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Superfund Record of Decision

**Palmer Barge Line Superfund Site
Port Arthur, Jefferson County, Texas**

September 2005



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6**



195673

EXHIBIT 2

**PALMER BARGE LINE SUPERFUND SITE
PORT ARTHUR, JEFFERSON COUNTY, TEXAS
RECORD OF DECISION**

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**PALMER BARGE LINE SUPERFUND SITE
PORT ARTHUR, JEFFERSON COUNTY, TEXAS
RECORD OF DECISION**

PART 1: DECLARATION

SITE NAME AND LOCATION

The Palmer Barge Line Superfund Site is located in Port Arthur, Jefferson County, Texas. The National Superfund Database (CERCLIS) identification number for this Site is TXD068104561. This Site has not been divided into separate operable units and all areas and media within the Site are addressed together in this Record of Decision.

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Palmer Barge Line Superfund Site located in Port Arthur, Jefferson County, Texas, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 USC § 9601 *et seq.*, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300 *et seq.*, as amended.

This decision was based on the Administrative Record, which has been developed in accordance with Section 113(k) of CERCLA, 42 U.S.C. § 9631(k), and is available for review at the Port Arthur Public Library, 4615 9th Avenue, Port Arthur, Texas; at the Texas Commission on Environmental Quality (TCEQ) offices in Austin, Texas; and at the United States Environmental Protection Agency (EPA) Region 6 offices in Dallas, Texas. The Administrative Record Index (Appendix B to the Record of Decision) identifies each of the items comprising the Administrative Record upon which the selection of the remedial action is based.

The State of Texas, through the TCEQ, concurs with the Selected Remedy.

ASSESSMENT OF THE SITE

The response action selected in this Record of Decision (ROD) is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

DESCRIPTION OF THE SELECTED REMEDY

This ROD sets forth the selected remedy for the Site, which will protect human health and the environment by removing contaminated materials that exceed risk based levels from the Site.

The major components of this remedy are:

- Excavation of approximately 1,204 cubic yards of the upper two feet of soil that exceed risk-based levels at each of the response areas;
- Confirmation sampling at each of the response areas. Confirmation samples will be collected from each response area and analyzed for Contaminants of Potential Concern (COPC);
- Backfilling of excavated areas that exceed risk based levels with clean soil;
- Off-site disposal of the excavated soils at a permitted disposal facility;
- Implementation of Institutional Controls to restrict future land use to industrial purposes only. The Institutional Control shall be a restrictive covenant by the property owner, to the benefit of the State of Texas and the United States Government, recorded in the real property records of Jefferson County, Texas;
- Abandonment of existing monitoring wells - Five (5) existing monitoring wells at the Site will be abandoned; and
- Wastewater Above-ground Storage Tank (AST) demolition and sludge removal - Sludge contained within one remaining Wastewater AST will be removed and disposed of off-site. The tank will be decontaminated and reused as scrap metal by the site owner.

STATUTORY DETERMINATIONS

The selected remedy for the soil and sediment contamination is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, and is cost-effective. The contaminated soil and sediment "hot spots" in several areas of the Site are considered to be "low-level threat wastes" based on the absence of a highly toxic or highly mobile characteristic. Since the soil and sediment contamination represents a low-level threat waste, the selected remedy does not utilize treatment to reduce the toxicity, mobility, or volume of contamination and therefore does not satisfy the statutory preference for treatment as a principal element of the remedy.

Since the selected remedy will result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted to ensure that the remedy remains protective of human health and the environment. Pursuant to CERCLA Section 121(c), 42 U.S.C. § 9621(c), and as provided in the current guidance on Five Year Reviews [OSWER Directive 9355.7-03B-P, *Comprehensive Five-Year Review Guidance* (June 2001)], the EPA will conduct a statutory five-year review within five years from initiation of the remedial action.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record file for this Site.

- Chemicals of concern (COCs) and their respective concentrations (see the Identification of Chemicals of Concern Section);
- The baseline risk represented by the COCs (see the Risk Characterization Section);
- Cleanup levels established for the COCs and the basis for these levels (see the Remedial Action Objectives and Goals Section and the Expected Outcomes of Selected Remedy Section);
- Source materials constituting principal threat wastes have not been identified in the soil and sediment at this Site (see the Principal and Low-Level Threat Wastes Section);
- Current and potential future beneficial land and water uses used in the ROD (see the Current and Potential Future Land and Ground Water Uses Section);
- Potential land and water use that will be available at the Site as a result of the Selected Remedy (see the Expected Outcomes of Selected Remedy Section);
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs; discount rate, and the number of years over which the remedy cost estimates are projected (see the Summary of Estimated Remedy Costs Section); and,
- Decisive factor(s) that led to selecting the remedy (see the Summary of the Rationale for the Selected Remedy).

AUTHORIZING SIGNATURE

By: John R. Hegala for
Samuel Coleman, P.E., Director
Superfund Division
U.S. EPA Region 6

Date: 9/30/05

**RECORD OF DECISION
PALMER BARGE LINE SUPERFUND SITE
CONCURRENCE LIST**

By: Carlos A. Sanchez
Carlos A. Sanchez
Remedial Project Manager

Date: 9/26/05

By: [Signature]
Gustavo T. Chavarria, Chief
AR/TX Project Management Section

Date: 9/26/05

By: John R. Hepola
John Hepola, Chief
AR/TX Branch

Date: 9/27/05

By: Joseph C. Compton, III
Joseph Compton
Site Attorney

Date: 9/27/05

By: [Signature]
Mark A. Peycke, Chief
Superfund Branch, Office of Regional Counsel

Date: 09/29/05

By: _____
June Buzzell, Writer
Superfund Division

Date: _____

By: John R. Hepola, for
Patricia Phillips, Deputy Director
Superfund Division

Date: 9/30/05

**PALMER BARGE LINE SUPERFUND SITE
PORT ARTHUR, JEFFERSON COUNTY, TEXAS
RECORD OF DECISION**

PART 2: DECISION SUMMARY

SITE NAME, LOCATION, AND BRIEF DESCRIPTION

The Palmer Barge Line Superfund Site is located on Pleasure Islet on the western shore of Sabine Lake, in Jefferson County, Texas. The site is located approximately 4.5 miles east-northeast of the City of Port Arthur. A site location map is provided in Figure 1-1. The Palmer Barge Site encompasses approximately 17 acres and is located on Old Yacht Club Road on the South Industrial Islet. The Site is bounded to the north by vacant property, to the west by Old Yacht Club Road, to the south by the State Marine Superfund Site, and to the east by Sabine Lake. There is very little topographical relief to the Site. The Site is located approximately 0.5 miles southwest of the confluence of the Neches River and the Sabine Neches Barge Canal.

