

Health Consultation

Assessment of Dioxins in Soil

VEGA BAJA SOLID WASTE DISPOSAL

RIO ABAJO WARD, VEGA BAJA COUNTY, PUERTO RICO

EPA FACILITY ID: PRD980512669

APRIL 22, 2004

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

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

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 document has previously been released for a 30 day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The health consultation has now been reissued. 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.

You May Contact ATSDR TOLL FREE at
1-888-42ATSDR

or

Visit our Home Page at: <http://www.atsdr.cdc.gov>

HEALTH CONSULTATION

Assessment of Dioxins in Soil

VEGA BAJA SOLID WASTE DISPOSAL

RIO ABAJO WARD, VEGA BAJA COUNTY, PUERTO RICO

EPA FACILITY ID: PRD980512669

Prepared by:

Puerto Rico Department of Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Health Consultation

Vega Baja Solid Waste Disposal Site Assessment of Dioxins in Soil

Vega Baja, Puerto Rico

EPA Facility ID: PRD980512669

April 15, 2004

Prepared by:

The Puerto Rico Department of Health
Under a cooperative agreement with the
Agency for Toxic Substances and Disease Registry

Background and Statement of Issues

The Environmental Protection Agency (EPA) Caribbean Division conducted an assessment for soil dioxin contamination at the Vega Baja Solid Waste Disposal site in Puerto Rico. EPA asked the Cooperative Agreement Program of the Puerto Rico Department of Health to evaluate data obtained in the assessment and to determine whether exposures to the concentrations of dioxin detected could result in adverse health effects for community members in the area. The Puerto Rico Department of Health prepared this Health Consultation under its cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

Site Description

The Vega Baja Solid Waste Disposal site is a 72-acre, inactive, unlined, and uncapped solid waste disposal facility located in the Rio Abajo Ward area of the town of 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 woodlands to the south. It is approximately 1.2 mile south of the town of Vega Baja. This area was proposed for the National Priorities List (NPL) on April 22, 1999, and was subsequently listed on July 22, 1999.

The municipality of Vega Baja operated the landfill from approximately 1948 to 1979 for the dumping and open-burning of commercial, industrial, and domestic wastes. The site is situated within the doline karst terrain of the North Coast Limestone Province aquifer and within the regional Río Cibuco watershed system. Beneath the site is a thin unconsolidated deposit consisting of clay and sandy clay that overlies the Aymamón limestone.

A drainage ditch is located south of the Brisas del Rosario community and crosses Altura Road which is also close to two rows of homes in the community. Members of the community use Altura Road to walk or drive to different destinations (the market place, visiting neighbors, going to work or school, and gaining access to Trio Vegabajeño Ave). Children play on the street and also in the ditch, which directs storm water from the site to Rio Indio.

During the 1970s, people began constructing homes on the site and moving to the landfill. Currently, more than 200 homes cover nearly 55 acres at the site. Debris mounds greater than 10 feet thick were observed in some yards at the site. Some homes have backyard gardens that typically contain fruits, root crops, and legumes; and some residents rear farm animals such as chickens, goats, pigs, and rabbits. More than 2,000 persons live within a one-mile radius of the site, and more than 40,000 persons live within a four-mile radius of the site. The Puerto Rico Land Authority (PRLA) currently owns 17 unoccupied acres (wooded area) of the site that are undeveloped and overgrown with vegetation. In 1979, PRLA transferred ownership of the residential area to the

Puerto Rico Housing Department (PRHD), which provided property titles to some community members.

From April to December 1998, EPA conducted a three-phased soil-sampling program at the Vega Baja Landfill site to assess the extent of lead contamination. Through preliminary screening activities, EPA identified the following chemicals of concern: arsenic, chromium, dieldrin, lead, polychlorinated biphenyls, and thallium (EPA 2002). The site was divided into two operable units (OU); OU #1 for groundwater and OU #2 for soil. Then the investigation was divided in four phases. The first phase was the sampling conducted from April to June 1998. During this investigation the site was considered as one unit. During phase two the investigation was conducted from August to December. The sampling area at this time consisted only of the residential area. During the third phase of this investigation the sampling was focused on the garbage mounds in the residential area, this was performed in December of 1998. These phases evaluated the soil lead levels.

