

Health Consultation

VEGA BAJA SOLID WASTE DISPOSAL SITE
ASSESSMENT OF ORGANIC AND INORGANIC CHEMICALS IN THE
DRAINAGE DITCH'S SEDIMENT

VEGA BAJA, PUERTO RICO

EPA FACILITY ID: PRD980512669

MARCH 28, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation 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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Prepared by:
Puerto Rico Department of Health
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
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February 26, 2005

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List of Abbreviations

| | |
|----------|---|
| ATSDR | Agency for Toxic Substances and Disease Registry |
| CEL | Cancer Effect Level |
| CERCLA | Comprehensive Environmental Response Compensation and Liability Act |
| CLP | Contract Laboratory Program |
| CREG | Cancer Risk Evaluation Guide |
| CV's | comparison values |
| DHHS | Department of Health and Human Services |
| ED | Exposure Dose |
| EF | Exposure Factor |
| EMEG | Environmental Media Evaluation Guide |
| EPA | U.S. Environmental Protection Agency |
| ERS | Emergency Response Section |
| ESI | Expanded Site Inspection |
| IARC | International Agency for Research on Cancer |
| kg | kilogram |
| Km | kilometer |
| LOAEL | Lowest Observed Adverse Effect Level |
| mg | milligram |
| MRL | minimal risk level |
| NPL | National Priorities List |
| NTP | National Toxicological Program |
| PA | Preliminary Assessment |
| PCB | polychlorinated biphenyl |
| PHA | public health assessment |
| ppb | parts per billion |
| ppm | parts per million |
| PR BRFSS | Puerto Rico Behavioral Risk Factor Surveillance System |
| PRASA | Puerto Rico Aqueduct and Sewer Authority |
| PRCAP | Puerto Rico Cooperative Agreement Project |
| PRDOH | Puerto Rico Department of Health |
| PREQB | Puerto Rico Environmental Quality Board |
| PRHD | Puerto Rico Housing Department |
| PRLA | Puerto Rico Land Authority |
| RfD | Reference Dose |
| RI/FS | Remedial Investigation and Feasibility Study |
| START | Superfund Technical Assistance and Response Team |
| sec | second |
| SI | Site Inspection |
| SVOC | semi-volatile organic compound |
| VOC | volatile organic compound |

Background and Statement of Issues

CDM Federal Programs Corporation (CDM) under the Response Action Contract (RACII) Program, performed a Remedial Investigation (RI) and Feasibility Study (FS), for the United States Environmental Protection Agency (EPA), Region II at the Vega Baja Solid Waste Disposal Site, Vega Baja, Puerto Rico. The purpose of this RI report was to present the results of the field investigations at the site. The goal of this investigation was to define the nature and extent of site-related contamination in groundwater, nearby public supply wells, springs/seeps, river and drainage ditch sediment, and surface water, and to define the hydro-geologic framework of the site.

The Environmental Protection Agency (EPA) asked the Puerto Rico Program to Conduct and Coordinate Site Specific Activities to evaluate the data obtained on the RI for organic and inorganic chemicals detected in the drainage ditch's sediment. The EPA wanted to know whether exposures to sediment's contaminants are occurring and if health effects could result from exposures to the contaminants. The Puerto Rico Department of Health (PRDOH) prepared this Health Consultation (HC) under its cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) to answer those questions.

Site Description and History

The Vega Baja Solid Waste Disposal Site is a 72-acre, inactive, unlined and uncapped solid waste disposal facility located in the area of the Rio Abajo Ward, Vega Baja, Puerto Rico. The site consists of a residential area known as Brisas del Rosario, which is south of Route 22 and east of Avenue Trio Vegabajeño, terminating on Calle Progreso to the east and woodland to the south. The site was proposed for the National Priorities List (NPL) on April 22, 1999, and it was listed on July 22, 1999. The site is located approximately 1.2 miles south of the town of Vega Baja. From approximately 1948 to 1979, the municipality of Vega Baja operated the landfill. Commercial, industrial, and domestic wastes were dumped and or open-burned at the site.

The site has a drainage ditch which at the time of the site visits was heavily covered with grass. The ditch is located to the south of the community, crossing through one of the streets in the community (Altura Road). The ditch directs storm water from the site to Río Indio. This ditch is very close to two rows of homes in the community, and is beside Altura Road, one very busy street in the community. Members of the community use this street to get to their destinations (work, school, market, visit some neighbor, etc.) by walking, and children had been seeing playing on the ditch.

