Public Health Assessment

Delatte Metals
Ponchatoula, Tangipahoa Parish, Louisiana
CERCLIS NO. LAD052510344

Prepared by

Louisiana Department of Health and Hospitals
Office of Public Health
Section of Environmental Epidemiology and Toxicology
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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I. Summary

The Delatte Metals National Priorities List (NPL) site is 19 acres in size and is located in Ponchatoula, Tangipahoa Parish, Louisiana. The site encompasses the entire Delatte Metals property, a portion of the inactive Ponchatoula Battery Company, and several residential yards. These areas were found to be contaminated, and scheduled for remediation. To address contamination that posed an immediate health threat, an EPA Comprehensive Environmental Response Compensation and Liability Act emergency removal action occurred in 1996. As of March 2004, remedial activity for the entire Delatte Metals site has been completed. The levels of contaminants present in the *on-site surface and subsurface soils and off-site surface soils and sediments* at Delatte Metals formerly represented a *public health hazard*, but since the completion of remedial activity the site represents *no apparent public health hazard.*

At both the Delatte Metals property and the Ponchatoula property similar operations were performed and the same types of waste were generated so they were merged into a single site for NPL activities. Spent lead-acid batteries were cut open and the acid drained into holding ponds. The battery casings were discarded on site. Lead was recovered from the acid and smelted, then sold. Arsenic, antimony and lead were the major contaminants of concern at this site.

The site is 5.5 miles southeast of Hammond and 1.5 miles southeast of Ponchatoula, Louisiana. It is in a rural location with a population within 1 mile of the Delatte Metals NPL site of approximately 645 people. Access to the municipal water supply has been recently installed, but most homes have wells which may still be in use. A day care center was located in the site's vicinity, approximately 0.25 miles from the site. The site is within 15 miles of two wildlife management areas and freshwater wetlands.

The community health concerns included lead exposure and ground water contamination, possible worker exposure in the past, and health effects unique to childhood exposure. Concerns also included the cancer incidence in the area and the current business activities at the Delatte Metals site.

Louisiana Department of Health and Hospitals (LDHH) staff went door-to-door, visiting residents of the Delatte Metals site, informing them that free blood lead screenings would be offered for the children residing on or around the Delatte Metals site. This screening occurred from November 1996, through July 1997. Blood sampling of children living nearby revealed several children with elevated blood lead concentrations. The Parish Health Unit, under the auspices of LDHH, offered the screening event. The children with elevated blood leads were referred from the Health Unit to their private physician for follow-up treatment.

Exposure to contaminants in soil and sediment posed a public health hazard because adverse health outcomes could have resulted from prior exposure to contaminants by workers, residents and trespassers. The air exposure pathway has posed no apparent health hazard.

Exposure to shallow groundwater and surface water presents no public health hazard. Potential exposure to contaminated shallow groundwater may be possible if contamination were to discharge to surface water or travel to the depth of adjacent residential wells. The available data indicate that the groundwater from which the nearby residential wells obtain water is not contaminated.

II. Purpose and Health Issues

The 1986 Superfund Amendments and Reauthorization Act to the Comprehensive Environmental Response, Compensation and Liability Act 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. Among those activities, ATSDR was mandated to perform a public health assessment for each facility or site listed or proposed to be listed on the National Priorities List (NPL).

The Section of Environmental Epidemiology and Toxicology of the Department of Health and Hospitals, Office of Public Health (OPH) is conducting this public health assessment for the Delatte Metals NPL site to determine if public health has been adversely impacted by this site. OPH reviewed environmental and health data and responded to community concerns. Lastly, this public health assessment contains recommendations to continue to protect public health.

III. Background

A. Site Description and History

The Delatte Metals site was proposed for addition to the United States Environmental Protection Agency's (EPA) list of hazardous waste sites, also known as the National Priorities List (NPL) on July 28, 1998. It was finalized in January 1999. Elevated levels of lead and other metals have been found both on and off site.

The Delatte Metals NPL site is located on the North side of Weinberger Road in Ponchatoula, Tangipahoa Parish, Louisiana (Figures 1 and 2). The site is about 5.5 miles south-southeast of Hammond, Louisiana, and 1.5 miles southeast of Ponchatoula, Louisiana. The Delatte Metals NPL site is approximately 19 acres in size and encompasses the entire Delatte Metals property and a portion of the inactive Ponchatoula Battery Company. The sites lie on adjacent properties. The site is bounded by a tributary of Selser's Creek to the north, private residences to the east and west, and Weinberger Road to the south. The portion of Ponchatoula Battery which is not included in the NPL has been called Robertson's Property (RP) during prior investigations and received EPA non-Superfund emergency removal action in 1996. Delatte Metals operated most recently as a battery and aluminum can recycle transfer station.

At both the Delatte Metals property and the Ponchatoula property similar operations were performed and the same type of waste material was generated, so they were merged into a single site for NPL activities. Spent lead-acid batteries were cut open and the acid drained into holding ponds. The battery casings were discarded on site. Lead was recovered from the acid and smelted at Delatte Metals and sold. Both facilities shared a drainage pathway, the northern tributary of Selser's Creek [1].

Ponchatoula Battery Company

The Ponchatoula Battery Company was the first of the sites to operate. It was made up of two land parcels, one on the North side of Weinburger Road, North Ponchatoula Battery (NPB), and one on the South side, Robertson's Property (RP). Operations began at RP in the 1960's. In the 1970s the operations moved to a 3.7 acre area in the north side of the road and adjacent to the 11.8 acre Delatte Metals.

The RP site is a residential tract of land, 1.95 acres in size, with a pile of battery casings almost 1 acre in size, and a pond that had been used as an acid neutralization impoundment, were located. The site also housed two residences.

At NPB, operations were conducted from the 1970's until 1981. The operation was originally cited for acid discharge to off-site waterways in the 1970s. Noncompliance with both the Louisiana Department of Environmental Quality (LDEQ) and the Office of Safety and Health Administration (OSHA) regulations forced the company to cease operations in 1981. Several site evaluation and clean up efforts were conducted by the property owner. These included removing a battery casing pile, backfilling surface impoundments, and remediating soils to less than 1,000 parts per million (ppm) lead. A 6 to 8 inch cover of clean soil was put down in a contaminated area. The soils were taken to Delatte Metals for processing. In 1987, the remaining lead and casings were moved to the Delatte warehouse. Additional contaminated soils were also excavated and moved to the Delatte Metals concrete pad. Eight monitoring wells were installed in the area, three of which were located at NPB [2-5].

EPA conducted a Site Inspection (SI) in 1981 and an Expanded Site Inspection (ESI) was conducted in 1993. As a result of this effort, a three-phase EPA Site Assessment was initiated in 1994 and continued in 1995. Soil samples from both NPB and RP were taken. Through these various inspections and assessments, it was determined that the NPB site would not rank on the NPL. However, the lead concentrations in residential soils near the RP site were elevated. The EPA, through its Emergency Response Branch (now the Response and Prevention Branch), performed an emergency removal action at the RP. The action consisted of the excavation, transport and disposal of 7,000 tons of battery chips and soil and 1,200 cubic yards of lead contaminated soil. This removal included the top 2 feet of soil surrounding the two houses on the property.

Delatte Metals Company

The inactive Delatte Metals business began a battery recycling and smelting operation in the 1960s as the Delatte and Fuscia Battery Company. It was renamed Delatte Metals in the early 1980's. A scrap metal salvage business is still operated from a portion of the property. Batteries were brought to the site by truck or railroad car, the batteries were cut and the acid drained out. The acid waste was stored in ponds. Battery casings were discarded on site. The lead was recovered from the acid and smelted into lead ingots which were sold to lead recycling facilities.

In 1982, the facility submitted a closure plan to the Louisiana Department of Natural Resources (later referred to as LDEQ) for an on-site acid neutralization pond. In 1984, LDEQ's Hazardous Waste Management Division conducted a site inspection, which identified the facility as a hazardous waste treatment storage and disposal facility. In January 1987, a LDEQ inspection revealed unauthorized activities including surface discharge of caustic water. The site was also inspected by EPA and a variety of violations were cited. The facility was denied its hazardous waste operating permit in 1995 by LDEQ, but it has continued to function as a scrap metal dealer.

The site was referred to LDEQ's Inactive and Abandoned Sites Division in March 1996. An EPA site investigation was completed in March 1997 and a removal assessment was completed in March and April 1998. A time-critical source control removal action was conducted during the fall of 1998. More than 30,000 tons of waste including crushed battery casings and slag were removed from the facility area. Sulfuric acid and waste oil were also removed. Contaminated soils from residential properties were excavated [6].

During the 1998 removal, approximately 30,000 tons of crushed battery casings, smelter slag, smelter ash, and other source material; 68 tons of grossly contaminated smelter equipment; 28 drums of lead contaminated oil and oil debris; approximately 6,617 gallons of sulfuric acid; and, approximately 650 tons of scrap metal were disposed of. In addition, contaminated sediment in a roadside ditch along Weinberger Road was excavated to facilitate the installation of a public water supply pipe, and contaminated soil found in the active areas of two residential properties was excavated.