From June 23, 2001, to July 2, 2001, EPA's Environmental Response Team Center (ERTC), personnel from the Response Engineering and Analytical Contract (REAC), conducted phase IV of the investigations. The primary objective of the investigation was to evaluate the extent of surface and subsurface soil dioxin contamination in the residential area and in the adjoining wooded areas. The site was divided into two zones based on an analysis of aerial photographs: zone 1 represented the total extent of the solid waste area, and zone 2 represented the remainder of the residential area. In zone 1, one sampling point was randomly selected from each 200-foot by 200-foot grid block; 31 random sampling points were located in zone #1. In zone 2, one sampling point was randomly selected from each 400-foot by 400-foot grid block; 14 sampling points were located in zone 2. Figure 1 (Appendix A) shows the 50 points (45 random and five biased) that were identified and subsequently sampled. Soil samples were collected using soil augers (see definition in Appendix B). At each sampling point, where soil thickness permitted, three discrete soil samples were collected at depths of 2 inches, 4 inches, 1-foot, and 2-feet below ground surface. A total of 121 soil samples were collected and analyzed from 50 sampling points.

Data /Discussion

For the completion of the following data analysis and discussion the Puerto Rico Department of Health under its Cooperative Agreement follow the methodology used by ATSDR for this type of documents. First of all the Puerto Rico Staff reviewed the Final Report Assessment of Soil Dioxins Contamination prepared by the EPA. After a thorough examination of the document previously mentioned, the Puerto Rico staff used the guides and parameters on the Public Health Assessment Guidance Manual and the Comparison Values for this discussion.

The Puerto Rico Department of Health (PRDOH) reviewed the Final Report: Assessment of Soil Dioxin Contamination and prepared the following discussion. The results presented are for the Dioxin Toxicity Equivalent (TEQ) for each dioxin/furan congener for which a toxicity equivalency factor (TEF) was available and for the dioxin compound 2,3,7,8-tetrachlorodibenzodioxin (2,3,7,8-TCDD).

In preparing the following discussion, PRDOH used ATSDR's comparison values to determine whether the concentrations of dioxin detected warranted further evaluation. (See definition of comparison values in Appendix C). Comparison values are used as screening values. If an identified contaminant exceeds a comparison value, the contaminant is further evaluated to determine whether the concentrations detected may result in adverse health effects following exposure.

Some community leaders reported that people trespass the wooded area for fruits and vegetables. Dioxin in contaminated soil may result in dioxins in the food chain if the food comes in contact with contaminated soil or if a plant bio-accumulates the contaminant. An estimated 98% of exposure to dioxins is through the oral route (Pohl 1995). Comparison values used as screening tools are related to the ingestion of soil, but people do not generally eat soil. Therefore, although people may eat fruits and vegetables from the wooded area, exposure to the soil concentrations would not result in adverse health effects.

Soil comparison values for 2,3,7,8-TCDD are 0.00005 parts per million (ppm) for children and 0.0007 ppm for adults. The 2,3,7,8-TCDD concentrations detected, range from 0.00000014 ppm to 0.0000299 ppm; and are all well below the soil comparison values. Therefore, no health effects are anticipated from dioxin exposures at the concentrations detected.

Concentrations detected for the TEQ range from 0.0000025 ppm to 0.001540 ppm. One sampling point (0002WDA387GT) exceeded ATSDR's action level. Concentrations at this sampling location were 0.001220 ppm collected from 2-inch depths and 0.001540 ppm from 1-foot depths. Because this sampling point is located in a wooded area, the probability of exposure is minimal and adverse health effects are not expected. Trespassers would not likely come into contact with the TEQ contamination in this area. ATSDR has established an action level of 0.001 ppm in soil for TCDD, or the TCDD toxicity equivalent. The most probable type of exposure scenario would be from skin contact with contaminated soil. However, TCDD and TEQ were detected at very low concentrations that would not result in adverse health effects.

Children's Health Considerations

Children are at a greater risk than adults for exposure to hazardous substances emitted from waste sites and their associated adverse health effects. 1) They spend more time, increasing the likelihood to come into contact with chemicals in the environment. 2) they may breathe higher concentrations of dust, soil, and heavy vapors that are found

close to the ground, because of their height. 3) Children are also smaller, resulting in higher doses of chemical exposure per body weight. 4) the developing body systems of children can sustain permanent damage if exposure to certain toxics occurs during critical growth stages, and 5) children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care.

No health hazards for children are anticipated at the site because the concentrations of dioxin detected do not exceed comparison values, and exposures would not result in adverse health effects. Only one sampling point in the wooded area exceeded the ATSDR established action level for this contaminant, and exposures from the concentrations detected would not result in adverse health effects.

Conclusions

The PRDOH cooperative agreement staff reviewed the available data to evaluate whether exposures to dioxins could be plausible and to determine what health effects, if any, could be expected from exposures to the contaminants identified. Data evaluated for dioxins in soil at the site indicate that no public health hazard exists.