People began constructing homes on the site and moving to the landfill during the 1970s. Currently, over 200 homes spread over nearly 55 acres at the site. Debris mounds greater than 10 feet wide can be observed in some yards of the site. Some homes have a backyard garden typically containing fruits, root crops, and legumes. In addition, some

households rear farm animals such as chickens, goats, pigs, and rabbits. Over 2,000 people live within a one-mile radius of the site, and more than 40,000 people live within a four-mile radius. The 17 unoccupied acres (wooded area) of the site, owned by the Puerto Rico Land Authority (PRLA), are undeveloped and overgrown with vegetation. In 1979, the PRLA transferred the ownership of the residential area of the site to the Puerto Rico Housing Department (PRHD). The PRHD provided property titles to some of the community members of the site.

In May of 1994, Puerto Rico Environmental Quality Board (PREQB) conducted a Site Inspection (SI) at the site. During the SI, five sediment samples were collected, two from locations along the site drainage ditch and three from locations on the Río Indio. In the sediment samples the organics found were acetone, 2-butanone, tetrachloroethylene and toluene. The inorganics detected were aluminum, arsenic, chromium, copper, lead, mercury, nickel and zinc.

From June until August 1996, an Expanded Site Inspection (ESI) was conducted by the PREQB and the EPA Superfund Technical Assistance and Response Team (START). As part of the ESI, three sediment samples were collected from the site drainage ditch. In the sediment samples analytical results indicate the presence of aluminum, arsenic, chromium, copper, lead, mercury, nickel and zinc. No organic compounds of significance were detected in the surface water samples.

The EPA conducted a Remedial Investigation in which sediment samples were collected in the drainage ditch that directs stormwater from the site to the Río Indio in order to define the potential for offsite contaminant migration. Also, surface water and groundwater samples were collected during the RI. This HC evaluates the sediment data. The data for surface water and ground water is evaluated in separate documents.

Site Visits and Community Concerns

The Puerto Rico Cooperative Agreement Project (PRCAP) has visited the community on several occasions to collect and respond to community concerns. Specifically, PRCAP visited the Brisas del Rosario community in September 2002, December 2002, January 2003, June 2003, August 2003, September 2003, December 2003 and April 2004.

PRCAP visited the community in September 2003 in response to a resident's report and concern regarding flooding of their homes with contaminated water. At that time the drainage ditch was full from recent rains. Residents were concerned that their homes would flood (as had happened in the past) and that chemicals found on the ditch would contaminate their homes. Following the visit, the PRCAP made a referral to the Environmental Health Program of the PRDOH.

To summarize, relative to sediments, community members are concerned about the possibility of exposure to the contaminants in the drainage ditch. Specially, they are concerned about the possible exposure of their children, given the fact that they

sometimes play on the ditch. The community members were also concerned that by doing part of their outside house work they can be exposed to some contaminants when working in the ditch (e.g., trimming the grass.)

Demographics and Land Use

The site is located approximately 1.2 miles south of the town of Vega Baja, a place known as Brisas del Rosario. It is surrounded by residential areas to the north, east and west and is bordered by mogotes (conical limestone hills) to the south. There is a baseball park and a Head Start School (The Río Abajo Head Start) located approximately 0.21 miles from the site. Also the community has two churches. It is estimated that 2,280 people live within one-quarter mile radius, while 6,871 people live within one mile of the site. Based on the Census 2000 data the total population of Vega Baja is 61, 929 in 2000, making the average population density for the municipality 1,349.5 people per square mile.

There are approximately 214 dwellings on the 55 residential acres of the Brisas del Rosario Community. The average household of Vega Baja is 3.07 so the estimated population at the site is 657 (CDM, 2003).

Data/Discussion

Environmental contamination-Drainage Ditch

Along the drainage ditch of the community ten sampling points, from SD1 to SD10, to collect sediment samples, were selected (see Appendix A, Table 1A). CDM completed two rounds of sampling (in which collected 20 samples). The first one was conducted from October 23 through 25, 2001. The second round was conducted from May 22 through 23, 2002 (CDM 2003). Sediment samples were collected from all locations except the Rio Indio intake (SD10) (see Appendix B, Figure 1).