Delatte Metals site

The North Ponchatoula Battery (NPB) property was combined with Delatte Metals to form the Delatte Metals site on the NPL. In January 19, 1999, EPA formally announced the addition of the Delatte Metals/NPB site to the NPL in the Federal Register. This site is approximately 19 acres in size. In March 1999, EPA sampled soil, sediment, surface water, and ground water samples adjacent to the site to define the extent and nature of contamination [7]. A remedial investigation was conducted from January to May 1999 and the report was released in January 2000.
Remedial action began in 2002 at the Delatte Metals site. During the remedial action, approximately 41,000 cubic yards (cy) of on-facility and 1,400 cy of off-facility soil were

excavated, treated, and disposed of at an offsite landfill. The total weight of soil disposed of at the landfill was 85,444 tons. An estimated 1.5 million gallons of water was treated and discharged. Approximately 450 tons of concrete was disposed of as hazardous waste. A total of 33 acres was cleared and grubbed and all trees, shrubs, and stumps were chipped and scattered on-facility.

Currently, long-term operations and maintenance activities are ongoing. These activities include groundwater monitoring activities which include well sampling to determine whether the groundwater pH downgradient of the permeable reactive barrier (PRB) is increasing, that metals concentrations in the groundwater downgradient are decreasing, and that the metals concentrations in the ground water of the third water-bearing zone are not increasing. In addition, routine maintenance and visual site inspections will be performed at the site to ensure the integrity of the remedial action. Inspections will be made of the monitoring network, and the institutional controls limiting site reuse to industrial.

B. Site Visits

In March 1996, representatives of the OPH, the EPA, the EPA contractors, and LDEQ conducted a site visit. OPH representatives noted the proximity of homes and the accessibility of the battery casing pile on the Robertson's Property to children. The absence of fencing to restrict access to the site was discussed. Health education about lead poisoning and blood lead testing was proposed. Door-to-door community outreach was conducted in April 1996, to inform residents of the available free blood lead testing.

On September 3, 1998, OPH representatives attended a meeting with city and parish officials at the Ponchatoula city hall. An overview of the site history and background was presented. EPA officials estimated that removal of contamination at the Delatte Metals facility, which included piles of slag, dust, battery chips, the acid tank farm, furnace building, drums of metal contaminated wastes, and tote bags of baghouse dust, would take from 6 to 8 weeks to complete. Residents who may potentially be affected by the site were provided with additional information about site activities and the dangers of lead contamination exposure to small children. The site was observed from outside the fence line. This made it possible to see some of the boundaries of the site. Buildings used for operating the facility and one building that is used as a residence were observed.

On October 28, 1998, an OPH representative assisted EPA officials in interviewing community members to learn the concerns of the residents before preparing the community relations plan for the Delatte Metals site. Residents interviewed were eager to give their opinions. Residents were most interested in potential effects of hazardous materials to children. Informative public health flyers, fact sheets, and truck routes of the waste transporters were made available to residents who were not available at the time of the interviews.

On June 18, 1999, representatives of OPH conducted a site visit to observe current conditions of the site after the completion of the EPA time-critical removal actions. EPA had removed slag, dust and battery chips, drums and the furnace building. The fence was not continuous and would not adequately prevent trespassing. Some items observed on site may pose physical hazards. A section on "Physical and Other Hazards" appears later in this document.

On May 5, 2000, OPH representatives conducted another site visit. A aluminum can and used battery transfer station continues to operate. The site was fenced on the side facing Weinberger Road. The presence of workers could be a deterrent; nevertheless, access to the site from the driveway leading to the abandoned house on the west side is still possible.

On November 2001, OPH conducted another site visit. Site conditions had not changed from the previous site visit.

To keep current on site conditions, OPH staff spoke with officials from the Tangipahoa Parish government in June 2003 and March 2004. The Delatte Metals site had been remediated.

C. Demographics, Land Use, and Natural Resources

Demographic data provides information on population and housing characteristics of communities living near hazardous waste sites. Demographic information from the 1990 Census relating to the population living in the Ponchatoula area is presented below for general information.

The Delatte site is located in a rural and wooded area on Weinberger Road in Ponchatoula, Louisiana. Approximately 650 people live within 1 mile of the site and approximately 90 to 100 persons live within 0.25 mile of the site (Figure 2). Selser's Creek is approximately 800 feet west of the site. The site is within 15 miles of two wildlife management areas and freshwater wetlands. The Joyce Wildlife Management Area is about 1.4 miles downstream and the Manchac Wildlife Management Area is 12.5 miles downstream. Tangipahoa Parish contains areas that are used for crops such as bell peppers and strawberries, and timber harvesting [8, 9].

Appendix B, Table 1 lists the population distribution of the Ponchatoula community for race and sex, while Appendix B, Table 2 gives a description of population by age groups for Ponchatoula, as compared to Tangipahoa Parish.

A search of all Department of Transportation and Development registered water wells for all uses, except monitoring, recovery, and piezometer wells within a 2 mile radius of the site was made in July 1996. The search identified 55 wells within a 2 mile radius of the site. Five of the wells were identified as public supply wells, and 48 are domestic wells. Nearly all of the wells were located in the northern half-circle of the 2 mile radius. The depths of the public supply wells ranged from 120 feet to 1,912 feet, and the depths of the domestic wells ranged from 70 feet to 2,040 feet. Most wells were approximately 200 feet deep.

The EPA contractor conducted a door-to-door well water survey within a 0.5 mile radius of the site to inventory unregistered wells. Thirty-eight households were contacted. All households either owned a well or used an adjacent well. The well depths ranged from 38 feet to 600 feet below ground surface (bgs).

D. Health Outcome Data

Heath outcome data refers to the rates or incidence of certain adverse health effects (such as cancers, miscarriage, stillbirth, or birth defects) that are recorded by state and federal agencies. Physicians and hospitals are obligated by law to report occurrences of these effects to the OPH, Section of Vital Records and the Louisiana Tumor Registry. The Section of Vital Records provides reports on information regarding, births, stillbirths, birth defects, and death.

The OPH offered free blood lead testing for children younger than six years old from November 1996 through June 1997. When requested, older children were also tested. This testing took place at a local Parish Health Unit. A small number of children were tested, but almost 30% of those tested had blood lead levels higher than 20 micrograms per deciliter (µg/dL). At this concentration, the Centers for Disease Control and Prevention recommend a full medical evaluation including a detailed environmental and behavioral history, a physical examination and, testing for iron deficiency (Appendix B, Table 3). After the initial blood test, these children were taken to their private physicians for follow-up.

IV. Community Health Concerns

Community health concerns include lead exposure and ground water contamination, possible worker exposure in the past, and health effects unique to childhood exposure. Concerns also include the cancer incidence in the area and the current business activities at the Delatte Metals site.

In April 1996, the Office of Public Health (OPH), Section of Environmental Epidemiology and Toxicology made arrangements with parish health unit nurses to test area children less than 6 years of age for lead in their blood. OPH staff members conducted a door-to-door outreach program around the site in order to: (1) provide residents with health education material concerning lead, (2) determine the number of children in the area, and (3) offer free blood lead testing. All homes within approximately 0.25 miles of the site were visited within 2 days. OPH staff members spoke with at least one resident at 12 out of 16 homes. At the request of residents, some homes were visited twice in order to speak with family members who were not present at the time of the first visit. Health information materials on lead were left at all homes.

In July 1996, the United States Environmental Protection Agency (EPA), the Louisiana Department of Environmental Quality (LDEQ) and the OPH held an informational meeting for citizens at the Hammond Parish Health Unit. In August 1996, OPH staff followed up on concerns received at the informational meeting. From November 1996 through June 1997, OPH offered free blood lead testing in children younger than 6 years old. This testing took place at a local parish health unit.

In October 1998, EPA officials interviewed community members in preparation of the Community Relations Plan for the Delatte Metals site in Ponchatoula. Those interviewed were eager to give their opinions. Community members were most interested in potential effects of hazardous materials to children. Also, two community members were very concerned about an EPA truck which had recently run off the road near the site. Although the truck did not have a load, people are fearful of a recurrence. One person was upset following prior removal efforts because a ditch in front of his property was not adequately restored. As a result, he currently had a mosquito infestation. Informative public health flyers, fact sheets, and truck routes were made available to those who were not available at the time of the interviews.

During this same time, the EPA held an open house to inform the local community about the activities at Delatte Metals. The removal action was taking place on the site at the time. Health concerns were discussed during and after the meeting. These concerns included lead exposure, groundwater contamination, metal exposure and health effects, possible worker health effects, and exposure to children.

In March 1999, the EPA held an open house for citizens at the Tangipahoa Parish health unit. Residents were concerned with the effect that Superfund status would have on their property values. They were also concerned that current business activity on the site was not being monitored or overseen, even though the activities were supposedly not resulting in hazardous waste generation. Others were concerned with the condition of the roads and weight capacity of trucks used to transport contaminants from the site. Many were interested in cancer incidence data for the area (Appendix B, Tables 11 and 12; Health Outcome and Community Concerns Data Evaluation Section).

