Public Health Assessment for

GULF STATES UTILITIES COMPANY
(A/K/A NORTH RYAN STREET FACILITY)
LAKE CHARLES, CALCASIEU PARISH, LOUISIANA
EPA FACILITY ID: LAD985169317
AUGUST 22, 2006

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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EPA FACILITY ID: LAD985169317

Prepared by:

Louisiana Department of Health and Hospitals
Office of Public Health
Section of Environmental Epidemiology and Toxicology
Under a Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations - the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly, chronically ill, and

people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Health Assessment Supervisor, Environmental Epidemiology and Toxicology, 6867 Bluebonnet Blvd., Conference Room 118, Baton Rouge, LA 70810.

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List of Acronyms

ATSDR	Agency for Toxic Substances and Disease Registry
BHC	Beta hexachlorocyclohexane
bgs	Below Ground Surface
CAP	Community Assistance Panel
CERCLA	The Comprehensive Environmental Response, Compensation, and Liability Act
CI	Confidence Interval
CLEAN	Calcasieu League for Environmental Action Now
CREG	Cancer Risk Evaluation Guide
CTF	Calcasieu Task Force
DNR	Department of Natural Resources
DWEL	Drinking Water Effect Level
EE/CA	Engineering Evaluation and Cost Analysis
EMEG	Environmental Media Evaluation Guides
EPA	Environmental Protection Agency
ft	Foot, Feet
GSU	Gulf States Utilities
HARP	Health Activities Recreation Panel
HCB	Hexachlorobenzene
HCBD	Hexachlorobutadiene
IARC	International Agency for Research on Cancer
in	Inch, Inches
kg	Kilogram
L	Liters
LDEQ	Louisiana Department of Environmental Quality
LDHH	Louisiana Department of Health and Hospitals
LDOTD	Louisiana Department of Transportation and Development
LOAEL	Lowest Observed Adverse Effect Level
LTHA	Lifetime Health Advisory
MCL	Maximum Contaminant Level (µg/L)

mg	Milligram
mg/kg	Milligrams per kilogram
MRL	Minimal Risk Level
MW-6	Monitoring Well #6
NA	Not Available
NCI	National Cancer Institute
ND	Not Detected
NOAEL	No Observed Adverse Effect Level
NPL	National Priorities List
OCDD	Octa-chlorodibenzo-dioxin
OPH	Office of Public Health
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
pg	Picogram
ppb	Parts per billion: microgram per liter (µg/L water), Microgram per kilogram (µg/kg soil)
ppm	Parts per million: milligrams per liter (mg/L water), Milligrams per kilogram (mg/kg soil)
RBC	Risk-Based Concentration
RDA	Recommended Daily Allowances
RfD	Reference Dose
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
ROD	Record of Decision
RMEG	Reference Dose Media Evaluation Guide
SARA	Superfund Amendments and Reauthorization Act
SEET	Section of Environmental Epidemiology and Toxicology
SIR	Standardized Incidence Ratio
SMCL	Secondary Maximum Contaminant Level
SSI	Screening Site Investigation
TCDD	2,3,7,8 tetra-chlorodibenzo-para-dioxin
TCDF	Tetra-chlorodibenzo-para-furan

TEF	Toxic Equivalency Factor
µg	Microgram
VOCs	Volatile Organic Compounds
yds	Yard

Summary and Statement of Issues

The Gulf States Utilities (GSU) site (a/k/a North Ryan Street Facility) is situated on the Calcasieu River, southeast of Two O'Clock Point and northeast of the city of Lake Charles. The site consists of a 3- to 4-acre east service yard and a 16-acre west service yard. North Ryan Street divides these yards. This site currently functions as a storage and repair facility for GSU, a subsidiary of Entergy Services, Inc. It was proposed to the Environmental Protection Agency's (EPA) National Priorities List (NPL) for hazardous waste sites in February 1995. The 16-acre west service yard site is contained entirely within a well-maintained fence, and access to the site is limited to employees of GSU. The 3- to 4-acre east service yard is closed but not fenced. Public access to this yard is unrestricted. This site is located next to the Greater Lake Charles Water Company. Some municipal wells previously existed on the site, but have since been closed.

A manufactured-gas plant operated on a portion of the GSU west yard from 1916–1932. From 1932-1980, the site was used as a landfill and storage area for various materials including electrical poles, transformers, oils, electrical equipment, and old appliances. The landfill was closed in 1980 and covered with soil and shells. The entire site was subsequently used as a storage facility. In 1988, the Louisiana Department of Environmental Quality (LDEQ) was contacted to investigate oily material found in a trench dug along the north side of the storage yard. Coal tar and fuel pits were discovered on the site.

Three sources of hazardous substances were identified at this site: the coal gasification plant, two former fuel oil pits, and the 6-acre marsh area used as the landfill. A major contaminant associated with this site is coal tar, which contains volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs).

The Louisiana Department of Health and Hospital's (LDHH) Office of Public Health (OPH) conducted an Environmental Health Education Program in 1993, along with the issuance of a public health informational fish and seafood advisory for the Calcasieu River System from the salt barrier above Lake Charles to the Gulf of Mexico. Bodies of water near the site have been and continue to be used for recreational activities. Community concerns include recreational sports and subsistence fishing along the banks near the site. The community proposed that the area be posted with signs and that community health education be implemented. Representatives from OPH attended a public meeting on January 19, 1999. Residents expressed concerns about the health effects of exposure to PAHs and PCBs, the safety of drinking water and food grown in local gardens, respiratory illnesses, and the presence of skin rashes. In response, the LDHH/OPH/Section of Environmental Epidemiology and Toxicology (SEET), in cooperation with the federal Agency for Toxic Substances and Disease Registry (ATSDR), has reviewed currently available environmental data and has subsequently prepared this GSU Public Health Assessment. A Public Comment version of this health assessment was made available to the community for questions or comments from September 17, 2002 until October 31, 2002. SEET did not receive any comments about this document within the defined time period.

A number of public outreach activities have occurred to keep the residential community involved in the remediation activities at the GSU site. These activities have included newspaper announcements, the release of fact sheets updating residents about remedial activities at the site, open houses and workshops, public meetings, and community interviews. On July 6, 2000, a public meeting was held to present the Proposed Plan for the Ground Water Operable Unit; public comment about the plan was accepted through July 12, 2000. An online public dialogue took place in July 2001 to discuss improving public involvement. A fact sheet released in March 2002 informed the public that the removal action activities had been modified to the contingency alternative. An open house was held on May 14, 2002, to inform the community about the progress of on-site excavation and offsite disposal of contaminated soils and sediments, which was completed in July 2002.

Prior to remediation activities, contamination of soil, sediment, surface water, and groundwater posed a public health hazard to past and present on-site workers, trespassers, and nearby residents. Residents using the shallow, 200-ft aquifer in the vicinity of the site as a private source of drinking water were at risk of being exposed to contamination. Alternative water supplies are available, and most shallow wells have been closed.

Source material and contaminated soils located in the western utility yard, known as the exposed tar area and the storm sewer area, were cleaned up first. The contaminated soils in the storm sewer area were excavated to a depth of five feet, characterized and treated. Since the previously approved method of treatment did not work, soils from these areas were treated with the approved contingency method, excavation and off-site treatment or disposal. The soils were transported to an appropriate off-site disposal facility in compliance with the off-site rule. The Entergy Corporation implemented the removal action at the site under oversight by EPA, Region 6.

The remedial alternative chosen for cleanup of Groundwater Operable Unit Number 1 included groundwater-use restrictions, monitored natural attenuation of groundwater, surface water, and public water supply monitoring.

The Gulf States Utilities site remedial actions were not compromised by flooding related to Hurricane Rita on September 24, 2005.

I. Purpose and Health Issues

The Superfund Amendments and Reauthorization Act (SARA) to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 directs the Agency for Toxic Substances and Disease Registry (ATSDR) to perform specific public health activities associated with actual or potential exposures to hazardous substances released into the environment. Part of this mandate is for ATSDR to perform a public health assessment (PHA) for each facility or site listed on or proposed to the National Priorities List (NPL).

The Louisiana Department of Health and Hospitals/Office of Public Health/Section of Environmental Epidemiology and Toxicology (SEET) has conducted this PHA of the Gulf States Utilities (GSU) west yard and surrounding area to determine the public health significance of the site. SEET has reviewed environmental data and responded to initial community concerns. This PHA contains recommendations to reduce or prevent site-related exposure that might result in adverse health effects.

II. Background and Statement of Issues

A. Site Description and History

The Gulf States Utilities (GSU) site is also called the North Ryan Street Facility or the Lake Charles Manufactured-gas Plant Site. It is currently owned and used by Entergy Corporation, which merged with GSU in 1994. The GSU site (Figure 1) is situated on the Calcasieu River northeast of Lake Charles, approximately 1.5 miles north of Interstate Highway 10 and 3/4 miles east of Louisiana Highway 3077. The site's address is 303 North Ryan Street, Lake Charles, Calcasieu Parish, Louisiana, 70601. The site is defined by the coordinates $30^{o}14'27"$ north latitude and $93^{o}13'09"$ west longitude.

The site is bounded to the north by River Road and the Calcasieu River and to the southwest by the Greater Lake Charles Water Company and the wastewater treatment plant. The site is bounded to the west by a cypress wetland, which is owned by the City of Lake Charles, and to the east by residential areas.

The lower Calcasieu River system has been impacted by several industries (petrochemical, agrochemical, etc.) that have historically discharged waste into the Calcasieu River and its tributaries. Several contamination studies have been conducted within the Calcasieu Estuary. In 1986, the United States Geological Survey (USGS) conducted a study to determine the levels and transport of toxic compounds in this river system [1]. In 1992, the Louisiana Office of Public Health (OPH) and the Louisiana Department of Environmental Quality (LDEQ) issued a joint informational consumption advisory for fish and seafood from within the river system, and advisories against swimming, wading, and water sports in Bayou D'Inde [1]. In March 1999, the Environmental Protection Agency (EPA) began a federally-led Remedial Investigation and Feasibility Study (RI/FS) of the Calcasieu Estuary sediments.

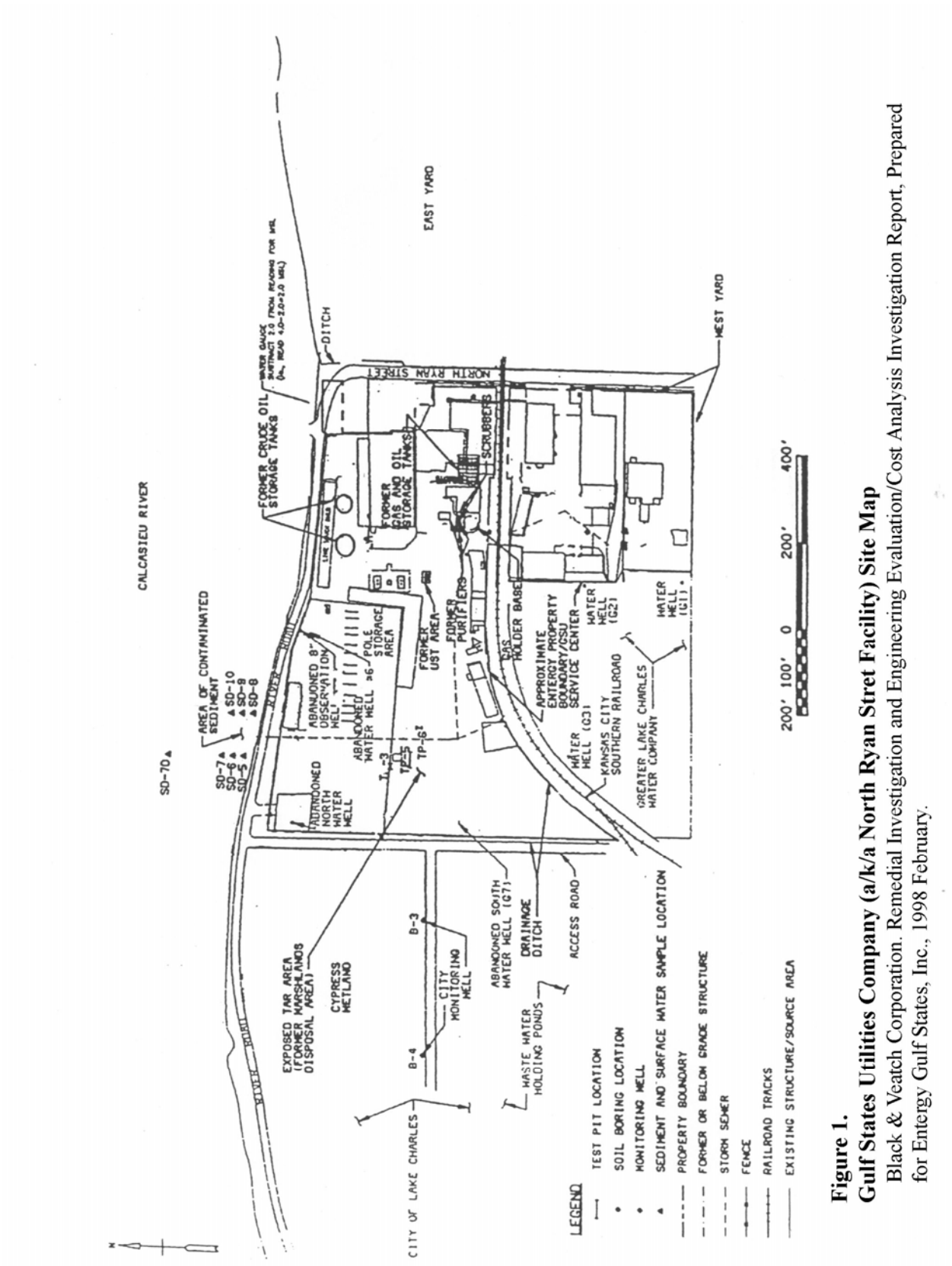

Figure 1.
Gulf States Utilities Company (a/k/a North Ryan Stret Facility) Site Map
Black & Veatch Corporation. Remedial Investigation and Engineering Evaluation/Cost Analysis Investigation Report, Prepared for Entergy Gulf States, Inc., 1998 February.