However, one sampling point in an adjacent wooded area slightly exceeded the action level for dioxin. Although the probability of exposure is minimal, community members stated that people go to the wooded area for fruits and vegetables. Considering the maximum concentration of dioxin detected in the wooded area, adverse health effects are not likely.

Recommendations

- Community members should receive health education about dioxin as it relates to this site and to the wooded area adjacent to the site.
- PRDOH will review additional available data as they become available and then further characterize the area, determine the contaminant concentrations detected, and decide whether adverse health effects could occur from exposure to soil or from eating fruits or vegetables from the area. Nevertheless trespassers should not collect fruit and vegetables naturally growing in the wooded area.

Public Health Action Plan

A Public Health Action Plan details actions to mitigate and prevent adverse human health effects that result from exposure to hazardous substances in the environment. No public health hazard was identified for this site.

Actions Completed:

The following materials were shared with community members during a community meeting on June 25, 2003:

- Summary of the Dioxin Health Consultation for the Vega Baja Waste Disposal site.
- Resumen sobre la Consulta de Salud de Dioxinas del Vertedero de Vega Baja Comunidad Brisas del Rosario
- Dioxinas Respuesta a las Preguntas más frecuentes

Preparers of Report

Encijar Hassan Ríos, DrPH(c)
PI/Project Director
Puerto Rico Cooperative Agreement Project

Karlo Malavé Llamas, MS
Environmental Health Scientist
Puerto Rico Cooperative Agreement Project

Concurrence:

Lovyst L. Luker
Technical Project Officer
Agency for Toxic Substances and Disease Registry

Arthur Block
Regional Representative
Agency for Toxic Substances and Disease Registry

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1994. Toxicological profile for chlorodibenzofurans. Atlanta: US Department of Health and Human Services.

Agency for Toxic Substances and Disease Registry (ATSDR). 1998. Toxicological profile for chlorinated dibenzo-p-dioxins. Atlanta: US Department of Health and Human Services.

Dioxin Homepage. 2002. Available online at: <http://www.ejnet.org/dioxin/>

Hinckley A., Wilson C., Erdman N.. 2000. Dioxins.

Available on-line at:

<http://www.cvmb.colostate.edu/enhealth/eh520pres/dioxin/index.html>

Pohl H. 1995. Chemosphere. Public health assessment for dioxins exposure from soil. 31(1):2437-54.

Remillard RB, Bunce N J. 2002. Linking dioxins to diabetes: epidemiology and biologic plausibility. Environ Health Perspect 110(9): 853-858. Available on-line at:

<http://ehpnet1.niehs.nih.gov/docs/2002/110p853-858remillard/abstract.html>.

Thornton J. 1997. PVC: The poison plastic dioxin from cradle to grave. Available on-line at: <http://archive.greenpeace.org/~usa/reports/toxics/PVC/cradle/dcg01.html>

US Caribbean Environmental Protection Agency (EPA). 2002. Final report: Assessment of soil dioxin contamination, Vega Baja solid waste disposal site, Vega Baja, Puerto Rico. Work Assignment No.:0-076.

APPENDIX A



APPENDIX B

Additional Information

Soil Auger

Tool used to “cut” channels in the ground to enable the easy collection of a soil sample in the area selected. Available online at: (die.net <http://dict.die.net/earth%20borer/>)

Chlorinated dibenzo-p-dioxins

The chlorinated dibenzo-p-dioxins are a class of compounds loosely referred to as dioxins; 75 possible dioxins are known (ATSDR 1994). The compound with four chlorine atoms at positions 2,3,7,8 of the dibenzo-p-dioxin chemical structure is called 2,3,7,8 TCDD and is a colorless solid with no known odor (ATSDR, 1998). It can be produced inadvertently in very small amounts as an impurity during the manufacture of certain herbicides and germicides and has been detected in products of incinerated municipal and industrial waste (Hinckley et al. 2000).

The International Agency for Research on Cancer [IARC] -- part of the World Health Organization -- announced February 14, 1997, that 2,3,7,8-TCDD, the most potent dioxin, is now considered a Class 1 carcinogen, meaning a "known human carcinogen." (Thornton 1997).

Burning chlorine-based chemicals with hydrocarbons forms dioxins. The major source of dioxin in the environment is from incinerators that burn chlorinated wastes (Dioxin Home Page). Dioxin pollution is also associated with paper mills that use chlorine bleaching in their process and with the production of polyvinyl chloride (PVC) plastics.