SITE BACKGROUND AND ENFORCEMENT ACTIVITIES

Site History

The Site, along with the adjacent properties to the north and south, were used as a Municipal Landfill for the City of Port Arthur from 1956 to 1987. Although disposal at the landfill has long since ceased and the landfill contents have been covered with dredged sediments, the contents are still present on the Site in the subsurface soils.

In April 1982, John Palmer, President of Palmer Barge Line, Inc., purchased approximately 17 acres from the City of Port Arthur, for the purpose of servicing and maintaining barges and marine vessels. In July 1983, Barker Phares, a trustee of Jefferson County, placed a lien on the Palmer Barge Line Property. In October 1994, Wrangler Capital assumed all claims from the Palmer Barge Line, Inc. In July 1997, Wrangler Capital purchased Palmer Barge Line from receivership, and the company ceased operations on the property. The current owner is Mr. Chester Slay. At present, the Site is used by Mr. Slay for industrial purposes. Metal structures on-Site are being salvaged, and the salvaged metal is being used by the current owner to construct marine equipment on the Site.

During operation, the typical activities performed at the Site included cleaning, degassing, maintenance, and inspection of barges and other marine equipment. Cleaning operations included the removal of sludge and other residual material by pressure steaming the vessel holds, engines and boilers. Engines were degreased, and accumulations of sludges were removed. Degassing activities involved the removal of explosive vapors from vessel holds using nitrogen

or boiler exhaust. Maintenance and inspection activities included the replacement and/or repair of valves, engine repairs, and line leak repairs followed by pressure tests. A flare was located on-site to burn excess gases and liquids produced during facility operations.

History of Federal and State Investigations

Previous investigations of the Site include the following:

- December 1996: Texas Natural Resource Conservation Commission (TNRCC, now named the Texas Commission on Environmental Quality, or TCEQ) Region 10 Field Office personnel conducted a multi-media investigation. The purpose of this study was to determine the compliance status of the facility.
- March 1998: TNRCC Region 10 Field Office with EPA Region 6 conducted an investigation to identify potential sources and to sample soil and sediment. Five areas of stained soil were identified on-site, which included the following: stained soils near sumps, stained soil near the boiler house, stained soil near the flare, stained soil near aboveground storage tanks, and stained soil near wastewater tanks. Sample results indicated the presence of inorganic constituents such as metals, semi-volatile organic constituents (SVOCs), and pesticides in on-site soil. Metals and SVOCs were detected in offshore sediment adjacent to the Site.
- July 1999: TNRCC Region 10 Field Office sampled aboveground storage tanks, roll off-boxes and "slop" tanks to characterize materials stored.
- October 1999: EPA Region 6 conducted an Expanded Site Inspection (ESI; Weston 2000) to determine the presence and nature of constituent occurrence on-site and off-site and to determine migration routes and routes of exposure of site related constituents. Results of the inspection indicated the presence of volatile organic constituents (VOCs), SVOCs, pesticides, polychlorinated biphenyls (PCBs), and metals.
- In 2000, the Site was ranked and was placed on the National Priority List (NPL). The Hazard Ranking concluded that constituents present in Sabine Lake sediments adjacent to the Site were a potential threat to human health primarily via the fish consumption exposure pathway (USEPA, 2000).
- 2003: URS Corporation (URS), on behalf of the Potentially Responsible Parties (PRPs), conducted a remedial investigation (RI) at the Site in July 2003, which characterized the nature and extent of constituents present in environmental media at the Site and in adjacent Sabine Lake surface water and sediments (URS, 2004d).

History of CERCLA Removal Actions

In August 2000, EPA Region 6 conducted a Removal Action to remove source materials stored on-site. Activities included waste removal, water treatment, oil/water separation, and sludge stabilization. Approximately 250,000 gallons of water were treated on site; 500 cubic yards of sludge stabilized; and 100,000 gallons of oil/styrene were separated and removed from the site. All of the above-ground storage tanks were removed except for a 25,000 gallon AST on the northern portion of the site that contains sludge. Several of the concrete AST foundations remain along with gravel throughout the Site.

History of CERCLA Enforcement Activities

On September 30, 2002, EPA Region 6 issued an Administrative Order on Consent to conduct the remedial investigation and feasibility study (RI/FS) for the Palmer Barge site. Voluntary respondents to the Order were: E. I. du Pont de Nemours and Company, Chevron/Texaco Inc.; Kirby Inland Marine, LP; Kirby Inland Marine, Inc. of Louisiana; and Ashland Inc.

National Priorities List

The EPA published a proposed rule on May 11, 2000, to add the Palmer Barge Line Site to the National Priorities List (NPL) of Superfund sites. The Site was added to the NPL in a final rule published on July 27, 2000 [Federal Register Listing (FRL-6841-3), Volume 65, Number 145, Pages 46096 - 46104].

COMMUNITY PARTICIPATION

The Remedial Investigation and Feasibility Study Report, along with the Proposed Plan for the Palmer Barge site in Port Arthur, Texas, were made available to the public on July 27, 2005. These and other Site documents can be found in the Administrative Record file and the information repositories at the following locations: Port Arthur Public Library located at 4615 9th Avenue, Port Arthur, Texas; the U.S. Environmental Protection Agency Region 6 located at 1445 Ross Avenue, Dallas, Texas; and the Texas Commission on Environmental Quality located at 12100 Park 35 Circle, Building E, 1st Floor, Austin, Texas. The notice of the availability of these documents was published in the Port Arthur News on July 28, 2005. A public comment period was held from July 27, 2005 to August 25, 2005. The EPA and the Texas Commission on Environmental Quality conducted a public meeting on August 11, 2005, to discuss the Proposed Plan and receive comments from the community. The public meeting was held at the West Groves Education Center, located at 5840 West Jefferson, in Groves, Texas. These activities meet the community participation requirement of CERCLA 300.430(f)(3) and the NCP. In the Responsiveness Summary, EPA responded to all comments received during the public comment period. The Responsiveness Summary is included as part of this ROD.