From 1916–1926, this site was used as a manufactured-gas (coal-gasification) plant. GSU purchased the site in 1927 and operated the manufactured-gas plant between 1927 and 1932. The plant used coal to produce gas for lighting and heat. Coal tar, a byproduct of this process, was landfilled into a 6-acre marsh area to the west of the gas plant. This marsh area is located within what is currently called the "west service yard." Until the 1980s, an outcropping of exposed tar was visible. The manufactured-gas plant included a 16-acre west yard, west of North Ryan Street and a 4-acre east yard, east of North Ryan Street. When the manufactured-gas plant closed, the west yard continued to be used as a landfill and storage area. Various materials—including electrical poles, transformers, transformer oils, electrical equipment, debris, and appliances—were deposited into this landfill. In 1980, the landfill became full, and the area was covered with soil and shells. The east service yard was used for storage and has never been owned by Entergy. It is unfenced and no longer used for storage [2].

On July 20, 1988, workers digging a trench along the north side of the west yard noticed an oily material flowing from the trench, which was traced by LDEQ to the GSU west service yard. LDEQ also discovered several old pits containing waste tar, transformers, oils, and drums.

On September 19, 1989, GSU was ordered to submit a plan for determining the extent of contamination and remediation. Three investigations by GSU were carried out. Phase I, II, and III investigations are dated December 1988, March 1989, and March 1990, respectively. In October 1990, EPA performed a Screening Site Investigation (SSI). The site was proposed for the National Priorities List (NPL) in February 1995. GSU and the EPA completed an Administrative Order on Consent for cleanup actions in February 1997 [2,3].

An Engineering Evaluation and Cost Analysis (EE/CA) and an RI/FS for Operable Unit 1 were completed in February of 1998 [4]. The Operable Unit 1 investigation addressed groundwater. RI activities performed included the excavation of seven test pits, the drilling of 28 soil borings, the installation of six monitoring wells, and the collection of 22 sediment samples, 18 surface water samples, and 12 groundwater samples.

In March 1999, Addendum #1 to the RI and EE/CA was completed [4]. The objective of the Addendum was to further evaluate the connection between subsurface soil contamination and the river. In March 1999, the Baseline Risk Assessment was also completed. In January 1999 and January 2000, annual groundwater sampling reports were completed [5,6]. Domestic well water from 25 additional wells was sampled in April 1999.

Three sources of contaminants were identified: the former manufactured-gas plant which operated from 1916–1932, two fuel oil pits used from 1900–1920, and the marsh area used by GSU as a landfill from 1932–1980. None of the disposal areas were contained; the coal tars were pumped into the marsh, the fuel oil stored in earthen pits, and the landfill covered with soil and

shells and used to create a base for the storage yard. No records of waste type, amount, location, or capacity of the pits were available. Fuel oil pits were located in the northern area of the site, near the Calcasieu River. Polychlorinated biphenyls (PCBs) were found in areas associated with landfill operations on the site. A storm water drain line transported coal tar from the site to the river until 1995, when it was plugged. Removal of contaminated sediments on site began in May 2000.

In January 2003, a Revised Baseline Risk Assessment was prepared for Entergy Gulf States, Inc., the current owners of the GSU site [7]. This re-assessment evaluated the risks posed to future onsite workers by soil contamination in the west yard of the site. The re-assessment was required with the completion of sediment removal activities in the west yard near the former exposed tar area.

For the purposes of the Revised Baseline Risk Assessment, the west yard was divided into north and south portions. All soil data from the west yard used during the baseline risk assessment were used in the revised assessment with the exception of data from excavated areas. No revised assessments were made to the other areas of the site because no unacceptable health risks were identified in these areas, or wastes had been removed until removal action goals were met in these areas.

The Revised Baseline Risk Assessment found no current risk of exposure on site. The exposed tar area has been excavated and the excavation site has been covered with fill material and capped [7].

On September 24, 2005, Hurricane Rita, a category 3 hurricane, made landfall with top winds of 120 mph on the coast of southwestern Louisiana. Hurricane Rita caused flooding and property damage to businesses and residences throughout Lake Charles, LA. On September 30, 2005, LDEQ representatives and contractors visited the site and reported no visual impacts at the site. That same day, EPA collected 2 surface water samples at Gulf States Utilities as a preliminary assessment of potential impacts from the hurricane. No constituents of coal tar contamination were detected in either of these samples. EPA concluded that the remediation steps taken at the Gulf States Utilities site were not affected by Hurricane Rita [8].

B. Site Geology and Hydrogeology

The GSU site geology consists of a surface-fill layer which overlays a cohesive sandy clay layer. The fill, brought in to elevate the site, ranges from 1–12 ft deep. A pocket of sand up to 30 ft deep is present in the northwest corner of the site at a depth of 20–36 ft below ground surface (bgs). The EPA studied this sand pocket and determined that it did not provide a subsurface pathway for contaminants to move to the Calcasieu River. The cypress wetland, which lies west of the GSU west service yard, contains no fill.

The groundwater in the vicinity of GSU consists of shallow alluvial aquifers and the deeper Chicot Aquifer. The shallow aquifers are linked to the Calcasieu River. They receive recharge

waters from and discharge to the river. The Lake Charles area uses the Chicot Aquifer as its major water source. The Chicot Aquifer has major sands at 200, 500, and 700 ft.

The City of Lake Charles obtains its water supply from seventeen water wells screened in either the 500- or 700-ft sands of the Chicot Aquifer. GSU is located adjacent to the Greater Lake Charles Water Company. Three municipal water wells, which were screened in the 700-ft sands are located on GSU property and have been closed. Six other city wells are located within 300 - 400 yards (yds) south of the site on Lake Charles Water Department property. Five of these wells are screened in the 500-ft sands and one is screened in the 700-ft sands.

Beneath the GSU site, the 200-ft sands of the Chicot Aquifer are not receiving recharges from the shallow aquifers. Soil borings, on-site and under the river, show a continuous clay layer that extends across the site and under the riverbed. The clay makes it unlikely that site contaminants will migrate into deeper groundwater. The groundwater flows in a north to northwest direction toward the Calcasieu River. The monitoring wells south of the GSU site (up gradient) showed no contamination. The EPA concurred with the site contractor that homes to the south and east were up gradient of groundwater.

Rural communities and the residences along River Road get their water from the 200-ft sands of the Chicot Aquifer. As part of the RI, a list of registered wells was received from the Louisiana Department of Transportation and Development (LDOTD) in May 1997. From this list, 36 wells were counted within a one-mile radius of the site. Four of these wells draw from the 200-ft sands while the remaining draws from the deeper sands of the Chicot Aquifer. A house-to-house well survey was conducted at residences down gradient (north and west) of the site. One domestic well 1/4 mile to the west and installed to a depth of 306 ft was identified. This well was used by a group of homes and camps. As of 1998, municipal water service was being installed to these homes.

C. Site Visit

On August 18, 1995, health assessors for the OPH conducted a site visit of the GSU site, along with representatives of Entergy, Gulf State Utilities, and LDEQ. Many employees were working on-site during the visit. The following observations were made:

- The site was located in a sparsely populated section of the City of Lake Charles, Louisiana, near other industries. A small community, with the closest house approximately 500 yards (yds) away from the site, was located to the east.

- An eight-ft-high fence with razor wire was maintained around the perimeter of the site, and provided a barrier to human and animal access. No signs of trespassing were observed.

- The site was mostly covered with crushed shells and used as a storage facility for electrical equipment and transformers. Many transformers were raised off the ground on wooden pallets. An exposed tar spot (2 x 4 ft) was observed on-site.

- The coal-tar pit was recessed and covered with a corrugated tin cover. Standing water was observed on-site.

- The off-site trench, originally dug to install fiber optic cables, had been covered. No visual indications of contaminants were present.

- The Calcasieu River was located across River Road from GSU, approximately 50 ft north of the site. Water runoff from the site flows to a ditch toward River Road and the river. In addition, during periods of high water, the Calcasieu River could easily overflow onto the site. The western border of the site is a cypress wetland flood plain or marsh.

- Many people were seen fishing along River Road and some directly across the street from the site, near the outflow pipe of the Municipal Wastewater Treatment Plant.

- A sheen of an oily, organic substance was visible, floating on the river's surface near the site. Oil bubbles were observed coming from beneath the water, near the outflow pipe.

- No on-site wells were operable. The municipal wells had been plugged.

On June 30, 1999, a visit to the area outside of the GSU west yard fence was made. The fencing remains in excellent condition. Signs posted by the EPA in December 1998 were observed and clearly visible. The signs read as follows:

WARNING

Contaminated Sediments: No recreational activity recommended

between these signs. Cleanup pending.

For more information, contact EPA at 1-800-533-3508.

Although the signs were clearly visible, one fisherman was observed fishing.

Table 1. 1990 US Census Data for Census Tract 2. City of Lake Charles, Louisiana.

	African American	Caucasian American	Asian American	American Indian or Alaskan Native	Hispanic or Latino (of any race)	Other
Population Number	2,008	77	4	2	23	19
% of total	94.1	3.6	0.2	0.1	1.1	0.9

D. Demographics, Land Use and Natural Resources Use

The GSU site is located in the northwestern section of Lake Charles, LA. As estimated in Census 2000, GSU lies within the 70601 zip code and within census tract 0002, encompassing 2,133 residents. Table 1 lists the residential breakdown of this census tract by reported race [9].

Many industrial facilities are located upstream from the GSU site. The site is bordered to the south by the Greater Lake Charles Water Treatment facilities, which supplies water to the surrounding area. To the east, residential areas border the site and several schools are located within or near a one-mile radius.

The Calcasieu River is an important resource for the area. Its uses include industrial shipping and recreational fishing, swimming, and boating. Currently, an OPH informational health advisory for the Calcasieu River from the salt barrier across from the site to the Gulf of Mexico is in effect.

E. Community Health Concerns

In September 1995, OPH met with the Calcasieu Task Force (CTF) to request that they serve as a Community Assistance Panel (CAP) for the GSU site. CTF had been initially established during Governor Buddy Roemer's administration (1988-1992) and is comprised of private citizens who present environmental concerns of the community and other stakeholders. Concerns discussed included the subsistence fishing of the poorer community members along River Road and whether the informational fish and seafood consumption advisory in effect for the Calcasieu Estuary should also include recreational activities.

OPH gathered community health concerns during the first quarterly meeting with the EPA and Calcasieu League for Environmental Action Now (CLEAN) on March 23, 1999. During the meeting, members of the audience expressed the following health concerns:

- People fish near the site, especially by the water treatment outflow pipe. This pipe releases warm, nutrient-rich water into the river, which attracts more fish. These people often are socioeconomically-disadvantaged members of the community who subsistence fish.

- Signs should be posted to warn people of the presence of hazardous chemicals to which they could be exposed during activities such as fishing and playing in water and sediment near the site.

- The informational fish and seafood consumption advisory in effect for the Calcasieu Estuary should include advice related to aquatic recreational activities as well.

These concerns will be addressed in the Community Health Concerns Evaluation section of this document.

III. Discussion

Exposure to or contact with chemical contaminants drives the Agency for Toxic Substances and Disease Registry (ATSDR) public health assessment process. Persons may be exposed to chemicals by breathing, eating, or drinking a substance containing the contaminant, or by skin (dermal) contact with a substance containing the contaminant. The release or disposal of chemical contaminants into the environment does not always result in exposure or contact.

Even when exposure occurs, it does not always result in adverse health effects. In addition, the type and severity of effects in an individual as a result of contact with contaminants depend on several factors:

- the toxicological properties of the contaminants
- how much of the contaminant the individual is exposed to
- how often and/or how long the individual was exposed
- the manner in which the contaminant enters or contacts the body (breathing, eating, drinking, or skin/eye contact)
- the number of contaminants to which an individual is exposed (combinations of contaminants).

Once exposure occurs, a person's specific characteristics—such as age, sex, nutritional status, genetics, life style, and health status—influence how he or she absorbs, distributes, metabolizes, and excretes the contaminant. All of these variables may influence whether exposure to a contaminant results in adverse health effects.

To assess the potential health risks contaminants pose at this site, OPH compared contaminant concentrations to health assessment comparison values. Comparison values are media-specific (for example, water, soil, air, or biota) concentrations used to screen contaminants for further evaluation. Comparison values do not assess which contaminants represent a public health hazard; they are only used to determine which of the contaminants detected need to be more closely evaluated. Once a contaminant that should be further evaluated is identified, the exposure factors listed previously must be considered as part of the health assessment. The details of the health assessment process used to evaluate the contaminants detected are described in Appendix B.

A. Environmental Contamination and Other Hazards

The toxicological evaluation process is explained in detail in Appendix B. Contaminants detected in on- and off-site samples at the GSU site were screened using comparison values to identify which of the samples needed to be closely evaluated using factors such as the exposure route and the duration of exposure.

The contaminants of concern identified in each medium in the 1999 baseline risk assessment are evaluated in the subsequent sections of this health assessment to determine whether exposure to them would have public health significance (see Tables C-1 through C-12). Subsequent sections present the analytical results for contaminants detected in off-site soil, sediment, surface water, and groundwater. Data were obtained during the following investigations:

- The Screening Site Investigation (SSI), conducted in 1992 [2]
- The Remedial Investigation and Engineering Evaluation/Cost Analysis (RI and EE/CA) field activities, performed February 3–24, 1997 [4]
- Addendum #1 to the RI and EE/CA Investigation Report, dated March 1999 [5]
- Annual groundwater-monitoring results for 1998 and 1999 [6,11]
- Private-well water sampling, conducted in April 1999.

The groundwater data are from quarterly monitoring performed during the weeks of June 22, September 8, and December 15, 1997. Surface water samples were also collected from the Calcasieu River during September 1997 groundwater monitoring [12]. Data collected prior to the

SSI were not included in this report. Results of the data will be discussed under the Public Health Implications section (Section C).

1. On-Site Contamination

a. Soils

In 1997, seven samples of surface soils were collected during the RI and EE/CA. The surface soil consists of gravel fill. The gravel, which averages four feet in depth, was brought in to cover the GSU west yard. The EPA and its contractor discontinued sampling, however, because the pathway was no longer complete. These data were not evaluated for the PHA because the soil has been removed. GSU maintains the gravel cover placed over the excavated areas by re-grading to prevent exposure to subsurface contamination.