Recent epidemiologic studies suggest a possible association between dioxin-like compounds (DLCs) and diabetes in human populations, although experimental links between DLCs and diabetes are lacking. The public health significance of such an association is that all populations are exposed to small but measurable levels of DLCs, chronic low-dose exposure to which may hasten the onset of adult-onset diabetes in susceptible individuals (Remillard and Bunce 2002). Veterans exposed to various herbicides in wartime have reportedly experienced an increased risk of developing diabetes mellitus. When examined by cohort studies in New Hampshire and Sweden, the observed risk of diabetes mellitus was also present in pulp and paper mill workers (as well as non-working residents of the area). This links the common constituent, dioxin, to the increased morbidity of persons exposed (Hinckley et al. 2000).

Short-term exposure of humans to high levels of dioxins may result in skin lesions, such as chloracne and patchy darkening of the skin, and altered liver function. Long-term exposure is linked to impairment of the immune system, the developing nervous system, the endocrine system, and reproductive functions. Chronic exposure of animals to dioxins has resulted in several types of cancer (Hinckley et al. 2000). Several studies have been performed to define the association between the herbicide, Agent Orange, and birth defects and several diseases, in particular Hodgkin's disease, soft tissue sarcoma, and non-Hodgkin's lymphomas.

The most frequently studied group, in relation to occupational dioxin exposure, involves male workers. Recent studies have been performed on reproductive effects in sawmill workers exposed to chlorophenate wood preservative, known to be contaminated with dioxin. These studies looked at cumulative exposures of dioxins (whose biologic half-lives are in years) and reproductive effects in males. No effects on male fertility were observed in these studies, but the group was used in a prospective study, and reproductive outcomes yielded higher levels of spina bifida, anencephaly, and congenital anomalies of the eyes and genitals. The highest odds ratio for outcomes was found for cumulative exposures during the 3 months before pregnancy and exposure during the entire pregnancy, but whether these effects are a result of a sperm-cell exposure or indirect transmission is undetermined.

A cohort study of nearly 1200 chemical plant workers in Hamburg, Germany, examined the relationship between mortality and exposure to TCDD and other dioxins. Results showed a dose-dependent relationship of TCDD and its combination of all dioxins to specific causes of mortality. The highest relative risks occurred for cancer mortality and mortality due to ischemic heart disease (Hinckley et al. 2000).

APPENDIX C

ATSDR Glossary of Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health. This glossary is not a complete dictionary of environmental health terms but defines some words that ATSDR uses to communicate with the public. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

Adverse health effect

A change in body function or cell structure that might lead to disease or health problems

Comparison value (CV)

Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed persons. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Concentration

The amount of a substance present per unit of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant

A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Dermal

Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact

Contact with (touching) the skin [see **Route of exposure**].

Dose (for chemicals that are not radioactive)

The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Environmental media

Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism

Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA

United States Environmental Protection Agency.

Exposure

Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure pathway

The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental medium and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (persons potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Hazard

A source of potential harm from past, current, or future exposures.

Health consultation

A review of available information or a collection of new data to respond to a specific health question. Health consultations focus on specific exposure issues. Health consultations are more limited than public health assessments, which review the exposure potential of each pathway and chemical [compare **Public health assessment**].

Health education

Programs designed for a community to explain health risks and how to reduce them.

Ingestion

A way by which hazardous substance can enter the body through eating, drinking, or mouthing objects. [see **Route of exposure**].

Inhalation

A way by which hazardous substances can enter the body through breathing. [see **Route of exposure**].

National Priorities List (NPL)

EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated regularly.

No public health hazard

A category used in ATSDR's public health assessment documents to classify sites where people have never and will never come into contact with harmful amounts of site-related substances.

Population

A group or number of persons living within a specified area or sharing similar characteristics (such as occupation or age).

ppb

Parts per billion.

ppm

Parts per million.

Public health action

A list of steps designed to protect public health.

Public health assessment

An ATSDR study that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. It also lists actions that need to be taken to protect public health. [Compare **Health consultation**]

Risk

The probability that something will cause injury or harm.

Route of exposure

The way persons come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Superfund The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). It was amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986.

Other Glossaries and Dictionaries

Environmental Protection Agency (<http://www.epa.gov/OCEPATERMS/>)

National Center for Environmental Health (CDC)
(<http://www.cdc.gov/nceh/dls/report/glossary.htm>)

National Library of Medicine (NIH)
(<http://www.nlm.nih.gov/medlineplus/mplusdictionary.html>)

For more information on the work of ATSDR, please contact

Office of Policy and External Affairs
Agency for Toxic Substances and Disease Registry
1600 Clifton Road, N.E. (MS E-60)
Atlanta, GA 30333
Telephone: (404) 498-0080