SCOPE AND ROLE OF RESPONSE ACTION

In August 2000, EPA conducted a Time Critical Removal Action at the site to remove, transport, and dispose off-site all hazardous substances (except for approximately 233 cubic yards), pollutants, and contaminants located on the Site. The removal action consisted of waste removal, water treatment, oil/water separation, and sludge stabilization. Approximately 250,000 gallons of water were treated on site; 500 cubic yards of sludge stabilized; and 100,000 gallons of oil/styrene were separated and removed from the site. All of the above-ground storage tanks were removed except for a 25,000 gallon AST on the northern portion of the site that contains approximately 233 cubic yards of sludge that may be hazardous. Several of the concrete AST foundations remain along with gravel throughout the Site.

This response action is the final Site remedy and is intended to address the remaining threats to human health and the environment posed by the conditions at this Site. The purpose of this response action is to implement a remedy that prevents exposure to contaminated soils and sediments and prevents future runoff of contaminants to the Sabine Lake sediments. This response action addresses the remaining "hot spots" at the Site that pose a risk to human health and ecological receptors that were not addressed by the prior removal action. This remedial action will also remove approximately 233 cubic yards of sludge from the remaining AST.

SITE CHARACTERISTICS

Sources of Contamination

As part of the ESI conducted in October 1999, a site reconnaissance was performed to identify Areas of Concern (AOCs) on the Site. The following AOCs were identified on site:

- Wastewater Aboveground Storage Tanks (ASTs): Four ASTs were located in the northeastern portion of the Site. The four ASTs included one 25,000-gallon tank and three 5,000-gallon tanks. They were constructed of steel and surrounded by an earthen berm. The tanks were used for bulk storage during barge cleaning operations.
- Boiler House ASTs: Four ASTs were located adjacent to the boiler house located in the southwestern portion of the Site. The ASTs were approximately 7,000-gallon capacity each. Three of the four boiler house ASTs were reportedly used to store diesel fuel for steam boilers that were operated as part of the barge cleaning process. The fourth boiler house AST was used to store fresh water. The ASTs were located on the ground surface and did not have containment berms or dikes.
- Open Top Slop Tanks: Four open top slop tanks were located on the western portion of the Site near the flare area. The tanks were constructed of steel and measured 8 feet by 5 feet by 4 feet. The tanks were placed on the ground and did not have secondary containment.

- **Horizontal ASTs:** The horizontal ASTs were located in the southeastern portion of the Site near the Sabine Lake shoreline. The three ASTs had a capacity of 10,000 gallons each. A concrete berm surrounded the three ASTs. The tanks were used as part of the barge cleaning and degassing system.
- **Twelve ASTs:** Twelve (12) ASTs were located in the eastern portion of the Site near the shoreline of Sabine Lake. Each tank was approximately 7,000 gallons in capacity. The tank farm is surrounded by a concrete berm measuring 95 feet by 30 feet lateral dimension by 1 foot in height. The tanks were likely used for liquid transfer and liquid separation activities during cleaning operations.
- **Flare:** A flare was located in the central portion of the Site. The flare was used to burn excess gases produced during cleaning operations.

Locations of these AOCs are shown in Figure 1-2. EPA's removal action in August 2000, removed all above-ground storage tanks except for a large tank on the northern portion of the site that contains sludge. Several of the concrete AST foundations remain along with gravel throughout the Site.

Remedial Investigation Summary

The following summarizes findings related to the extent of constituents identified during the RI conducted in July 2003:

- Generally, there appear to be a number of metals present in soil above the background 95% upper confidence limit (UCL). These concentrations are quite variable with high metals often being present in soil with obvious signs of municipal waste and other times in soil with no apparent sign of "impact." The background data set itself had some results that appeared to be "outliers" from the rest of the background set suggesting that the soil used as "cap material" for the site may not be uniform. The origin of this cap material could not be determined, therefore it is unknown if constituents found in the cap material are naturally occurring or from another contaminated site.
- **Wastewater AST Area:** Soil contained a large number of semivolatile constituents as well as pesticides such as pentachlorophenol (PCP). It is unknown if the PCP was related to the Wastewater activities, because the highest concentrations of PCP were found in soil that also contained municipal waste. The groundwater impact downgradient is minimal as indicated by the MTBE detected concentration of 32 ug/l.
- **Boiler House ASTs:** Soil contaminated with SVOCs was detected in this area. There is no apparent ground water impact downgradient from this area.

- Open Top Slop Tanks: Soil from near the Slop Tanks contained SVOCs and metals. The high concentrations were not associated with the soil near the unit, but rather the soil that surrounded a drum of black sludge that was formerly buried near this area. The groundwater impact downgradient is minimal.
- Horizontal ASTs: Concentrations of benzene and isopropylbenzene were detected near this area. However, there were no constituents in soil above residential criteria in this area.
- Twelve ASTs: Soil near this area contained VOCs, SVOCs, and metals. The distribution of these results suggest more VOCs are present in soil from the north and east sides of the unit. The ground water impact downgradient from this area appears minimal based on the low detection of 18 ug/l of MTBE. Metals detected in ground water were comparable to those from the background well.
- Flare: Soil samples from this area indicated that surface soils did not contain detectable constituents related to the Flare, except for a "J-value" concentration of benzene, which indicates that the concentration is an estimated value below levels that can be reliably quantified. The deeper soil that contained municipal waste contained numerous metals above the background 95% UCL and three "J-value" pesticide/PCBs. The ground water impact downgradient appears minimal as indicated by the "J-value" concentration of 3 ug/l of MTBE. Metals detected in groundwater were comparable to those from the background well.
- Surface Water: Samples of surface water did not contain any site-related VOC constituents. The only SVOC detected was bis(2-ethylhexyl)phthalate, which appeared in the lab blank associated with these samples. Four metals were detected above the practical quantification limit in surface water (aluminum, manganese, mercury, and zinc). Four additional metals were detected at "J-value" concentrations (barium (J), copper (J), chromium (J), and nickel (J)).
- Sediment: Site-related VOCs were not detected in the eight sediment samples collected adjacent to the Palmer Site. The largest number of quantifiable detections of SVOCs/pesticides/PCBs were at a location closest to the south end of the sheet piling.