Other soil samples at the site were collected over a period of time. In 1992, 16 subsurface soil samples were collected during the SSI. In February 1997, during the RI and EE/CA soil investigation, 28 soil borings were drilled. Six of the borings were completed as monitoring wells. Seven additional test pit locations were also sampled. The 1997 borings and test pit samples were collected between five and 10 ft below ground surface (bgs). In March 1998, nine additional subsurface soil samples were collected. In December 1998, 21 additional on-site subsurface soil samples were collected in the vicinity of monitoring well 6 (MW-6). Samples were collected to a depth of 20 ft. This sampling event was conducted to learn more about movement of PAHs through subsurface soil, and samples were analyzed for volatile organic compounds (VOCs), PAHs, polychlorinated biphenyls (PCBs), and metals. Soil samples were also taken during the soil removal activities in 2001 and 2002, and results from these sampling events are listed in tables C-13 and C-14. [7].

The GSU water table was encountered at a depth of around 6.5 ft. Any construction activities that could result in exposure of subsurface soils would be limited to soils above groundwater (Tables C-1 and C-2), although soils contamination has been found as deep as 17 ft.

Soil sampling indicated that benzene, PCBs, PAHs, and manganese exceeded the comparison values (Table C-1). Each carcinogenic PAH was assigned a toxic equivalence factor (TEF) by which its cancer potency was estimated [13]. The assessment of PAHs using TEFs and toxicity equivalence quotients (TEQs) is explained in detail in Appendix B, and the TEFs for on-site soil sampling are listed in Table C-2. The sum of the PAH TEQs was 4661.9 ppm, which is greater than the benzo(a)pyrene soil comparison value of 0.1 On-site soil PAH levels, and the pathways through which the public might come in contact with them, were therefore further evaluated for their potential to pose public health hazards.

b. On-Site Groundwater

In February 1997, groundwater samples from the 12 monitoring wells were collected and analyzed for PAHs, VOCs, phenols, and metals. Six groundwater-monitoring wells had been installed in Phase II of the GSU investigation, and an additional six wells were installed as part of the RI and EE/CA investigation. Two of the 12 wells are actually off of the GSU property, in the cypress wetland to the west. One of the 12 was abandoned because it had been installed through a sanitary sewer line. The remaining 11 were sampled again in June, September, and December 1997. In August 1998 and July 1999, the wells were sampled again. The list of analyses for the 1999 samples omitted metals [11].

The locations and depths of the wells were strategically planned to help in the gathering of information about the groundwater's quality, flow direction, and vertical movement between subsurface soils. The wells were installed to depths between 8 and 51.5 ft bgs to monitor both shallow and deep groundwater in the clay, as well as shallow sand lenses within the clay at the site. MW-6 monitors the discontinuous sand lense, which is in the clay layer and which contains visible liquid tar.

Results of the groundwater samples indicated an exceedance of drinking water comparison values for acetone, benzene, ethylbenzene, toluene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, 2-methylnaphthalene, naphthalene, arsenic, aluminum, barium, beryllium, lead, manganese, nickel, thallium, vanadium, and PAHs (Tables C-3 and C-4). The sum of the PAH TEQs is 744.98 parts per billion (ppb), which is above the drinking water CREG of 0.005 ppb (Table C-4). On-site groundwater PAH levels, and the pathways through which the public might come in contact with them, were therefore further evaluated for their potential to pose public health hazards.

2. Off-Site Contamination

The EPA collected samples outside of the GSU west yard fence line to determine how far contamination had spread. Sediment samples were collected from three locations: the cypress wetland, the drainage ditch along the western and southern boundary of the GSU yard, and Calcasieu River sediments. Surface water samples were collected from the drainage ditches, the cypress wetland and the Calcasieu River. Soil samples were collected along the north fence line and in the cypress wetland west of the GSU yard.

a. Sediment

Sediments in the vicinity of the GSU site included those found in the Calcasieu River, the drainage ditches along the western and southern site boundaries, and the cypress wetland to the west of the site. The data from each location is summarized separately below.

In September 1992, nine surficial sediment samples were taken from the Calcasieu River where it runs adjacent to River Road across from GSU. During the months of January, February, and March 1998, 38 Calcasieu River sediments were collected. They were analyzed for VOCs, PAHs, pesticides, PCBs, and metals. River sediment sampling was designed to determine the horizontal distribution of GSU contaminants from three discharge points into the river. The sediment samples were obtained from the 0–6 ft in depth and at distances of 25, 75, and 200 ft from shore. The sample collected 200 ft from shore was from 33 ft underwater. Actual exposure to sediment from this depth is unlikely, but this sample was taken to contribute to a general indication of contaminant concentrations in Calcasieu River sediments. Sediment samples were collected from the immediate areas of the three observed discharge points into the river, as well as locations near the east and west boundaries, and at background locations upstream and downstream from the site. Because no comparison values exist for sediments, soil comparison values were used (Tables C-5 and C-6).

Benzo(a)pyrene exceeded ATSDR soil comparison values. Lead exceeded the level considered by the EPA to be protective for soils under a residential use. The highest concentrations of PAHs were detected in the area of the discharge from the former facility's drain pipe. The sum of the PAH TEQs was 488 ppm, which exceeds the CREG of 0.1 ppm. These PAH levels, and the pathways through which the public might come in contact with them, were therefore further evaluated for their potential to pose public health hazards.

In February 1997 and March 1998, six soil and three ditch sediment samples were collected and analyzed for VOCs, PAHs, pesticides, PCBs, and metals. The west ditch was a narrow, man-made stream, approximately 4 ft wide and less than 6 in deep. This ditch flowed intermittently, carrying water from the south side of the yard and a railroad, around the west boundary, and into the Calcasieu River. In addition, this ditch probably received seepage water from the wastewater holding pond southwest of the site. Benzo(a)pyrene and DDE, a DDT-breakdown product, exceeded soil comparison values. The sum of the PAH TEQs equals 2.3 ppm, which exceeds the soil comparison value CREG of 0.1 ppm. These PAH levels, and the pathways through which the public might come in contact with them, were therefore further evaluated for their potential to cause public health hazards. Other contaminants detected were present in levels that did not exceed their comparison values (Tables C-7 and C-8).

In February 1997 and March 1998, 11 soil and sediment samples were collected from the cypress wetland and analyzed for VOCs, PAHs, pesticides, PCBs, and metals. Results indicated that Benzo(a)pyrene exceeded ATSDR comparison values (Tables C-9 and C-10). The sum of the PAH TEQs is 15.7 ppm, which is above the CREG of 0.1 ppm (Table C-9). These PAH levels, and the pathways through which the public might come in contact with them, were therefore further evaluated for their potential to pose public health hazards.

Under normal conditions, surface water from the site cannot flow into the area because the cypress wetland is topographically separated from the GSU yard site. In addition, the west ditch

collected surface water runoff from the site before it can flow into the wetland. Occasional flooding on the Calcasieu River, however, creates the potential for a water connection between the site and the wetland.

b. Surface Water

In September 1997, seven surface water samples were collected from the Calcasieu River at the locations of the sediment samples that were 200 ft from the shore. The water was approximately 33 ft deep at the sample locations. Arsenic (2–5 ppb) and thallium (2–5 ppb) were the only contaminants present in the river water that exceeded drinking water comparison values. The contaminant levels were lower in the river water than in the ditch and wetland water.

Also in 1997, two surface water samples were collected, one from the west ditch and one from the south ditch. Three surface water samples were collected from the cypress wetland to the west of the GSU property. The following contaminants exceeded comparison values in one or more samples: bromodichloromethane, dibromochloromethane, benzo(a)pyrene, aldrin, dieldrin, aluminum, arsenic, barium, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel,and vanadium (Table C-11). The sum of the PAH TEQs is 0.38 ppb, which is above the CREG of 0.005 ppb (Table C-12). This comparison values is very conservative and assumes adult consumption of two liters of water per day, a level of consumption that would be from a source of drinking water. These PAH levels, and the pathways through which the public might come in contact with them, were further evaluated for their potential to pose public health hazards.

Several of the contaminants detected are not associated with manufactured-gas plants and are likely to have come from other sources. Two contaminants, bromodichloromethane and dibromochloromethane, may be byproducts of drinking water disinfection. Two others, aldrin and dieldrin, are pesticides widely used in the past and could have originated from sources unaffiliated with the GSU site.

c. Domestic Well Water

In April 1999, 25 residential well waters along River Road were sampled. VOCs, semi-volatile organic compound (SVOCs), PCBs, pesticide, metal, and dioxin analysis were performed. The sampling of residential wells detected iron (maximum 2.56 ppm), manganese (0.42 ppm) and sodium. In one sample, sodium was detected at 116 ppm. This concentration exceeds the EPA's Drinking Water Equivalent Level (DWEL) of 20 ppm. A DWEL is the lifetime exposure level for drinking water at which adverse, noncarcinogenic health effects would not be expected to occur. Although sodium is found in table salt and many foods, the sodium level in the residential well could present a problem to persons who may be on a sodium-restricted diet.

The samples were analyzed for dioxins by EPA Method 1613, which achieves a reporting limit of 0.01 nanograms/liter (ng/L) for 2,3,7,8 tetrachlorodibenzo-p-dioxin (TCDD) and

tetrachlorodibenzo-p-furan (TCDF). The reporting limit for all other congeners was 0.051 ng/L. Octachlorodibenzo-p-dioxin (OCDD) was detected at a concentration of 0.1100 ng/L in one of the 25 samples. Several dibenzofurans with six and seven chlorines were identified but were present at concentrations below the method reporting limit. OCDD has toxicity potential 1000 times lower than 2,3,7,8 TCDD. These results indicate that dioxin levels in the domestic well water do not pose a health hazard.

Iron and manganese, however, exceeded the EPA's secondary maximum contaminant levels (SMCL). An SMCL is a level at which a concentration which could cause an aesthetic effect, such as an odor or taste, but which would be unlikely to cause a health effect. The levels of iron and manganese detected in the drinking water were compared to the recommended dietary allowances (RDAs) and do not represent a health concern.

3. Physical and Other Hazards

The GSU site is currently used to store heavy equipment and other items. Normal physical hazards posed by this type of equipment are present to workers and visitors on-site. The tar pit is covered with a raised aluminum panel, which may present a physical hazard to workers on-site. The site is entirely fenced, making it unlikely that unauthorized persons would gain access to the site.

B. Pathway Analysis

To determine whether nearby residents are exposed to contaminants from the site, SEET and ATSDR evaluated the environmental and human components that can lead to human exposure. This pathway analysis consists of five elements:

- a source of contamination
- transport through an environmental medium
- a point of exposure
- a route of human exposure
- a receptor population.

An exposure pathway can be *eliminated* if at least one of the five elements is missing and will never be present.

ATSDR and SEET categorize exposure pathways that cannot be eliminated as either a *completed* exposure pathway or a *potential* exposure pathway. Completed pathways require that all five necessary elements exist and indicate that exposure to a contaminant has occurred in the past, is currently occurring, or will occur in the future. Potential pathways differ from completed

pathways in that at least one of the five elements is missing, but could exist. Potential pathways also indicate that exposure to a contaminant could have occurred in the past, could be occurring now, or could occur in the future.

For roughly a century, the GSU yard was used as a manufactured-gas plant, fuel oil storage tank site, and landfill. It continues to be an active storage facility with traffic from approximately 150 workers employed at the site. Located in an industrial area bordered by the Greater Lake Charles Water Company treatment facility, the site consists of east and west service yards separated by North Ryan Street. The area east of North Ryan Street was originally leased for storage. It is no longer used, however, and has never been owned by Entergy.

The west service yard, the focus of this report, is used as a storage area and repair center. Sources of contaminants within the west yard included the six-acre landfill on the western portion, the area of the former gas plant in the south-central area, two unlined oil storage pits in the center of the yard, and the drainpipe that extends to the Calcasieu River.

Contaminants from the manufactured-gas plant were found within the GSU west yard below the gravel fill, outside of the fenced yard in the ditches, the cypress wetland west of the west yard, and the Calcasieu River. The Calcasieu River and the cypress wetland border the western and northern boundaries of the site. Residential areas are located approximately one-half mile to the south and one-quarter mile to the east. Residents live along River Road and pass the site on a regular basis. In addition, people have been observed fishing near the site.

1. Completed Exposure Pathways

Completed exposure pathways at the GSU site are summarized in Table 2 (see page 18). In the past, these pathways include soil from off-site, the wetlands near the site, ditches running from the site, and the Calcasieu River. Each of these pathways is discussed in detail in the following sections.

a. Off-Site Soils, Sediments, and Surface Water

Volatile organic compounds (VOCs), and coal tar constituents were detected at concentrations above comparison values in the northwest section of the GSU west yard. Overland flow of surface water may have carried some contaminants or contaminated soils off of the property. The surface water flow is toward the northwest corner of the site, approximately 60 ft across River Road, to the marsh and river. Contaminated soil and sediment that moved off-site toward the western and southern ditches, the cypress wetland, and the Calcasieu River may have contained PCBs, PAHs, and VOCs. Sources of these contaminants may have included the west yard's tar pit, trench, and storage area.

Table 2. Completed Exposure Pathways, Gulf States Utilities (GSU), Lake Charles, Louisiana.

Pathway	Source	Medium	Exposure Point	Exposure Route	Time of Exposure	Exposure Activities	Chemicals	Public Health Impact?
soil	GSU	off-site soil	soils off-site	ingestion inhalation dermal	past	work recreational fishing		none (soil excavated)
wetlands	GSU west yard unknown	surface water, soils, sediment	cypress wetland	ingestion inhalation dermal	past	work recreational fishing	arsenic (sediment and soil)	none (soil and sediment excavated)
ditch	GSU west yard unknown	water and sediments	west ditch south ditch	ingestion inhalation dermal	past	work recreational fishing	arsenic (sediment)	none (sediment excavated)
river	GSU	water and sediments	Calcasieu River	ingestion inhalation dermal	past	work recreational fishing	PAHs*, arsenic, lead, thallium (water only)	none (sediment excavated)

*PAHs = polycyclic aromatic hydrocarbons

Off-site surface water samples collected from the cypress wetland and ditches contained PAHs, pesticides, metals, and some chlorinated VOCs at levels above comparison values. In general, these contaminants can be widespread in an environment, so their presence in off-site surface water in this case may be attributable to a source other than—or in addition to—the GSU yard. Chlorinated VOCs, for instance, are frequently formed during water chlorination. Similarly, the detected pesticides may also have come from another source. Although no longer permitted because of their persistence in the environment, at one time these chemicals were widely used to control disease-transmitting insects.

