ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

PESTICIDE WAREHOUSE III
PALO ALTO, MANATI COUNTY, PUERTO RICO
EPA FACILITY ID: PRD987367299

SEPTEMBER 9, 2005

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

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

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

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

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PUBLIC HEALTH ASSESSMENT

PESTICIDE WAREHOUSE III

PALO ALTO, MANATI COUNTY, PUERTO RICO

EPA FACILITY ID: PRD987367299

Prepared by:

Puerto Rico Department of Health
Under a Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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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
cm	centimeter
CRDL	contract required detection limit
CREG	cancer risk evaluation guide
CRQL	contract required quantitation limit
CSF	cancer slope factor
CVs	comparison values
ED	exposure dose
EF	exposure factor
EMEG	environmental media evaluation guide
EPA	U.S. Environmental Protection Agency
ERS	Emergency Response Section
FDA	Food and Drug Administration
HHS	U.S. Department of Health and Human Services
IARC	International Agency for Research on Cancer
IDL	instrument detection limit
IRIS	Integrated Risk Information System (EPA)
kg	kilogram
km	kilometer
LOAEL	lowest-observed-adverse-effect level
MCL	maximum contaminant level
mg	milligram
MRL	minimal risk level
NOAEL	no-observed-adverse-effect level
NPL	National Priorities List
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration
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
PRLA	Puerto Rico Land Authority
PWIII	Pesticide Warehouse III
RfD	reference dose

List of Abbreviations (continued)

RI/FS	remedial investigation and feasibility study
RMEG	reference dose media evaluation guide
sec	second
SI	site inspection
SVOC	semivolatile organic compound
TAL	target analyte list
TCL	target compound list
VOC	volatile organic compound

Summary

The Pesticide Warehouse III (PWIII) site is an inactive facility located on Road No. 670, kilometer (km) 3.7, in Palo Alto, Manatí, Puerto Rico. Proposed for inclusion on the National Priorities List (NPL) in September 2002, the PWIII was added to the list in April 2003 [U.S. Environmental Protection Agency (EPA), 2002]. This site operated from 1954 until February 2003 when the facility operations were relocated. On June 2003, a fire consumed the facility.

PWIII is approximately 2 acres in size. When in operation, it consisted of a main warehouse, a smaller warehouse, and a small shed that contains a water well. The facility was used to prepare pesticides/insecticides, herbicides, and fertilizers, and to process and can pineapple.

Four waste sources are associated with this site: 1) contaminated soils resulting from pesticide spills during the process of mixing water and pesticides in tanker trucks at the loading platform; 2) the leach pit that collected runoff containing spilled pesticides; 3) the drums and bags that contained pesticides; and, 4) the pit beneath the former truck scale that collected any pesticides that may have spilled from the trucks during weighing (Weston, 1997).

The Puerto Rico Environmental Quality Board (PREQB) conducted a preliminary assessment (PA) at the site on behalf of EPA in April 1989. On the basis of the identification of potential pesticide contamination on-site and the potential effect on off-site receptors, EPA conducted a site inspection (SI) sampling in May 1996 that consisted of an on-site reconnaissance and a subsequent sampling site inspection. This investigation included the collection of 15 surface soil samples (depth: 0 to 6 inches) and two water samples.

The Puerto Rico Cooperative Agreement Project (PRCAP) conducted its first site visit in September 2003. The PRCAP gathered information on the site and concerns from community members and state and federal officials. According to these people and the research of the site, the major concern is the exposure of the site workers to the pesticides. The workers started to wear protective equipment in 1986. Before then the employees managed the pesticides without any control measures to protect their bodies. The employees commonly had contact with the contaminants by the dermal, oral or inhalation routes. Even after the workers started to use protective equipment, they were not strict with the safety measures necessary to protect themselves from exposure to the pesticides. Workers in the facility could have been exposed to the pesticides for most of the approximately 50 years the site was operating.

The community surrounding the site is composed of approximately 10 houses, one retirement home (divided into a home for residents and one for ambulatory patients), a private school, the administrative offices of a Protestant church (Misión Puertorriqueña del Norte), and another Protestant church (Iglesia de Dios de la Profesía). The community

also includes some businesses, a pasture where approximately 15 goats graze, and a school under construction on the premises of the Misión Puertorriqueña del Norte offices.

The PRCAP evaluated the limited available environmental data and identified several contaminants in soil and in the water sample that were above the environmental comparison values (CVs). On the basis of the available data, the PRCAP determined that heptachlor, aldrin, heptachlor epoxide, dieldrin, toxaphene and arsenic were present at concentrations above their respective CVs for soil. Site specific exposure doses were estimated for the incidental ingestion of the contaminants in soil by the facility's workers. When compared with the numbers in scientific literature, the estimated doses were found to be below the concentrations reported to cause adverse health effects. Although the environmental data is limited, PRCAP concluded that the incidental ingestion of soil by the former workers represents no apparent public health hazard.

In groundwater, dieldrin and bis(2-ethylhexyl)phthalate were identified at concentrations above their respective comparison values. Because groundwater is the drinking water source for the site and surrounding area (within 0.25 miles), exposure doses were estimated for the workers and the people around the site. The doses estimated were below the health guidelines used as a comparison. However, since only one water sample was available, the PRCAP concluded that the groundwater represents an indeterminate public health hazard.

The people around the site could be exposed to contaminants from the site that could travel through the air and deposit in their yards. However, no environmental data exists to evaluate this potential exposure pathway.

The Puerto Rico Department of Health (PRDOH) recommends that EPA conduct additional soil and groundwater sampling to evaluate the potential for adverse health effects on the former workers and the people around the site. The PRCAP is available to review the remedial investigation and feasibility study (RI/FS) sampling plan and the environmental data as they become available. Also, the PRCAP will implement the health education plan being developed for the PWIII site.

Background

Purpose and Health Issues

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal agency within the U.S. Department of Health and Human Services. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) authorizes and requires ATSDR to conduct public health activities at hazardous waste sites proposed or included on the National Priorities List (NPL). Proposed for inclusion on the NPL in September 2002, the Pesticide Warehouse III (PWIII) site was added to the list in April 2003 (EPA, 2002). The Puerto Rico Department of Health (PRDOH) has a cooperative agreement with ATSDR to conduct public health assessments and consultations for sites in Puerto Rico. The PRDOH completed this public health assessment under the cooperative agreement. The purpose of the public health assessment is to identify completed exposure pathways, to determine whether (and what) health effects might occur as a result of the site-specific exposure, and to evaluate specific community health concerns about the site.

Site Description and History

The Pesticide Warehouse III (PWIII) site is an inactive facility located on Road No. 670, kilometer (km) 3.7, (latitude 18°25'41" N, longitude 66°27'25" W) in a minimal flooding rural/residential area known as Coto Norte in the municipality of Manatí, Puerto Rico (Weston, 1997). The site, approximately 2 acres in size, consists of a main warehouse, a smaller warehouse, and a small shed that contains a water well. The Puerto Rico Land Authority (PRLA) owned and operated the site from 1954 to 1996, preparing pesticides/insecticides, herbicides, and fertilizers. The PRLA also used part of one of the warehouses for processing and canning pineapple. Agrocampo Incorporado operated the site from September 1999 until February 2003.

Four waste sources are associated with this site: 1) contaminated soils resulting from pesticide spills during the process of mixing water and pesticides in tanker trucks at the loading platform; 2) the leach pit that collected runoff containing spilled pesticides; 3) the drums and bags that contained pesticides; and, 4) the pit beneath the former truck scale that collected any pesticides that may have spilled from the trucks during weighing (Weston, 1997).

The Puerto Rico Environmental Quality Board (PREQB) conducted a preliminary assessment (PA) at the site on behalf of the U.S. Environmental Protection Agency (EPA) on April 12, 1989. According to the PA report, the PREQB noted nine drums containing an unspecified organochlorine pesticide, seven drums containing toxaphene E8, seven drums containing Chemax, and sacks containing pesticides in the warehouse. The drums were approximately 50 gallons each, and the bags inside those drums each held an estimated 20 pounds of pesticide. All of the empty pesticide drums and bags were

placed outside, behind the main warehouse. The PA report mentioned a hole containing activated carbon on the south side of the building that supposedly was used to recover any spills from drums on the loading platform. The report noted that a small landfill on the site was used to burn waste. The PA report also noted that site workers had presumably suffered from exposures in the work area; however, the report did not elaborate on this information.

In 1996–1997, EPA conducted a site inspection (SI) investigation that consisted of an on-site reconnaissance and a subsequent sampling site inspection (EPA, 2003). During the reconnaissance, the following were noted to be stored in bags in the main warehouse: magnesium sulfate, Ochoa fertilizer, sulfate of potash, zinc sulfate, ferrous sulfate, urea, MoCap 10G, Karmex DF, Baylethon, Hyvar X, Nemacor 3, and Solobar. SI personnel noted spilled materials in various locations and stained soils throughout the site. Surface drainage was observed to be toward the west, where it entered a drainage ditch. This ditch extended along the western and northern boundaries of the site, terminating in a leach pit north of the on-site buildings. This pit was noted as an unlined pit that appeared to be a natural sinkhole.

EPA did not identify air contamination; however, its report stated that site contaminants might migrate off-site through the air pathway because the site lacks vegetation to keep soil contaminants from migrating (Weston, 1997).

On the basis of the identification of a potential pesticide contamination on-site and the potential impact to off-site receptors, EPA conducted a SI sampling on May 30, 1996. This investigation included the collection of 15 surface soil samples (depth: 0 to 6 inches) and two water samples.

