected from the wetland and Las Lajas creek was lead, which was below human health criteria. However, lead was above ecological values for freshwater as discussed in the following paragraph.

The 2016 Site Wide Screening Evaluation (Ref. 9) compared the surface water analytical results for Las Lajas Creek to USEPA Region 2 Puerto Rico Fresh Surface Water and Marine Surface Water Surface Water Ecological Screening Values (ESVs). Petroleum hydrocarbons, such as GRO, DRO, and ORO were not detected in surface water samples. Additionally, no VOCs or SVOCs were detected in the surface water samples. Only lead (total) was detected in surface water sample SWLC-02 at a concentration greater than the fresh surface water ESV (3.18 µg/L), but less than the marine surface water ESV (8.5 µg/L). Dissolved lead, which is more bioavailable to ecological receptors, was not detected in surface water sample SWLC-02.

Petroleum hydrocarbons, such as GRO, DRO, and ORO, also were not detected in surface water samples in the undeveloped wetland areas. VOCs and SVOCs were not detected in the wetland surface water samples either. Only one inorganic compound, lead, was detected. Lead (total) was detected in surface water samples SWW-03 and SWW-04 at concentrations greater than the fresh surface water ESV (3.18 µg/L), but less than the marine surface water ESV (8.5 µg/L). Dissolved lead, which is more bioavailable to ecological receptors, was not detected in surface water samples SWW-03 and SWW-04. Total lead was detected in sample SWLC-02 at a concentration of 5.9 µg/L, SWW-03 at 5.6 µg/L, and SWW-02 at 5.2 µg/L.

As dissolved lead, which is more bioavailable to receptors than total lead, was not detected in any surface water and total lead concentrations were less than marine surface water ESV, impacts are not considered significant (Ref. 6). Additionally, since LNAPL plumes are not located near the surface water areas, no additional significant impacts are anticipated.

6. Can the **discharge** of "contaminated" groundwater into surface water be shown to be "**currently acceptable**" (i.e., not cause impacts to surface water, sediments or ecosystems that should not be allowed to continue until a final remedy decision can be made and implemented[4])?

___ If yes - continue after either: 1) identifying the Final Remedy decision incorporating these conditions, or other site-specific criteria (developed for the protection of the site's surface water, sediments, and ecosystems), and referencing supporting documentation demonstrating that these criteria are not exceeded by the discharging groundwater; OR 2) providing or referencing an interim-assessment[5], appropriate to the potential for impact, that shows the discharge of groundwater contaminants into the surface water is (in the opinion of a trained specialist, including an ecologist) adequately protective of receiving surface water, sediments, and ecosystems, until such time when a full assessment and final remedy decision can be made. Factors which should be considered in the interim-assessment (where appropriate to help identify the impact associated with discharging groundwater) include: surface water body size, flow, use/classification/habitats and contaminant loading limits, other sources of surface water/sediment contamination, surface water and sediment sample results and comparisons to available and appropriate surface water and sediment "levels," as well as any other factors, such as effects on ecological receptors (e.g., via bio-assays/benthic surveys or site-specific ecological Risk Assessments), that the overseeing regulatory agency would deem appropriate for making the EI determination.

___ If no - (the discharge of "contaminated" groundwater can not be shown to be "**currently acceptable**") - skip to #8 and enter "NO" status code, after documenting the currently unacceptable impacts to the surface water body, sediments, and/or ecosystem.

___ If unknown - skip to 8 and enter "IN" status code.

Rationale:

This question is not applicable. See the response to Question 5.

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[4] Note, because areas of inflowing groundwater can be critical habitats (e.g., nurseries or thermal refugia) for many species, appropriate specialist (e.g., ecologist) should be included in management decisions that could eliminate these areas by significantly altering or reversing groundwater flow pathways near surface water bodies.