Incidental ingestion of surface water could occur if workers had tasks to perform along the ditches or in the cypress wetland. Incidental ingestion might also occur in children or adults during recreational activities. Such accidents, however, would occur infrequently, and the amount of water ingested would probably be very small. Therefore, accidental ingestion of surface water poses **no apparent public health hazard**.

The western ditch of the west yard received water run-off from both River Road and the GSU west yard. The ditch sediments contained PAHs, Aroclor 1260, and DDE. The benzo(a)pyrene, Aroclor 1260, and DDE concentrations were below levels characteristic of background levels in the area. Children who played in the ditch or workers who maintained the roads and grass could have come into contact with the ditch soils, sediments, and surface water. Low levels of PAHs and arsenic were found in the soils and sediments in the cypress wetland. Children and adults might have trespasses in the wetland and be exposed to soils, sediments, and surface waters; worker exposure would have been infrequent. The western ditch was excavated and capped as part of the removal action and is therefore no longer a potential source of exposure [14].

Sampled ditch and cypress wetland contaminant levels were below background levels. The contaminant levels in the cypress wetland, soils, ditch sediments and water were low. Because human exposure to the soils, sediments, and water is infrequent and because contaminated ditch sediments have been excavated, contaminants in these areas pose **no apparent public health hazard**.

b. Calcasieu River

An LDEQ, Department of Natural Resources (DNR), and LDHH Informational Health Advisory has been in effect since 1993 for the Calcasieu River. It affects the area from the salt barrier, located upstream from the GSU site, to the Gulf of Mexico. Nevertheless, people have been seen fishing directly across from the site or within one-quarter mile downstream of the site [1, 15, 16]. In addition, River Road residents and others frequent the river to fish, wade, and swim.

Of the areas outside of the GSU west yard, Calcasieu River sediments were the most likely to present a source of exposure to contaminants from GSU. The Calcasieu River offers more diverse recreational uses than the cypress wetland or ditches, and OPH has seen people fishing on the river during several site visits.

Sediments collected from the Calcasieu River were contaminated with PAHs, which decreased with distance from the shore. In addition to having been carried by water run-off, PAHs were transported to the river sediments through the drainpipe, which was closed in 1995. Contaminated river sediments were excavated as part of the removal action and are therefore **no longer a potential source of exposure** [14].

Sampling showed that the river water was relatively clean and contaminant levels exceeded drinking water comparison values for only two metals, thallium and arsenic. The comparison value used to determine health risks related to consuming water assumes that a person drinks two liters of contaminated water daily. The only ingestion of water from the GSU site would be accidental ingestion during recreational activities and would not equal the two liters per day assumption. Movement of groundwater from beneath the site to surface river water has been noted, but groundwater flow is preferentially horizontal and not vertical. No decline in surface water quality has occurred. Incidental consumption of Calcasieu River water should pose **no apparent public health hazard** [14].

2. Potential Exposure Pathways

Potential exposure pathways at the GSU site are summarized in Table 3 (see page 21). These pathways include air from the GSU west yard, the biota caught and consumed from around the site, soils on-site, and shallow groundwater from the GSU site. Each pathway is discussed in detail in the following sections.

a. On-Site and Off-Site Air

VOCs, PAHs, and PCBs were widely distributed throughout the yard, especially toward the northwest corner of the property. Some of these constituents may have been released into the atmosphere and some may have bound to soil particles and become airborne. The presence of gravel fill, which averages 4 ft in depth, minimizes dust generation. On-site workers and visitors may have been exposed to released volatile compounds and other contaminants through inhalation, skin contact, and ingestion of these compounds. Prior to the removal actions, persons could be exposed through ingestion or inhalation of contaminated dust and soil particles during movement of equipment, digging in the soil, and/or during dry periods when the soil was disturbed by wind and contaminated particles disperse into the air. A **potential health risk** for inhalation of dust will exist for longer exposures experienced by onsite workers **if any excavation of the capped area to the depth of the waste occurs** [7]. As long as no further excavation occurs, exposure to on-site air is **not a completed pathway**.

Airborne contaminants may have traveled off-site in particles and dust or as vapors from the excavated area before the gravel fill was brought in or during periods of excavation or remediation. These exposures would have been of a short duration and low concentration that would have posed **no apparent public health hazard** to residents. With the excavation and capping of contaminated soils, exposure to off-site air is **not a completed pathway**.

Table 3. Potential Exposure Pathways, Gulf States Utilities (GSU), Lake Charles, Louisiana.

Pathway	Source	Medium	Exposure Point	Exposure Route	Time of Exposure	Exposure Activities	Chemicals	Likely Public Health Impact?
air	GSU west yard	air	on or near the sitee	inhalation	past, future, during any digging	breathing	PAHs* PCBs† metals VOCs‡	for workers, if future on-site excavation of capped area to depth of waste occurs
biota	unknown	fish	where the fish are eaten (ingestion)	ingestion	past present future	eating fish	HCB§ HCBD¶ PCBs	for consumers who do not observe local fish advisory
soils on-site	GSU west yard	soils below the gravel fill	GSU west yard	ingestion inhalation dermal	past future	work	PAHs PCBs VOCs	for workers, if future on-site excavation of capped area to depth of waste occurs
shallow groundwater	GSU	residential well water	point where groundwter feeds into surface water; tap water	ingestion inhalation dermal	future	domestic activities	PAHs PCBs metals VOCs	none

PAHs* = polycyclic aromatic hydrocarbons
PCBs† = polychlorinated biphenyls
VOCs‡ = volatile organic compounds
HCB§ = hexachlorobenzene
HCBD¶ = hexachlorobutadiene

b. On-Site Groundwater

The shallow groundwater beneath the GSU yard is contaminated. Coal tar contacted groundwater at 6.5 ft bgs. Coal tar is a mixture of organic contaminants with varying levels of solubility in water, so some contaminants are more likely than others to migrate into and via groundwater. If a shallow well were drilled on the site, it would complete the exposure pathway. Drilling would be highly unlikely, however, because a delivery system for city water is currently being installed.

Exposure to on-site groundwater is **not a completed pathway** because the water is not used for any purpose, does not feed the deeper aquifers from which drinking water is obtained, and does not degrade surface water in the Calcasieu River.

c. Off-Site Domestic Well Water

Within a one-mile radius of GSU, four residential wells draw from the 200-ft sands of the Chicot Aquifer. The city wells in the area draw from the 500- and 700-ft sands. Soil borings on-site and under the river show a continuous clay layer that extends across the site and under the riverbed. This layer makes site-contaminant migration into the 200-ft sands of the Chicot Aquifer unlikely. Testing of residential wells has shown no GSU-site contaminants present. Therefore, consumption of contaminated groundwater via a residential well is **not a completed pathway**.

d. Biota

The Calcasieu River is currently under an informational health advisory from the saltwater barrier, located across from the GSU site, to the Gulf of Mexico. The advisory is the result of hexachlorobenzene (HCB), hexachlorobutadiene (HCBD) and PCBs in fish samples collected in sections of the Calcasieu Estuary, including samples collected from Lake Charles [1]. PCBs were found in the landfill at the GSU west yard before . The other fish contaminants are not associated with GSU and are most likely the result of other sources. Presently, signs warning of contamination are posted along the river near GSU. Consumption of contaminated biota is considered a **potential exposure pathway** because whether or not people limit their consumption of local fish as a result of the advisory is unknown.

e. On-Site Subsurface Soil

The three major sources of contamination within the GSU west yard were the former manufactured-gas plant site, two former fuel-oil pits, and the 6-acre marsh area used as a landfill, including the trench. VOCs, PAHs, and some metals were found in soil borings to 6.5 ft bgs**.** PCBs were detected from the middle of the site to the exposed tar pit area in the northwest section. The subsurface soil was covered by two or more feet of gravel to prevent exposure.

Before the gravel fill barrier was in place, worker exposure could have occurred because contaminants may have been present at the surface. Exposure to on-site subsurface soils would present a **potential health risk if future site operations require excavation of gravel fill to the depth of the waste**. In this case, on-site workers would be exposed to contaminants in subsurface soils through ingestion, inhalation and dermal routes [7]. As long as no excavation occurs, on-site subsurface soil is **not a completed pathway**.

3. Eliminated Exposure Pathways

The surface soils within the service yard have been eliminated as a current and future exposure pathway. The on-site surface soil is covered by two or more ft of gravel fill. The gravel layer prevents exposure of current workers to wastes. This gravel is maintained and graded regularly by Entergy. The gravel, along with the 8-ft fence that surrounds the service yard, prevents trespasser exposure to surface soils. The planned surface soil sampling during the RI and EE/CA field activities was not completed. Only seven samples were collected.

Calcasieu River sediments were dredged, dewatered, and disposed of off-site to reduce the ecological risk to biological communities on or near the site. Sediments remaining in the river were capped with geotextile fabric, concrete, and new sediment to provide stability and preserve the aesthetics of the shoreline [14]. Contaminated sediments were also removed from the western drainage ditch. These exposure pathways are **no longer a potential source for a public health hazard**.

C. Public Health Implications

1. Toxicologic Evaluation

This section will discuss the health effects for persons who are exposed to specific contaminants, outline relevant child health issues, and address specific community health concerns. The toxicological evaluation process is explained in detail in Appendix B. Appendix B also contains additional background for the contaminants of concern identified at the GSU site before site remediation was completed. Appendix C contains tables listing the contaminants of concern detected at the site and the concentrations in which they were present.

Polycyclic Aromatic Hydrocarbons (PAHs)

Benzo(a)pyrene and other carcinogenic PAHs were detected at concentrations above comparison values in on-site subsurface soil, groundwater, and Calcasieu River sediment. Former GSU workers would have a moderately elevated cancer risk of 1.15×10^{-2} (or 115 cases of cancer per 1000 people) if they had ingested 100 milligrams of soil containing the highest on-site concentrations of PAHs over each eight-hour day, five days a week, 52 weeks per year, for 70 years. This constant ingestion of soil with these concentrations of PAHs would have been unlikely for workers at this site; therefore, there should be **no apparent public health hazard** related to former ingesting soil from the GSU site.

No apparent public health hazard exists for adults who may trespass on-site and incidentally ingest subsurface soil or surface soil contaminated with PAHs. In addition, **no apparent public health hazard** exists for adults from ingesting PAHs-contaminated, off-site surface soil and sediments. Contact with groundwater is unlikely and therefore poses **no apparent public health hazard**.

Prior to the remedial actions, individuals likely to swim or wade in the Calcasieu River would have had an increased opportunity for exposure to PAHs in river sediments. However, these exposures would have been low exposures due to accidental ingestion of small quantities of sediment. Exposure doses would have been below the Lowest Observed Adverse Effects Levels (LOAEL) of 133.3 mg/kg/day for oral exposures [17]. Dermal exposure durations would also have been low, reflecting the time individuals actually spent swimming or wading in the river for recreational purposes. These sediments have since been dredged and disposed of off-site and therefore pose **no apparent public health hazard**.

Naphthalene and Methylnaphthalene

Naphthalene and methylnaphthalene are constituents of coal and coal tar. Naphthalene is also isolated from coal tar for industrial use [19]. The sediments and soils that contained naphthalene and methylnaphthalene have been excavated and capped at the site. Even before excavation, it was unlikely that adults or children trespassing at the site would ingest enough soil or sediment containing these contaminants to cause adverse health effects. There is **no apparent public health hazard** from on-site soils and sediments contaminated with naphthalene and methylnaphthalene to former workers at the site, or to adults and children who may trespass on the site.

Polychlorinated Biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) are a group of human-made organic chemicals that have been widely used in coolants and lubricants in transformers, capacitors and other electrical equipment [21]. Prior to the soil removal actions, PCBs were found in the ditch sediments, but at concentrations below background levels. They were also found in the subsurface soil samples taken on the GSU west yard. Exposure doses for these contaminants would have been below the NOAEL of 0.007 mg/kg/day. Workers regularly ingesting small amounts of soil containing the highest detected concentrations of aroclor 1242 at the site would have increased cancer risks; however, with a range of 0.558 - 533 mg/kg/day detected within on-site subsurface soil, regular exposure to only the highest of these concentrations would have been unlikely. These soils have since been excavated, and the locations have been filled and capped. PCBs at the site pose **no apparent public health hazard**.

Metals

Metals occur naturally in all soils and sediments. Metals can also be the result of industrial processes. For example, chemicals that would have been present in coal tar waste include PAHs benzo(a)pyrene and naphthalene, nonhalogenated, semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), benzene, and metals such as arsenic.

The off-site surface waters contained many metals in concentrations that exceeded ATSDR comparison values or EPA Maximum Contaminant Levels (MCLs) or Lifetime Health Advisory Levels (LTHAs). These metals included aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, thallium and vanadium [21, 22, 23, 24, 25, 26, 27]. These concentrations would be of concern if found in a drinking water source. However, the off-site surface waters are not a drinking water source for local residents. Accidental ingestion of very small quantities river water would be more likely because the river could be used for swimming or other recreational activity. Also, river water was the least contaminated of the various surface waters sampled. Therefore, **no apparent public health hazard** would be expected from the accidental ingestion of any of the surface waters.

Arsenic

Prior to remediation activities at the site, arsenic was detected at levels above comparison values in all the completed pathways. Although arsenic was detected in the river, ditch, and wetland surface water, ingestion of these waters would be by accident and in small quantities. **No apparent public health hazards** related to arsenic would be expected from the accidental ingestion of any of the surface waters [21].

Arsenic was also detected in the off-site soils and sediments. Arsenic is classified as an EPA Group A carcinogen, a known human carcinogen. SEET estimated the cancer risk posed by the levels detected in the soil and sediment and determined that there is **no apparent public health hazard** from exposure to the levels of arsenic detected in the soil, sediment, and groundwater [21].

Lead

Prior to sediment removal actions, lead was detected above a residential soil screening level in Calcasieu River sediments. Infants and children exposed to lead on a daily basis can experience adverse neurological effects. However, the amount of exposure to Calcasieu River sediments would have been much lower than that of daily residential exposure to soils. The contaminated river sediments have been excavated and are no longer a source of lead exposure. Therefore, Calcasieu River sediments present **no apparent public health hazards** related to lead exposures [22].