On June 2003, a fire consumed the facility; no workers were present because the operation had moved in February 2003. Firefighters contained the fire within 2-to-3 hours, but the site reportedly smoldered into the next morning. The pesticides and herbicides stored at the facility may have been removed before the fire. But, one of the firefighters told the Puerto Rico Cooperative Agreement Project (PRCAP) staff on January 23, 2004, that he was almost positive that some drums were in one of the warehouses. He was not able to identify the contents of the drums. The asbestos and creosote used in the construction of the building caused concern. Responders to the fire did not use any respiratory protection, and air monitoring was not conducted in the area. Because of that, on July 2, 2003, the ATSDR regional representative requested assistance from the ATSDR Emergency Response Section (ERS) concerning the firefighters. None of the responders reported any adverse symptoms or sought medical treatment immediately after the fire, a fact confirmed by a firefighter to the PRCAP on January 23, 2004.

PRCAP staff, EPA, and PRLA visited the PWIII site on September 4, 2003. PRCAP staff members noted physical hazards on the site. These hazards included burned metal and wood structures, rusted metal debris, and broken glass in the area used for parking and in the area that used to be the main warehouse of the site. A sign, gate, and

fence are on the property, but access to the site is unrestricted. The sign, written only in English, does not identify an agency contact. The gate is unlocked.

During the site visit, PRCAP, EPA, and PRLA staff met with a community member who was a PWIII employee for 35 years. PRCAP, EPA, and PRLA staff members are concerned about the groundwater because the former employee told the group that 20 drums of an unknown pesticide had been buried on the site. That statement has yet to be confirmed.

Since the September 2003 visit, the PRCAP staff has communicated with EPA and the PRLA and scheduled visits to the surrounding areas of the PWIII. On January 23, 2004, PRCAP staff members inspected the surrounding areas of the PWIII. On another visit, on May 4, 2004, the staff members talked with people living and or working near the site. The staff members noted that although the fence and gate were in better condition and most of the physical hazards had been removed, the entrance to the site was still unrestricted. The sign was still only in English, and neighbors had seen people entering the site.

EPA started a removal action in May 2004 in which most of the remaining physical hazards were removed. The site is now fenced. EPA has not completed a sampling plan for the remedial investigation (RI), or set a start date for the RI.

Demographics, Land Use, and Natural Resource Use

To identify and define the size, characteristics, location, and possible unique vulnerabilities of populations near the PWIII site, the PRCAP staff studied available demographics and land use information. Demographics information helps the PRCAP staff understand the number and makeup of the population. Land use information helps identify possible exposure situations in the area (that is, what activities are occurring, have occurred, or might occur in the future). This information helps determine whether and how people might come in contact with site-related contamination, as well as the characteristics of those people.

Demographics and Land use

According to the 2000 U.S. Census, the Cotto Norte area has a population of 11,311, approximately 25% of the total population of the municipality of Manatí.

The PWIII operated from 1954 until 2003. Nine employees worked directly in the facility, and approximately 100 people visited the facility two times a month for their payment during the period of operation.

Between January 23, 2004, and February 2, 2004, the PRCAP inspected facilities around the site to make a more accurate description of the area. One residential retirement home, “Centro Geriátrico Virgilio Ramos Casellas Inc.,” and one nursing home are west of the site. The retirement home, serving 40 people from Manati, has

operated for approximately three years. Three kinds of residents live at the home: people who can walk without problems, people who can move with aid (escort, cane or wheelchair), and people who are bedridden. The retirement home has 21 fulltime and 5 part-time employees. Although the visiting hours are 7 days a week from 10:00 AM until 7:00 PM, only a few people (family members and friends of the residents) routinely visit the home. Celebrations and holidays are the only occasions when more people are in the facility.

The nursing home, "Remanzo de Paz," located beside the retirement home, serves a different population. The home, open to people who live in Manatí from 8:00 AM until 2:00 PM., provides services to an ambulatory, nonresidential population. Designated municipality wagons transport people who use the services of the home. At the time of the visit, 65 people were receiving the services of the nursing home, where 18 fulltime and one part-time employee work. The members of the nearby church celebrate activities such as birthdays, Christmas, and Thanksgiving in the homes' yard.

"Colegio Wamiriel," a private school, has been operating in front (south) of the site for approximately 25 years. At the time of the visit, 95 children attended preschool through sixth grade classes. Years ago 125 students were enrolled. The school, with a capacity of 300 children, employs 12 fulltime and 3 part-time workers.

Since September 2002, one of the buildings on another property west of the site has housed the administrative offices of the Misión Puertorriqueña del Norte. Prior to September 2002, this building was a retirement home and then a rehabilitation home for people with drug addictions. Approximately 25 people work in this facility, which includes a library and a health food store. Meetings and activities, during which 400 to 500 people get together from 4:00 PM until late in the night, take place every three months on this property. The PRCAP staff learned that the number of sick leaves taken by employees has increased for unexplained reasons in recent months. The principal reason for sick leave involve respiratory problems (e.g., asthma and flu-like symptoms). The second of the buildings found on the property is a church, "Iglesia de Dios de la Profesia," which has worship services five days a week and receives people from different age groups. The third building, a private school, is almost finished being built.

Homes and other businesses are also near the site. In a visit on May 4, 2004, PRCAP staff members corroborated that approximately six homes, four apartments, and three businesses are in the immediate area. A total of 11 persons live in the area and approximately 20 persons work in the area. During the May 2004 visit, PRCAP staff members corroborated that although a gate in fairly good condition is on the site, Puerto Rico Environmental Protection Agency, PREQB, PRCAP staff members, and neighbors had seen adults trespassing onto the site.

Approximately 675 people have been or are close to the site boundaries. The number includes the people who worked at PWIII, the residents around the site and the people receiving services or visiting the facilities around the site. The site, or land within a radius of 200 feet, contains no protected ecosystems, lagoons, rivers, or animal or plant

species. Approximately 15 goats, which eventually are used for meat, graze on empty terrain near the site. Because no sampling has been done, sampling of this property is recommended. If elevated levels (levels above comparison values) of contaminants are detected on the property, the need to sample the goats will be considered.

Besides working with pesticides on the site, the Puerto Rico Land Authority (PRLA) processed and canned pineapple in part of one of the warehouses. Pineapple is grown in front of the site, around the private school, and on a small landfill reportedly used to burn waste. The PREQB prepared a preliminary assessment (PA) in 1989. According to the PA, Karmex, Gramoxene, Ametryn, Atrazine 80W, Hyvar X, Velpar, toxaphene, Diazinon, malathion, Vydate L, and Mocap G were used to treat the pineapple crops.

Natural Resource Use

Groundwater

The municipal water source around the site serves approximately 118,970 people (EPA, 2003). The Puerto Rico Aqueduct and Sewer Authority (PRASA) owns and operates three wells used for drinking water in the area. The PRASA also identified a private well owned by an industry nearby that is used for drinking water and industrial purposes. The PRLA owns one well for irrigation purposes. Groundwater beneath the site is assumed to flow northward toward the Atlantic Ocean; however, because the aquifer formation is karst, groundwater could flow in various directions. Groundwater within a 4-mile radius of the site is used for commercial, domestic, industrial, and stock purposes, and for private and municipal drinking water.

Because of the nature of the aquifer, groundwater flow beneath PWIII has not been characterized. Drinking water comes from the North Coast Limestone Aquifer system of Puerto Rico. In the vicinity of the site, the aquifer consists mainly of Aymamón Limestone above a layer of Aguada Limestone. Aymamón Limestone's uniform lithology consists mainly of thick-bedded to massive very pure limestone that is usually quartz free. The underlying Aguada Limestone consists of carbonate grading. The upper aquifer in the vicinity of Manatí is approximately 925 feet thick. In the vicinity of the site, blanket deposits of clayed quartz sand and sandy clay, approximately 100 feet thick, cover the upper aquifer.

The hydraulic conductivity of the Aymamón Limestone ranges from $2.0x10^{-1}$ to $2.01x10^{-2}$ centimeters per second (cm/sec). The hydraulic conductivity of the Aguada Limestone ranges from 10^{-2} to 10^{-4} cm/sec. The hydraulic conductivity of the surficial blanket deposits is approximately 10^{-4} to 10^{-6} cm/sec. Therefore, on the basis of its permeability, the overburden is considered to be a semiconfining layer (Weston, 1997). In the vicinity of the site, numerous karst features that include limestone hills and sinkholes characterize the site. The depth to the water table ranges from 81 to 89 feet below groundwater surface, based on measurements of the water levels in a well in Manatí, approximately 2 miles west of the site.

Discussion

Environmental Contamination

The Puerto Rico Cooperative Agreement Program (PRCAP) staff reviewed the available environmental data collected for the Pesticide Warehouse III (PWIII) site and selected contaminants for further evaluation. PRCAP staff members evaluated the adequacy of the sampling conducted and identified the maximum concentration and frequency of detection of the contaminants found in the various media. The staff also compared the detected concentrations with environmental and health-based screening values or comparison values (CVs).

PRCAP staff members selected contaminants based on the following:

- An understanding of contaminant concentrations detected on- and off-site
- A determination of overall data quality (field data quality, laboratory data quality, and sample design)
- Comparison of on- and off-site contaminant concentrations with the CVs
- Community health concerns

The health-based CVs are used as screening values to determine whether a contaminant should be further evaluated. CVs include uncertainty factors that account for sensitive populations. Because CVs are based on conservative assumptions, the presence of a contaminant at concentrations greater than CVs does not necessarily suggest that exposure to the contaminant will result in adverse health effects. Identification of contaminants of concern narrows the focus of the health assessment to those contaminants requiring additional evaluation.

PRCAP staff members obtained all available environmental data related to the site from the U.S. Environmental Protection Agency (EPA), which included the data from the site inspection (SI) sampling conducted on May 30, 1996. The samples collected during the SI were analyzed for target compound list (TCL) organic compounds and target analyte list (TAL) inorganic contaminants through the EPA Contract Laboratory Program (CLP). A laboratory selected under current EPA guidelines analyzed the samples for diazinon, malathion, and diuron.

Soil

Tanker trucks used to park near the loading dock where pesticides and water were mixed in the tanks. During the preliminary assessment (PA), the Puerto Rico Environmental Quality Board (PREQB) noted that excess pesticides spilled onto the soil. The PA report mentioned a hole containing activated carbon on the south side of the building that was supposedly used to recover any spills from drums on the loading platform. The report noted that a small landfill was used to burn waste on the site.