The public comment version of this public health assessment was made available to the community on September 6, 2001. The comment period ended November 6, 2001. No public comments were received by OPH. However, OPH has an on-going knowledge that residents are concerned about lead exposure and cancer incidence.

V. Environmental Contamination and Other Hazards

A. Environmental Contamination

The tables related to this section list the contaminants of concern and are located in Appendix B. These contaminants are evaluated in the subsequent sections of the public health assessment to determine whether exposure to the existing contaminants had public health significance. The Agency for Toxic Substances and Disease Registry (ATSDR) and the Office of Public Health (OPH) select and discuss these contaminants based upon the following factors:

1. Concentrations of contaminants on and off the site.
2. Field data quality, laboratory data quality, and sample design.
3. Comparison of on-site and off-site concentrations with health assessment comparison values for non-carcinogenic and carcinogenic endpoints, and
4. Community health concerns.

If a contaminant is listed in the data tables in Appendix B, it does not necessarily mean that it would have caused adverse health effects from exposure. Instead, it indicates which contaminants were evaluated further in the public health assessment. Since the completion of remedial activity at the site, contaminants of concern now present no apparent public health hazard.

Comparison values for public health assessments are concentrations of contaminants in specific media that are used to select contaminants for further evaluation. These include the Environmental Media Evaluation Guide (EMEG), Reference Dose Media Evaluation Guide (RMEG) and Cancer Risk Evaluation Guide (CREG) values provided by ATSDR. The EMEGs and RMEGs are comparison values derived for health effects with non-cancer end points, whereas, the CREG comparison values are estimated contaminant concentrations based on a one excess cancer in a million persons exposed over a lifetime. They are calculated from the EPA cancer slope factors. Comparison values are not intended to be used as predictors of adverse health effects or setting clean-up levels. Media concentrations below these levels are not likely to pose a health threat; however, levels above the comparison values do not necessarily mean a health threat is likely. Comparison values do not take into consideration highly sensitive or susceptible persons.

Appendix B, Tables 4 through 8 provide the summaries of the data. ATSDR comparison values for each of the contaminants are also listed in the tables. Contaminants which exceeded a comparison value or for which there is no comparison value warrant further consideration. Contaminants whose concentrations were below ATSDR's comparison values were excluded from further consideration.

With the exception of one background surface soil data point, soil and sediment data collected before the 1998 removal action was not evaluated in this public health assessment.

1. On-site Contamination

On-site Surface (Collected from 0 to 1 foot depth) Soil

In the spring of 1999, the U.S. Environmental Protection Agency (EPA) collected soils from 229 on-site soil locations. The samples were analyzed for metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) and total petroleum hydrocarbons (TPHs) (Appendix B, Table 4). The maximum concentrations of antimony, arsenic and cadmium, 1,860 milligrams per kilogram soil (mg/kg), 2,100 mg/kg and 199 mg/kg, respectively, exceeded health based comparison values of 20 mg/kg, 20 mg/kg and 10 mg/kg, respectively. The maximum lead concentration of 185,000 mg/kg exceeded 400 mg/kg, the EPA screening level for lead in soil for residential use. Remedial activities that began in 2002 at this site have removed this contaminated soil.

On-site Subsurface (Collected from 1 to 2 feet depth) Soil
In the spring of 1999, the EPA collected soils from 229 on-site soil locations. The samples were analyzed for metals, VOCs, SVOCs and TPH (Appendix B, Table 4). The maximum concentrations of antimony, arsenic and cadmium, 1,870 mg/kg, 277 mg/kg and 36.4 mg/kg, respectively, exceeded health based comparison values of 20 mg/kg, 20 mg/kg and 10 mg/kg, respectively. The maximum lead concentration of 96,800 mg/kg exceeded 400 mg/kg, the EPA screening level for lead in soil for residential use. Remedial activities that began in 2002 at this site have removed this contaminated soil.

On-site Shallow Groundwater
In the spring of 1999, EPA collected 116 shallow groundwater samples from a depth of 8 to 12 feet below ground surface (bgs). All samples were analyzed for metals and a subset received VOC, SVOC and TPH-gasoline and TPH-diesel analysis (Appendix B, Table 5). Concentrations of aluminum, antimony, beryllium, cadmium, lead, nickel, vanadium, and zinc exceeded health based comparison values. Currently, post-remediation groundwater monitoring is continuing at this site.

On-site Air
In 1998, total suspended particulate and lead air samples were collected over a 4-day period. The highest concentration of lead reported on site was 0.000216 milligram per cubic meter (mg/m^3). The Occupational Safety and Health Administration (OSHA) limit for workers was not exceeded. The Clean Air Act has set a primary standard for lead in air to protect public health, including the health of sensitive populations. This ambient air standard for lead, called the National Ambient
Air Quality Standard, is a quarterly average concentration of 0.0015 mg/m^3. The ambient air samples collected at Delatte Metals did not exceed the ambient air lead standard. No table is included.

2. Off-site Contamination

Off-site Soil (Collected from 0 to 1 foot, 1 to 2 feet, and 2 to 3 feet depths)

In January 1999, the EPA collected off-site soil samples from 154 locations which were analyzed for metals. Ten percent of the perimeter samples were analyzed for VOCs, SVOCs and TPH (Appendix B, Table 6). The maximum concentrations of antimony, arsenic and cadmium, 56.20 mg/kg, 60.1 mg/kg and 55.7 mg/kg, respectively, exceeded health based comparison values of 20 mg/kg, 20 mg/kg and 10 mg/kg, respectively. No health based comparison value exists for copper but the concentration of 74.3 mg/kg exceeded the EPA Region 6 background concentration of 20 mg/kg. The lead concentration was 635 mg/kg which exceeded the EPA screening level for lead in soil for residential use of 400 mg/kg. Remedial activities that began in 2002 at this site have removed this contaminated soil.

Off-site Sediment
In the spring of 1999, EPA collected sediment samples from 46 locations. Samples were collected from tributaries to Selser's Creek, Selser's Creek, and the cypress swamp located southwest of the site across Weinberger Road. The EPA also sampled three upstream background locations. At each location one 0 to 6 inch and one 18 to 24 inch sediment sample was collected. All samples received metals analysis and five locations also received VOC and SVOC analysis (Appendix B, Table 7). The maximum concentrations of arsenic (51.85 mg/kg), cadmium (94.85 mg/kg), copper (213 mg/kg), and lead (17,680 mg/kg) exceeded health based comparison values. The highest concentrations were found in sediments obtained from the ditch which drained from the site. Remedial activities that began in 2002 at this site have removed this contaminated sediment.

Off-site Surface Water
In the spring of 1999, the EPA collected surface water samples from 22 locations. Samples were collected from tributaries to Selser's Creek, Selser's Creek, and the cypress swamp located southwest of the site across Weinberger Road. All samples were analyzed for metals and two were analyzed for SVOCs (Appendix B, Table 8). Cadmium (189 micrograms per liter water (µg/L) and lead (3,050 µg/L) exceeded health based comparison values of 2 µg/L and 15 µg/L respectively. The highest concentrations were found in the surface water obtained from the ditch which carried surface water from the site toward Selser's Creek.

Off-site Residential Well Water
In January 1999, the EPA sampled 10 residential wells and two on-site water wells. The samples were analyzed for VOCS, SVOCs, metals, and total diesel and gasoline petroleum hydrocarbons. Residential wells had been previously sampled in 1994 (12 wells) and 1995 (12 wells) also. No contaminants were present at levels above EPA primary Maximum Contaminant Levels.

Off-site Air
No off-site air samples have been taken.

B. Physical and Other Hazards

The poor condition of the fence surrounding the site allowed access to the site and was noted in reports from the June 1999 and May 2000 site visits. The front of the site has a locked gate. Physical hazards at the site include truck traffic related to the on-going battery collection operations. However, the site has now been remediated, and the truck traffic has subsided. Currently, site access would not pose a health risk due to physical hazards.

VI. Discussion

A. Pathways Analysis

To determine whether nearby residents are exposed to contaminants migrating from the site, ATSDR and OPH evaluated the environmental and human components that lead to human exposure. This pathways analysis consists of five elements: (1) a source of contamination, (2) transport through an environmental medium, (3) a point of exposure, (4) a route of human exposure, and (5) a receptor population.

ATSDR categorizes an exposure pathway as a completed or potential exposure pathway if the exposure pathway cannot be eliminated. Completed pathways require that the five 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, however, require that at least one of the five elements is missing, but could exist. Potential pathways indicate that exposure to a contaminant could have occurred in the past, could be occurring now, or could occur in the future. An exposure pathway can be eliminated if at least one of the five elements is missing and will never be present. Appendix B, Table 9 identifies the completed exposure pathways, and Appendix B, Table 10 identifies the potential exposure pathways.

1. Completed Exposure Pathways

Before remediation, completed exposure pathways included on-site and off-site surface soil and sediment. Elevated metals were present in surface soils and access was not restricted. Surface soils to the west of the site contained higher concentrations of contaminants than soils to the east of the site. Delatte Metals workers could have been exposed to soil contaminants when the site was operational. The most likely exposed populations would have included nearby residents who visited the areas of highest soil contamination, trespassers to the Delatte NPL site, current on-site workers, and persons fishing in Selser's Creek (Table 9).