[5] The understanding of the impacts of contaminated groundwater discharges into surface water bodies is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration to be reasonably certain that discharges are not causing currently unacceptable impacts to the surface waters, sediments or eco-systems.

7. Will groundwater **monitoring**/measurement data (and surface water/sediment/ecological data, as necessary) be collected in the future to verify that contaminated groundwater has remained within the horizontal (or vertical, as necessary) dimensions of the "existing area of contaminated groundwater?"

_X_ If yes - continue after providing or citing documentation for planned activities or future sampling/measurement events. Specifically identify the well/measurement locations which will be tested in the future to verify the expectation (identified in #3) that groundwater contamination will not be migrating horizontally (or vertically, as necessary) beyond the "existing area of groundwater contamination."

___ If no - enter "NO" status code in #8.

___ If unknown - enter "IN" status code in #8.

Rationale:

In November 2015, EPA approved PUMA's recommendation to implement semi-annual sampling for 2016 and annual groundwater sampling for three years thereafter. The monitoring program includes all 73 monitoring wells at the site (Ref. 11).

8. Check the appropriate RCRIS status codes for the Migration of Contaminated Groundwater Under Control EI (event code CA750), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (attach appropriate supporting documentation as well as a map of the facility).

_X_ YE - Yes, "Migration of Contaminated Groundwater Under Control" has been verified. Based on a review of the information contained in this EI determination, it has been determined that the "Migration of Contaminated Groundwater" is "Under Control" at the PUMA Energy Caribe, LLC site, EPA ID# PRD00632182, located at Road PR-28, km 2 Luchetti Industrial Park in Bayamon, Puerto Rico. Specifically, this determination indicates that the migration of "contaminated" groundwater is under control, and that monitoring will be conducted to confirm that contaminated groundwater remains within the "existing area of contaminated groundwater." This determination will be re-evaluated when the Agency becomes aware of significant changes at the facility.

___ NO - Unacceptable migration of contaminated groundwater is observed or expected.

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

Completed by: Connie Crossley Date: 9/20/17

Connie Crossley
Associate
Booz Allen Hamilton

Reviewed by: Amy Brezin Date: 9/20/17

Amy Brezin
Lead Associate
Booz Allen Hamilton

Also reviewed by: Date: 9/28/2017

David N. Cuevas-Miranda,
Lead Physical Scientist, RCRA Section
Response and Remediation Branch
Caribbean Environmental Protection Division,
EPA Region 2

Approved by: Date: 9/29/2017

Teresita Rodríguez, Chief
Response and Remediation Branch
Caribbean Environmental Protection Division,
EPA Region 2

Locations where references may be found:

References reviewed to prepare this EI determination are identified on the following page. Reference materials are available at Puerto Rico Environmental Quality Board.

Contact telephone and e-mail numbers: David N. Cuevas-Miranda
(787) 977-5856
cuevas.david@epa.gov

References

1. Documentation of Environmental Indicator Determination, RCRA Correction Action CA725 Current Human Exposures Under Control, Caribbean Petroleum Refinery, Bayamon, Puerto Rico, 2008.

2. Documentation of Environmental Indicator Determination, RCRA Correction Action CA750 Migration of Groundwater Under Control, Caribbean Petroleum Refinery, Bayamon, Puerto Rico, 2008.

3. Memorandum from David Cuevas, Caribbean Environmental Protection Division to File, Re: Status of RCRA Corrective Action Environmental Indicators (EIs), Caribbean Petroleum Refining (CPR), Status of RCRA Corrective Action Environmental Indicators (EIs), Caribbean Petroleum Refining (CPR), LP (PRD000632182), December 29, 2010.

4. PUMA Energy Caribe, LLC Current Conditions Report, Former Caribbean Petroleum Refining Facility, Bayamon, Puerto Rico. Prepared by Arcadis. Revised May 2012.

5. PUMA Energy Caribe, LLC, RFI Work Plan Former Caribbean Petroleum Refining Facility. Prepared by Arcadis. Dated September 2013.