Stained soils throughout the site and spilled materials were noted during the site visit. Surface drainage was observed to be toward the west, where it entered a drainage ditch. This ditch extended along the western and northern boundaries of the site, terminating in a leach pit north of the on-site buildings. This pit was noted as an unlined pit that appeared to be a natural sinkhole (EPA, 2003).

The SI identified two sources of contamination for the hazard ranking system (HRS) evaluation of the site: 1) contaminated soil and, 2) the drainage ditch and associated leach pit. The SI identified other areas of environmental concern (Appendix A, Figure 1), e.g., a pit observed at the bottom of a former truck scale south of the main warehouse entrance where no samples had been taken. Other areas of environmental concern included a cistern below the ruined northeast portion of the main warehouse building, and suspected asbestos-containing materials on some of the piping ruins within the small warehouse (EPA, 2003).

A total of 15 surface soil (0–6 inches) samples were collected from throughout the PWIII site, including the drainage ditch and nearby (Appendix A, Figure 1). Eleven soil samples were collected from the site (SS01-SS11). One soil sample (SS12) was collected from the former retirement home property, now the "Misión Puertorriqueña del Norte," to determine whether site-related contaminants migrated off-site. A duplicate soil sample (SS15) was collected at one of the on-site locations for quality control purposes, and two background soil samples were collected from off-site (SS13-SS14). Tables B1 through B5 (Appendix B) summarize environmental sampling data for the contaminants analyzed in soil. The following table presents a summary of the contaminants identified in soil in concentrations above the CVs, their range of detected concentrations, the environmental comparison value and the number of samples above the CV for each contaminant.

Table 1. Contaminants identified in soil in concentrations above the comparison values (CVs)

Contaminant	Range of detected concentrations (ppm)	Comparison Value (ppm)	Number of samples above the CVs and sampling points
Heptachlor	0.0036J–1.000J	CREG=0.2	4 (SS01, SS02, SS03, SS04,)
Aldrin	0.0045J–1.700J	CREG=0.04	4 (SS01, SS02, SS03, SS04)
Heptachlor epoxide	0.014J–0.170J	CREG=0.08	2 (SS02, SS03)
Dieldrin	0.0047J–3.6J	CREG=0.04	10 (SS01, SS02, SS03, SS04, SS05, SS06, SS07, SS08, SS13, SS15)
Toxaphene	1.2J–200J	CREG=0.6	12 (SS01, SS02, SS03, SS04, SS05, SS06, SS07, SS08, SS11, SS13, SS14, SS15)
Arsenic	8.1–41.9	CREG=0.5	15
Beryllium	0.1B–1.1B	EMEG=1,000 *Cancer classes: EPA–B1 NTP–1 IARC–1	0

B: Estimated value, compound present below contract required detection limit (CRDL), but above instrument detection limit (IDL)
CREG: Cancer risk evaluation guide
EMEG: Environmental media evaluation guide
EPA: U.S. Environmental Protection Agency
IARC: International Agency for Research on Cancer
J: Estimated value, compound present below contract required quantitation limit (CRQL), but above IDL
NTP: National Toxicology Program
ppm: parts per million
*Cancer classes are provided because a CREG is not available. EPA class B1 is a probable human carcinogen (limited human, sufficient animal studies), inhalation route; NTP–1 is defined as a known human carcinogen and IARC–1 means carcinogenic to humans (sufficient human evidence).

None of these contaminants were present off-site at the former retirement home, now the "Misión Puertorriqueña del Norte." However, dieldrin (SS13) and toxaphene (SS14) had concentrations at the background sample locations above the CVs. Heptachlor, aldrin, heptachlor epoxide, dieldrin, toxaphene and arsenic were detected at concentrations above their respective CVs for soil and therefore were selected for further evaluation. Toxaphene was used as an insecticide in the pineapple plantations that cover most of the land around the site (PREQB, 1989). The laboratory reported no problems with the analyses of organophosphorus pesticide compounds (Weston, 1996a).

Of all the metals analyzed in soil, arsenic was the only contaminant detected above the CV. The cancer risk evaluation guide (CREG) for arsenic is 0.5 ppm, and all 15 samples had arsenic concentrations above this concentration. The range of detected concentrations for arsenic was 8.1 ppm to 41.9 ppm. Arsenic was detected in all the sampling points including off-site (SS12) and the background (SS13 and SS14). Other metals detected were calcium, iron, magnesium, mercury, potassium, sodium and thallium; as no CVs exist for these metals, their levels were compared with their background levels. All of these metals were detected in all the sampling points, except mercury that was detected in 12 and thallium in 9 sampling points.

Table 2. Comparison of metals levels with background levels

Contaminant	Background Levels			Range of Detected Concentrations (ppm)
	SS13 (ppm)	SS14 (ppm)	Mean (ppm)	
Calcium	7,040	2,090J	4,565	2,390–103,000
Iron	12,200	11,600	11,900	17,200–48,100
Magnesium	279B	146B	213	334–2,190
Potassium	231B	152B	192	180–2,450
Sodium	59.3B	57.2B	58	39.2–119
Mercury	0.07B	0.08B	0.075	0.06–0.34
Thallium	0	0	0	0.69–2.1

B: Estimated value, compound present below contract required detection limit (CRDL), but above instrument detection limit (IDL)
J: Estimated value, compound present below contract required quantitation limit (CRQL), but above IDL
ppm: parts per million

All but one of the calcium levels were above the mean value level (4,565) for the background. The mean concentration for calcium was 4.75 times higher than the level at background sampling point SS13 and 16.02 times higher than the level at background sampling point SS14.

All the iron levels detected were above the mean level (11,900 ppm) for the background. The mean concentration for iron was 2.53 times higher than the level at background sampling point SS13 and 2.66 times higher than the level at background sampling point SS14.

All magnesium concentrations were above the mean level (213 ppm) for the background. The mean concentration for the magnesium levels was 1.89 times higher than the level at background sampling point SS13 and 3.63 times higher than the level at background sampling point SS14.

Potassium's concentrations were all above the mean level (192 ppm) for the background. The mean concentration for potassium was 2.79 times higher than the level at background sampling point SS13 and 4.24 times higher than the level at background sampling point SS14.

The mean concentrations for sodium, mercury, and thallium were slightly above the levels at background sampling points SS13 and SS14. Because calcium, iron, magnesium and potassium had mean concentrations more than twice the background levels (except magnesium's 1.89 at SS13), they were selected for further analysis.

The limited available environmental data are inadequate to answer all exposure issues. The sampling does not characterize the contamination in soils of areas with different land uses: residential yards, school, church and retirement home yards, and the empty land space close to the site. Comparison of on-site and off-site contaminant concentrations was limited because only one off-site point was sampled. The site should be better characterized, especially the area beside the section that used to be the loading dock and the area between the main warehouse and the smaller warehouse. Samples were not collected upwind and downwind of the pineapple plantation, a possible source of air pollution.

A sampling plan for the remedial investigation and feasibility study (RI/FS) has not been completed yet. The PRCAP staff will provide comments on the sampling plan to be sure to get data from possible points of exposure.

Groundwater

One tap water sample and one duplicate sample were collected from a faucet, a Puerto Rico Aqueduct and Sewer Authority (PRASA) supply valve outside the building, to determine whether any contaminants have migrated from the site into the groundwater. Appendix A, Figure 1 locates sample sites, and Appendix B, Table B6 identifies the metals detected in the water sample. They were below their respective CVs. Dieldrin and bis(2-ethylhexyl)phthalate were identified at concentrations above their respective CVs. The levels of other contaminants found in the water samples, γ-BHC (lindane), diuron, and di-n-butylphthalate, were not above the CVs values. The laboratory did not report problems with the samples and analysis of the water samples.

Table 3. Contaminants identified in on-site water sample

Contaminant	Range of detected concentrations (ppm)	Number of Samples above the CV's	Comparison values (ppm)
γ-BHC (Lindane)	0.00016J	0	0.003 child RMEG 0.010 adult RMEG
Dieldrin	0.00017J,N–0.00035J,N	2	0.000002 CREG
Diuron	0.000272–0.000666	0	0.020 child RMEG 0.070 adult RMEG
Bis(2ethylhexyl)phthalate	0.002J–0.004J	1	0.003 CREG
Di-n-Butylphthalate	0.001J	0	10 child RMEG 40 adult RMEG

CREG: Cancer risk evaluation guide
CVs: Comparison values
J: Estimated value, compound present below contract required quantitation limit (CRQL), but above instrument detection limit (IDL)
N: Presumptive evidence of the presence of the material
ppm: parts per million
RMEG: Reference dose media evaluation guide

It is important to note that almost all the values reported are estimated, which means that they could be inaccurate or imprecise.

Exposure Pathway Analyses

This section summarizes the completed and potential exposure pathways associated with the Pesticide Warehouse III (PWIII) site. One of the goals of the public health assessment (PHA) process is to identify exposure pathways. Exposure pathways are studied to understand the different ways that people might come in contact with the contaminants of concern. In short, the purpose of the exposure pathway evaluation is to determine if, when (how often, over what time period), where, and how people might come into contact with the environmental media under study. This information alone does not define exposure, but is a simple tool to better understand the plausibility of exposures. The Puerto Rico Cooperative Agreement Program (PRCAP) staff members analyzed the exposure pathway information and the environmental data to determine whether adverse health effects could result from exposures to the identified contaminant concentrations.

To determine whether people may have been exposed to contaminants at or near the site, PRCAP staff members evaluated the environmental and human components of exposure pathways. An exposure pathway consists of five elements: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and a receptor population.

An exposure pathway can be eliminated if at least one of the five elements is missing and will never be present. Exposure pathways not eliminated are categorized as either completed or potential. For completed pathways, all five elements exist and exposure to a contaminant has occurred, is occurring, or will occur. For potential pathways, at least one of the five elements is missing, but could exist. For potential pathways, exposure to a contaminant could have occurred, could be occurring, or could occur in the future.