Geologic Setting

The Palmer Barge Site is located on the seaward margin of the southeastern Gulf Coastal Plain of Texas. In general, the sediment in this area is tens of thousands of feet thick at the coastline. The unconsolidated sediment sequence consists of sand, silt, and clay and represents depositional marine and non-marine environments. As a result of subsidence of the Gulf Coast basin these sediments thicken toward the Gulf.

In general, the near surface soils along waterways in this area of the Coastal Plain consist of fill and spoil material dredged from Sabine Lake. In the subsurface, the Coastal Plain sediments are primarily Quaternary alluvium, composed of clay and silt. The Beaumont Clay, Montgomery Formation, and Willis Sand make up the underlying Chicot Aquifer. Based on historical information, the Palmer Barge Site and associated barge cleaning operations have been built on top of fill and sediment that was removed during dredging of the Intercoastal Waterways and the Sabine-Neches ship channel. This dredged material was placed adjacent to the shipping canals. The former municipal landfill was developed on this small manmade island.

Surface soils are a variable mixture of dark brown to black clay, sand, and silt often with shell material. The majority of the site subsoil is derived from dredge sediment from Sabine Lake. Part of the islands was use as a municipal landfill by the City of Port Arthur and a layer of cap material was placed over the landfill areas. The origin of the cap material has not been determined. Aside from areas that are mowed or have gravel, or concrete foundations, most of the soil is covered by tall grasses. No distinct soil horizons have formed, nor is there a clearly distinct "trash layer" of municipal waste. The upper 1-2 feet of surface soil consists of sand and silt and are typically free of municipal waste material. This upper cover often has roots from site vegetation or shell from dredging. Waste was encountered sporadically in the fill between about one foot to five feet below ground surface (bgs). The interval from about five feet bgs to approximately 18 feet is a mix of dark gray to gray clay, silt, and fine sand. At a depth of about 18 feet bgs, the top of the native Sabine Lake sediments is encountered. This gray silty clay is much more homogeneous than the overlaying dredge fill and becomes firmer with depth. This unit is much more consistent than the dredge spoil unit and extends to at least 30 feet bgs.

Hydrogeologic Findings

Groundwater was encountered in the sandy portions of the dredge fill unit. The first shallow water-bearing zone at the Palmer Barge Site is typically encountered at depths of approximately 4 feet bgs. Static water levels ranged from almost 9 feet above Mean Sea Level (MSL) at an upgradient well to slightly over 1 foot above MSL at the edge of Sabine Lake. This water bearing zone is not part of the deep Chicot Aquifer that is generally used as a drinking water source. The surficial shallow water-bearing zone resulted from the adjacent shipping channel dredge materials that were used to build the island where the site is located. Groundwater in this unit also includes infiltrated precipitation. This groundwater flows towards and discharges to Sabine Lake.

Sediment Sampling - Sabine Lake

Sediment sampling results indicated the presences of several polycyclic hydrocarbons (PAHs) at low concentrations. No pesticides, PCBs or VOCs were detected in the sediment samples collected. Several metals were detected in the sediment samples. Most of these such as chromium, copper, lead, manganese, nickel, and vanadium were reasonably consistent. Barium and zinc results had more variation, and there were some detections of mercury. Organic carbon

results ranged from 8,630 mg/kg to 16,300 mg/kg (0.8% to 1.6%). The ratio of simultaneously extracted metal/acid-volatile sulfide (SEM/AVS) ranged from 0.06 to 0.30. The SEM/AVS ratio can be used to infer the bioavailability of divalent metals to benthic organisms. The lower the SEM/AVS ratio, the lower the bioavailability of the metal.

Surface Water Sampling - Sabine Lake

The only constituents detected in surface water from Sabine Lake were "J-value" concentrations of bis(2-ethylhexyl)phthalate (believed to be due to blank contamination), and aluminum, barium, manganese, and zinc. Mercury (0.00008 ug/L) was detected at one location. Calcium carbonate hardness was also measured, and it ranged from 1000 mg/L to 1080 mg/L.

CURRENT AND POTENTIAL FUTURE LAND AND GROUND WATER USES

Land Uses

The former Palmer Barge site is currently being operated by the site owner as an industrial property for metal scraping activities. Future use of the Site is also anticipated to be limited to industrial use due to its location and other surrounding industrial sites. The closest school is located approximately 2.7 miles from the site. There are only fourteen (14) residential properties located within a 1-mile radius.

Ground Water Uses

There is no current or anticipated future use of the shallow ground water at the site. The shallow ground water at the site is not considered a potential drinking water source. The shallow ground water resulted from the dredging activities that formed the isle where the former Palmer Barge site is located.

SUMMARY OF SITE RISKS

Baseline Human Health Risk Assessment

The primary sources of information used in the Baseline Human Health Risk Assessment (BHHRA) conducted in June 2005, are the Expanded Site Inspection Report (ESI) (Weston, 2000) and the Remedial Investigation (RI) Report for Palmer Barge Line Superfund Site (URS, 2004d). The Site Conceptual Exposure Model for the risk assessment indicates that the primary exposure scenarios of interest are on-site industrial worker exposure to constituents present in surface soil and off-site exposure to a recreational fisherman primarily via consumption of fish from Sabine Lake that may have accumulated site-related constituents from surface water and sediment.