Thallium

Thallium is a metal that can be a trace contaminant of coal. Thallium ingestion can affect the heart, nervous system, and respiratory system [23]. It was found in on-site groundwater and Calcasieu River water above the LTHA. However, the LTHA is an advisory for drinking water. Consumption of the Calcasieu River water would be accidental and in very small quantities. There is also currently no access to on-site groundwater for consumption. Thallium therefore poses **no apparent public health hazard** at the GSU site.

Sodium

Sodium was detected at 116 micrograms per liter (mg/L) in the residential well water sample. This concentration exceeds the EPA's DWEL of 20 mg/L. Although sodium is a component of table salt and can be found in many foods, the sodium level in the residential well could present a problem to persons who may be on a sodium-restricted diet, such as individuals with high blood pressure.

Iron and Manganese

Iron and manganese in residential well water exceeded the EPA's SMCL. The levels of iron and manganese detected in the drinking water were compared to the recommended dietary allowances (RDA) [24, 28], including an estimated iron dose for children. The levels of iron and manganese in area drinking water pose **no apparent public health hazard** [24].

2. Community Health Concerns Evaluation

The OPH and ATSDR responded to each of the community health concerns with the following statements:

(1) Signs should be posted to warn people fishing or playing in the water and sediment near the site.

The EPA required the posting of signs defining the area of contamination in Calcasieu River sediments in December 1998. EPA asked Entergy to remove the signs after completion of the removal action since the dredging removed or contained the sediment contamination. Data gathered during the Calcasieu Estuary Initiative was also shared with residents via public meetings and the EPA outreach office.

(2) Many socioeconomically disadvantaged members in the community subsistence fish near the site, especially the water treatment outflow pipe. This pipe releases warm, nutrient-rich water into the river, attracting more fish.

This Public Health Assessment recommends health education and a fact sheet for this community. The fact sheet should explain the hazards of the GSU west yard and surrounding

area. It should also include the fish consumption advisory in effect for the Calcasieu River system.

(3) The informational fish and seafood consumption advisory in effect for the Calcasieu Estuary should include recreational activities as well.

The EPA signs posted before the sediment removal action read, “No recreational activity recommended.” This text was selected because it covered all recreational activities, including fishing. At present, a seafood and fish consumption advisory is in effect for the entire Calcasieu Estuary.

A Public Comment version of this health assessment was made available to the community for further questions or comments from September 17, 2002 until October 31, 2002. SEET did not receive any comments about this document within the defined time period.

D. Health Outcome Data Evaluation

Residents near the GSU site were concerned about potential health effects, most notably cancer incidence. *Cancer incidence* is the number of new cancer cases diagnosed over a period of time. In October 2002, OPH/SEET completed a cancer incidence review of Calcasieu Parish [10] and compared it to the entire state of Louisiana. The Louisiana Tumor Registry was used to ascertain cancer cases. The Tumor Registry, operated by Louisiana State University Medical Center, is a population-based cancer registry covering the entire state of Louisiana. The population estimates used are from the US Bureau of the Census.

Comparisons of incidence rates were conducted for 22 distinct types of cancer and all cancers combined. Specific cancers examined included bladder, brain, breast, cervical, colorectal, esophageal, leukemia, liver, lung, lymphomas, multiple myelomas, oral, ovarian, pancreatic, prostate, renal, soft-tissue tumors, skin, stomach, testicular, thyroid, and uterine. Because cancer rates often differ by race/ethnicity and sex, separate comparisons for each of these cancer types were made for black females, black males, white females, and white males.

Statistical comparisons of cancer incidence between Calcasieu Parish and Louisiana employed *standardized incidence ratios* (SIRs). The SIR is defined as the *observed* number of cancer cases divided by the *expected* number of cancer cases. The expected number of cases is based on cancer incidence in the comparison population. Because cancer rates increase with age, study and comparison populations must have similar age compositions or be age-adjusted for comparisons to be meaningful. The investigators age-adjusted expected numbers of cancer cases for Calcasieu Parish by multiplying Louisiana's age-specific incidence rates by the parish’s age-specific population data. National Cancer Institute (NCI) annual estimates provided the age-specific populations.

If the observed number of cases equals the expected number of cases, the SIR is 1. When the SIR is <1, fewer cases than expected were observed. For SIRs >1, more cases than expected were observed. A chi-square (χ^2) test assesses whether SIRs differ significantly from 1. A *statistically significant* difference in cancer incidence occurs when there is a ≤5 % probability that the difference in observed and expected rates could be due to chance alone ($p \leq 0.05$). *Confidence intervals* (CIs) mark the boundaries of statistical significance. If the CI for a SIR does not encompass 1, the observed number of cases differs significantly from the expected number of cases.

For black and white males living in the census tract nearest the GSU site, incidence ratios for prostate cancer were significantly elevated when compared to the state (see Appendix A). None of the contaminants detected at the GSU site have a causative link to prostate cancer, a common type of cancer in older males. PCBs have been shown to be endocrine-active compounds; they can affect the action of estrogen, which influences the growth and differentiation of prostate tissue as well as other tissues. However, PCB exposures on-site and off-site prior to excavation are not likely to have been high enough to cause the significant elevation of prostate cancer. Therefore, the higher rate of prostate cancer in men living in the census tract that contains the GSU site cannot be clearly attributable to contaminants at the GSU site.

Limitations in the data collection and analysis processes of the health outcomes data may affect accurate interpretation. The addresses provided to the Louisiana Tumor Registry for cancer cases are those reported at the time of diagnosis; included individuals who may not have experienced a significant period of exposure to any contaminants from the GSU site. The Louisiana Tumor Registry does not include carcinomas *in situ* of the cervix or basal cell and squamous cell carcinomas of the skin among its reportable diagnoses. The development of many types of cancer may also be influenced by multiple factors in addition to environmental exposures, including genetic predispositions and lifestyle factors such as smoking.

IV. Site Update

Entergy Corporation, under oversight by EPA, began the work for the cleanup at the Gulf States Utilities/North Ryan Street site on May 22, 2000. This first phase involved dredging and dewatering river samples. This phase was completed in July 2000.

Contaminated soils in the storm sewer area were excavated to a depth of five ft and characterized. Following treatment, these soils were transported to an appropriate off-site disposal facility. The storm sewer area removal work plan was submitted in December, and the work began in early January 2001. The work was completed in February 2001.

The exposed tar area was to be treated using an in-situ thermal treatment process, in-situ thermal desorption (ISTD). The ISTD work began in February 2001 with installation of the heater and vacuum wells. The success of the ISTD depended, in part, on successfully lowering the groundwater below the thermal-desorption zone. Efforts to lower groundwater at the site began in March 2001, but the target groundwater level could not be achieved. Entergy notified EPA in January 2002 that the ISTD plan was no longer viable. The contingency alternative to ISTD was excavation and off-site treatment or disposal. EPA directed Entergy to implement this contingency plan. The process involved removing 2.5–6 ft of surface soils from the various contaminated areas and adding material to firm it up for disposal. Samples were collected from the remaining soils. The area was then backfilled with clean soil and geogrid, and a final engineered cover was installed in early 2003. Air monitoring took place throughout the entire process. Excavation of the exposed tar area removed the source material for the plume of contamination detected in the shallow groundwater.

Following the removal action activities, a Revised Baseline Risk Assessment was conducted to reevaluate the current and future non-carcinogenic and carcinogenic risks posed by residual soil contamination in the north and south portions of the former exposed tar area [7]. For Operable Unit 2 (Soils), EPA issued a No Further Acton Record of Decision (ROD) in September 2004 because the contaminants that posed a potential human health risk had been excavated during the removal actions.

The remediation chosen for Operable Unit Number 1 (Groundwater) was alternative two, which includes groundwater-use restrictions, monitored natural attenuation of groundwater, surface water, and public water supply monitoring.

Institutional controls have been implemented at the site by the Entergy Corporation. Institutional controls are administrative and legal tools that help reduce the possibility of human exposure to contamination at sites [29]. A conveyance notice filed with the GSU property deed protects human receptors from current and future exposure through the following restrictions:

1. Unauthorized excavation is prohibited.
2. Unauthorized use of contaminated soil is prohibited.
3. Use of the ground water within the first-water bearing zone is restricted.
4. Use of the property for purposes other than industrial or commercial is prohibited.

The property deed file will be inspected periodically to insure that the outlined institutional controls remain in place [14].

Signs informing the public of the fish consumption advisory remain in place near the site. However, LDEQ staff performing inspections of the grounds near the site have seen items, such as ice chests and crawfish heads, which suggest that fishing may still be taking place in the area.

Since no fishing has actually been seen in progress, it is unclear whether, if it is taking place, it is for purely recreational catch-and-release purposes or if the catch is being taken home and eaten.

V. Conclusions

1. Sediments in the Calcasieu River adjacent to the Gulf States Utilities (GSU) yard were excavated as part of the removal action. There is **no apparent public health hazard** involved in recreational activities in the Calcasieu River near the GSU yard.

2. Ditch sediments containing elevated levels of arsenic contamination were also excavated as part of the removal action. As with the Calcasieu River, exposure to surface water in the wetland and ditches poses **no apparent public health hazard**.

3. Exposure to contaminants within the GSU yard may have occurred in the past, but current worker exposure is prevented by the presence of fill gravel across the yard, which averages 4 ft in depth. Both the fill and a perimeter fence also prevent trespasser exposure. Therefore, there is **no apparent public health hazard** involved in exposure to soil from the GSU site.

4. Shallow groundwater beneath the GSU yard contains elevated levels of PAHs and other contaminants. The shallow groundwater discharges to the Calcasieu River but does not impact water quality. A continuous clay layer beneath the shallow groundwater prevents contamination from entering the river or from migrating to the 200-ft sands, which are used to supply drinking water. Analysis of residential wells in the area shows that no site-related contamination is present.

5. Data gathered during the Calcasieu Estuary Initiative was shared with residents via public meetings and the EPA outreach office. Current information regarding fish consumption includes signs posted at the river by the west yard. These signs warn of possible fish contamination and announce the informational fish and seafood advisory for the Calcasieu Estuary, including the Lake Charles area.

6. Municipal wells G-4, G-6, and G-7, three of the wells screened in the 700-ft sands and located on the GSU site, have been closed. Five other city wells are located 300–400 yds south of the site on the Lake Charles City Water Department property. Since there is no flow of groundwater from the GSU site to these wells, there is **no public health hazard** involved in drinking water from these wells.

7. Volatile organic compounds (VOCs) may create a health threat if further excavation into areas that were contaminated occurs. To protect the health of on-site workers, the

engineered cap over the excavated exposed tar area should not be disturbed. To this end, land use restrictions have been placed on the GSU property to prevent excavation into areas with residual contamination [7].

8. Water sampling at the GSU site following Hurricane Rita determined that remediation activities at the site were not disturbed by the hurricane.

VI. Recommendations

1. Entergy should continue to restrict access to the Gulf States Utilities (GSU) west yard and to restrict possible exposure by ensuring that subsurface soils are covered by two or more ft of gravel fill and by maintaining the fence surrounding the site.

2. The City of Lake Charles should continue with the installation of a city well-water system for area residences that still use private wells.

3. OPH should conduct a public meeting to learn additional community concerns.

4. Health education should be conducted and a site-specific fact sheet prepared to provide information to the community.

VII. Public Health Action Plan

The following section describes actions taken and planned by ATSDR and/or OPH at the Gulf States Utilities/North Ryan site and surrounding areas. The purpose of this section is to ensure that the PHA identifies public health hazards at the site and provides a plan of action to mitigate and prevent adverse human health effects resulting from exposure. Included is a commitment by ATSDR and OPH to follow-up on these plans to ensure that they are carried out.

Actions Taken:

- EPA sampled sediments in the river adjacent to the site for contaminants;
- EPA posted signs near the site regarding the hazards of fishing and recreating near the site, particularly near the Municipal Water Treatment Facility outflow pipe and where oily bubbles occur;
- EPA surveyed nearby residents for private drinking water well use; and
- GSU continues to restrict the potential for access to the site and possible exposure by maintaining the perimeter fence.

Actions to be Taken:

- Assisted by the Community Assistance Panel (CAP), OPH will learn more community concerns through a public meeting. Such a meeting will be held to educate and assist the population affected by the site and to assess their potential for exposure to the contaminants of concern. The meeting will include information on the site in the form of a short fact sheet and copies of the health assessment for comment. An executive summary of the PHA will also be available.
- OPH will provide environmental medical education related to the site's contaminants for physicians who service the exposed community.
- OPH will share the findings of any ongoing statistical analysis of Calcasieu Parish cancer data.

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Certification

This Gulf States Utilities Company (a/k/a North Ryan Street Facility) public health assessment was prepared by the Louisiana Department of Health and Hospitals under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures at the time the health assessment was begun. The editorial review was conducted by the Cooperative Agreement Partner.

Jeffrey Kellam
Technical Project Officer, Division of Health Assessment and Consultation (DHAC)

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.

Alan W. Yarbrough
Cooperative Agreement Team Leader, DHAC, ATSDR

Appendix A. Health Outcome Data

Table A-1. Standardized Incidence Ratios (SIR) for Gulf States Utilities (Census Tract 0002), 1988–1996.Comparison of Observed and Expected Cancer Incidence Using Louisiana Region V Rates (1988–1992). All Races.

Cancer Type	Sex	Cases		SIR	p-value
		Observed	Expected		
All Cancers	Male Female	35 22	28.43 26.18	1.23 0.84	0.2176 0.4144
Breast	Female	4	6.96	0.57	0.2620
Colorectal	Male Female	<3 4	3.44 3.40	– 1.18	– 0.7432
Lung/Bronchus	Male Female	9 4	6.99 4.21	1.29 0.95	0.4475 0.9197
Prostate	Male	14	7.75	1.81*	0.0249

* Statistically elevated at the p<0.05 level.

Table A-2. Standardized Incidence Ratios (SIR) for Gulf States Utilities (Census Tract 0002), 1988–1996. Comparison of Observed and Expected Cancer Incidence Using Louisiana Region V Rates (1988–1992). African Americans Only.

Cancer Type	Sex	Cases		SIR	p-value
		Observed	Expected		
All Cancers	Male Female	30 20	30.53 26.31	0.98 0.76	0.9231 0.2185
Breast	Female	4	5.83	0.69	0.4489
Colorectal	Male Female	<3 3	3.46 4.14	– 0.73	– 0.5764
Lung/Bronchus	Male Female	7 4	7.87 6.21	0.89 0.64	0.7571 0.3750
Prostate	Male	13	8.27	1.57*	0.1002

* Statistically elevated at the p<0.05 level.