Completed Exposure Pathways

Surface Soil

Nine former workers were exposed to contaminated soils resulting from pesticide spills through direct (dermal) contact during the handling of the drums and bags that contained pesticides and during the preparation of the pesticides. Also, inhalation of contaminants in air (dust, vapor or gases), including those volatilized or otherwise emitted from the soil, could have occurred. Incidental ingestion of contaminated soil could have occurred when the workers ate with their hands, smoked cigarettes, or put their fingers in their mouths, because tiny particles can stick to hands, clothes, cigarettes and food. There is no current exposure since there are no workers onsite since February, 2003.

Drinking Water

The source for drinking water for the site's workers was the same source for the water tap that was sampled, the Puerto Rico Aqueduct and Sewer Authority (PRASA) well Coto Sur No. 5. This is the only potable groundwater well within 0.25 miles of the site. Approximately 1,260 people within a distance of 0.25 miles from the site obtain drinking water from that well.

Potential Exposure Pathways

Air

The 83 people at the retirement home, 66 at the nursing home, 11 at the houses, and 20 at the commercial places nearby could have been exposed to airborne contaminants while the site was active. The pesticides could have volatilized or become airborne during their preparation and handling. Workers at the site or people living nearby then could have inhaled, ingested or come into dermal contact with the pesticides.

Soil

Exposure to the site-related contaminants that could have become airborne and deposited in the soil could have occurred in the past, could be occurring currently, or could occur in the future to people around the site. Soil or dust particles can adhere to hands, clothes, cigarettes and food. Therefore, during typical behavior patterns, people

accidentally ingest soil when they eat food with their hands, smoke cigarettes, or put their fingers in their mouths. Dermal exposure to soil can occur through a variety of activities such as gardening, outdoor recreation, or construction. Also, trespassers to the site could be contacting contaminants, and contaminants could adhere to workers clothes.

Drinking Water (Future)

People who receive drinking water from the Coto Sur No. 5 well could be exposed to groundwater contaminants in the future.

Public Health Implications

The primary purpose of this section is to provide public health officials, physicians, toxicologists, and other interested individuals and groups with an overall perspective of the toxicology and a depiction of significant exposure levels associated with various adverse health effects of the discussed contaminants. This section contains descriptions and evaluations of studies and presents levels of significant exposure for the contaminants based on toxicologic studies and epidemiologic investigations.

To evaluate the exposures, the PRCAP staff derived exposure doses for the chemicals that exceeded the comparison values. The exposure doses were then compared with the health-based guidelines. Exposure to a certain chemical does not always result in harmful health effects. The type and severity of the health effects depend on the exposure concentration, the frequency and duration of exposure, the route or pathway of exposure, and the multiplicity of exposure.

Soil

Heptachlor, aldrin, heptachlorepoxide, dieldrin, toxaphene, and arsenic were selected for further evaluation because they were detected at concentrations above their respective comparison values for soil. Exposure doses were estimated using site-specific exposure assumptions.

Exposure doses are expressed in milligrams per kilogram per day (mg/kg/day). When estimating exposure doses, health assessors evaluate chemical concentrations to which people could have been exposed, and the duration and frequency of exposure. Collectively, these factors influence an individual's physiological response to chemical exposure and potential outcomes. The PRCAP staff used site-specific information regarding the frequency and duration of exposures.

The following equation estimates incidental ingestion of chemicals in soil:

$$ED = (C \times IR \times EF \times CF) / BW$$

Where:
ED: Estimated exposure dose

C: Concentration of the chemical in parts per million (ppm, which is also mg/kg)
IR: Ingestion rate, adult = 100 milligrams (mg) of soil per day
EF: Exposure factor, or number of exposure events per year of exposure (250 days/year, 5 workdays/week)
CF: Conversion factor (10^{-6})
Exposure duration: for the workers, 36 years, approximate number of years that they worked at the site
BW: Body weight, male adult in Puerto Rico = 78 kilograms (kg)*
*Puerto Rico Behavioral Risk Factor Surveillance System (PR BRFSS), 2001-2002. The BRFSS is a phone survey of adult residents of Puerto Rico 18 years of age and older.

Table 4. Estimated exposure doses for incidental ingestion of chemicals in soil compared to health guidelines

Contaminant	Maximum concentration detected (ppm)	Estimated exposure dose (mg/kg/day)	Oral health guideline (mg/kg/day)	Basis for health guideline	Estimated excess cancer risk
Heptachlor	1.00J	0.00000872	0.0005	Chronic RfD	3.9×10^{-5}
Aldrin	1.70J	0.0000148	0.00003	Chronic MRL	2.5×10^{-4}
Heptachlor epoxide	0.170J	0.00000148	0.000013	Chronic RfD	1.3×10^{-5}
Dieldrin	3.60J	0.0000314	0.00005	Chronic MRL	5.0×10^{-4}
Toxaphene	200J	0.0017*	0.001	Intermediate MRL	1.9×10^{-3}
Arsenic	41.90	0.000365*	0.0003	Chronic MRL	5.5×10^{-4}
Beryllium	1.1B	0.00000959	0.002	Chronic MRL	CSF not available

B: Estimated value, compound present below contract required detection limit (CRDL), but above IDL
CSF: Cancer slope factor
J: Estimated value, compound present below contract required quantitation limit (CRQL), but above instrument detection limit (IDL)
mg/kg/day: milligrams per kilogram per day
MRL: Minimal risk level
ppm: parts per million
RfD: Reference dose
*Estimated exposure exceeds health guideline; however, an exposure dose that is higher than the MRL or RfD does not necessarily result in harmful health effects. These contaminants are further evaluated in this section of the PHA.

Using the maximum concentration detected, the resulting exposure doses for toxaphene and arsenic slightly exceeded their respective health guidelines. However, calculated exposure doses higher than the health guidelines do not automatically result in harmful health effects. Rather, the higher exposure doses are an indication that PRCAP staff should further examine the harmful effects levels reported in the scientific literature and more fully review exposure potential.

The following discussion details PRCAP staff evaluations of exposure from incidental ingestion of arsenic and toxaphene, both found in soil on the site.

Arsenic

Arsenic, found naturally in soil and in many kinds of rocks, is widely distributed in the earth's crust. Most arsenic compounds have no smell or distinctive taste. In the environment, arsenic is usually combined with other elements such as oxygen, chlorine, and sulfur and is called inorganic arsenic. When combined with carbon and hydrogen, arsenic is called organic arsenic. The organic forms of arsenic are usually less harmful than the inorganic forms (ATSDR, 2000).

Approximately 90% of all commercially produced arsenic is used to pressure-treat wood. Arsenic is also used in lead-acid car batteries, semiconductors, light-emitting diodes, and in some munitions. In the past, arsenic was widely used as a pesticide; in fact, some organic arsenic compounds are still used in pesticides.

Incidental ingestion of arsenic-contaminated soil is one way arsenic can enter the body. Once in the body, the liver changes some of the arsenic into a less harmful organic form. Both inorganic and organic forms of arsenic leave the body in urine. Studies have shown that 45%–85% of the arsenic in the human body is eliminated within 1–3 days (Buchet et al, 1981; Crecelius, 1977; Mappes, 1977; Tam et al, 1979b, as cited in ATSDR, 2000); however, some arsenic will remain in the body for several months or longer.

Some studies describe less serious health effects like diarrhea and abdominal pain resulting from exposure to 0.02 mg/kg/day of arsenic; hypopigmentation and hyperpigmentation resulting from exposure to 0.01 mg/kg/day; deficits in cutaneous microcirculation of the toes resulting from exposure to 0.064 mg/kg/day; and absent ankle jerk reflex and vibration sense in legs resulting from exposure to 0.03 mg/kg/day (Borgono and Greiber, 1972; Borgono et al, 1980; Tseng et al, 1968; Tseng et al, 1995; Szuler et al, 1979, as cited in ATSDR, 2000).

The oral health guideline, the chronic minimal risk level (MRL) of 0.0003 mg/kg/day, is based on a study in which humans were exposed to arsenic at a dose of 0.0008 mg/kg/day for more than 45 years. A lowest-observed-adverse-effect level (LOAEL) of 0.05 mg/kg/day was estimated in a human study for several systems of the body. The systems included gastrointestinal (gastrointestinal hemorrhages), hepatic (vascular fibrosis, portal hypertension) and dermal (hyperpigmentation with keratoses, possibly precancerous). The exposure oral duration ranged from 3 through 22 years (Morris et al, 1974 as cited in ATSDR, 2000). The estimated exposure dose (3.65×10^{-4} mg/kg/day) for the workers of PWIII only slightly exceeded the MRL and was about 140 times lower than the lowest dose found in the mentioned study that caused a harmful noncancer health effect. Daily exposure to the maximum concentration of arsenic in soil on the site for 36 years is not expected to cause any harmful health effects in the workers. Also, the occasional exposure of trespassers is not expected to cause harmful health effects.

Dermal exposure to arsenic is usually not of concern because only a small amount of arsenic will pass through the skin into the body (4.5% of inorganic arsenic in soil, Wester et al, 1993, as cited in ATSDR, 2000). Direct skin contact with arsenic is not likely to result in any serious internal effects.

Arsenate and arsenite are absorbed through the inhalation route. Most information on human inhalation exposure to arsenic derives from occupational settings such as smelters and chemical plants, where the predominant form of airborne arsenic is arsenic trioxide dust.

Workers exposed to arsenic dusts in air often experience irritation of the mucous membranes of the nose and throat. The irritation may lead to laryngitis, bronchitis, or rhinitis (Dunlalp, 1921; Lundgren, 1954; Morton and Caron, 1989; Pinto and McGill, 1953, as cited in ATSDR, 2000). Despite the known respiratory irritant effects of arsenic, few systematic investigations of respiratory effects in humans exposed to arsenic have been conducted (ATSDR, 2000).