Before remediation, exposure to sediment was a completed pathway. Off-site residents and fishers and trespassers could have been exposed to contaminants present in ditch and swamp sediments. These persons could have been exposed by incidental ingestion of sediment. Of the sediments, the ditch sediments contained the greatest lead concentrations.

Additional completed exposure pathways included surface water, subsurface soil, shallow groundwater and residential well water. Delatte Metals and Ponchatoula Battery employees could have been exposed to contaminated surface water in the past when the site was operational. Trespassers, current on-site remedial workers (conducting operation and maintenance activities), and residents could have been exposed to contaminated surface water in the on-site ditches, Selser's Creek, and water in the cypress swamp southwest of the site.

Exposure to subsurface soils could have occurred in the past to Delatte Metals or Ponchatoula Battery employees during work activities.

Exposure to shallow groundwater could have occurred at the point where it discharges to surface water, at Selser's Creek. Exposure could have occurred in the past. Persons fishing at Selser's Creek would have been the most likely exposed population.

Exposure to airborne contaminants could have occurred in the past to Delatte Metals and Ponchatoula Battery workers when the site was active. Lead particulate data collected while the site was abandoned showed no lead concentrations in air which exceed OSHA standards set to protect worker health or EPA ambient air standards set to protect public health. Therefore, the air exposure pathway is classified as a no apparent health hazard. Because we have no data about the levels of contaminants in the air when the smelter was operational, the air pathway was considered an indeterminate public health hazard in the past when the smelter was operating.

2. Potential Exposure Pathways

Exposure to site contaminants through residential well water is a potential future exposure pathway. Contamination in shallow groundwater under the site has been identified. Sampling of residential wells on three occasions has revealed no site related contaminants. Access to public water has been installed in the area surrounding Delatte Metals. A person could be exposed in the future if shallow groundwater contamination migrated to depths that serve private wells and a person continued to use private well water instead of city water (Table 10).

B. Public Health Implications

1. Toxicological Evaluation

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 noncancerous, harmful 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 (less than 14 days), intermediate (15 to 364 days) and chronic (greater than 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.

When MRLs are not available, reference doses (RfDs) provided by the EPA are used. The reference dose is an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. For carcinogenic effects, an excess cancer risk was calculated using the cancer potency factor or slope factor. The cancer potency factor is an upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. It is used to estimate an upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen.

The adverse health effects which result from the interaction of an individual with a hazardous substance in the environment depend 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.

Another factor is the level of contaminant to which a person is exposed, and the amount of the exposure dose that is actually absorbed into the body. Mechanisms by which chemicals are altered in the environment, or inside the body once absorbed, are also important. Many variations in these mechanisms exist between individuals, making them more or less susceptible to adverse health effects.

For the Delatte Metals site, several different exposure scenarios were considered to determine the degree of exposure to the population in the past, present or in the future. However, since the completion of remedial activity at this site, it is expected that no contaminants would present an apparent public health hazard at the site.

Contaminants which exceeded comparison values in on-site soil are antimony, arsenic, cadmium, and lead. Contaminants which exceeded comparison values in shallow groundwater include aluminum, antimony, beryllium, cadmium, lead, nickel, vanadium, and zinc. Contaminants which exceeded comparison values in off-site soil west of the site include antimony, arsenic, cadmium, copper, and lead. Contaminants which exceeded comparison values in the sediments include arsenic, cadmium, copper, and lead.

Aluminum

The maximum aluminum concentration found in shallow groundwater was 4,160,000 micrograms per liter (µg/L). The EMEG is 20,000 µg/L. Aluminum is the most abundant metal in the earth's crust. It occurs naturally, and its compounds are widely used in industry. It is very reactive and is never found as a free metal in nature. Aluminum can have toxic effects, particularly on the brain and kidneys, when present in very high doses in the blood [10]. EPA has not classified aluminum for human carcinogenicity; however, an MRL based on a NOAEL (no-observed-adverse-effect-level) for toxic nerve effects in mice has been established.

Exposure to shallow groundwater would have occurred at the point where groundwater discharges to surface water. The most likely exposed person would be a fisher or trespasser on the banks of Selser's Creek who accidentally ingests some water. However, those who fish or trespass on the site would not visit frequently enough or for a duration necessary to accidentally ingest 2 liters of water. An insufficient amount of water would be consumed to result in a health effect. Aluminum in shallow ground water poses no public health threat.

Antimony
Antimony was found at a maximum concentration of 1,860 milligrams per kilogram (mg/kg) in on-site surface soil, 1,870 mg/kg in on-site subsurface soil, 56.2 mg/kg in off-site surface soil and 38.9 mg/kg in off-site subsurface soil. Antimony was detected in both on-site and off-site soil samples above the health based screening level of 20 mg/kg [11]. This antimony most likely came from the batteries. Antimony is a silvery white metal of medium hardness and small amounts are found in the earth's crust. Antimony metal is too easily broken to be used much by itself. To make it stronger, a little antimony is usually mixed with other metals such as lead and zinc to form mixtures called alloys. These alloys are used in lead storage batteries, solder, sheet and pip metal, bearings, and pewter [11]. Antimony can have toxic effects including diarrhea, joint and/or muscle pain, vomiting, problems with the blood (anemia) and heart problems (altered electrocardiograms) [11]. EPA has not classified antimony for human carcinogenicity; however, an oral reference dose (RfD) for cellular necrosis in rats has been established (www.epa.gov/IRIS/subst/0006.htm).

There are no air monitoring data available from the time that metal smelting was done, which prevents concluding whether harmful health effects resulted from that exposure. Children may have been exposed by eating the dirt containing antimony. Before remediation, antimony in soils presented a public health hazard at Delatte Metals.

Arsenic
Arsenic was detected at levels in excess of health based comparison values in on-site soil at a maximum concentration of 2,100 mg/kg, soil (0-1 ft bgs) west of the site at 60.1 mg/kg, and ditch sediments at 51.85 mg/kg. Arsenic is a naturally occurring metal in the earth's crust. It is particularly high in the soil, surface water, and groundwater in areas with sulfur deposits and in areas where industrial wastes and pesticide applications are prevalent [12]. EPA studies have found that background surface soil concentrations for arsenic range from 1 to 40 mg/kg with an average value of 5 mg/kg. Arsenic levels in water from rivers and lakes are usually below 10 micrograms per liter (µg/L). The main use of arsenic is in wood preservation products. It is also used as an insecticide, herbicide, algicide, growth stimulant for plants and animals, and for medicinal purposes.

Low levels of inorganic arsenic (ranging from 300 µg/L to 30,000 µg/L in food and water) can cause irritation to the stomach and intestines, with symptoms such as pain, nausea, vomiting, and diarrhea. Other effects one might experience from ingesting arsenic include decreased production of red and white blood cells, abnormal heart function, blood-vessel damage, and impaired nerve function, which causes a "pins and needles" sensation in the hands and feet [12].

There is clear evidence from studies in humans that exposure to inorganic arsenic may increase the risk of cancer. Most studies have involved occupational settings where most researchers observe that the risk of lung cancer increases as a function of exposure level and duration. Other studies suggest that people, who live near smelters, chemical factories, or waste sites with arsenic, may have a small increased risk of lung cancer. Arsenic has also been shown to cause cancer when it enters the body by the ingestion route. The main carcinogenic effect from ingestion of inorganic arsenic is skin cancer, but it may also increase the risk of internal tumors (mainly of the liver, bladder, kidney, and lung). According to EPA, arsenic is classified as a group "A" carcinogen, which means that arsenic is a human carcinogen [12]. Exposure was estimated for the scenarios described above. Before remediation, arsenic in soils presented a public health hazard at Delatte Metals.

Beryllium

The maximum beryllium concentration found in shallow groundwater was 169 µg/L. The MCL is 4 µg/L. Beryllium is a gray metal and it is used in the electronics and nuclear industries, among others. A major source of environmental beryllium is the burning of coal and fuel [13]. Studies have found that beryllium can cause cancer, and it is classified as an EPA group B2 carcinogen, a probable human carcinogen.

Exposure to beryllium is unlikely at this site, because it was an analyte found in shallow groundwater, but not in surface soils or sediments. Exposure to shallow groundwater would occur at the point where groundwater discharges to surface water. The most likely exposed person would be a fisher or trespasser on the banks of Selser's Creek who accidentally ingests some water. The amount of water consumed by accident would be far less that the 2 liter amount assumed for derivation of the MCL. An insufficient amount of water would be consumed to result in an adverse health effect. Beryllium poses no public health threat in the surface water at this site.

Cadmium

Cadmium was found at concentrations above health based comparison values in on-site soil (199 mg/kg), off-site soil (55.7 mg/kg), ditch sediment (94.85 mg/kg) and shallow groundwater (4,740 µg/L), and surface water (creek at 3.5 µg/L, ditch at 189 µg/L and swamp at 3.5 µg/L). Cadmium is an element that occurs naturally in the earth's crust and does not degrade.