The primary constituents of concern detected at the Site are polycyclic aromatic hydrocarbons (PAHs), pesticides, and metals. Baseline risk calculations for surface soil were performed for each of six AOCs based on analytical data reported in the RI. Risks for the recreational

fisherman were estimated using data from the RI report supplemented by data from other investigations of Sabine Lake sediment and fish tissue concentrations. Each of the media and pathways evaluated in the baseline calculations resulted in risk estimates within the range of risk management criteria typically employed in the Superfund program (10^{-6} to 10^{-4} cancer risk and a noncancer hazard index of 1.0), with one exception. The maximum concentration of benzo(a)pyrene present in sediment resulted in an estimated cancer risk via fish consumption that is slightly above the upper end of the target risk range. However, actual fish tissue data from Sabine Lake indicates that the benzo(a)pyrene result does not represent a threat to human health.

An uncertainty analysis was performed to identify sources of uncertainty in the baseline risk calculations. A significant observation of the uncertainty analysis was that historic pre-RI soil data would likely produce risk estimates approximately an order of magnitude greater than the estimates developed based on the RI soil data. Therefore, Site soil concentrations from both the historic and RI data were compared to risk-based preliminary remediation goals (PRGs) that were developed for the range of applicable target risk criteria (10^{-6} to 10^{-4}).

Several surface soil sample locations with concentrations exceeding PRGs for the 10^{-5} target risk range were identified as "hot spots" to be addressed in the selected remedy. Addressing the identified "hot spots" in the selected remedy will result in a risk level that is protective of human health and the environment.

Identification of Chemicals of Concern

Chemicals of potential concern (COPCs) were identified from the remedial investigation which exceeded commercial/industrial medium specific screening level (MSSL) values to prepared the site specific Human Health Risk Assessment (HHRA). Table 1 summarizes the COPCs and contains the exposure point concentrations used to evaluate the reasonable maximum exposure scenario (RME) in the baseline risk assessment. Lead was analyzed separately.

Receptor	Exposure Medium	Chemical of Concern	Maximum Concentration (mg/kg)	Exposure Point Concentration (mg/kg)	Statistical Measure
Industrial Worker	On-Site Surface Soil	Aroclor-1254	4.18	4.18	Maximum Detection
		Benzene	2.02	2.02	Maximum Detection
		Benzo(a)pyrene	3.3	3.3	Maximum Detection
		Benzo(b) fluoranthene	2.73	2.73	Maximum Detection
		Dieldrin	0.4	0.4	Maximum Detection
		Pentachlorophenol	150	150	Maximum Detection

Table 1 Summary of Chemicals of Concern and Exposure Point Concentrations from RI					
Receptor	Exposure Medium	Chemical of Concern	Maximum Concentration (mg/kg)	Exposure Point Concentration (mg/kg)	Statistical Measure
		Arsenic	120	120	Maximum Detection
Key: mg/kg: milligrams per kilogram					
The table presents the COCs and exposure point concentration for each of the COCs detected in the media (<i>i.e.</i> , the concentration that will be used to estimate the exposure and risk from each COC in the soil). The table includes the maximum concentrations detected for each COC, the exposure point concentration (EPC), and how the EPC was derived.					

Exposure Assessment

The exposure scenarios evaluated for Human Health Risk are:

On-site Industrial Worker exposed by way of:

- Incidental ingestion of soil;
- Dermal contact with soil;
- Inhalation of airborne dust; and
- Inhalation of vapors emanating from volatile constituents in soil;

Recreational Angler exposed by way of:

- Dermal contact with surface water during angling; and,
- Ingestion of fish harvested from Sabine Lake.

In accordance with Risk Assessment Guidance for Superfund (RAGS), exposure assumptions for the risk assessment were selected to represent the reasonable maximum exposure (RME) that could occur at the Site. For the industrial worker scenario, these assumptions were taken from EPA's Region 6 MSSSLs. A summary of these assumptions is presented on Tables 2 and 3 below.

The concentration that an individual would be exposed to over the chronic exposure periods assumed in the risk assessment would be best represented by an arithmetic average of the concentrations present throughout the medium where the exposure would occur over that time period. To account for uncertainty in what the true average concentration is based on the limited sample data available, risk assessments often utilize an upper confidence limit (UCL) of the mean to represent the exposure concentration. However, statistical evaluation of this sort for the Palmer Barge Site was complicated by the presence of non-detect results in the sample data set. This was particularly the case for this site since constituents were *not* detected in a majority of the samples analyzed for the many COPCs identified for the Site. For the Palmer Barge Site, the simple and conservative approach taken for this assessment was generally to assume that the

receptor was exposed to the maximum detected concentration of the COPC. This approach will probably result in an overestimation of actual risks associated with the Site.

One exception to the use of maximum detected concentrations in the risk assessment was for the evaluation of lead (Pb) in soil. Since the distribution of lead concentrations in soil ranged from below background to above MSSLs, and the frequency of detection was high, a 95% UCL was utilized to represent the exposure concentration of lead in soil.

Exposure Assumptions for Industrial Worker

Table 2 Exposure Assumptions for Industrial Worker				
Symbol	Definition	RME Value	Units	Source
EF	Exposure Frequency	225	days/yr	a
ED	Exposure Duration	25	yrs	a
IRs	Ingestion Rate of Soil	100	mg/day	a
BW	Body Weight	70	kg	a
ATc	Averaging Time-carcinogenic effects	70	yrs	a
ATnc	Averaging Time-noncancer effects	25	yrs	a
IRa	Inhalation Rate of Air	20	m ³ /day	a
SA	Surface Area of Skin Exposed	3300	cm ² /day	a
AF	Adherence Factor	0.2	cm ² /day	a
PEF	Particulate Emission Factor	1.32x10 ⁹	mg ³ /kg	a

Exposure Assumptions for Recreational Fisherman Scenario

Table 3 Exposure Assumptions for Recreational Fisherman Scenario				
Symbol	Definition	RME Value	Units	Source
EFf	Exposure Frequency for Fish Consumption	365	days/yr	a
EFd	Exposure Frequency for Dermal Contact	100	days/yr	d
ED	Exposure Duration	30	yrs	a