Exposure to inorganic arsenic, through the inhalation route, has been associated with cardiovascular diseases (increase incidence of vasospacticity and clinical Raynaud's phenomenon) and with lung cancer (ATSDR, 2000). The inhalation route could not be evaluated for the PWIII workers, however, because no environmental data for air were available.

The U. S. Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP) and EPA independently have determined that arsenic is carcinogenic to humans.

The estimate of the theoretical excess cancer risk is 5.5×10^{-4} for the former workers of the site. This estimate reflects a small or slight increase in the chance for the workers to develop cancer. The estimated exposure dose for the PWIII workers was 3.65×10^{-4} mg/kg/day. This exposure dose was at least two orders of magnitude less than the cancer effect level (CEL: 0.04) for carcinomas of the skin and of the lung reported in a human study (Luchtrath, 1983, as cited in ATSDR, 2000). In another human study (Chen et al, 1986, as cited in ATSDR, 2000), a CEL of 0.064 was reported for bladder, lung, and liver cancers. A CEL is the lowest exposure level associated with the onset of carcinogenesis in experimental or epidemiologic studies. CELs are always considered serious effects.

Toxaphene

Toxaphene is an insecticide containing more than 670 chemicals. Usually found as a solid or gas, toxaphene in its original form is a yellow to amber waxy solid that smells like turpentine. Toxaphene does not burn, but evaporates when in solid form or when mixed with liquids. Toxaphene is also known as camphechlor, chlorocamphene, polychlorocamphene, and chlorinated camphene. Toxaphene was one of the most heavily used insecticides in the United States until 1982, when it was discontinued for most uses; all uses were banned in 1990. Used primarily in the southern United States to control insect pests on cotton and other crops, toxaphene was also used to control insect pests on livestock and to kill unwanted fish in lakes (ATSDR, 1996).

Toxaphene is more likely to be found in air, soil, or sediment at the bottom of lakes or streams, than in surface water because it does not dissolve well in water. Detected in 12 soil samples from PWIII at levels above the comparison values, toxaphene breaks down very slowly in the environment. Entering the environment from hazardous waste sites and the air by evaporation, toxaphene accumulates in fish and mammals.

People near a hazardous waste site where toxaphene was disposed can be exposed to toxaphene through inhalation if the contaminant becomes airborne (ATSDR, 1996).

Breathing, eating, or drinking high levels of toxaphene can damage the lungs, nervous system, and kidneys, and can even cause death (ATSDR, 1996). PWIII operated from 1954 until February 2003. Until new environmental regulations went into effect in the 1990s, workers and people living near the facility could have been exposed to toxaphene. The U.S. Department of Health and Human Services (HHS) has determined that toxaphene may reasonably be anticipated to be a carcinogen.

Toxaphene is toxic following short-term, high-dose oral exposure. The minimum lethal dose of toxaphene in humans has been estimated to be 2–7 grams of ingested chemical (Hayes, 1963 as cited in ATSDR, 1996). In animal studies the no-observed-adverse-effect level (NOAEL) was 56 mg/kg/day for hepatic diseases and thyroid adenomas and 13 mg/kg/day for hepatocellular carcinoma for exposures of 80 weeks. The cancer effect level (CEL) estimated in animal studies (80 weeks of exposure) is 56 mg/kg/day for thyroid adenomas and 13 mg/kg/day for hepatocellular carcinoma. These levels are extremely high in comparison with the estimated dose of exposure calculated for the workers of PWIII. However, the exposure period of the PWIII workers was longer (approximately 36 years) in comparison with the exposure period in the experimental studies. The occasional exposure of trespassers is not expected to cause harmful health effects.

Aldrin and dieldrin

The theoretical excess cancer risk for aldrin and dieldrin showed a slight chance for the workers to develop cancer. The estimated exposure doses for aldrin and dieldrin were compared with the cancer effect levels (CELs) observed in the literature. Animal studies reported a CEL of 2.1 mg/kg/day for thyroid cancer (74–80 weeks of exposure) and a CEL of 1.7 mg/kg/day for liver cancer (2 years of exposure). An experimental study for oral exposure (2 years) to dieldrin reported a CEL of 1.7 mg/kg/day for liver cancer. The estimated exposure doses for the workers of PWIII are below the CELs reported in the experimental studies. The PWIII workers, however, had a longer duration of exposure than the subjects of the experimental studies.

Calcium, iron, magnesium, potassium, and sodium

Essential nutrients like calcium, iron, magnesium, potassium, and sodium are important minerals that maintain basic life functions; therefore, certain doses are recommended on a daily basis. Because these chemicals are necessary for life, MRL's and RfDs do not exist for them. The PRCAP staff compared the estimated exposure doses for calcium, iron, magnesium, potassium, and sodium with their recommended daily intake (Appendix C, Table C1).

Iron exceeded its recommended daily intake. An estimate of an ingestion of iron of 32.68 mg/day was obtained for the workers of PWIII, which is more than twice the recommended daily intake (15 mg). Iron is a naturally occurring element in the environment. As a pure metal, iron is very reactive chemically and will rapidly corrode, especially in moist air or at high temperatures. It is hard and brittle, and is usually combined with other metals to form alloys, including steel.

Iron, an important mineral, assists in the maintenance of basic life functions. Iron combines with protein and copper to make hemoglobin, which transports oxygen in the blood from the lungs to other parts of the body, including the heart. Iron also aids in the formation of myoglobin, which supplies oxygen to muscle tissues. Without sufficient iron, the body cannot produce enough hemoglobin or myoglobin to sustain life. Iron deficiency anemia is a condition occurring when the body does not receive enough iron.

The health consequences of iron excess include hemochromatosis, an iron storage disease associated with liver damage further exacerbated by alcohol consumption. Progressive liver damage associated with this condition is generally attributed to increased oxidative stress (Swanson, 2003).

The estimated exposure doses for calcium, magnesium, potassium, and sodium were far below the recommended daily intake (Appendix C, Table C1).

Groundwater

Dieldrin and bis(2-ethylhexyl)phthalate were selected for further evaluation because sampling data identified the presence of these contaminants above their respective CVs. This evaluation consisted of calculating estimated exposure doses using site specific exposure assumptions (Table 5). The following equation estimates incidental ingestion of chemicals in water:

$$ED = (C \times IR \times EF) / BW$$

Where:

ED: Estimated exposure dose

C: Contaminant concentration (mg/L)

- PRCAP staff used the maximum concentration detected

IR: Intake rate of contaminated water (L/day):

- 3 L/day for adult male workers of the facility
- 2 L/day for adult residents
- 2 L/day for children <18 years

EF: Exposure factor

- For adult residents and children <18 years: 0.99
    - Taking into consideration an exposure of 365 days a year for 30 years (national upper-bound time–90th percentile) at one residence for adults
    - Taking into consideration an exposure of 365 days a year for 18 years
- For Adult Male Workers: 0.68
    - Taking into consideration an exposure of 250 days a year for 36 years.

BW: Body weight (kg)

- Adult Males Workers: 78 kg*
- Adult residents: 76 kg*
- children <18 years: 43 kg†

*Puerto Rico Behavioral Risk Factor Surveillance System (PR BRFSS), 2001-2002. The BRFSS is a phone survey of adult residents of Puerto Rico 18 years of age and older.

†Estimated average body weight of male and females of Puerto Rico less than 18 years of age.

Table 5. Estimated exposure doses for ingestion of chemicals in water compared to health guidelines

Contaminant	Type of population	Estimated exposure dose (mg/kg/day)	Maximum detected concentration (ppm)	Oral health guideline (mg/kg/day)	Basis for health guidelines
Dieldrin	Male Workers	0.00000915	0.00035J,N	0.00005	Chronic MRL
	Adult residents	0.00000912			
	Children< 18 years	0.0000161			
Bis(2-Ethylhexyl) Phthalate	Male Workers	0.0000104	0.004J	0.06	Chronic MRL
	Adults residents	0.000104			
	Children < 18 years	0.000184			

J: Estimated value, compound present below contract required quantization limit (CRQL), but above instrument detection limit (IDL)
mg/kg/day: milligrams per kilograms per day
MRL: Minimal risk level
N: Presumptive evidence of the presence of the material
ppm: parts per million

Although dieldrin and bis(2-ethylhexyl)phthalate slightly exceeded the cancer risk evaluation guide (CREG), the contaminants' estimated exposure dose did not exceed the chronic oral health guideline (MRL). The levels of contaminants in the drinking water found in the samples at PWIII in Manatí are not of health concern.

Also, calcium, magnesium, and sodium were detected in the tap sample. On the basis of likely exposures at this site, none of the metals evaluated exceeded the recommended daily dose (Appendix C, Table C2) and therefore are not of health concern.

Children's Health Considerations

Children are at greater risk for adverse health effects from exposures to hazardous substances than 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.

A private school across the street from the site serves a population of 95 children from preschool through sixth grade. The potential of any health risk for the children, however, cannot be determined because off-site sampling data are not available.

Children from the school have not been reported trespassing on the site. Although the school is just across the street, children likely cannot enter the site because the school premises are restricted by two fences and the site is fenced.

Adults comprise the entire population immediately beside the site. PRCAP staff verified that children visited one of the nearby households on weekends. Children (e.g., grandsons, granddaughters, nephews, nieces) probably visit adults living in other homes near the site. Nevertheless, these children likely cannot get into the site.

Community Health Concerns

On September 4, 2003, the Puerto Rico Cooperative Agreement Project (PRCAP) staff conducted a site visit in coordination with the EPA's remedial project manager (RPM) and a Puerto Rico Land Authority (PRLA) representative to gather information about the site and to assess current site conditions. The group compiled community health concerns that had been expressed to the local offices of federal and state agencies and met with a community member who had been a PWIII employee for 35 years. He was concerned that many of his fellow employees had died in past years and that many of his peers had swelling in the abdominal area.

The EPA, PRLA, and PRCAP representatives have been concerned about the groundwater since receiving a report that about 20 drums of an unknown pesticide had been buried on the site in the 1970s. This report has not been confirmed, but the representatives have forwarded the information to EPA.