6. PUMA Energy Caribe, LLC, RCRA Facility Investigation Report, Former Caribbean Petroleum Refining Facility. Prepared by Arcadis. Dated September 2015.

7. Letter from Brenda Torano Diaz, PUMA Energy Caribe, Inc.to David Cuevas, Caribbean Environmental Protection Division re: Responses and RCRA RFI Implementation Final Report for Former Capeco Site Facility, Bayamon, Puerto Rico. Dated January 21, 2016.

8. PUMA Energy Caribe, LLC, RCRA Facility Investigation Supplemental Sampling Report, Former Caribbean Petroleum Corporation Refinery/Terminal – Bayamon, Puerto Rico. Prepared by Arcadis. Dated November 2016.

9. PUMA Energy Caribe, LLC, Updated Site Screening Evaluation, RCRA Corrective Action at Puma Energy Caribe, LLC (Former Caribbean Petroleum Corporation) Bayamón, Puerto Rico EPA ID PRD000632182. Prepared by Arcadis. Dated March 2017.

10. Semi-Annual Sampling Report June 2016, Former Caribbean Petroleum Corporation Refinery/Terminal – Bayamon, Puerto Rico. Prepared by Arcadis. Dated March 2017.

11. Semi-Annual Sampling Report December 2016, Former Caribbean Petroleum Corporation Refinery/Terminal – Bayamon, Puerto Rico. Prepared by Arcadis. Dated April 2017.

Figures and Tables

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

1. Figure 1 from the RCRA Facility Investigation Report, Former Caribbean Petroleum Refining Facility. Prepared by Arcadis. Dated September 2015. Referenced in Facility Information section.
2. Figure 6 from the RCRA Facility Investigation Report, Former Caribbean Petroleum Refining Facility. Prepared by Arcadis. Dated September 2015. Referenced in Question 1.
3. Figure 7 from the RCRA Facility Investigation Report, Former Caribbean Petroleum Refining Facility. Prepared by Arcadis. Dated September 2015. Referenced in Question 1.
4. Tables 9 and 10 from the Current Conditions Report, Former Caribbean Petroleum Refining Facility, Bayamon, Puerto Rico. Prepared by Arcadis. Revised May 2012. Referenced in Question 1.
5. Figure 18 from the RCRA Facility Investigation Report, Former Caribbean Petroleum Refining Facility. Prepared by Arcadis. Dated September 2015. Referenced in Questions 1, 2, and 3.
6. Figures 3 and 4 from the Semi-Annual Sampling Report December 2016, Former Caribbean Petroleum Corporation Refinery/Terminal – Bayamon, Puerto Rico. Prepared by Arcadis. Dated April 2017. Referenced in Questions 2 and 3.
7. Figures 11 and 12 from the RCRA Facility Investigation Report, Former Caribbean Petroleum Refining Facility. Prepared by Arcadis. Dated September 2015. Referenced in Question 2.
8. Figure 17 from the RCRA Facility Investigation Report, Former Caribbean Petroleum Refining Facility. Prepared by Arcadis. Dated September 2015. Referenced in Question 2.
9. Figures 20-28 from the RCRA Facility Investigation Report, Former Caribbean Petroleum Refining Facility. Prepared by Arcadis. Dated September 2015. Referenced in Question 2.
10. Figure 15 from the RCRA Facility Investigation Report, Former Caribbean Petroleum Refining Facility. Prepared by Arcadis. Dated September 2015. Referenced in Questions 2 and 3.
11. Figure 16 from the RCRA Facility Investigation Report, Former Caribbean Petroleum Refining Facility. Prepared by Arcadis. Dated September 2015. Referenced in Question 2.
12. Figure 31 from the RCRA Facility Investigation Report, Former Caribbean Petroleum Refining Facility. Prepared by Arcadis. Dated September 2015. Referenced in Question 3.