Cadmium is a heavy metal that bioaccumulates, particularly in the kidney and liver [14]. Drinking water that is contaminated with cadmium may increase cadmium levels in the body and cause adverse health effects such as high blood pressure, anemia, liver disease, and nerve damage. The greatest potential for above-average exposure of the general population to cadmium is from smoking, which may double the exposure of a typical individual [14].

Exposure was estimated for the past and present trespasser and fisher and future resident scenarios as described. Although cadmium exceeded comparison values in contaminants before remediation, the maximum concentrations and frequency of detection resulted in doses that are not a public health hazard. It is unlikely that a person (resident, on-site worker or trespasser) would consistently be exposed to a level of cadmium at the maximum concentration found on the site. Cadmium in soils, sediment, groundwater and surface water presents no public health hazard at the Delatte Metals site.

Copper

Copper was detected in surface soil west of the site (74.3 mg/kg), and ditch sediment (213 mg/kg), and swamp sediment (29.30 mg/kg). No comparison value exists for this metal; however EPA Reg. 6 considers 20 mg/kg to be a typical background concentration. Copper is an essential nutrient in the human diet and is necessary for good health [15]. For infants and adults, the intakes estimated to be adequate and safe are 0.4 - 0.6 mg/day and 1.5 - 3.0 mg/day, respectively. Ingestion of 200 mg soil per day by a child which weighs 35 kg would provide 0.04 mg/day, an amount below what is considered adequate in the human diet.

Copper has been assigned a “D” cancer classification, indicating that there is inadequate data regarding its carcinogenicity. Excessive amounts of copper, both inhaled and ingested, can cause adverse noncancer health effects. Exposure was estimated for the scenarios described above. Copper in soils and sediment presents no public health hazard at the Delatte Metals site.

Lead

The concentrations of lead in on-site surface soil (0 to1 foot) were high enough (185,000 mg/kg) to cause health concerns for adults and older children trespassers and fishers, Delatte Metals workers in the past, and future residents. Elevated concentrations of lead were found in on-site soil (185,000 mg/kg), off-site soils (635 mg/kg), shallow groundwater (2,190 µg/L), sediment (ditch at 17,680 mg/kg and swamp at 1,375 mg/kg), and surface water (creek at 17.3 µg/L, ditch at 3,050 µg/L and swamp at 658 µg/L). Residential well water samples contained no detectable lead.

Lead is a naturally occurring metal that is used commercially in batteries, paints, glazes, enamels, glass, pigment, and ammunition. During the production process, lead is typically contaminated with antimony, arsenic, copper, and zinc. Currently in the U.S., lead is predominantly used in batteries.

The Office of Public Health offered free blood lead testing for children younger than 6 years old from November 1996 through June 1997. When requested, older children were also tested. This testing took place at a local Parish Health Unit. A small number of children were tested, but about a quarter of those tested had blood lead levels higher than 20 micrograms per deciliter (µg/dL). At this concentration, the Centers for Disease Control and Prevention recommend a full medical evaluation including a detailed environmental and behavioral history, a physical examination and, testing for iron deficiency. After the initial blood test, these children were taken to their private physicians for follow-up.

Dermal absorption of inorganic lead compounds is reported to be much less significant than absorption by inhalation or oral routes of exposure, because of the greatly reduced dermal absorption rate. Skin contact with dust and dirt containing lead occurs every day, but only a small amount of the lead will pass through your skin and enter the blood if it is not washed off.

Lead can affect almost every organ and system in the body [16]. The most sensitive is the central nervous system, particularly in children. Lead also damages kidneys and reproductive system. At high levels, similar to those detected at the Delatte Metals site, lead may decrease reaction time, cause weakness in fingers, wrists, ankles, and possible effect in memory. Lead may cause anemia, and damage the male reproductive system. Lead has caused cancer in animals, and may cause cancer in humans.

Exposure to lead is more dangerous for fetuses and young children and exposures can result in decreased mental abilities and learning difficulties. Young children are particularly susceptible to the health effects of lead because they have greater potential exposure to lead. Children often play in dirt and are more likely to ingest soil by putting their hands in their mouths. A child's physiology is also different from that of an adult, and lead has greater impact on a child's central nervous system and other organs. Many of the symptoms of short-term exposure to high levels of lead poisoning mimic the symptoms of other illnesses such as the flu. A blood lead test can help determine if the child's symptoms are from lead poisoning. In light of the remedial activity that has occurred at this site, lead should not present a significant health hazard.

Nickel

Nickel was found in shallow ground water above the health based comparison value at a maximum concentration of 6,100 µg/L. Nickel is a natural component of food, and normally dietary intake is about 170 µg/day. The most common adverse health effect of nickel in humans is an allergic reaction (skin rash at the site of contact) [17]. The Department of Health and Human Services (DHHS) has determined that nickel and certain nickel compounds maybe carcinogens. Exposure to shallow groundwater would occur at the point where groundwater discharges to surface water. The most likely exposed person would be a fisher or trespasser on the banks of Selser's Creek who accidentally ingests some water. An insufficient amount of water would be consumed to result in an adverse health effect. Nickel in shallow groundwater poses no current public health threat at the Delatte Metals site.

Vanadium

Vanadium was found in shallow ground water above the health based comparison value at a maximum concentration of 3,610 µg/L. The EMEG is 30µg/L. Vanadium is a natural element in the earth. It has no particular odor. Rocks and soil containing vanadium can get into the air, groundwater, surface water or soil when it is broken down into dust by wind and rain. Lung irritation, sore throat and red irritated eyes can occur as a result of exposure to large amounts of vanadium [18].

Exposure to shallow groundwater would occur at the point where groundwater discharges to surface water. The most likely exposed person would be a fisher or trespasser on the banks of Selser's Creek who accidentally ingests some water. The amount of water consumed by accident would be far less than the two liter amount assumed to derive the health based comparison value. An insufficient amount of water would be consumed to result in an adverse health effect. Vanadium in shallow groundwater poses no public health threat at the Delatte Metals site.

Zinc

Zinc was found in shallow grand water at concentrations above health based comparison values. The maximum zinc concentration was 11,200 µg/L. Zinc is an essential element in our diet. The recommended dietary allowance (RDA) for zinc is 15 mg/day. Not enough zinc in one's diet can result in a loss of appetite. Large amounts can cause stomach cramps, nausea and vomiting. There is no classification of zinc as a carcinogen [19].

Exposure to shallow groundwater would occur at the point where groundwater discharges to surface water. The most likely exposed person would be a fisher or trespasser on the banks of Selser's Creek who accidentally ingests some water. An insufficient amount of water would be consumed to result in a health effect. Zinc in shallow groundwater poses no public health threat at the Delatte Metals site.

2. Child Health Considerations

This Child Health Considerations Section recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination of their water, soil, air, or food. Children are at greater risk than adults from certain kinds of exposures to hazardous substances emitted from waste sites and emergency events. They are more likely to be exposed because they play outdoors and they often bring food into contaminated areas. They are shorter than adults, which means they breathe dust and soil close to the ground. Children are also smaller, resulting in higher doses of chemical exposure per body weight. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most importantly, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care.

Lead was a contaminant of concern at Delatte Metals. Lead is particularly harmful to children. The neurological damage that lead can cause in children is irreversible. Because lead was present in soils at Delatte Metals and in off-site soils, OPH conducted a door-to-door survey to identify children in the area in 1996. Free blood lead testing was offered from November 1996 through June 1997 and several children had a blood concentration greater than 20 µg/dL. Since the site was only partially fenced and did not completely restrict access to the Delatte Metals site, the public health assessment used child soil ingestion rates to determine the site contaminants which were a public health hazard. In light of the remedial activity that has occurred at this site, lead should not present a current significant health hazard.

3. Community Concerns and Health Outcome Data Evaluation

Community Concerns

The community health concerns included lead exposure and ground water contamination, possible worker exposure in the past, and health effects unique to childhood exposure. Concerns also included the cancer incidence in the area and the current business activities at the Delatte Metals site.

The public comment period for the Delatte Metals Public Health Assessment was from December 29, 2001, to January 29, 2002. During this period OPH and ATSDR tried to learn what concerns people in the area may have had about the impact of the site on their health. Consequently, attempts are made to actively gather information and comments from people who live or work near the site. No comments were received from the public during this comment period.

Health Outcome Data Evaluation

The apparent excess cancer rates in the area were a community concern voiced in March 1999. In response, the Louisiana Tumor Registry (LTR) was accessed for the ascertainment of cancer incidence cases. The Tumor Registry, operated by the Louisiana State University Health Sciences Center, is a population-based cancer registry covering the entire state of Louisiana. The registry has been in operation in the New Orleans metropolitan area since 1974, in South Louisiana since 1983 and in the rest of the state since 1988. By law, every health care provider is required to report newly diagnosed cancers.

The period of time selected for evaluation of the cancer incidence data was 1988–1996, which was the most recent health data available for this part of the state at the time of analysis. The smallest geographic area for which we can calculate rates of disease is the census block group. Cancer incidence was chosen for this review because cancer death rates are affected by how advanced the cancer was at the time of diagnosis, access to health care, and other factors not related to exposure. A case was defined as an individual residing in the area of the site in the selected census block groups and who was diagnosed with a new primary malignant cancer during the evaluation period. The variables used to analyze the cancer data included address at time of diagnosis, parish of residence, primary cancer site or histology type, date of diagnosis, age at diagnosis, race, sex, census tract, and block group. Information on other risk factors such as occupational exposures or personal lifestyle habits was not available in the abstracted medical data used in this review.