Table 3 Exposure Assumptions for Recreational Fisherman Scenario				
Symbol	Definition	RME Value	Units	Source
IRf	Ingestion Rate of Fish (annual average)	0.0175	kg/day	b
BW	Body Weight	70	kg	a
ATc	Averaging Time-carcinogenic effects	70	yrs	a
ATnc	Averaging Time-noncancer effects	30	yrs	a
SA	Surface Area of Skin Exposed	5170	cm ² /day	c
Isc	Thickness of Stratum Corneum	0.001	cm	c

Notes:

a - EPA Region 6 Medium-Specific Screening Levels, January 2004

b - Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health, EPA 2000

c - Supplemental Guidance for Dermal Risk Assessment, RAGS Part E, EPA 2001

d - Conservative assumption for a recreational angler fishing 2 times per week 50 weeks/year

Fish Tissue Concentrations

Evaluation of potential exposures via fish consumption as a result of impacts in groundwater, surface water, and sediment data involves use of a bioaccumulation model to estimate the concentration of COPCs in fish tissue. Use of bioconcentration factors (BCFs), bioaccumulation factors (BAFs), and biota-sediment accumulation factors (BSAFs) are a significant source of uncertainty in the risk assessment due to the complex metabolic processes being simulated by these published factors. Therefore, the risk assessment relied preferentially on measured fish tissue concentrations from the 1995 Texas Department of Health (TDH) study in lieu of modeled estimates where possible. While use of measured fish tissue concentrations eliminates the uncertainty of the modeled estimates, it also results in an evaluation of risks associated with all sources of loading to the fish tissue that is not limited to impacts that might have originated specifically from the Palmer Barge Site. Although samples in the TDH were collected from various locations throughout Sabine Lake, the risk assessment utilized the maximum detected concentration identified in any species from any sample location in Sabine Lake as a conservative measure to account for any uncertainty associated with the age or quality of the data.

Since the TDH study did not analyze all Palmer Barge COPCs, modeled fish tissue concentrations were generated for these constituents as necessary. In addition, in cases where the maximum measured fish tissue concentrations were reported as not detected, modeled fish tissue concentration estimates were generated and compared to the detection limit. If the modeled estimate was lower than the measured detection limit, the modeled estimate was used to

represent the fish tissue concentration as an estimate of the censored concentration that might be present below the analytical detection. If the modeled estimate resulted in a fish tissue concentration that was higher than the detection limit in the non-detect analysis, then the measured result was used to represent the fish tissue concentration in the risk assessment since the measured result is considered more reliable than the estimated result.

Toxicity Assessment

Excess lifetime cancer risks were determined for each exposure pathway by multiplying a daily intake level with the chemical specific cancer slope factor. Cancer slope factors have been developed by the EPA from epidemiological or animal studies to reflect a conservative "upper bound" of the risk posed by potentially carcinogenic compounds. That is, the true risk is unlikely to be greater than the risk predicted. The resulting risk estimates are expressed in scientific notation as a probability (e.g. 1×10^{-6} for 1/1,000,000) and indicate (using this example), that an average individual is not likely to have greater than a one in a million chance of developing cancer over 70 years as a result of site-related exposure to the compound at the stated concentration. All risks estimated represent an "excess lifetime cancer risk" - or the additional cancer risk on top of that which we all face from other causes such as cigarette smoke or exposure to ultraviolet radiation from the sun. The chance of an individual developing cancer from all other (non-site related) causes has been estimated to be as high as one in three. The EPA's generally acceptable risk range for site related exposure is 10^{-4} to 10^{-6} . Current EPA practice considers carcinogenic risks to be additive when assessing exposure to a mixture of hazardous substances.

Carcinogenic and noncarcinogenic risk estimates were calculated using a reasonable maximum exposure (RME). Excess lifetime cancer risk is calculated from the following equation: Risk = CDI x SF, where:

- Risk = a unitless probability (e.g., 2×10^{-5}) of an individual's developing cancer
- CDI = chronic daily intake averaged over 70 years (mg/kg-day)
- SF = slope factor, expressed as (mg/kg-day)⁻¹.

A summary of the cancer toxicity data relevant to the COCs is presented in Table 4.

Chemical of Concern	Oral Cancer Slope Factor (mg/kg)/day	Dermal Cancer Slope Factor (mg/kg)/day	Inhalation Cancer Slope Factor (mg/kg)/day	Weight of Evidence/Cancer Guideline Description	Source	Date of Publication
Benzene	5.5E-02	N/A	2.9E-02	A	IRIS	01/28/2005
Pentachlorophenol	1.2E-01	1.2E-01	N/A	B2	IRIS	01/28/2005
Benzo(a)anthracene	7.3E-01	7.3E-01	N/A	B2	NCEA	07/01/1993

Table 4 Cancer Toxicity Data Summary						
Chemical of Concern	Oral Cancer Slope Factor (mg/kg)/day	Dermal Cancer Slope Factor (mg/kg)/day	Inhalation Cancer Slope Factor (mg/kg)/day	Weight of Evidence/Cancer Guideline Description	Source	Date of Publication
Benzo(a)pyrene	7.3E+00	7.3E+00	3.1E+00	B2	IRIS	01/28/2005
Benzo(a)fluoranthene	7.3E-01	7.3E-01	N/A	B2	NCEA	07/01/1993
Dieldrin	1.6E+01	1.6E+01	1.61E+01	B2	IRIS	01/28/2005
Heptachlor epoxide	9.1E+00	9.1E+00	9.1E+00	B2	IRIS	01/28/2005
PCB-1254	2.0E+00	2.0E+00	2.0E+00	N/A	IRIS	01/28/2005
Arsenic	1.5E+00	1.5E+00	1.51E+01	A	IRIS	01/28/2005

Key: IRIS: Integrated Risk Information System, U.S. EPA NCEA: National Center for Environmental Assessment HEAST: Health Effects Assessment Summary Tables N/A: Not available	EPA Group: A - Human carcinogen B1 - Probable human carcinogen - Indicates that limited human data are available B2 - Probable human carcinogen - Indicates sufficient evidence in animals and inadequate or no evidence in humans D - Not classifiable as a human carcinogen
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The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (*e.g.*, life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ < 1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemical(s) of concern that affect the same target organ (*e.g.*, liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. A HI < 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. A HI > 1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows: Non-cancer HQ = CDI/RfD, where:

CDI = Chronic daily intake

RfD = Reference Dose.