As part of the community involvement plan to collect community health concerns, the PRCAP staff met informally with representatives from the facilities nearest the site on January 23, 2004, and February 2, 2004. The representatives from the two sections of the retirement home, the church (Iglesia de Dios de la Profesía), the administrative offices of the Misión Puertorriqueña del Norte and the Colegio Wamiriel private school expressed concerns about an evacuation that occurred on May 1, 2003. The Puerto Rico Environmental Quality Board (PREQB) and the Puerto Rico Civil Defense, involved in the evacuation process, confirmed that this event had nothing to do with the PWIII site. The evacuation was related to the misuse of a new fertilizer (gallinazo) on the pineapple crop near the site.

The PHA was released for public comments. The public comments period (May 9, 2005 – June 3, 2005) was announced through the major newspapers in P.R.

Conclusions

This Public Health Assessment (PHA) evaluates the exposure to contaminants from the Pesticide Warehouse III site in Palo Alto, Manatí, Puerto Rico. On the basis of the available data, the Puerto Rico Cooperative Agreement Project (PRCAP) staff makes the following conclusions:

- Exposure of workers and trespassers to on-site soil poses no apparent public health hazard. Although the site's workers were exposed to the contaminants detected in the surface soil while working at the PWIII, the exposure to such contaminants, according to the data available, is unlikely to have a detrimental health result.
- The limited data available for drinking water indicated that contaminants were below levels of health concern. Nevertheless, the drinking water exposure pathway is classified as an indeterminate public health hazard because the data are insufficient to make a full assessment.
- The PRCAP staff identified as a potential exposure pathway the air route for the workers and the neighbors of the area while the facility was operating. The air pathway could not be evaluated because critical information is lacking to support a judgment regarding the level of public health hazard. The air pathway, therefore, is classified as an indeterminate public health hazard.
- The PRCAP staff identified the surface soil adjacent to the site as a potential exposure pathway for neighbors of the site. The full extent of the contamination of the soil in areas adjacent to the site is unknown. Because critical information is lacking to support a judgment regarding the level of public health hazard, the surface soil pathway is classified as an indeterminate public health hazard for neighbors of the site.

Recommendations

1. Characterize fully the nature and extent of on-site and off-site soil and air contamination.
2. Characterize fully the nature and extent of ground water contamination and determine whether other private wells are in use in the area.
3. Characterize sediments and surface water in the drainage ditch.
4. Verify the existence and contents of the drums reportedly buried on-site. If the drums exist, an investigation should determine if the drums are damaged, if a spill has occurred, and if the spill has affected the groundwater.
5. Restrict access to the site more effectively through better position of warning signs to discourage site trespassers.

Public Health Action Plan

Actions Completed

- Meetings with representatives from state and federal agencies and community members to identify community concerns:
    - Puerto Rico Land Authority (PRLA)
    - Puerto Rico Environmental Quality Board (PREQB)
    - Municipal fire station personnel
    - U.S. Environmental Protection Agency
    - Past employees of Pesticide Warehouse III
    - Private school director
    - Centro Geriátrico Virgilio Ramos Casellas director
    - Remanzo de Paz director
    - Mision Puertorriqueña del Norte treasurer
    - Neighbors of the site
- Health education needs assessment for the community near PWIII, Manatí, Puerto Rico.
- Implementation of the health education plan. The objectives of the health education plan are the following:
    1. Identify the concerns of the community.
    2. Increase the access of the community members to educational materials related to the site.
    3. Increase the participation of the community and the agencies in the PHA evaluation.

  Some of the activities to achieve the objectives were:
    1. Contact the workers of the site to gather their concerns.
    2. Prepare a fact sheet (summary) in Spanish of the PHA.
    3. Prepare a repository for the educational materials of the site.
    4. Distribution of the PHA to the community members and agencies involved with the site.
    5. Prepare an evaluation form for the PHA in Spanish.

- Release of the brown cover version of the PHA for public comments.

Actions Planned

- The Puerto Rico Cooperative Agreement Project (PRCAP) staff will evaluate the remedial investigation and feasibility study (RI/FS) sampling work plan as soon as it is available.
- The PRCAP staff will review new monitoring data as they become available and modify conclusions of this public health assessment as necessary.
- EPA will try to verify the alleged existence of buried drums.
- EPA will start a remedial investigation on the site.

Preparers of Report

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PR Department of Health
Cooperative Agreement

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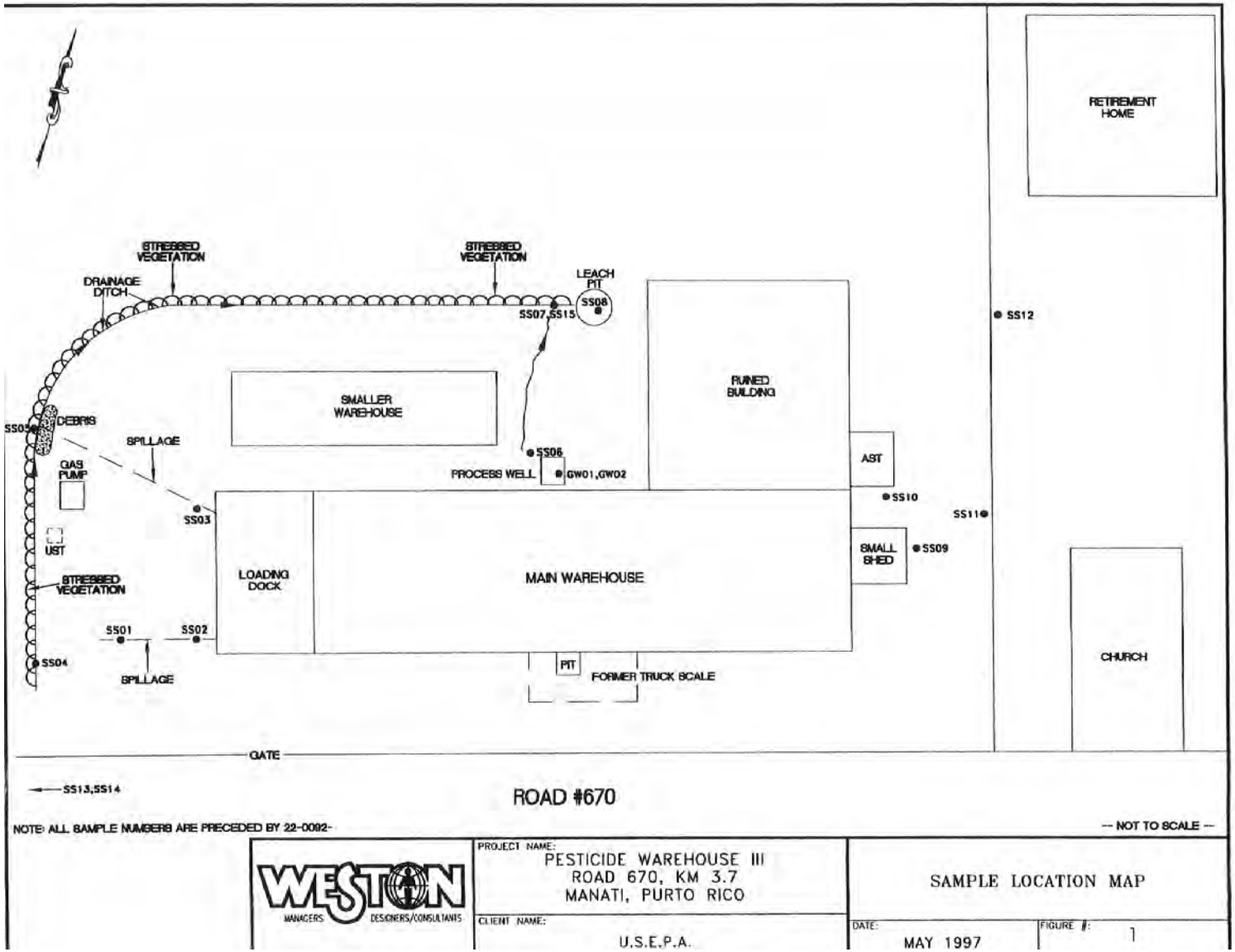
Appendix A: Layout of the PWIII Site and Sample Locations


RETIREMENT HOME
STRESSED VEGETATION
STRESSED VEGETATION
DRAINAGE DITCH
LEACH PIT
SS08
SS07,SS15
SS12
SMALLER WAREHOUSE
RUINED BUILDING
SS05
DEBRIS
SPILLAGE
SS06
AST
GAS PUMP
PROCESS WELL
GW01,GW02
SS10
SS11
SS03
UST
SMALL SHED
SS09
LOADING DOCK
MAIN WAREHOUSE
STRESSED VEGETATION
SS01
SS02
SS04
SPILLAGE
PIT
FORMER TRUCK SCALE
CHURCH
GATE
SS13,SS14
ROAD #670
NOTE: ALL SAMPLE NUMBERS ARE PRECEDED BY 22-0092-
-- NOT TO SCALE --
WESTON
MANAGERS DESIGNERS/CONSULTANTS
PROJECT NAME:
PESTICIDE WAREHOUSE III
ROAD 670, KM 3.7
MANATI, PURTO RICO
CLIENT NAME:
U.S.E.P.A.
SAMPLE LOCATION MAP
DATE:
MAY 1997
FIGURE #:
1

Appendix B: Summary of Environmental Sampling Data

List of the semivolatile organic compounds (SVOCs) not detected during the analysis of the groundwater samples collected on May 30, 1996