The PRCAP staff compared the concentrations of the inorganic contaminants, volatile organic compounds, semi volatile organic compounds, pesticides and polychlorinated biphenyls (PCBs) detected in the drainage ditch's sediment with the environmental guideline or the comparison values (CVs) and or the Cancer Classes. The CVs for soil were used as screening tools to determine whether a contaminant should be further evaluated. It is important to take into consideration that the CVs presuppose incidental ingestion of soil by individuals. CVs are quite conservative and include ample uncertainty factors that account for most sensitive populations. Because comparison values are based on extremely conservative assumptions, the presence of a contaminant at concentrations greater than comparison values does not necessarily suggest that exposure to the contaminant will result in adverse health effects.

The levels of the volatile organic compounds, the semi volatile organic compounds, the pesticides and of the polychlorinated biphenyls (PCB) detected in the drainage ditch's sediment were all below their respective CVs.

Arsenic was slightly above the child Environmental Media Evaluation Guide (EMEG) in one of the samples. The detected concentration was 20.2 parts per million (ppm) at SD-5-R2-Dup. The child EMEG is 20 ppm. The EMEG is a guideline for non carcinogenic effects. All the arsenic levels detected in the samples collected were above the Cancer Risk Evaluation Guide (CREG). Sediment sampling data from the drainage ditch identified arsenic concentrations that ranged from 1.9 ppm to 20.2 ppm. The CREG for arsenic is 0.5 ppm.

Lead does not have a comparison value. The PRCAP used the EPA guidelines. The EPA standards are intended to protect children from hazards posed by lead. Under the standard lead is considered a hazard if there are greater than 400 ppm of lead in bare soil in children's play areas or 1,200 ppm average for bare soil in the rest of the yard. (EPA, 1996). The highest concentration of lead (1,180 ppm) was found in sampling point SD4. This was the only sample with lead concentrations above the EPA's guidelines.

Arsenic and lead will be the only inorganic contaminants that will be further evaluated since the rest of the metals were all below their respective CVs.

Exposure pathways analyses

This section summarizes the exposure pathways to sediments at the drainage ditch associated with the Vega Baja Solid Waste Disposal Site. Exposure pathways are studied to understand the different ways that people might come in contact with the contaminants of concern. The exposure pathways evaluation determine if, when, where and how anyone might come into contact with the environmental media under study.

Some residents of the community can be exposed to the detected concentrations of the contaminants in the sediment of the drainage ditch. The adult male residents of the homes in front of the drainage ditch used to clean the yard, including the area of the drainage ditch several times every month. Also, some municipality workers used to clean the area of the drainage ditch. The greatest concern would be for children who play in the drainage ditch. Some children tend to eat non-food items. This behavior, called pica, generally occurs in a small segment of the population and often in younger children. We have no knowledge of pica children residing in the community. If there were pica children in the community, they would probably be exposed the drainage ditch occasionally rather than daily. Such exposures would not be expected to result in a health effect.

Exposure may result from dermal contact with the soil or by inhaling the dust and then swallowing after mucociliary transport up out of the lungs. The contaminants may be tracked into the houses and other members of the family may be exposed. Children may be exposed while crawling or playing on the floor.

Public health implications

The exposure to chemical substances does not always result in harmful health effects. The type and severity of the health effects expected to occur depend on the chemical concentration, the frequency and duration of exposure, the route or pathway of exposure and the multiplicity of exposure. The PRCAP estimated exposure doses for arsenic. The exposure doses were estimated using site specific exposure assumptions (Appendix C).

Arsenic

The United States Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and EPA have independently determined that arsenic is carcinogenic to humans.

The PRCAP estimated the theoretical excess cancer risk for adults (5.58^{-5}) and for the children younger than 18 years (7.89^{-4}). The results obtained for the estimated cancer risk for the two age groups evaluated indicate that the toxicology literature should be carefully reviewed before making conclusions about potential cancer risk.

The Cancer Effect Level (CEL) is the lowest exposure level associated with the onset of carcinogenesis in experimental or epidemiologic studies. Several studies estimated CELs in exposed humans to arsenic through ingestion. A study evaluated the chronic exposure to arsenic through ingestion for 16 years and reported a CEL for basal cell and squamous cell carcinomas of the skin, small cell and squamous cell carcinoma of the lung of 0.04 mg/kg/day (Luchtrath, 1983 as cited in ATSDR, 2000).

A CEL of 3.67 mg/kg/day was estimated for bladder cancer based in a study of a cohort of 478 patients treated with Fowler's solution (potassium arsenite) in Lancashire, England. A significant excess of bladder cancer mortality occurred (observed/expected ratio = 5 / 1.6; $p = 0.05$). The exposure duration ranged from two weeks to 12 years (Cuzick et al. 1992 as cited in ATSDR, 2000).