CDI and RfD are expressed in the same units and represent the same exposure period (*i.e.*, chronic, subchronic, or short-term). Table 5 lists the COCs and their respective non-cancer toxicity data.

Table 5 Non-Cancer Toxicity Data Summary						
Chemical of Concern	Chronic Oral RfD Value (mg/kg-day)	Chronic Dermal RfD (mg/kg-day)	Chronic Inhalation RfD (mg/kg-day)	Primary Target Organ	Sources of RfD: Target Organ	Dates of RfD:
Benzene	4.0E-03	N/A	3.0E-02	Bone Marrow	NCEA	—
Pentachlorophenol	3.0E-02	3.0E-02	N/A	Liver/ Kidney/	IRIS	01/28/2005
Dieldrin	5.0E-05	5.0E-05	N/A	Liver	IRIS	01/28/2005
Heptachlor epoxide	1.3E-05	1.3E-05	N/A	Liver	IRIS	01/28/2005
PCB-1254	2.0E-05	2.0E-05	N/A	Skin/immune system	IRIS	01/28/2005
Arsenic	3.0E-04	3.0E-04	N/A	Vascular system/skin	IRIS	01/28/2005

Key:
N/A: Not available
IRIS: Integrated Risk Information System, U.S. EPA
NCEA: National Center for Environmental Assessment

Risk Characterization

Using the elements of the Site Conceptual Exposure Model (SCEM) and associated exposure assumptions, constituent-specific cancer risk and noncancer hazard were calculated as well as cumulative cancer risk and noncancer hazard. The detailed results of the calculations are included in Appendix B of the Baseline Human Health Risk Assessment (BHHRA) RAGS Part D spreadsheets.

For all carcinogens, cumulative cancer risk, assuming simultaneous exposure to multiple carcinogens, was assumed to be additive (that is, the individual cancer risks for all carcinogenic constituents present in soil were summed). For simultaneous exposure to multiple noncarcinogens in soil, the target noncancer hazard index of 1.0 is applicable on a per organ/system basis rather than on the cumulative hazard index for an exposure scenario. Noncancer hazards are apportioned by target organ in Appendix B of the BHHRA RAGS Part D tables.

Due to the unique biokinetic metabolism of lead, a cancer risk or hazard index was not calculated for lead in the same manner as the other COPCs. For lead in soil, risk characterization consisted of comparison of the 95% UCL of soil lead concentrations to the Region 6 industrial worker MSSL for lead of 800 mg/kg. The Region 6 MSSL for lead used in this assessment is based on industrial land use and exposure of a developing fetus within an adult worker assumed to work at the site during pregnancy. Thus, exceedence of the Region 6 MSSL for lead in industrial soil would suggest that a target blood lead level in a developing fetus would be exceeded. Because the target organ (e.g. blood) for lead in adults is different from target organs for other noncarcinogenic constituents, there are no additive assumptions necessary for lead. Thus, the

risk-based evaluation of lead in soil consisted of comparison of the Region 6 MSSL for lead with the 95% UCL of concentrations found at the Site.

On-Site Worker

The resulting cancer risk and hazard index estimates for the industrial worker scenario, based on the RI data, for each of the six soil AOCs are presented on Table 6. The cancer risk results range from 3×10^{-6} to 7×10^{-5} and Hazard Index results range from 0.02 to 0.5. Risk and Hazard Index results by constituent and pathway for this scenario are shown in Appendix B of the BHHRA RAGS Part D formatted tables. For lead in site soils, the 95% UCL of 590 mg/kg lead from the RI soil data is less than the Region 6 industrial worker Medium-Specific Screening Level (MSSL) for lead of 800 mg/kg.

Table 6 Cumulative Cancer Risk and Noncancer Hazard Indices for Soil from RI Data		
Area of Concern	Cumulative Cancer Risk	Hazard Quotient
Wastewater AST Area	4×10^{-5}	0.1
Boiler House ASTs	9×10^{-6}	0.09
Former Open Top Slop Tanks	4×10^{-6}	0.02
Horizontal ASTs	3×10^{-6}	0.02
Twelve ASTs	7×10^{-5}	0.5
Flare	1×10^{-5}	0.4

Off-Site Recreational Angler

The resulting cancer risk and hazard index estimates for the recreational angler scenario are presented on Table 7.

Table 7 Cancer Risk and Noncancer Hazard Indices		
Source Medium	Cancer Risk	Hazard Index
Ground Water	7×10^{-9}	0.5
Surface Water	No carcinogen COPCs	0.003
Sediment	2×10^{-4}	1.5

For the off-site recreational angler, the primary contributors to the 2×10^{-4} cancer risk associated with sediment was benzo(a)pyrene. However, interpretation of this result should consider the following factors:

- The calculated benzo(a)pyrene cancer risk was associated with a modeled fish tissue concentration. The actual measured fish tissue concentration for benzo(a)pyrene was non-detect in all samples collected from Sabine Lake in the 1995 TDH study.
- The modeled fish uptake was based on the maximum detected benzo(a)pyrene concentration in sediment (0.29J mg/kg). The maximum detected concentration of benzo(a)pyrene in sediment was a "J"-flagged result indicating that the concentration is an estimated value below levels that can be reliably quantified. Benzo(a)pyrene was not detected above laboratory detection limits in over 60% of the sediment samples analyzed. The assumption that fish uptake is based on the maximum detected concentration in sediment results in an artificially elevated estimate of the concentration that could be present in fish tissue.
- The benzo(a)pyrene in sediments adjacent to the Site may be present as a result of sources other than the barge cleaning operations performed at the site. Other potential sources may include barge traffic, and other industrial and urban runoff sources in the vicinity.
- The rapid metabolism of polycyclic aromatic hydrocarbons (PAHs) in fish into readily excreted substances prevents substantial bioaccumulation from occurring. Partitioning of PAHs from surface water and sediment into fish tissue can result in an overestimation of risk due to ingestion of fish assumed to be exposed to PAHs in surface water and/or sediment.