Appendix B. Toxicological Evaluation

Screening Process

To assess the potential health risks contaminants pose at the GSU/North Ryan site, OPH compared contaminant concentrations to health assessment comparison values. Comparison values are media-specific concentrations used to screen contaminants for further assessment. Comparison values do not predict whether a contaminant will cause adverse health effects. These extremely protective levels are used only to target which of the samples need to be closely evaluated. Further evaluation must include the following factors:

- the toxicologic properties of the contaminants
- how much of the contaminant the individual is exposed to (for example, drinking 1 liter of water per day or accidentally ingesting a small amount of water)
- how often and/or how long the individual was exposed (for example, exposure on a daily basis or occasional recreational exposure)
- the manner in which the contaminant enters or contacts the body (breathing, eating, drinking, or skin/eye contact)
- the number of contaminants to which an individual is exposed (combinations of contaminants).

Non-cancer comparison values are called environmental media evaluation guides (EMEGs) or reference-dose media evaluation guides (RMEGs) and are based, respectively, on ATSDR's minimal-risk levels (MRLs) and the Environmental Protection Agency's (EPA) reference doses (RfDs). MRLs and RfDs are estimates of the level of daily human exposure to a contaminant that is unlikely to cause adverse, non-cancer health effects. Cancer-risk evaluation guides (CREGs) are based on the EPA's chemical-specific cancer slope factors and an estimated excess lifetime cancer risk of one in one million persons exposed. We used standard assumptions to calculate appropriate comparison values.

In some instances, OPH compares contaminant concentrations in water to EPA's maximum contaminant levels (MCLs). MCLs are chemical-specific maximum concentrations allowed in water delivered to the users of a public water system. MCLs are considered protective of public health over a lifetime (estimated 70 years) of exposure at an ingestion rate of two liters per day. MCLs may be based on available technology and economic feasibility. Although MCLs apply only to public water supply systems, OPH often uses them to help assess the public health implications of contaminants found in water not intended for public consumption.

Contaminants that are of concern after the initial screening process are examined using exposure scenarios such as ingestion, inhalation, and dermal contact. Use of these scenarios allows health assessors to measure the potential public health impact of each contaminant of concern.

Estimated exposures may be compared to reported No Observed and Lowest Observed Adverse Effects Levels (NOAELs and LOAELs) and to known effect levels in humans, when available.

Background for Contaminants of Concern

Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs are a class of more than 100 different compounds that are found in and formed during the incomplete combustion of coal, oil, wood, or other organic substances. In the environment, PAHs are found as complex mixtures of compounds, rarely as single compounds alone. Some uses for PAHs include the manufacture of medicines, dyes, plastics and pesticides. More typically, they are found in petroleum-based products such as coal tar and asphalt.

Because combustion processes produce them, PAHs are widespread in the environment. In rivers, the majority of PAHs will be bound to sediments. Degradation is slow and is measured in years. Accumulation of PAHs in fish tissue is not a major concern because most fish can metabolize PAHs and excrete them over a few days.

PAHs have been detected in completed pathways including off-site soils, ditch sediments, wetland soil and sediments, and river sediments. PAHs were also detected in most of the potential pathways. The greatest exposures to PAHs for the general population are from inhaling tobacco smoke, wood smoke, and contaminated air, as well as from eating contaminated foods. For non-smokers, diet is the largest background exposure to PAHs. Cooking methods that involve combustion, such as charbroiling or smoking, increase exposures to PAHs in food [17]. Work activities with significant opportunities for exposure to PAHs include working with coal tar, asphalt, or roofing materials; working in a foundry; working in a mine, or working as a chimney sweep [17, 18].

Non-cancer adverse health effects associated with PAHs exposure have been observed in animals, but generally not in humans [17]. On the basis of animal study results, ATSDR has established several MRLs for oral exposure to individual PAHs. MRLs are estimates of human exposure to a contaminant that is unlikely to cause non-cancer adverse health effects over a lifetime. The MRL for naphthalene of 0.02 milligrams per kilogram of body weight per day (mg/kg-d) is the lowest of all the individual PAHs. It is based on an animal study in which minimal effects on the liver were observed in mice after 90 days of intense oral exposure to naphthalene [17]. For skin contact with PAHs, the main concern is adverse reactions of the skin. For example, benzo(a)pyrene was found to irritate skin lesions for people with pre-existing skin conditions and to make the skin of animals more sensitive to ultraviolet light [17].

The available evidence indicates that mixtures of PAHs can cause cancer in humans. The evidence in humans comes primarily from occupational studies of workers exposed to mixtures containing PAHs as a result of their involvement in such processes as coke production, roofing, oil refining, or coal gasification (e.g., coal tar, roofing tar, soot, coke oven emissions, coot, crude

oil). However, PAHs have not been clearly identified as the causative agent. Cancer associated with exposure to PAHs mixtures in humans occurs predominantly in the lung and skin following inhalation and dermal exposure, respectively [17, 18]. The mechanism of action for PAHs carcinogenicity is thought to be that when the body metabolizes PAHs, the products (i.e., "breakdown products") formed are highly reactive with DNA macromolecules, potentially resulting in genetic damage [17].

On the basis of toxicological evidence, EPA currently classifies seven PAHs as probable human carcinogens. Benzo(a)pyrene, the best studied of the carcinogenic PAHs, is the only one for which an oral cancer potency factor has been determined by EPA (7.3 per mg/kg-d) [17]. The potencies of the other six carcinogenic PAHs can be estimated from the potency of benzo(a)pyrene and toxic equivalency factors [16,17].

A recent study found that PAHs can pass through the placental barrier between a pregnant woman and a fetus [17, 18]. There is also some evidence from experiments with animals that exposures to certain PAHs *in utero* can affect reproduction and development; however, the available studies show contradictory results. In Mackenzie and Angevine [17, 18], pregnant mice were exposed to benzo(a)pyrene by the oral route during gestation. At the highest dose level, the number of mice giving birth was significantly decreased. Offspring from all the dose levels experienced reproductive problems ranging from decreased fertility to sterility. These results were contradicted, however, by a study in which mice were exposed to benzo(a)pyrene in their diet during mating, gestation, and birth at levels comparable to the first study, but no effects were observed [18].

Certain persons are more susceptible to the toxic effects of PAHs than the general population. Of primary concern are developing fetuses, children, and the elderly, because the detoxification mechanisms used by the body to mitigate the effects of exposure are either immature or declining in function. People with nutritional deficiencies, pre-existing skin or liver disease, genetic diseases that inhibit DNA repair, or compromised immune systems may also be at increased risk. Finally, anyone who is exposed to PAHs from other sources *in addition* to exposures at the site (e.g., from smoking or working with asphalt or coal tar) would be more susceptible because exposures to PAHs are cumulative [17, 18].

Noncarcinogenic PAHs at this site include acenaphthene, anthracene, fluoranthene, fluorene, benzo(g,h,i)perylene, naphthalene, and pyrene. Acenaphthene, anthracene, and fluorene are chemical intermediates in dyes, plastics, pesticides, explosives, and chemotherapeutic agents.

Studies have found that certain PAHs can cause cancer in animals. Benzo(a)pyrene is classified as an EPA group B2 carcinogen, a probable human carcinogen. Skin tumors among individuals exposed to mixtures of PAHs have been reported. These reports provide qualitative testimony to the potential of carcinogenicity of PAHs. Studies in animals have documented the ability of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and indeno(1,2,3-

cd)pyrene to induce skin tumors following intermediate skin exposure. These contaminants are considered complete carcinogens.

The overall carcinogenic potential of a mixture of PAHs was evaluated using toxicity equivalency factors (TEFs). A TEF was used to weight each PAH's toxicity as compared to the toxicity of benzo(a)pyrene, the most well-studied of the PAHs. The TEF for benzo(a)pyrene is set to 1. PAHs which are more carcinogenic than benzo(a)pyrene have higher TEFs, and PAHs which are less carcinogenic than benzo(a)pyrene have lower TEFs. Multiplying the actual concentration of each PAH by its TEF produces a toxicity equivalence quotient (TEQ). The sum of PAH TEQs at each sample location was used to evaluate the health effects of the PAH mixtures present.

Naphthalene and Methylnaphthalene

Naphthalene and methylnaphthalene are constituents of coal and coal tar. Naphthalene is also isolated from coal tar for industrial use. The main ingredient in mothballs, naphthalene is also used for making dyes and pesticides. Exposure to naphthalene and methylnaphthalene can damage the red blood cells, resulting in anemia. Such exposure has also been associated with adverse effects to the nervous system and the liver [19]. Inhalation of naphthalene can result in respiratory irritation. Naphthalene and methylnaphthalene are not classified with respect to human carcinogenicity.

Polychlorinated Biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) are a group of human-made organic chemicals with many different side chains of chlorinated hydrocarbons, which influence the potential level of various harmful effects. PCBs have been widely used in coolants and lubricants in transformers, capacitors and other electrical equipment. Because of their size and water solubility, they do not travel far, but they are persistent in the environment [20].

Health effects from exposure to PCBs can include skin irritation as well as liver, stomach, thyroid gland, and reproductive defects. Some studies have associated PCB exposure with unborn children and young children with developmental delays. In addition, PCBs have been determined to be a probable human carcinogen [20].

Toxicological Evaluation

This section will discuss the health effects for persons who are exposed to specific contaminants, outline relevant child health issues, and address specific community health concerns.

To evaluate health effects, ATSDR has developed minimal risk levels (MRLs) for contaminants commonly found at hazardous waste sites. The MRL is an estimate of daily human exposure to a

contaminant below which non-cancerous adverse health effects are unlikely to occur. The MRLs are developed for each route of exposure, such as ingestion and inhalation, and for length of exposure, such as acute (≤14 days), intermediate (15–364 days) and chronic (≥365 days). ATSDR presents these MRLs in Toxicological Profiles. These chemical-specific profiles provide information on health effects, environmental transport, human exposure, and regulatory status. Where MRLs are not available, RfDs provided by the EPA are used.

The exposure scenarios for children were based on an older child (7 years or older) visiting the site to play before the site was fenced off and a young child (1–6 years old) playing in contaminated soil in off-site ditches, yards, and around the GSU west yard site. It was assumed that young children would have more adult supervision and would not wander onto the site. For adults, one scenario was for a site employee who worked in the yard for approximately 25 years or more. The other scenario was for an adult resident living near the site who occasionally visited the site for recreational purposes over a lifetime.

Factors such as duration of exposure, age, and body weight are used to help estimate the amount of contaminant that is likely to enter a person's body. These assumptions are as follows:

- Young children (0–6 years old):

  Assumptions for exposure calculations for a young child is a body weight of 10 kilograms (kg) (approx. 22 pounds), with an ingestion rate of 5,000 mg of soil per day. Known to put items into their mouths, young children have the highest chance of being exposed to soil contaminants.

- Older children (7 years and older):

  Assumptions for older children are a body weight of 16 kg (approx. 35 pounds) and a soil ingestion rate of 200 mg per day.

- Adults (18 years and older):

  The adult assumptions are a body weight of 70 kg (approx. 150 pounds) and a soil ingestion rate of 100 mg per day.

The maximum concentration found in a particular media was used for calculating risks and doses, so the evaluation is based on a worst-case scenario.

The health effects resulting from an individual's exposure to a hazardous substance in the environment depends on several factors. One factor is the route of exposure (for instance, whether the chemical is inhaled, consumed with food or water, or contacts the skin). Other

factors are the dose to which a person is exposed and the amount of the exposure dose actually absorbed into the body. Mechanisms by which chemicals become altered, either in the environment or inside the body once absorbed, are also important. These mechanisms can vary greatly from person to person, making individuals more or less susceptible to adverse health effects.

When performing an exposure assessment, all routes of exposure (ingestion, inhalation, and skin contact) must be considered to determine the overall exposure to a chemical. Because it is difficult to determine the amount of adsorption through the skin accurately, MRLs for skin exposure have not been developed. For this reason, it is difficult to determine the health effects from skin exposure. However, because the levels of many of the chemicals detected are relatively low and because they are generally not widespread, harmful effects from exposure through skin contact in the past or future are unlikely. Therefore, skin contact as a route of exposure will not be evaluated further.

Child Health Data Evaluation

Children are at greater risk than adults from certain kinds of exposure to hazardous substances emitted from waste sites. They are more likely to be exposed for several reasons. They play outdoors more often than adults, thus increasing the likelihood that they will come into contact with chemicals in the environment. Because of their smaller stature, children may breathe dust, soil, and heavy vapors close to the ground. Children who wade or swim may swallow more water and have greater contact with sediments. In the event of exposure, children are likely to receive a higher dose of chemical per unit of body weight. The developing body systems of children can sustain permanent damage if certain toxic exposures occur during critical growth stages. Children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care.

Appendix C: Contaminants of Concern at the Gulf States Utilities Site

Table C-1. Contaminants Detected in On-Site Subsurface Soil to 6.5 ft[*] bgs[†] at Gulf States Utilities, Lake Charles, Louisiana. Baseline Risk Assessment, March, 1999.

Contaminant	Concentration Range (ppm)[‡]	Comparison Value ppm	source	Mean Background Concentration
Volatile Organic Compounds (VOCs)				
Benzene	0.086–90	10	CREG[§]	NA
1,3,5-Trimethylbenzene	0.005–35.7	51,000	RBC[¶]	NA
1,2,4-Trimethylbenzene	0.007–441	51,000	RBC	NA
Polychlorinated Biphenyls (PCBs)				
Aroclor 1016	26	4	RMEG[**]	NA
Aroclor 1242	0.558–533	1.4	RBC	NA
Aroclor 1248	0.231–5.4	1.4	RBC	NA
Aroclor 1254	0.477–200	1	EMEG[††]	NA
Aroclor 1260	0.201–0.454	1.4	RBC	NA
Semi-volatile Organic Compounds				
Benzo(a)pyrene	0.016–1,200	0.1	CREG	NA
Anthracene	0.033–3,500	20,000	child RMEG	NA
Acenapthene	0.130–3,100	3000	child RMEG	NA
Fluoranthene	0.017–9,800	2000	child RMEG	0.192
Fluorene	0.017–5,300	2000	child RMEG	NA
Naphthalene	0.24–28,000	1000	child int. EMEG	NA
1-Methylnaphthalene	0.085–10,000	4000	child EMEG	NA
2-Methylnaphthalene	0.082–16,000	3000	child EMEG	NA
Pyrene	0.022–8,200	2000	child RMEG	0.193
Metals				
Manganese	14.8–1,430	3000	child RMEG	164

[*]ft—feet
[†]bgs— below ground surface
[‡]ppm—parts per million
[§]CREG—Cancer Risk Evaluation Guide
[¶]RBC—Risk-Based Concentration
[**]RMEG—Reference Dose Media Evaluation Guide
[††]EMEG—Environmental Media Evaluation Guide
[‡‡]int.—intermediate

Table C-2. Toxicity Equivalency Factors (TEFs) and Products for Polycyclic Aromatic Hydrocarbons (PAHs) Detected in GSU West Yard On-Site Subsurface Soil to a Depth of 6.5 ft* bgs†. Gulf States Utilities, Lake Charles, Louisiana.