Phenol
Bis(2-Chloethyl)Ether
2-Chlorophenol
1,3-Dicholobenzene
1,4-Dichlorobenzene
1,2-Dichlorobenzene
2-Methylphenol
2,2-Oxybis(1-Chloropropane)
4-Methylphenol
N-Nitroso-Di-n-Propylamine
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
bis(2-Chloroethoxy)Methane
2,4-Dichlorophenol
1,2,4,-Trichlorobenzene
Naphthalene
p-Chloroaniline
Hexachlorobutadiene
4-Chloro-3-Methylphenol
Naphthalene
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloroanphthalene
2-Nitroaniline
Dimethyl Phthalate
Acenaphthylene
2,6-Dinitrotoluene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
Diethylphthalate
4-Chlorophenyl-phenylether
Fluorene
4-Nitroaniline
4,6-Dinitro-2-Methylphenol
N-Nitrosodiphenylamine
4-Bromophenyl-phenylether
Hexachlorobenzene
Pentachlorophenol
Phenanthrene
Anthracene
Carbazole
Fluoranthene
Pyrene
Butylbenzylphthalate
3,3’-Dichlorobenzidine
Benzo(a)Anthracene
Chrysene
Di-n-Octyl Phthalate
Benzo(b)Fluoranthene
Benzo(a)Pyrene
Indeno(1,2,3-cd)Pyrene
Dibenz(a,h)Anthracene
Benzo(g,h,i)Perylene

List of volatile organic compounds (VOCs) not detected during the analysis of soil and groundwater samples collected on May 30, 1996

Chloromethane
Bromomethane
Vinyl Chloride
Chloroethane
Carbon Disulfide
1,1-Dichlroethene
1,1-Dichlroethane
1,2-Dichloroethene (total)
Chloroform
1,2-Dichlorethane
2-Butanone
1,1,1-Trichloroethane
Carbon Tetrachloride
Bromodichloromethane
1,2-Dichloroprpane
cis-1,3-Dichloropropene
Trichloroethene
Dibromochloromethane
1,1,2-Trichloroethane
Benzene
Trans-1,3_Dichloropropene
Bromoform
4-Methyl-2-Pentanone
2-Hexanone
Tetrachloroethene
1,1,2,2-Tetrachloroethane
Toluene
Chlorobenzene
Ethylbenzene
Styrene
Xylenes (total)

List of the semivolatile organic compounds (SVOCs) not detected during the analysis of the soil samples collected on May 30, 1996

Phenol
Bis(2-Chloethyl)Ether
2-Chlorophenol
1,3-Dicholobenzene
1,4-Dichlorobenzene
2-Methylphenol
2,2-Oxybis(1-Chloropropane)
4-Methylphenol
N-Nitroso-Di-n-Propylamine
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
bis(2-Chloroethoxy)Methane
2,4-Dichlorophenol
1,2,4,-Trichlorobenzene
p-Chloroaniline
Hexachlorobutadiene
4-Chloro-3-Methylphenol
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloroanphthalene
2-Nitroaniline
Dimethyl Phthalate
Acenaphthylene
2,6-Dinitrotoluene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
Diethylphthalate
4-Chlorophenyl-phenylether
Fluorene
4-Nitroaniline
4,6-Dinitro-2-Methylphenol
N-Nitrosodiphenylamine
4-Bromophenyl-phenylether
Hexachlorobenzene
Anthracene
Carbazole
3,3’-Dichlorobenzidine
Indeno(1,2,3-cd)Pyrene
Dibenz(a,h)Anthracene
Benzo(g,h,i)Perylene

Table B1. Summary of the analytical results for SVOCs in soil samples taken on May 30, 1996

Compound	Sample (µg/kg)														
	SS01	SS02	SS03	SS04	SS05	SS06	SS07	SS08	SS09	SS10	SS11	SS12	SS13	SS14	SS15
1,2-dichlorobenzene	-	-	-	-	120J	-	-	-	-	-	-	-	-	-	-
Naphthalene	-	-	-	-	-	96J	-	-	-	-	-	-	-	-	-
2-methylnaphthalene	-	-	-	-	-	96J	-	-	-	-	-	-	-	-	-
Pentachlorophenol	-	-	-	-	49J	91J	48J	-	-	-	-	-	-	-	-
Phenanthrene	-	140J	-	-	-	-	-	-	-	-	-	-	-	-	-
Di-n-butylphthalate	-	70J	-	-	48J	76J	-	-	-	-	-	-	-	-	
Fluoranthene	-	210J	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	-	140J	-	-	76J	-	-	-	-	-	-	-	-	-	-
Butylbenzylphthalate	69J	240J	520J	-	72J	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	-	-	67J	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	-	96J	-	-	-	-	-	-	-	-	-	-	-	-	-
bis(2-ethylhexyl)phthalate	430J	9,100*J	3,500*J	210J	1,500J	640J	250J	120J	1,100J	-	-	66J	-	55J	59J
Di-n-octylphthalate	-	5,300*J	170J	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	160XJ	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	170XJ	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene	-	65J	-	-	-	-	-	-	-	-	-	-	-	-	-
Di-n-butylphthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	51J	76J

µg/kg: milligrams per kilograms
-: Compound analyzed for, but not detected
J: Estimated value, compound present below contract required quantitation limit (CRQL), but above instrument detection limit (IDL)
SVOCs: semivolatile organic compounds
X: Sample could not be chromatographically resolved
* Value transferred from the dilution analysis
Detection limits elevates if dilution factor >1 and/or percent moisture >0%

Table B2. Summary of the analytical results for VOCs in soil samples taken on May 30, 1996

Compound	Sample (µg/kg)														
	SS01	**SS02**	**SS03**	**SS04**	**SS05**	**SS06**	**SS07**	**SS08**	**SS09**	**SS10**	**SS11**	**SS12**	**SS13**	**SS14**	**SS15**
Methyl chloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Acetona	-	-	-	R	R	R	R	R	R	R	R	R	R	R	R

-: Compound analyzed for, but not detected
R: Analysis did not pass U.S. Environmental Protection Agency quality assurance/quality control (EPA QA/QC)
VOCs: volatile organic compounds
Detection limits elevates if dilution factor >1 and/or percent moisture >0%

Table B3. Summary of the analytical results for organophosphorus pesticides in soil samples taken on May 30, 1996

	Sample (µg/kg)														
Pesticide	**SS01**	**SS02**	**SS03**	**SS04**	**SS05**	**SS06**	**SS07**	**SS08**	**SS09**	**SS10**	**SS11**	**SS12**	**SS13**	**SS14**	**SS15**
Diazinon	230	980†	340	180	320	240	410†	190†	20J	11J	3.1	-	-	-	380†
Malathion	15J	14	20	75	29	65	14	38	28J	-	-	-	-	-	23
Diuron	3,007†	18,782§	34,558§	5,245‡	30,140§	21,096§	25,481§	5,856‡	-	374	-	-	72.5	-	26,811J§

Blank space - compound analyzed for, but not detected
J - Estimated value
† Dilution factor was 10 times
‡ Dilution factor was 50 times
§ Dilution factor was 100 times

Table B4. Summary of the analytical results for pesticides in soil samples taken on May 30, 1996

Pesticide	Sample (µg/kg)							
	SS01	**SS02**	**SS03**	**SS04**	**SS05**	**SS06**	**SS07**	**SS08**
Alpha-BHC	-	-	12J	-	-	1.2J	-	-
Beta-BHC	-	-	R	-	R	-	-	-
Delta-BHC	-	-	-	-	-	-	-	-
Gamma-BHC(lindane)	-	-	-	-	-	-	-	-
Heptachlor	930J	550J	560*J	1,000J	62J	30J	9.2J	14J
Aldrin	120J	1,700J	150J,N	310J	R	R	R	-
Heptachlor epoxide	-	170J	90J	-	32J,N	18J	14J,N	15J,N
Endosulfan I	7.9J,N	100J	-	-	51J	36J	16J	6.8J
Dieldrin	780J	3,600*J	170J,N	2,000J	710*J	500*J	170J	150J
4,4'-DDE	-	-	330J,N	R	-	-	R	-
Endrin	190J,N	-	-	-	130J	-	-	-
Endosulfan II	-	-	-	-	-	-	-	-
4,4'-DDD	-	-	-	R	-	R	R	-
Endosulfan sulfate	-	-	-	-	-	-	-	-
Methoxychlor	-	-	220J	-	-	-	-	-
Endrin ketone	-	R	R	R	R	R	R	-
Endrin aldehyde	330J,N	540J,N	R	-	-	-	-	93J,N
Alpha-chlordane	170J	-	-	200J	-	-	-	-
Gamma-chlordane	1,700*J	1,100*J	620*J	3,200*J	330*J	130J,N	R	R
Toxaphene	64,000J	110,000J	96,000J	200,000J	57,000J	22,000J	27,000J	18,000J
Aroclor-1016	-	-	-	-	-	-	-	-
Aroclor-1221	-	-	-	-	-	-	-	-
Aroclor-1232	-	-	-	-	-	-	-	-
Aroclor-1242	-	-	-	-	-	-	-	-
Aroclor-1248	-	-	-	-	-	-	-	-
Aroclor-1254	-	-	-	-	-	-	-	-
Aroclor-1260	-	-	-	-	-	-	-	-

-: Compound analyzed for, but not detected
J: Estimated value, compound present below contract required quantitation limit (CRQL), but above instrument detection limit (IDL)
R: Analysis did not pass U.S. Environmental Protection Agency quality assurance/quality control (EPA QA/QC)
N: Presumptive evidence of the presence of the material
* Value transferred from the dilution analysis
Detection limits elevates if dilution factor >1 and/or percent moisture >0%

Table B4. Summary of the analytical results for pesticides in soil samples taken on May 30, 1996 (continued)