It is not expected that the daily exposure to the maximum concentration of arsenic detected in sediment (20.2 ppm) will result in cancer, since the exposure doses estimated for the two groups evaluated (adults and children younger than 18 years) are several orders of magnitude below the levels associated with cancer in the studies reviewed. It is important to mention that only one sampling point had an arsenic concentration of 20.2 ppm, however to be conservative the PRCAP used this concentration to estimate the exposure doses.

The Minimal Risk Level (MRL) for arsenic is 0.0003 mg/kg/day (Table 1). The exposure doses for the children younger than 18 years (0.000526 mg/.kg/day) were slightly above the MRL. For these reason, several scientific studies on non cancer effects were reviewed.

The exposure doses for arsenic that caused adverse health effects in the studies reviewed were above the estimated exposure doses for the adults and the children younger than 18 years of age residents of Brisas del Rosario in Vega Baja. The PRCAP was conservative in the exposure dose calculation since the maximum concentration detected for arsenic was used for the estimation even when that concentration was the only one above the CV. The other levels detected along the drainage ditch were below the CV.

According to the evidence from the scientific literature and the fact that exposure is intermittent and that the contamination with arsenic is not wide spread it is unlikely that the exposure (through ingestion) to the concentrations of arsenic detected in the drainage ditch's sediment provoke an adverse health effect.

Dermal exposure to arsenic is usually not of concern because only a small amount will pass through the skin into the body (4.5% of inorganic arsenic in soil, Wester et al. as cited in ATSDR, 2000). Direct skin contact is not likely to result in any serious internal effects.

Table 1. Estimated exposure doses compared to health guidelines

| Contaminant | Type of population | Estimated exposure dose (mg/Kg/day) | Maximum concentration detected (ppm) | Oral health guideline (mg/Kg/day) | Basis for health guidelines |
|--------------------|---------------------------|--|---|--|------------------------------------|
| Arsenic | Adults | 0.0000372 | 20.2 | 0.0003 | Chronic MRL |
| | Children < 18 years | 0.000526 | | | |

Lead

The scientific literature reviewed is based on environmental data for soil contamination with lead and its health effects, since no scientific literature is available for contaminated sediment and its impact on the public health. The PRCAP evaluated scientific literature on the relationship between soil lead levels and blood lead levels and subsequently evaluated the literature on the association of blood lead levels and health effects. This approach was used since a great deal of the human health effects data are expressed in terms of blood lead levels rather than exposure dose.

McMichael et al. (1985) evaluated approximately 600 children up to four years to determine the relationship between the lead levels in soil and the blood lead levels. Blood lead levels were higher in children living in the areas with the most elevated lead levels in soil. Children living in areas with soil lead levels higher than 1,000 ppm had blood lead levels up to 35 µg/dl. Children in the residential area with soil lead levels of 500-1,000 ppm, had blood lead levels up to 28 µg/dl. Lanphear et al. (1998) found that

an increase in the soil lead level of 400 ppm was related with an increase in the blood lead levels of 2 µg/dl. 12.20% of the children had blood lead levels higher than 10 µg/dl (Centers for Disease Control and Prevention standard) when the soil lead levels were higher than 400 ppm.

The lead levels detected along the drainage ditch were low (2.9 ppm – 150 ppm). Only one sample was above the EPA standard (400 ppm). It is unlikely that the residents would consistently be exposed to the high level detected at the sampling point four (SD-4) so it is unlikely that exposure to lead in the drainage ditch will increase the blood lead levels for residents of Brisas del Rosario.

Children's Health Considerations

Children are not small adults. They differ from adults in their exposures and may differ in their susceptibility to hazardous chemicals. Children's unique physiology and behavior can influence the extent of their exposure. Vulnerability often depends on developmental stage. There are critical periods of structural and functional development during both prenatal and postnatal life and a particular structure or function will be most sensitive to disruption during its critical period(s). Damage may not be evident until a later stage of development (ATSDR, 2000).

Children are at greater risk of health effects from exposures to hazardous substances than are adults because 1) children play outside more often than adults (increasing the likelihood of contact with chemicals in the environment); 2) children are shorter than adults and more likely to be exposed to soil, dust, and heavy vapors close to the ground; 3) children are smaller than adults and their exposures would result in higher doses of chemical per body weight; and 4) children's developing body systems can sustain damage if toxic exposures occur during certain growth stages, 5) children depend completely on adults for risk identification and management decisions, housing decisions and access of medical care.