Contaminant	Maximum Concentration (ppm*)	TEF	Product
Dibenzo(a,h)anthracene	560	5	2800
Benzo(a)pyrene	1,200	1	1200
Benzo(a)anthracene	2,000	0.1	200
Benzo(b)fluoroanthene	1,400	0.1	140
Benzo(k)fluoranthene	1,100	0.1	110
Indeno(1,2,3-cd)pyrene	920	0.1	92
Anthracene	3,500	0.01	35
Benzo(g,h,i)perylene	1,200	0.01	12
Chrysene	2,600	0.01	26
Acenaphthene	3,100	0.001	3.1
Acenaphthylene	5,500	0.001	5.5
Fluoranthene	9,800	0.001	9.8
Fluorene	5,300	0.001	5.3
Phenanthrene	15,000	0.001	15
Pyrene	8,200	0.001	8.2
Benzo(a)pyrene Toxic Equivalent (TEF)			4661.9

*ft—feet
†bgs— below ground surface
‡ppm—parts per million

Table C-3. Contaminants Detected in On-Site Groundwater from Wells 8 to 51.5 ft[*] bgs[†] at GSU West Yard. Gulf States Utilities, Lake Charles, Louisiana. Data sources—Baseline Risk Assessment, March 1999, Groundwater Monitoring Reports, 1998 and 1999.

Contaminant	Concentration Range (ppb[‡])				Comparison Value	
	1990	1997	1998	1999	ppb	source
Volatile Organic Compounds						
Acetone	NA[§]–<10	<5–<5000	11–11,000	<100	9000	child RMEG[¶]
Benzene	4–25	<1–2600	25–2200	10–1800	0.6	CREG[**]
Ethylbenzene	44	28–1500	61–1400	49–960	700	LTHA[††]
Toluene	NA–10	7–1500	<25–1400	3–1000	200	child int.[‡‡] EMEG[§§]
1,3,5-Trimethylbenzene	NA	<1–<1000	4.5–<1000	NA	12	RBC[¶¶]
1,2,4-Trimethylbenzene	NA	<1–<1000	1.5–<1000	NA	12	RBC
Total Xylenes	<5–9	<1–<5000	3.4–<1300	1–720	2000	child int. EMEG
Semi-Volatile Organic Compounds						
Acenapthene	8–<10	<0.19–99.9	<1.8–<2700	0.1–550	600	child RMEG
Acenapthylene	<10	<0.19–4500	<2.3–1900	<0.1–1100	NA	
Anthracene	<10	<0.19–620	0.14–150	0.02–650	3000	child RMEG
Benzo(a)anthracene	<10	<0.19–350	<0.013–60	0.02–410	0.092	RBC
Benzo(b)fluoranthene	NA–<10	<0.19–50	<0.018–15	0.03–110	0.092	RBC

Table C-3. Contaminants Detected in On-Site Groundwater from Wells 8 to 51.5 ft bgs at GSU West Yard. Gulf States Utilities, Lake Charles, Louisiana. Data sources—Baseline Risk Assessment, March 1999, Groundwater Monitoring Reports, 1998 and 1999. (Continued)

Contaminant	Concentration Range (ppb)				Comparison Value	
	1990	1997	1998	1999	ppb	source
Semi-Volatile Organic Compounds (continued)						
Benzo(a)pyrene	NA	1–180	30	250	0.005	CREG
Benzo(g,h,i)perylene	0.76	<0.19–84	<0.079–<110	0.03–67	NA	
Benzo(k)fluoranthene	NA–<10	<0.6–<38	0.02–<26	0.02–73	0.092	RBC
Chrysene	NA–<10	<0.19–310	<0.15–90	0.02–240	9.2	RBC
Dibenzo(a,h)anthracene	NA–<10	<1.2–<38	<45	80	0.0092	RBC
Fluoranthene	NA–<10	<0.19–4300	<0.21–<320	0.03–840	400	child RMEG
Fluorene	NA–<10	<0.19–710	<0.21–220	0.03–880	400	child RMEG
Indeno(1,2,3-cd)pyrene	NA	<0.86–81	<64	80	0.092	RBC
Phenanthrene	0.01–<10	<0.19–1800	0.2–420	0.03–2300	NA	
Pyrene	2–<10	<0.19–2200	<0.27–140	0.05–1100	300	child RMEG
1-Methylnaphthalene	NA	NA	NA	42–1600	700	child EMEG
2-Methylnaphthalene	NA	NA	NA	39–1900	500	child EMEG
Naphthalene	NA–<10	<0.38–9400	<18–3000	<2–3900	100	LTHA

Table C-3. Contaminants Detected in On-Site Groundwater from Wells 8 to 51.5 ft bgs at GSU West Yard. Gulf States Utilities, Lake Charles, Louisiana. Data sources—Baseline Risk Assessment, March 1999, Groundwater Monitoring Reports, 1998 and 1999. (Continued)

Contaminant	Concentration Range (ppb)				Comparison Value	
	1990	1997	1998	1999	ppb	source
Metals						
Arsenic	12.39–43.3	2.1–27.3	<10–17.6	NA	.02	CREG
Aluminum	344–49,400	48.3–141,000	<75–49,100	NA	20,000	child int. EMEG
Barium	350–738	166–3,090	246–2,890	NA	700	child RMEG
Beryllium	<5	<1–8.4	<1–5.3	NA	4	MCL
Cobalt	3–67	1.6–68.1	<7–45.4	NA	100	child int. EMEG
Lead	<5–8.1	<1–87.1	<5–51.4	NA	15	EPA Action Level
Manganese	801–2,230	104–6,100	662–5,560	NA	500	child RMEG
Nickel	30–122	<0.1–101	<30–66.5	NA	100	LTHA
Thallium	NA–<10.0	<0.2–<150	<10–11.3	NA	0.5	LTHA
Vanadium	11–101	<1–204	<12–91	NA	30	child EMEG

[*] ft—feet
[†] bgs—below ground surface
[‡] ppb—parts per billion
[§] NA—Not Available
[¶] RMEG—Reference Dose Media Evaluation Guide
[**] CREG—Cancer Risk Evaluation Guide
[††] LTHA—Lifetime Health Advisory
[‡‡] int. —intermediate
[§§] EMEG—Environmental Media Evaluation Guide
[¶¶] RBC—Risk-Based Concentration

Table C-4. Toxicity equivalency factors (TEFs) and product for Polycyclic Aromatic Hydrocarbons (PAHs) detected in GSU west yard on-site groundwater. Gulf States Utilities, Lake Charles, Louisiana. Data sources—Baseline Risk Assessment, March 1999; Groundwater Monitoring Reports, 1998 and 1999.

Contaminant	Maximum Concentration (ppm*)	TEF	Product
Dibenzo(a,h)anthracene	80	5	400
Benzo(a)pyrene	250	1	250
Benzo(a)anthracene	410	0.1	41
Benzo(b)fluoroanthene	110	0.1	11
Benzo(k)fluoranthene	73	0.1	7.3
Indeno(1,2,3-cd)pyrene	81	0.1	8.1
Anthracene	650	0.01	6.5
Benzo(g,h,i)perylene	110	0.01	1.1
Chrysene	310	0.01	3.1
Acenaphthylene	4,500	0.001	4.5
Fluoranthene	4,300	0.001	4.3
Fluorene	880	0.001	0.88
Phenanthrene	2,300	0.001	2.3
Pyrene	2,200	0.001	2.2
Benzo(a)pyrene Toxic Equivalent			744.98

* ppb—parts per billion

Table C-5. Contaminants detected in off-site sediments in the Calcasieu River at GSU west yard. Gulf States Utilities, Lake Charles, Louisiana. Data sources—Baseline Risk Assessment, March 1999.

Contaminant September 1992 (n=9) and March 1998 (n=38)	Concentration Range (ppm *)	Comparison Value ppm	source	Mean Background Concentration (ppm)
Semi-Volatile Organic Compounds				
Benzo(a)pyrene	ND–240	0.1	CREG†	229
Metals				
Lead	5–1670	400	EPA‡	19.5

* ppm—parts per million
† CREG—Cancer Risk Evaluation Guide
‡ EPA—Environmental Protection Agency

TableC-6. Toxic equivalency factors (TEFs) and product for Polycyclic Acromatic Hydrocarbons (PAHs) detected in off-site Calcasieu River Sediments. Gulf States Utilities, Lake Charles Louisiana, October 18, 2000.

Contaminant	Maximum Concentration (ppm*)	TEF	Product
Dibenzo(a,h)anthracene	37	5	185
Benzo(a)pyrene	240	1	240
Benzo(a)anthracene	190	0.1	19
Benzo(b)fluoroanthene	140	0.1	14
Benzo(k)fluoranthene	110	0.1	11
Indeno(1,2,3-cd)pyrene	94	0.1	9.4
Anthracene	290	0.01	2.9
Benzo(g,h,i)perylene	130	0.01	1.3
Chrysene	240	0.01	2.4
Acenaphthene	450	0.001	0.45
Acenaphthylene	6.8	0.001	0.0068
Fluoranthene	480	0.001	0.48
Fluorene	150	0.001	0.15
Phenanthrene	1200	0.001	1.2
Pyrene	740	0.001	0.74
Benzo(a)pyrene Toxic Equivalent			488.03

* ppm - parts per million

Table C-7. Contaminants Detected in Off-Site Sediments in the West and South Ditch at Gulf States Utilities, Lake Charles, Louisiana. Data Sources—Baseline Risk Assessment, March 1999.

Contaminant February 1997 (N=6) March 1998 (N=3)	Concentration Range (ppm*)	Comparison Value ppm	source	Mean Background Concentration (ppm)
Polychlorinated Biphenyls (PCBs)				
Aroclor 1260	ND†–0.63	1.4	RBC‡	42.4
Semi-Volatile Organic Compounds				
Benzo(a)pyrene	ND–1.67	0.1	CREG§	464
Pesticides				
DDE	ND–0.01	1.9	RBC (residential)	9

* ppm—parts per million
† ND—Not Detected
‡ NA—Risk-based Concentration
§ CREG—Cancer Risk Evaluation Guide

Table C-8. Toxicity Equivalency Factors and Product for Polycyclic Aromatic Hydrocarbons (PAHs) Detected in Off-Site Ditch Sediments, Gulf States Utilities, Lake Charles, Louisiana, October 18, 2000

Contaminant	Maximum Concentration (ppm*)	TEF	Product
Dibenzo(a,h)anthracene	0.0297	5	0.1485
Benzo(a)pyrene	1.670	1	1.67
Benzo(a)anthracene	1.370	0.1	0.137
Benzo(b)fluoroanthene	1.480	0.1	0.148
Benzo(k)fluoranthene	0.672	0.1	0.0672
Indeno(1,2,3-cd)pyrene	0.816	0.1	0.0816
Anthracene	0.517	0.01	0.00517
Benzo(g,h,i)perylene	0.950	0.01	0.0095
Chrysene	2.470	0.01	0.0247
Acenaphthene	NA†	0.001	0.001
Acenaphthylene	0.240	0.001	0.00024
Fluoranthene	4.550	0.001	0.00455
Fluorene	0.364	0.001	0.000364
Phenanthrene	1.110	0.001	0.00111
Pyrene	5.410	0.001	0.00541
Benzo(a)pyrene Toxic Equivalent			2.30

* ppm—parts per million
† NA—not available

Table C-9. Contaminants Detected in Off-Site Sediments in Cypress Wetland. Gulf States Utilities, Lake Charles, Louisiana. February 1997 (n=10) and March 1998 (n=1). Data sources—Baseline Risk Assessment, March 1999.

Contaminant	Concentration Range (ppm) [*]	Comparison Value ppm	Comparison Value source	Mean Background Concentration (ppm)
Semi-volatile organic compounds				
Benzo(a)pyrene	ND[†]–10.8	0.1	CREG[‡]	403

[*] ppm—parts per million
[†] ND—not detected
[‡] CREG—Cancer Risk Evaluation Guide

Table C-10. Toxic Equivalency Factors and Product For Polycyclic Aromatic Hydrocarbons (PAHs) Detected in Off-Site Sediment from Cypress Wetland. Gulf States Utilities, Lake Charles, Louisiana. October 18, 2000

Contaminant	Maximum Concentration (ppm*)	TEF	Product
Dibenzo(a,h)anthracene	0.538	5	2.69
Benzo(a)pyrene	10.800	1	10.8
Benzo(a)anthracene	8.060	0.1	0.806
Benzo(b)fluoroanthene	5.260	0.1	0.526
Benzo(k)fluoranthene	2.490	0.1	0.249
Indeno(1,2,3-cd)pyrene	4.160	0.1	0.416
Anthracene	1.790	0.01	0.0179
Benzo(g,h,i)perylene	2.980	0.01	0.0298
Chrysene	10.200	0.01	0.102
Acenaphthene	1.940	0.001	0.00194
Acenaphthylene	ND	0.001	0.001
Fluoranthene	14.200	0.001	0.0142
Fluorene	0.518	0.001	0.000518
Phenanthrene	2.730	0.001	0.00273
Pyrene	20.800	0.001	0.0208
Benzo(a)pyrene Toxic Equivalent			15.68

*ppm —parts per million

Table C-11 - Volatile Organic Compounds, Polycyclic Aromatic Hydrocarbons (PAHs), Pesticides, Metals, detected in off-site ditch surface water and wetland surface water. Gulf States Utilities, Lake Charles, Louisiana. October 18, 2000.