Census Data

In order to compare the cancer incidence rates around the Delatte Metals Site with parish or regional rates, it is necessary to have specific population data. Population data (categorized by age) and health outcome data are both available at the census block group level. Census block groups are subdivisions of census tract and parishes. They are usually groups of 250 to 550 households, and they are designed to be relatively homogeneous or similar with respect to population characteristics, economic status, and living conditions.

The Delatte Metals Site lies within census block groups 9548-1 and 9548-2 of Tangipahoa Parish. The total population during the 9-year period, for the combined block groups was 21,528 persons, according to the 1990 census data.

Data Analysis

For the census block groups discussed, analysis was completed for all cancer types combined and for selected cancer types. The following specific cancer types were able to be analyzed because there were at least three observed cases in census block groups 9548-1 and 9548-2 in the LTR database. Because the area analyzed (the two census blocks) was so small, we examined the entire LTR database and reviewed the following specific types of cancer: bladder, breast, colorectal, lung, non-Hodgkin's lymphomas, ovarian, pancreatic, and prostate.

Analysis of cancer incidence was conducted using standardized incidence ratios (SIRs). The SIR is calculated by dividing the observed number of cases by the expected number of cases. The expected number was derived by multiplying a comparison population's age-, race-, and sex-specific incidence rates and the census block groups' age-, race-, and sex-specific population data. SIRs were calculated when three or more cases were observed in the combined census block groups. SIRs were calculated for all races combined, for whites, and for African-Americans. The Baton Rouge Region's (Region II) average annual incidence rates (1988-1992) were used to derive the expected number of cases. The Baton Rouge Region includes the parishes of Ascension, Assumption, East Baton Rouge, East Feliciana, Iberville, Livingston, Pointe Coupee, St. Helena, Tangipahoa, West Baton Rouge, and West Feliciana.

Evaluation of the observed and expected numbers is accomplished by interpreting the ratio of these numbers. If the observed number of cases equals the expected number of cases, the SIR will equal one (1.0). When the SIR is less than one, fewer cases were observed than expected. For SIRs greater than one, more cases were observed than expected.

Caution should be exercised, however, when interpreting the SIR. The interpretation must take into account the actual number of cases observed and expected, not just the ratio. Two SIRs can have the same number, but represent very different scenarios. For example, an SIR of 1.5 could mean three cases were observed and two were expected (3/2 = 1.5). Or it could mean 300 cases were observed and 200 were expected (300/200 = 1.5). In the first instance, only one excess cancer occurred, which could easily have been due to chance. But, in the second instance, 100 excess cancers occurred, and it would be less likely that this would occur by chance alone.

To help interpret the SIR, the statistical significance of the difference can be calculated. In other words, the number of observed cases can be determined to be significantly different from the expected number of cases or the difference can be due to chance alone. "Statistical significance" for this review means that there is a less than five percent chance (p-value <0.05) that the observed difference is merely the result of random fluctuation in the number of observed cancer cases. If the SIR is found to be statistically significant, then the difference between the expected and observed cases is probably due to some set of factors that influences the rate of that disease.

Because cancer is, unfortunately, so common (more than 1 in 3 of us will develop cancer in our lifetime), every community will experience a certain number of cancers. Through the years, you would expect some fluctuation in the numbers. One year, there may be a few more cases of a particular cancer and the next year a few less. This occurs by chance and there is no specific cause.

Result of Cancer Incidence Analysis

Standardized incidence ratios were computed for all cancers combined and for specific cancer sites when more than three cases were observed in the block groups. Appendix B, Table 11 shows the results of the SIR analysis for the combined block groups for all races combined by primary cancer type using Baton Rouge Region cancer rates as the comparison. Table 12 in Appendix B, presents the results of the SIR analysis for the combined census block groups for whites, and Appendix B, Table 13 shows the results for African-Americans by primary cancer type using Baton Rouge Region cancer rates as the comparison. For white females, breast, non-Hodgkin's lymphomas, and all cancers combined were higher than expected when compared to the Baton Rouge Region. For African-American males and for all males, lung cancer occurs more frequently than expected when compared to the rates for the Baton Rouge Region.

With the exception of skin cancer, breast cancer is by far the most common cancer among women in the United States [20]. Genetic and environmental factors, as well as certain reproductive events play a role in development of breast cancer.

Lymphomas are usually classified as Hodgkin's disease or non-Hodgkin's lymphoma. An estimated 45,000 new cases of non-Hodgkin's lymphoma were diagnosed in the United States in 1994 [21]. The incidence of non-Hodgkin's lymphoma has been rising inexplicably. Non-Hodgkin's lymphomas are cancers that affect the white blood cells of the immune system. They are characterized by the abnormal growth of lymphocytes, the infection-fighting cells in the lymph nodes, spleen, and thymus. The tonsils, stomach, small intestine, and skin may also be affected. Primary lymphomas of the skin are extremely rare.

Risk factors for non-Hodgkin's lymphoma are largely unknown. Altered immune function, whether due to exposure to specific viruses or other causes, clearly puts people at higher risk [22, 23]. The long-term use of hair coloring products, or exposure to pesticides, nitrates, or other solvents has been associated with this disease. To date, chemicals of this nature have not been found at the Delatte Metals Site.

Cancer of the lung is the leading cause of cancer deaths for both men and women. Cigarette smoking is the major cause of lung cancer. People who work with asbestos have higher risk of getting lung cancer. A number of other occupational agents contribute to the incidence of lung cancer: mustard gas, chloromethyl ethers, nickel, inorganic arsenic and polycyclic aromatic hydrocarbons. Other risk factors for lung cancer are aging and lung scarring from some types of pneumonia.

This screening helps to identify unusual patterns of adverse health effects and direct future public health actions. However, no cause or reason for the differences in cancer rates can be determined by this type of review. The influence of established risk factors for each type of cancer was not evaluated.

VII. Site Update

To address contamination that posed an immediate health threat, an EPA Comprehensive Environmental Response Compensation and Liability Act emergency removal action occurred in 1996 and 1998. On January 3, 2000, the EPA completed the Remedial Investigation. The Human Health Risk Assessment and the Ecological Risk Assessment were completed on March 3 and 16, 2000, respectively. On May 19, 2000, the Feasibility Study report was completed. The EPA Record of Decision was signed September 26, 2000. EPA completed the Final Remedial Design implementation of the Site Remedy on January 29, 2001.

The Record of Decision specified excavation and off-site disposal of the most contaminated soils, a permeable treatment wall to neutralize the acid in subsurface soil and groundwater monitoring to ensure the effectiveness of the plan. The plan included institutional controls in the form of deed restrictions to be placed on the property to inform future owners and the public about contamination and acceptable uses of the site. The site, including off site areas, was remediated to meet several different future uses: industrial, residential and ecological.

As of March 2004, remedial activity for the entire Delatte Metals site has been completed. The levels of contaminants present in the *on-site surface and subsurface soils and off-site surface soils and sediments* at Delatte Metals formerly represented a *public health hazard*, but since the completion of remedial activity represent *no apparent public health hazard.*

VIII. Conclusions

1. On-site and off-site soil and sediment at the Delatte Metals Site posed a public health hazard, especially to children. Exposure to contaminated soils (surface and subsurface) could have occurred in the past. Since the completion of remedial activity, soil contamination poses no apparent public health hazard.

2. Although they possess small amounts of contamination, on-site shallow ground water and off site shallow ground water at the Delatte Metals site, pose no public health hazard.

3. Residential well water has been tested three times and no site related contaminants found. The pathway remains a future potential exposure pathway because of the remote chance that shallow groundwater contamination could migrate to deeper groundwater.

4. No data exists to determine the level of exposure to air contaminants when the smelter was operational. Therefore, in the past the air exposure pathway is considered an indeterminate public health hazard. Currently, the air exposure pathway poses a no apparent public health hazard because the site is abandoned and no remedial activities are occurring.

5. OPH analyzed the following specific types of cancer: bladder, breast, colorectal, lung, non-Hodgkin's lymphomas, ovarian, pancreatic, and prostate. The results indicated for white females, breast, non-Hodgkin's lymphomas, and all cancers combined were higher than expected when compared to the Baton Rouge Region. For African-American males and for all males, lung cancer occurs more frequently than expected when compared to the rates for the Baton Rouge Region (Tables 11, 12 and 13). Although these elevated cancers are not expected to be site related, no cause and effect relationship could be established.

IX. Recommendations

1. As EPA has addressed future land uses by placing deed restrictions on site property limiting use to industrial, city officials should adhere to this procedure and diligently inform current and future land owners on acceptable site uses.

2. In accordance with the procedure for five-year reviews, the EPA will review the remedy to ensure that it continues to be protective of human health and the environment. This information should be provided to involved government agencies to ensure the continued safety of public health.