The PRCAP evaluated how the children of Brisas del Rosario might be affected by the types and quantities of chemicals detected in the sediment samples. The chemical's concentrations detected in the drainage ditch's sediment do not represent a health hazard for the children.

Conclusions

This HC evaluated the exposure to contaminants detected in the drainage ditch in the Brisas del Rosario community (Vega Baja Solid Waste Disposal Site) and the potential for adverse health effects. The PRCAP concluded that:

- ❖ Adverse health effects are not expected from exposure to the concentrations of the chemicals evaluated (volatile organic compounds, semi volatile organic

compounds, pesticides and metals) in the drainage ditch's sediment. These exposures pose no apparent public health hazard.

Recommendations

- ❖ No recommendations at this time.

Public Health Action Plan

Actions completed

- ❖ Health fair in the community
- ❖ Presentation to the community of the health fair blood tests results. The information was posted as a poster presentation in the churches of the community and some business visited by the community members.
- ❖ Several meetings with community leaders.
- ❖ Repository at the Vega Baja library.
- ❖ Meetings to identify community concerns with representatives from state and federal agencies and community members: EPA, EQB, professors of the University of Puerto Rico, librarian, priest, minister of the protestant church, business owners.

Actions underway

- ❖ Update of the health education needs assessment.
- ❖ Update of the health education plan.
- ❖ Development of site specific educational materials: fact sheets, activity and coloring books.

Actions planned

- ❖ The PRCAP will review new environmental data from the drainage ditch's sediment as it became available and modify the conclusions of this HC as necessary.
- ❖ The PRCAP will implement the health education plan.

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Puerto Rico Behavioral Risk Factor Surveillance System. 2001-2002.

APPENDIX A

Table 1A. Characteristics of the sampling locations.

| Sampling Location | Description of Sampling Location |
|--------------------------|--|
| SD 1 | Located in a drainage ditch in the Villa Piñares neighborhood to provide site background data from an area unaffected by the disposal site. |
| SD 2 | Located in a drainage ditch at a corner of Alturas and Trio Vegabajeño to characterized the impact of suspected soil waste disposal burn areas on sediment quality. |
| SD 3 | Located in a drainage ditch hydraulically downgradient from the church on Alturas to characterize the downgradient extent of contamination. |
| SD 4 | Located in a drainage ditch at the corner of Alturas and Principal to Characterized the sediment quality upstream of the baseball field. |
| SD 5 | Located in a drainage ditch downstream from the baseball field to characterized the extent of contamination in the residential area. |
| SD 6 | Located in the drainage ditch where it crosses the Río Indio flood plain to assess contamination in the lower reaches of the drainage ditch. |
| SD 7 | As DS 6 is also located in the drainage ditch where it crosses the Río Indio flood plain to assess contamination in the lower reaches of the drainage ditch. |
| SD 8 | Located in the Río Indio, upstream from the drainage ditch's probable point of entry into the Río Indio to characterize background conditions in the river. |
| SD 9 | Located in the Río Indio, at the drainage ditch's probable point of entry into the Río Indio, to characterize the extent of site related surface water and sediment contamination. |
| SD 10 | Located at the Puerto Rico Aqueduct and Sewer Authority (PRASA) Río Indio Water Treatment Plant intake downstream to characterize the potential impacts of site contamination and to define the downstream extent of site related contamination. |