Contaminant	Concentration Range (ppb*)	Comparison Value ppb	source
Volatile Organic Compounds			
Bromodichloromethane	2	0.6	CREG†
Dibromochloromethane	2	0.13	RBC‡
Polycyclic Aromatic Hydrocarbons			
Benzo(a)pyrene	0.29	0.005	CREG
Pesticides			
Aldrin	0.003—0.014	0.002	CREG
Dieldrin	0.022	0.002	CREG
Metals			
Aluminum	4—64,600	20,000	child int.§ EMEG¶
Arsenic	3—70	0.02	CREG
Barium	225—3990	700	RMEG**
Beryllium	10	4	MCL††
Cadmium	20	2	EMEG
Chromium	2—110	100	MCL
Cobalt	40	100	child int. EMEG
Copper	7—241	100	child int. EMEG
Lead	2—460	15	EPA Action Level
Manganese	370—9970	500	RMEG
Mercury	0.2—3.0	2	MCL
Nickel	2—100	100	LTHA‡‡
Vanadium	60—110	30	EMEG

* ppb—parts per billion
†CREG—Cancer Risk Evaluation Guide
‡RBC—Risk-based Concentration
§int. —intermediate
¶EMEG—Environmental Media Evaluation Guide
** RMEG—Reference Dose Media Evaluation Guide
††MCL—Maximum Contaminant Level
‡‡LTHA—Lifetime Health Advisory

Table C-12. Toxicity Equivalency Factors And Product for Polycyclic Aromatic Hydrocarbons (PAHs) Detected in Off-Site Ditch Surface Water and Wetland Surface Water. Gulf States Utilities, Lake Charles, Louisiana.

Contaminant	Maximum Concentration (ppm*)	TEF	Product
Benzo(a)pyrene	0.29	1	0.29
Benzo(a)anthracene	0.29	0.1	0.029
Benzo(b)fluoroanthene	0.30	0.1	0.03
Indeno(1,2,3-cd)pyrene	0.16	0.1	0.016
Anthracene	0.69–0.74	0.01	0.0074
Benzo(g,h,i)perylene	0.21	0.01	0.0021
Chrysene	0.22–0.32	0.01	0.0032
Phenanthrene	0.21–0.28	0.001	0.00028
Pyrene	0.28–0.58	0.001	0.00058
Benzo(a)pyrene Toxic Equivalent			0.38

* ppb—parts per billion

Table C-13. Revised Baseline Risk Assessment Evaluation of Chemicals of Potential Concern in West Yard.Gulf States Utilities, Lake Charles, Louisiana. 2003.

Chemical[1]	North Portion			South Portion		
	Frequency of Detection[2]	Range of Concentrations Detected[3]	Average Concentration Detected[4]	Frequency of Detection[2]	Range of Concentrations Detected[3]	Average Concentration Detected[4]
Volatile Organics (mg/kg)						
Acetone	7/10	0.0287-0.231	0.06399	6/18	0.0513-0.142	5.83682[7]
Benzene	8/26	0.00003-0.0008	0.001	38/71	0.00044-160	12.2750
Ethylbenzene	2/10	0.0146-0.305	0.03396	4/18	8.48-360	38.1509
Toluene	0/10	ND	0.0025	4/18	5.39-130	15.4793
Total Xylenes	4/10	0.0066-0.247	0.043685	7/18	0.00504-500	128.779
1,2,4-Trimethylbenzene	3/10	0.031-0.124	0.0226	4/14	0.00771-441	37.1523
1,3,5-Trimethylbenzene	2/10	0.0203-0.0287	0.0069	3/14	0.00503-35.7	3.48672
Isopropylbenzene	2/10	0.0112-0.0173	0.00485	4/14	0.0102-165	19.8682
Sec-butylbenzene	2/10	0.0173-0.0355	0.00728	0/14	ND	NA
Tert-butylbenzene	0/10	ND	0.0025	1/14	1.77	1.91411[7]
Semivolatile Organics (mg/kg)						
Aroclor 1242	0/26	ND	0.013	25/71	0.000558-2900	112.1933
Aroclor 1248	1/26	0.0054	0.013	2/71	0.00155-0.14	0.1219
Aroclor 1254	ND	ND	NA	5/71	0.36-350	6.3810
Aroclor 1260	1/26	0.033	0.014	3/71	0.000242-0.15	0.5128[7]
2-Methylnaphthalene	ND	ND	NA	2/4	9.3-6500	1627.53
Acenaphthene	12/26	0.0002-0.081	0.047	52/76	0.021-2700	208.195
Acenaphthylene	3/26	0.003-0.005	0.064	33/76	0.002-510	26.6642
Anthracene	16/26	0.002-0.86	0.080	66/76	0.0064-1200	109.703
Benzo(a)anthracene	22/26	0.01-1.6	0.144	67/76	0.015-850	83.5773
Benzo(a)pyrene	20/26	0.011-1.2	0.113	68/76	0.009-600	54.3083
Benzo(b)fluoranthene	23/26	0.013-0.73	0.128	66/76	0.012-380	34.7497
Benzo(g,h,i)perylene	18/26	0.009-0.293	0.064	64/76	0.011-380	39.3164
Benzo(k)fluoranthene	21/26	0.002-0.3	0.055	59/76	0.0044-230	19.5437
Chrysene	23/26	0.001-3.08	0.344	67/76	0.0114-690	67.056
Dibenzo(a,h)anthracene	18/26	0.001-0.42	0.044	61/76	0.0064-200	18.3885

Table adapted from: Black & Veatch Corporation. Revised Baseline Risk Assessment. North Ryan Street/Lake Charles Manufactured Gas Plant Site, Prepared for Entergy Gulf States, Inc., 2003 January.

Table C-14. Revised Baseline Risk Assessment Evaluation of Chemicals of Potential Concern in West Yard, continued.Gulf States Utilities, Lake Charles, Louisiana. 2003.

Chemical[1]	North Portion			South Portion		
	Frequency of Detection[2]	Range of Concentrations Detected[3]	Average Concentration Detected[4]	Frequency of Detection[2]	Range of Concentrations Detected[3]	Average Concentration Detected[4]
Fluoranthene	24/26	0.002-2.8	0.293	70/76	0.029-1800	185.997
Fluorene	15/26	0.002-0.489	0.063	61/76	0.012-2200	198.334
Indeno(1,2,3-cd)pyrene	19/26	0.007-0.46	0.066	66/76	0.0091-250	21.434
Naphthalene	5/26	0.0007-0.011	0.065[7]	47/76	0.013-7100	983.936
Phenanthrene	20/26	0.013-3.5	0.360	66/76	0.01-5900	540.181
Pyrene	23/26	0.001-5.9	0.631	71/76	0.0328-2500	249.506
Metals (mg/kg)						
Arsenic	8/10	0.58-2.85	1.1873	16/18	0.629-19.9	2.89756
Barium	10/10	30.9-125	81.62	18/18	39.8-334	140.906
Cadmium	0/10	ND	NA	5/18	0.57-3.66	1.22944
Chromium (III)	10/10	3.03-10	7.559	17/18	6.7-52.6	13.8467
Chromium (VI)	10/10	3.03-10	7.559	17/18	6.7-52.6	13.8467
Lead	10/10	6.4-40	18.4	18/18	5-180	36.3556
Manganese (nonfood)	10/10	31.9-143	76.49	18/18	42.5-1430	361.572
Mercury	1/10	0.814	0.1354	7/18	0.1-0.436	0.11473

Abbreviations:

ND Not detected
NA Not applicable
mg/kg Milligrams per kilogram

Notes:

(1) Chemicals not included in this table were not detected in any of the soil samples collected at the site.
(2) Primary/duplicate samples were counted as one sample.
(3) For primary/duplicate samples the range of sample concentrations detected includes the highest concentration detected of the two samples. The range presents the minimum and maximum concentrations detected, and does not include nondetects.
(4) The average concentration detected is the arithmetic mean of all detected sample concentrations and one-half the sample quantitation limit of the nondetect chemicals, and the primary/duplicate sample with the higher concentration.

Table adapted from: Black & Veatch Corporation. Revised Baseline Risk Assessment. North Ryan Street/Lake Charles Manufactured Gas Plant Site, Prepared for Entergy Gulf States, Inc., 2003 January.

Appendix D: Glossary of Selected Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number,
1-888-422-8737.

Adverse health effect	A change in body function or cell structure that might lead to disease or health problems
Aquifer	An underground geological formation, or group of formations, containing usable amounts of groundwater that can supply wells and springs.
Background level	An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.
Biota	Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.
Cancer	Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.
Cancer risk	A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.
Cancer Risk Evaluation Guides	CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million (10-6) persons

(CREGs)	exposed over their lifetime. ATSDR's CREGs are calculated from U.S. EPA's cancer potency factors (CPFs).
Carcinogen	A substance that causes cancer.
Chronic	Occurring over a long time.
Community Assistance Panel (CAP)	A group of people from a community and from health and environmental agencies who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.
Comparison value (CV)	Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)	known as Superfund, is the federal law that concerns the removal or CERCLA, also cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).
Concentration	The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.
Contaminant	A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.
Dermal	Referring to the skin. For example, dermal absorption means passing through the skin.
Disease prevention	Measures used to prevent a disease or reduce its severity.

Disease registry	A system of ongoing registration of all cases of a particular disease or health condition in a defined population.
Dose (for chemicals that are not radioactive)	The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.
DWEL	Drinking Water Equivalent Level. Protective level of exposure related to potentially non-carcinogenic effects of chemicals that are also known to cause cancer.
Environmental Contamination	The presence of hazardous substances in the environment. From the public health perspective, environmental contamination is addressed when it potentially affects the health and quality of life of people living and working near the contamination.
Environmental media	Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.
Environmental Media Evaluation Guides (EMEGs)	EMEGs are based on ATSDR minimal risk levels (MRLs) that consider body weight and ingestion rates. An EMEG is an estimate of daily human exposure to a chemical (in mg/kg/day) that is likely to be without noncarcinogenic health effects over a specified duration of exposure to include acute, intermediate, and chronic exposures.
Environment Protection Agency	The federal agency that develops and enforces environmental laws to protect the environment and the public’s health
Epidemiology	The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure	Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term (acute exposure), of intermediate duration, or long-term (chronic exposure).
Exposure assessment	The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.
Exposure investigation	The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.
Exposure pathway	The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.
Feasibility study	A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.
Groundwater	Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].
Hazard	A source of potential harm from past, current, or future exposures.
Hazardous waste	Potentially harmful substances that have been released or discarded into the environment.
Health consultation	A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a

	public health assessment, which reviews the exposure potential of each pathway and chemical.
Health education	Programs designed with a community to help it know about health risks and how to reduce these risks.
Incidence	The number of new cases of disease in a defined population over a specific time period .
Ingestion	The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].
Inhalation	The act of breathing. A hazardous substance can enter the body this way [see route of exposure].
Lifetime Health Advisory (LTHA)	A contaminant concentration that EPA considers to be protective of noncarcinogenic health effects during a lifetime (70 years) of exposure.
Lowest-observed-adverse-effect level (LOAEL)	The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.
Maximum Contaminant Level (MCL)	The MCL is the drinking water standard established by U.S. EPA. It is the maximum permissible level of a contaminant in water that is delivered to the free-flowing outlet. MCLs are considered protective of public health over a lifetime (70 years) for individuals consuming 2 liters of water per day.
Media	Soil, water, air, plants, animals, or any other parts of the environment that can contain contaminants.
Migration	Moving from one location to another.
Minimal risk level (MRL)	An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute,

	intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].
National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)	EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.
National Toxicology Program (NTP)	Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.
No apparent public health hazard	A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.
No-observed-adverse-effect level (NOAEL)	The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.
No public health hazard	A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.
Population	A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).
Potentially Exposed	The condition where valid information, usually analytical environmental data, indicates the presence of contaminant(s) of a public health concern in one or more environmental media contacting humans (i.e., air, drinking water, soil, food chain, surface water), and there is evidence that some of those persons have an identified route(s) of exposure (i.e., drinking contaminated water, breathing contaminated air, having contact with contaminated soil, or eating contaminated food).
Potentially responsible party (PRP)	A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

Public health action	A list of steps to protect public health.
Public health assessment (PHA)	An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].
Public health hazard	A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.
Public meeting	A public forum with community members for communication about a site.
Recommended Dietary Allowances (RDAs)	The levels of intake of essential nutrients that, on the basis of scientific knowledge, are judged by the Food and Nutrition Board to be adequate to meet the known nutrient needs of practically all healthy persons.
Record of Decision (ROD)	A public document that explains which cleanup alternative(s) will be used at National Priorities List Superfund sites and why these alternatives have been chosen. The ROD is based on information and technical analysis generated during a Remedial Investigation/Feasibility Study and involves the consideration of community comments and concerns.
Reference dose (RfD)	An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.
Reference Dose Media Evaluation Guides (RMEGs)	ATSDR derives RMEGs from U.S. EPA= oral reference doses. The RMEG represents the concentration in water or soil at which daily human exposure is unlikely to result in adverse noncarcinogenic effects.
Registry	A systematic collection of information on persons exposed to a specific substance or having specific diseases [see disease registry].
Remedial investigation	The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Risk	The probability that something will cause injury or harm.
Route of exposure	The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].
Sample	A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.
Secondary Maximum Contaminant Level (SMCL)	Maximum level of a contaminant in water delivered to the free flowing outlet of the ultimate user, or of contamination resulting from corrosion of piping and plumbing caused by water quality.
Stakeholder	A person, group, or community who has an interest in activities at a hazardous waste site.
Substance	A chemical.
Superfund	[see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)
Superfund Amendments and Reauthorization Act (SARA)	In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.
Surface water	Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Survey	A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].
Toxicological profile	An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.
Toxicology	The study of the harmful effects of substances on humans or animals.
Tumor	An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).
Volatile organic compounds (VOCs)	Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Appendix E: Cancer Classifications

Several government organizations, including EPA, the International Agency for Research on Cancer (IARC) and the National Toxicology Program (NTP), have established cancer classifications for toxic chemicals. This document adopts EPA's cancer classification, which is based on animal and human epidemiological studies. It is defined as follows:

Class A	The chemical is a human carcinogen
Class B1	Probable human carcinogen (based on limited human but sufficient animal data)
Class B2	Probable human carcinogen (based on inadequate human but sufficient animal data)
Class B2/C	Under consideration for placement into either B2 or the C classification
Class C	Possible human carcinogen (no human data and limited animal studies)