The primary contributors to the noncancer hazard index of 1.5 are Aroclor-1254, arsenic, cadmium, copper, mercury, and zinc. However, when apportioned out on a target organ basis the hazard index for each target organ is less than 1.0. Therefore, noncancer risk associated with PCBs and metals in sediment does not appear to be an issue from a human health perspective.

Data from Historic Investigations and Uncertainty

Although the data collected during the ESI were not combined with data collected during the RI for evaluation of soil in the body of the risk assessment, the ESI soil data were evaluated as part of the uncertainty analysis to further define any areas on or off site that exceeded risk-based target criteria.

To evaluate the significance of the ESI soil data set, concentrations from both the RI and ESI data sets were screened against Region 6 MSSLs. A review of these concentrations reveals that the maximum concentrations for each constituent on the list originates from samples collected during the ESI.

A simple baseline risk calculation performed based on the identified maximum concentrations results in risk estimates more than 10 times greater (i.e., 2×10^{-3} cancer risk and 4.3 hazard index) than those presented in the risk assessment based on the RI soil data only. The results of this risk calculation are shown on Table 8 below.

Table 8 Upper end Risk Estimate from RI and ESI Soil Data					
Constituents (a)	Max Sitewide Soil Concentration (mg/kg) (f)	Soil Concentration for HI=1.0 mg/kg (b)	Soil Concentration for TR= 1×10^{-6} (mg/kg) (c)	Hazard Quotient (d)	Cancer Risk (e)
4,4'-DDE	12	---	7.8	----	1.54E-06
4,4'-DDT	11	474	7.8	2.32E-02	1.41E-06
Aldrin	9.2	20.5	0.11	4.48E-01	8.36E-05
Aroclor 1254	4.18	11.8	0.83	3.54E-01	5.04E-06
Aroclor 1260	0.85	---	0.83	----	1.02E-06
Arsenic	120	284	1.8	4.22E-01	6.67E-05
Benzene	3.1	183	1.6	1.69E-02	1.94E-06
Benzo(a)anthracene	280	---	2.3	----	1.22E-04
Benzo(a)pyrene	240	---	0.23	----	1.04E-03
Benzo(b)fluoranthene	220	---	2.3	----	9.57E-05
Benzo(k)fluoranthene	190	---	23	----	8.26E-06
Dibenzo(a,h)anthracene	110	---	0.23	----	4.78E-04
Dieldrin	4.4	34.2	0.12	1.29E-01	3.67E-05
Heptachlor	1.0	342	0.43	2.92E-03	2.33E-06
Heptachlor Epoxide	9.5	8.89	0.21	1.07E+00	4.52E-05
Indeno(1,2,3)cd-pyrene	280	---	2.3	----	1.22E-04
Naphthalene	370	210	---	1.76E+00	----
Pentachlorophenol	570	12900	10	4.43E-02	5.70E-05
			SUM	4.27E+00	2.17E-03

Notes:

a - All constituents with detected concentrations in soil exceeding Region 6 MSSLs for an Industrial worker. Lead is evaluated separately.

b - Derived by ratios from baseline risk calculations, except Naphthalene based on published MSSL.

c - Region 6 MSSLs

d - Derived by Max Soil Concentration/Soil Concentration for HI = 1.0

e - Derived by Max Soil Concentration \times $1 \text{E-}6$ /Soil Concentration for TR = $1 \text{E-}6$

f - includes both RI and ESI soils data.

These results demonstrate that exclusion of the ESI data set from the baseline risk assessment for soil is a significant source of uncertainty in the soil risk assessment conclusions. Therefore, preliminary remediation goals (PRGs) were developed for the soil medium and soil concentrations from both the RI and ESI investigations. The PRGs were compared to both the RI and ESI soil test results to identify soil areas that will be addressed in the selected remedy.

Screening Level Ecological Risk Assessment

A Screening-Level Ecological Risk Assessment (SLERA) was performed for the Palmer Barge Line Superfund Site (Site) located in Port Arthur, Texas in June 2005. Ecological exposure and risk assessment for the Site were based on the 8-Step process outlined in EPA's Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (1997), and was performed consistent with the Texas Commission on Environmental Quality (TCEQ) document entitled Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas (2001; 2004 Draft). The SLERA consists of Steps 1 and 2 of the 8-Step process.

Initially, maximum concentrations of analytes detected in ecological exposure media were identified and screened against highly conservative Ecological Screening Levels (ESLs) to select constituents of potential concern (COPCs) for the Step 2 exposure and risk calculations. Exposure and risk characterizations of COPCs for direct contact were performed using the maximum detected concentrations and risks were characterized using Hazard Quotients. Subsequently, wildlife ingestion exposure pathways were evaluated for all bioaccumulative chemicals using dose modeling with the maximum concentrations and the 95%UCLs as requested by EPA, TCEQ and the Trustees. Risks to wildlife were characterized using Hazard Quotients (HQs) calculated for No-Observable-Adverse Effect Levels (NOAEL) and Lowest-Observable-Adverse Effect Levels (LOAEL) endpoints.

Results of the SLERA showed that the COPCs identified in Sabine Lake surface water and sediment do not pose risks of sufficient magnitude to require remedial action. Risks of COPCs to aquatic biota by a direct contact pathway were few and Hazard Quotients based on highly conservative ESLs were low, with few exceedances. Hazard quotients for COPC exposure to wildlife by a food/prey ingestion pathways were all less than 1.0 based on the comparison of the 95%UCL versus the LOAEL endpoint. Therefore, the proposed ecological risk management decision for sediment is to allow degradation to naturally attenuate organic COPCs and to implement on-Site source control to prevent potential for future inputs to Sabine Lake. In addition, potentially unacceptable risks will be addressed either in part or wholly by actions undertaken as part of the Natural Resource Damage (NRD) process.

The COPCs identified in On-Site surface soil could pose an unacceptable risk to terrestrial biota by a direct contact pathway and to wildlife by a food/prey ingestion pathway if receptors were