APPENDIX B

File Path: C:\Vega_Baja\vega_baja_working_mw.dwg

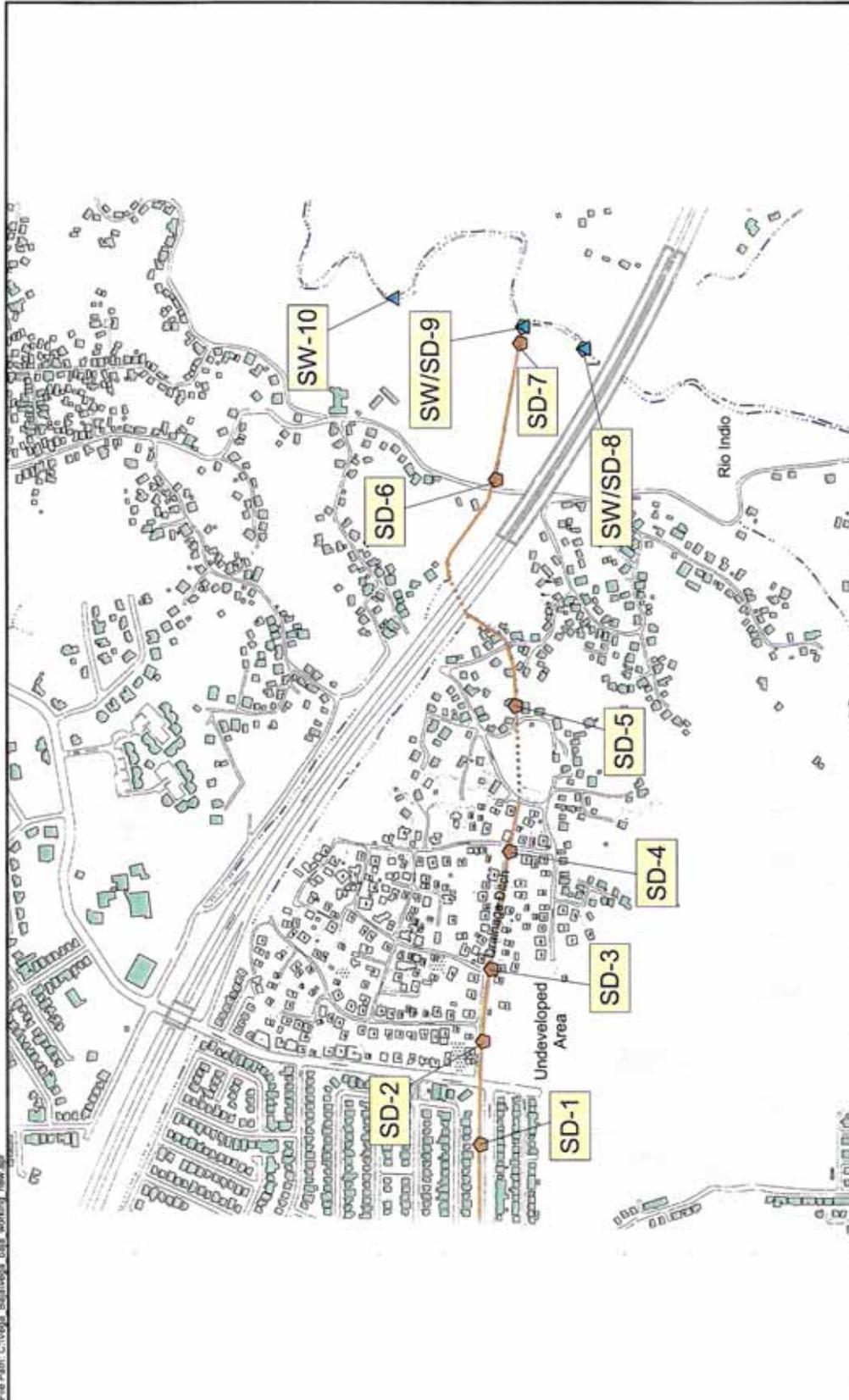


Figure 1
Surface Water and Sediment Sample Locations
Remedial Investigation / Feasibility Study
Vega Baja Solid Waste Disposal Site, Puerto Rico



CDM

APPENDIX C

Soil Ingestion Exposure Doses

Arsenic

| Exposure Dose | Adults | Children younger than 18 years |
|----------------------------------|------------------|---------------------------------------|
| Contaminant concentration | 20.2 mg/kg* | 20.2 mg/kg |
| Intake rate of contaminated soil | 100 mg/day | 200 mg/day |
| Exposure factor | 0.14 | 0.56 |
| Conversion factor | 10^{-6} | 10^{-6} |
| Body weight | 76 kg | 43 kg |
| Exposure dose | 0.0000372 | 0.000526 |

*mg/kg-milligram per kilogram

| Exposure Factor | Adults | Children younger than 18 years |
|------------------------|----------------------------|---------------------------------------|
| Frequency of exposure | 1 day/week x 52 weeks/year | 4 day/week x 52 weeks/year |
| Exposure duration | 30 years | 18 years |
| Time of exposure | 30 years x 365 days/year | 18 years x 365 days/year |
| Exposure factor | 0.14 | 0.56 |

Certification

This Vega Baja-Sediments Public Health Consultation was prepared by the Puerto Rico Department of Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated. . Editorial review was completed by the Cooperative Agreement partner.

Technical Project Officer, CAT, SPAB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.

Team Lead, CAT, SPAB, DHAC, ATSDR