X. Public Health Action Plan

The following is a description of actions already taken and those to be taken by the Office of Public Health (OPH), Section of Environmental Epidemiology and Toxicology and the Agency for Toxic Substances and Disease Registry (ATSDR) at the Delatte Metals Site and surrounding areas. The purpose of the public health action plan is to ensure that this public health assessment not only identifies public health hazards, but provides a plan of action to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances that are site-related. Included is a commitment on the part of OPH/ATSDR to follow up on these actions to ensure that they are implemented. The public health actions already implemented and planned for the future by OPH/ATSDR are as follows:

Past Actions

1. OPH had conducted site visits in March 1996, June 1999, May 2000, and November 2001. To keep abreast of current site conditions, In June 2002, OPH staff spoke with government officials from Tangipahoa Parish to ascertain that site conditions remained the same.

2. OPH conducted a door-to-door community outreach to offer lead poisoning health education and inform residents of free blood lead testing. This activity was completed in April 1996.

3. Free blood lead testing was provided at the Tangipahoa Parish Health Unit from November 1996 to June 1997. Parents of children tested were referred back to the Health Unit or to their private physician for follow-up.

4. OPH attended community meeting in September 1998.

5. OPH assisted EPA in administering community interviews in October 1998.

Actions Planned

1. If conditions on the site change from those evaluated in this public health assessment, the Office of Public Health will revisit its conclusions with respect to the public health hazards present on the site.

2. OPH will encourage private well owners to use municipal water for drinking and cooking.

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25. Environmental Protection Agency, Office of Solid Waste, Directive #9355.4-12. Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. August 1994.

XII. CERTIFICATION

This Delatte Metals 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 existing at the time the public health assessment was begun. Editorial review was completed by the cooperative agreement partner.

Technical Project Officer, Cooperative Agreement Team (CAT), Superfund and Program Assessment Branch (SPAB), Division of Health Assessment and Consultation (DHAC), ATSDR

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

Team Leader, Cooperative Agreement Team, SPAB, DHAC, ATSDR

APPENDICES

Appendix A
Figures 1 and 2

Appendix B
Tables

Table 1. Population Distribution by Race and Sex

	Caucasian American		African American		Other American		Total	Median Family Income	Median Household Income
	Female	Male	Female	Male	Female	Male			
Ponchatoula	1,738	1,545	1,144	968	12	18	5,425	16,563	12,992
Tangipahoa Parish	31,179	29,422	13,246	11,281	328	253	85,709	20,984	16,849
Census Tract 9548	1585	1473	493	410	18	14	3993	19,508	15,670

Source: 1990 U.S. Census data.

Table 2. Population Distribution by Age Groups.

	Age in Years								
	<5	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75>
Ponchatoula	401	1,068	688	780	764	456	521	433	314
Tangipahoa Parish	6,649	15,193	14,579	13,072	12,010	7,935	6,736	5,421	4,114
Census Tract 9548	304	714	538	558	567	389	373	372	223

Source: 1990 U.S. Census data

Table 3. Interpretation of Blood Test Results and Follow-Up Activities

Blood Lead Concentration	Comments
≤ 9 µg/dL	Child is not considered to be lead-poisoned
10–14 µg/dL	A large proportion of children with blood lead levels in this range should trigger community-wide childhood lead poisoning prevention activities. Children with blood lead levels in this range need to be re-screened more frequently and receive nutrition and education interventions.
15–19 µg/dL	Child should receive nutritional and educational interventions and more frequent screening. If the blood lead level persists in this range, an environmental investigation and intervention should be done.
20–44 µg/dL	Child should receive environmental evaluation and remediation and a medical evaluation. A child with this blood lead level may need pharmacologic treatment for lead poisoning.
45–69 µg/dL	Child will need both medical and environmental interventions, including chelation therapy.
≥70 µg/dL	Child is a medical emergency. Medical and environmental management must begin immediately.

Source: Lead Exposure Guidelines. Missouri Department of Health/Childhood Lead Poisoning Prevention Program. Recommendations based on CDC Preventing Lead Poisoning in Young Children, October 1991 [24].

Table 4. Concentration Range of Chemicals of Concern Found in On-site Soil. Delatte Metals, Tangipahoa Parish Louisiana. Remedial Investigation January 2000.

Constituent	Depth (ft bgs)*	Frequency of Detection	Minimum (mg/kg)†	Maximum (mg/kg)	Comparison Value
Antimony	0 – 1 1 – 2	30/58 61/111	1.3 1.3	1860 1870	20 (child RMEG)‡
Arsenic	0 — 1 1 — 2	53/58 90/111	1.2 1.1	2100 277	20 (child EMEG)§
Cadmium	0 – 1 1 — 2	19/58 25/111	0.503 0.62	199 36.4	10 (child EMEG)
Lead	0 - 1 1 - 2	56/58 98/111	5.18 3.3	185000 96800	400 (EPA [25])¶

* feet below ground surface
† milligram per kilogram
‡ Reference Dose Media Evaluation Guide
§ Environmental Media Evaluation Guide
¶ Environmental Protection Agency

Table 5. Concentration Range of Chemicals of Concern Found in Shallow Groundwater Delatte Metals, Tangipahoa Parish Louisiana. Remedial Investigation January 2000.

Constituent	Maximum (µg/L)	Comparison Value (µg/L)*
Aluminum	4,160,000	20,000 (EMEG)†
Antimony	350	6 (MCL)‡
Beryllium	169	4 (MCL)
Cadmium	4,740	2 (EMEG)
Lead	2,190	15 (EPA Action Level)
Nickel	6,100	100 (LTHA)§
Vanadium	3,610	30 (EMEG)
Zinc	11,200	3000 (EMEG)

* micrograms per liter
† Environmental Media Evaluation Guide
‡ Maximum Contaminant Level
§ Lifetime Health Advisory

Table 6. Concentration Range of Chemicals of Concern Found in Off-site Soil West of the Site. Delatte Metals, Tangipahoa Parish Louisiana. Remedial Investigation January 2000.

Constituent	Depth (ft bgs)*	Frequency of Detection	Minimum (mg/kg)†	Maximum (mg/kg)	Comparison Value (mg/kg)
Antimony	0 – 1 1 – 2 2 – 3	33/95 14/95 13/95	0.33 0.32 0.33	56.20 38.90 6.20	20 (child RMEG)‡
Arsenic	0 –- 1 1 –- 2 2 – 3	94/95 91/95 88/95	0.50 0.44 0.51	60.1 6.8 7.2	20 (child EMEG)§
Cadmium	0 – 1 1 – 2 2 – 3	49/95 45/95 35/95	0.05 0.04 0.05	55.7 1.3 3.3	10 (child EMEG)
Copper	0 – 1 1 – 2 2 – 3	94/95 93/95 93/95	0.54 0.49 0.41	74.3 19.8 18.7	20 (EPA Region 6 Background)
Lead	0 – 1 1 – 2 2 – 3	95/95 95/95 95/95	4.9 2.7 1.8	635 102 122	400 (EPA [25])¶

* feet below ground surface
† milligram per kilogram
‡ Reference Dose Media Evaluation Guide
§ Environmental Media Evaluation Guide
¶ Environmental Protection Agency

Table 7. Average Concentration of Chemicals of Concern Found in Sediment Delatte Metals, Tangipahoa Parish Louisiana. Remedial Investigation January 2000.

	Constituent	Minimum (mg/kg)*	Maximum (mg/kg)	Comparison Value (mg/kg)
Ditch	Arsenic	0.77	51.85	20 (child EMEG)†
	Cadmium	1.25	94.85	10 (child EMEG)
	Copper	1.14	213	20 EPA‡ Region 6 Background
	Lead	5.5	17,680	400 (EPA)
Swamp	Copper	10.65	29.30	20 EPA Region 6 Background
	Lead	38.3	1,375	400 (EPA)

* - micrograms per kilogram
† - Environmental Media Evaluation Guide
‡ - Environmental Protection Agency

Table 8. Concentration Range of Chemicals of Concern Found in Surface Water Delatte Metals, Tangipahoa Parish Louisiana. Remedial Investigation January 2000.

	Constituent	Frequency of Detection	Minimum (µg/L)*	Maximum (µg/L)	Comparison Value (µg/L)
Creek	Cadmium	7/8	1.2	3.5	2 (EMEG)†
	Lead	8/8	5.5	17.3	15 (EPA Action Level)‡
Ditch	Cadmium	7/7	1.5	189	2 (EMEG)
	Lead	7/7	99.4	3050	15 (EPA Action Level)
Swamp	Cadmium	3/3	0.71	3.5	2 (EMEG)
	Lead	3/3	15.10	658	15 (EPA Action Level)

* microgram per liter
† Environmental Media Evaluation Guide
‡ Environmental Protection Agency

Table 9. Completed Exposure Pathways

Pathway Name	Exposure Pathway Elements					Time
	Source	Environmental Media	Point of Exposure	Route of Exposure	Exposure Population	
Surface Soil	Delatte Metals	Surface Soil	On-site soil \Off-site soil	Incidental ingestion, inhalation	Delatte Metals/ Ponchatoula Battery worker	Past
					On-site trespasser Off-site resident Off-site fisher	Past
Sediment	Delatte Metals	Sediment	Off-site fishing Off-site water contact Wading	Incidental ingestion	Off-site resident Off-site fisher	Past
Surface Water	Delatte Metals	Surface water Sediment	On-site surface water Off-site Selsers Creek	Incidental ingestion	Off-site resident Worker Trespasser	Past
Subsurface Soil	Delatte Metals	Air Soil	On-site soil during excavation	Incidental ingestion, Inhalation	On-site worker	Past Present Future
Air	Smelter emissions	Air	On-site air	Inhalation	Delatte Metals/ Ponchatoula Battery worker Off-site resident	Past
	Airborne particulates	Air	Off-site air	Inhalation	Resident	Future
Shallow Groundwater	Delatte Metals	Shallow groundwater	Off-site shallow groundwater Discharge to surface water	Incidental ingestion	Off-site resident On-site trespasser	Past Present Future

Table 10. Potential Exposure Pathways

Pathway Name	Exposure Pathway Elements					Time
	Source	Environmental Media	Point of Exposure	Route of Exposure	Exposure Population	
Residential well water	Delatte Metals	tap water	Tap	Ingestion	Resident	Future

Table 11. Standardized Incidence Ratios (SIR) for Census Blocks Near the Delatte Metals Site (1988-1996). Comparison of Observed and Expected Cancer Incidence Using Louisiana Region II Rates (1988–1992). All Races.

Cancer Type	Sex	Cases		SIR	p-value
		Observed	Expected		
All Cancers	Male	60	52.1	1.15	0.27
	Female	56	47.9	1.17	0.24
Bladder	Male	3	2.70	1.11	0.86
Breast	Female	19	13.6	1.40	0.14
Colorectal	Male	7	5.49	1.28	0.52
	Female	6	6.67	0.90	0.80
Lung	Male	20*	11.35	1.76	0.01
	Female	7	6.78	1.03	0.93
Non-Hodgkin's Lymphomas	Male	4	1.66	2.41	0.07
	Female	4	1.82	2.20	0.11
Ovarian	Female	4	1.85	2.16	0.11
Pancreatic	Male	3	1.25	2.39	0.12
	Female	4	1.84	2.18	0.11
Prostate	Male	10	18.2	0.64	0.15

* Statistically elevated at the $p<0.05$ level.

Table 12. Standardized Incidence Ratios (SIR) for Census Blocks Near the Delatte Metals Site (1988-1996). Comparison of Observed and Expected Cancer Incidence Using Louisiana Region II Rates (1988-1992). Whites.

Cancer Type	Sex	Cases		SIR	p-value
		Observed	Expected		
All Cancers	Male	43	37.7	1.14	0.39
	Female	49*	35.0	1.40	0.02
Bladder	Male	3	2.34	1.28	0.67
Breast	Female	17*	10.4	1.63	0.04
Colorectal	Male	7	4.04	1.73	0.14
	Female	5	4.90	1.02	0.96
Lung	Male	11	8.21	1.33	0.01
	Female	4	5.22	0.76	0.59
Non-Hodgkin's Lymphoma	Male	3	1.38	2.17	0.17
	Female	4*	1.53	2.62	0.04
Prostate	Male	6	10.9	0.55	0.13

* Statistically elevated at the $p<0.05$ level.

Table 13. Standardized Incidence Ratios (SIR) for Census Blocks near the Delatte Metals Site (1988-1996). Comparison of Observed and Expected Cancer Incidence Using Louisiana Region II Rates (1988-1992). African-Americans.

Cancer Type	Sex	Cases		SIR	p-value
		Observed	Expected		
All Cancers	Male	17	13.97	1.21	0.41
	Female	7	12.60	0.56	0.11
Lung	Male	9*	3.09	2.91	0.00
	Female	3	1.63	1.84	0.28
Prostate	Male	4	4.63	0.86	0.77

* Statistically elevated at the $p<0.05$ level.
"Statistical significance" for this review means that there is a less than five percent chance (p-value <0.05) that the observed difference is merely the result of random fluctuation in the number of observed cancer cases.

Appendix C
List of Acronyms/Definitions

List of Acronyms

ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
CREG	Cancer Risk Evaluation Guide
CV	Comparison Values
EMEG	Environmental Media Evaluation Guides
EPA	Environmental Protection Agency
ESI	Expanded Site Investigation
LDEQ	Louisiana Department of Environmental Quality.
LTR	Louisiana Tumor Registry
MCL	Maximum Contaminant Level
MRL	Minimal Risk Level
NOAEL	No Observed Adverse Effect Level
NPB	North Ponchatoula Battery
NPL	National Priorities List
LDHH	Louisiana Department of Health and Hospitals
LTR	Louisiana Tumor Registry
OPH	Office of Public Health
OSHA	Occupational Health and Safety Administration
PAHs	Polycyclic Aromatic Hydrocarbon
RDA	Recommended Daily Allowances
RfD	Reference Dose
RMEG	Reference Dose Media Evaluation Guide
RP	Robertson's Property
RI/FS	Remedial Investigation/Feasibility Study
SEET	Section of Environmental Epidemiology and Toxicology
SI	Site Investigation
SIR	Standard Incidence Ratio
SVOCs	Semi-volatile Organic Compounds
TPH	Total Petroleum Hydrocarbons
VOCs	Volatile Organic Compounds

Definitions of Selected Terms

ATSDR
The Agency for Toxic Substances and Disease Registry. The ATSDR is a federal health agency in Atlanta, Georgia that deals with hazardous substances and waste site issues. ATSDR gives people information about harmful chemicals in their environment and tells people how to protect themselves from coming into contact with chemicals.

Background Level
A typical or average level of a chemical in the environment. *Background* often refers to naturally occurring or uncontaminated levels.

Cancer Risk Evaluation Guides (CREGs)
CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million (10^{-6}) persons exposed over their lifetime. ATSDR's CREGs are calculated from the U.S. EPA's cancer potency factors (CPFs).

Comparison Values
Estimated contaminant concentrations in specific media that are not likely to cause adverse health effects, given a standard daily ingestion rate and standard body weight. The *comparison values* are calculated from the scientific literature available on exposure and health effects.

Concentration
The amount of one substance dissolved or contained in a given amount of another. For example, sea water contains a higher concentration of salt than fresh water.

Contaminant
Any substance or material that enters a system (the environment, human body, food, etc.) where it is not normally found.

Dermal
Referring to the skin. *Dermal* absorption means absorption through the skin.

Dose
The amount of a substance to which a person is exposed. *Dose* often takes body weight into account.

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 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 milligrams per kilogram per day that is likely to be without noncarcinogenic health effects over a specified duration of exposure to include acute, intermediate, and chronic exposures.

EPA
U.S. Environment Protection Agency. The federal agency that develops and enforces environmental laws to protect the environment and the public's health.

Exposure
Contact with a chemical by swallowing, by breathing, or by direct contact (such as through the skin or eyes). *Exposure* may be short term (acute) or long term (chronic).

Ingestion
Swallowing (such as eating or drinking). Chemicals can get in or on food, drink, utensils, cigarettes, or hands where they can be ingested. After *ingestion*, chemicals can be absorbed into the blood and distributed throughout the body.

Inhalation
Breathing. Exposure may occur from inhaling contaminants because they can be deposited in the lungs and absorbed into the blood.

Media
Soil, water, air, plants, animals, or any other parts of the environment that can contain contaminants.

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) consuming 2 liters of water per day.

Minimal Risk Level (MRL)
An *MRL* is defined as an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (noncancer) over a specified duration of exposure. *MRLs* are derived when reliable and sufficient data exist to identify the target organ(s) of effect or the most sensitive health effect(s) for a specific duration via a given route of exposure. *MRLs* are based on noncancer health effects only. *MRLs* can be derived for acute, intermediate, and chronic duration exposures by the inhalation and oral routes.

National Priorities List (NPL)
The U.S. Environmental Protection Agency's (U.S. EPA) listing of sites that have undergone preliminary assessment and site inspection to determine which locations pose immediate threat to persons living or working near the release. These sites are most in need of cleanup.

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).

PRP
Potentially Responsible Party. A company, government or person that is responsible for causing the pollution at a hazardous waste site. PRP's are expected to help pay for the clean up of a site.

Public Health Assessment
The evaluation of data and information on the release of hazardous substances into the environment in order to assess any current or future impact on public health, develop health advisories or other recommendations, and identify studies or actions needed to evaluate and mitigate or prevent human health effects, also the document resulting from that evaluation.

Public Health Hazard
This public health conclusion category is used for sites that pose a public health hazard due to the existence of exposures to hazardous substances or conditions that could result in adverse health effects.

Reference Dose Media Evaluation Guides (RMEGs)
ATSDR derives RMEGs from U.S. EPA's 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.

Risk
In risk assessment, the probability that something will cause injury, combined with the potential severity of that injury.

Route of Exposure
The way in which a person may contact a chemical substance. For example, drinking (ingestion) and bathing (skin contact) are two different *routes of exposure* to contaminants that may be found in water.

Superfund
Another name for the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), which created ATSDR.