Pesticide	Sample (µg/kg) SS09	SS10	SS11	SS12	SS13	SS14	SS15
Alpha-BHC	R	-	-	-	-	-	-
Beta-BHC	R	-	R	-	-	-	-
Delta-BHC	R	-	-	-	-	-	-
Gamma-BHC(Lindane)	R	-	-	-	-	-	-
Heptachlor	R	-	-	-	3.6J	-	-
Aldrin	R	4.5J	-	-	R	-	R
Heptachlor epoxide	R	-	43J,N	-	R	R	-
Endosulfan I	R	-	19J,N	-	3.8J	-	-
Dieldrin	R	16J	R	4.7J	79*J	20J,N	130J
4,4'-DDE	R	-	R	-	26J,N	-	-
Endrin	R	-	-	-	28J	-	-
Endosulfan II	R	-	-	-	-	-	-
4,4'-DDD	R	-	R	-	R	R	-
Endosulfan Sulfate	R	-	-	-	-	-	-
Methoxychlor	R	-	-	-	-	-	-
Endrin Ketone	R	-	R	-	R	-	R
Endrin Aldehyde	R	-	R	-	-	-	-
Alpha-Chlordane	R	-	11J	-	-	-	-
Gamma-Chlordane	R	-	-	-	19J,N	9.2J	R
Toxaphene	R	-	28,000J	-	12,000J	1,200J	12,000J
Aroclor-1016	R	-	-	-	-	-	-
Aroclor-1221	R	-	-	-	-	-	-
Aroclor-1232	R	-	-	-	-	-	-
Aroclor-1242	R	-	-	-	-	-	-
Aroclor-1248	R	-	-	-	-	-	-
Aroclor-1254	R	-	-	-	-	-	-
Aroclor-1260	R	-	-	-	-	-	-

-: Compound analyzed for but not detected
J: Estimated value, compound present below contract required quantitation limit (CRQL), but above instrument detection limit (IDL)
R: Analysis did not pass U.S. Environmental Protection Agency quality assurance/quality control (EPA QA/QC)
N: Presumptive evidence of the presence of the material
* Value transferred from the dilution analysis
Detection limits elevates if dilution factor >1 and/or percent moisture >0%

Table B5. Summary of the analytical results for metals in the soil samples collected on May 30, 1996

Parameter Metals	SS01	SS02	SS03	SS04	SS05	Sample (mg/kg) SS06	SS07	SS08	SS09	SS10	SS11	SS12	SS13	SS14	SS15
Aluminum	3,440	6,280	3,370	7,650	7,700	5,650	10,800	5,470	9,670	8,610	8,950	14,100	6,390	6,460	6,430
Antimony	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	12N,J	24.3N,J	12.2N,J	22.7N,J	22.3N,J	26.5N,J	34.2N,J	19.6N,J	32.4N,J	41.9N,J	23.4N,J	29.6N,J	11.3N,J	8.1N,J	21.7N,J
Barium	20.1B	17.4B	13.2B	15.4B	15.9B	35.9B	19.3B	7.4B	27.2B	21.4B	51.1	38.9B	7.5B	3.6B	22.3B
Beryllium	-	0.15B	-	0.17B	0.18B	0.16B	0.25B	0.15B	0.62B	0.21B	0.57B	1.1B	-	-	0.17B
Cadmium	1.3	4.8	6.8	1.3	2.3	2.9	0.91B	0.44B	0.53B	1.0B	0.5B	1.0B	-	-	0.76B
Calcium	103,000J	40,300J	73,800J	56,700J	15,300J	46,100J	8,710J	9,720J	6,910J	2,390J	25,400J	41,600J	7,040	2,090J	5,580J
Chromium	34.1	78.1J	47.5J	54.3J	69.3J	65.8J	76.4J	86.4J	81.2J	63J	64.9J	90.1J	35.2J	30.4J	52.8J
Cobalt	4.4B	6.0B	4.1B	6.5B	4.8B	8.7B	8.0B	7.1B	15.1J	14.7J	11.7J	11.9J	3.0B	1.9B	7.1B
Copper	22.7	58.4	40.7	37.6	48.4	99.1	32.8	19.8	23.1	25.8	21.7	36.1	13.3	11.4	26.4
Iron	17,200	47,400	35,700	27,900	30,500	48,100	33,800	20,700	28,600	35,000	22,400	31,400	12,200	11,600	23,600
Lead	18.9	24.1	78.8	29	62.3	121	28.6	175	23.2	66	24.8	28.7	27.9	10.2	25.8
Magnesium	1,140	2,100	2,190	690B	957B	1,460	595B	383B	376B	334B	562B	948B	279B	146B	436B
Manganese	615	527	466	655	348	685	619	344	1,230	799	1,060	1,050	459	271	679
Mercury	-	-	-	0.06B	0.07B	0.06B	0.09B	0.07B	0.11	0.12B	0.21	0.34	0.07B	0.08B	0.12B
Nickel	9.3J	19.5J	13.7	11.9J	11.6J	20.6J	14.3J	8.1B	12.3J	12.7J	11.5J	17.4J	4.4B	4.3B	10.8J
Potassium	2,450	2,180	789B	356B	514B	354B	236B	203B	239B	307B	180B	367B	231B	152B	210B
Selenium	-	-	-	-	-	-	1.3B,N,J	-	-	-	-	-	-	-	1.2N,J
Silver	1.0B	0.77B	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium	103B	70.8B	112B	53.2B	59.9B	112B	70.6B	39.2B	72.8B	78.8B	89.9B	119B	59.3B	57.2B	64.7B
Thallium	-	0.69B	2.1B	-	0.95B	2.4B	1.4B	1.4B	1.4B	-	1.0B	1.4B	-	-	-
Vanadium	24.7J	48.2	24J	54.9	56.5	51.9J	78	48.6	79.5	65.8	63.3	88.8	31.4J	28.5J	53.2
Zinc	801	3,690	2,720	1,430	1,390	2,660	856	579	198	805	178	219	70	22.9	639

-: Compound analyzed for, but not detected

B: Estimated value, compound present below contract required quantitation limit (CRDL), but above instrument detection limit (IDL)

J: Estimated value

N: Presumptive evidence of the presence of the material

Table B6. Metals detected in water samples

Metal	Range of Detection (ppm)	Number of Samples Above CVs	Health Comparison Values (ppm)
Barium	0.0121	0	0.70 child RMEG 2.00 adult RMEG 2 MCL
Cadmium	0.001	0	0.005 child RMEG 0.020 adult RMEG .005 MCL
Calcium	96.3–98.0	-	No CV
Chromium	0.0061	-	.100 MCL
Cobalt	0.0024	0	0.10 child Intermediate EMEG 0.40 adult Intermediate EMEG
Iron	0.0149–0.0616	-	No CV
Magnesium	3.41–3.48	-	No CV
Manganese	0.0014	0	0.50 child RMEG 2.00 adult RMEG
Potassium	0.698–0.690	-	No CV
Sodium	9.54–9.82	-	No CV
Vanadium	0.0032	0	0.030 child Int EMEG 0.100 adult Int EMEG

CVs: Comparison values
EMEG: Environmental media evaluation guide
ppm: parts per million
RMEG: Reference dose media evaluation guide

Appendix C: Comparison of the estimated exposure doses for some nutrients with their recommended daily intake

Table C1. Estimated exposure doses (incidental soil ingestion) for some nutrients for the workers of PWIII compared with their recommended daily intake

Metal	Estimated exposure dose (mg/day)	Recommended Daily Intake Value (mg/day)
Calcium	69.96	1,500
Magnesium	1.48	400
Iron	32.68	15
Potassium	1.64	850

mg/day: milligrams per day

Table C2. Estimated exposure doses through drinking water for some nutrients compared with their recommended daily intake

Metal	Type of Population	Estimated exposure dose (mg/day)	Recommended Daily Intake Value (mg/day)
Calcium	Male Workers	199.92	1,500
	Adult residents	193.80	
	Children < 18 years	193.90	
Magnesium	Male Workers	7.098	400
	Adult residents	6.92	
	Children < 18 years	6.89	
Sodium	Male Workers	20.03	2,400
	Adult residents	19.46	
	Children < 18 years	19.44	

mg/day: milligrams per day

Appendix D: ATSDR Glossary of Terms

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 defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

General Terms

Acute

Occurring over a short time [compare with chronic].

Acute exposure

Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Adverse health effect

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

Analyte

A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Background level

An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Cancer

Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk

A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen

A substance that causes cancer.

CERCLA [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]

Chronic

Occurring over a long time [compare with acute].

Chronic exposure

Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

Comparison value (CV)

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

Completed exposure pathway [see exposure pathway].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

Concentration

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

Contaminant

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

Dermal

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

Dermal contact

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

Detection limit

The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

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.

Epidemiology

The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure

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

Exposure assessment

The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure pathway

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

Feasibility study

A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Groundwater

Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Hazard

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

Hazardous waste

Potentially harmful substances that have been released or discarded into the environment.

Health consultation

A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with public health assessment].

Health education

Programs designed with a community to help it know about health risks and how to reduce these risks.

Indeterminate public health hazard

The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Ingestion

The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation

The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure

Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

Lowest-observed-adverse-effect level (LOAEL)

The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

mg/kg

Milligram per kilogram.

mg/m3

Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Minimal risk level (MRL)

An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)

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

No apparent public health hazard

A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)

The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

NPL [see National Priorities List for Uncontrolled Hazardous Waste Sites]

Point of exposure

The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population

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

ppb

Parts per billion.

Public health action

A list of steps to protect public health.

Public health assessment (PHA)

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

Public health hazard categories

Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Public health statement

The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Receptor population

People who could come into contact with hazardous substances [see exposure pathway].

Reference dose (RfD)

An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Remedial investigation

The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)

This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RfD [see reference dose]

Risk

The probability that something will cause injury or harm.

Route of exposure

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

Sample

A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size

The number of units chosen from a population or an environment.

Source of contamination

The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Special populations

People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Substance

A chemical.

Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)

Surface water

Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Toxicological profile

An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology

The study of the harmful effects of substances on humans or animals.

Uncertainty factor

Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for

differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

Volatile organic compounds (VOCs)

Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other Glossaries and Dictionaries:

U.S. Environmental Protection Agency (http://www.epa.gov/OCEPAterms/)

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

For more information on the work of ATSDR, please contact:
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Appendix E: Response to public comments

Response to public comments

The Puerto Rico Cooperative Agreement Project received the following comments during the public comment period (May 9 through June 3, 2005) for the Public Health Assessment for Pesticide Warehouse III Palo Alto, Manatí, P.R. (February, 2005).

1. Comment: The information on the public health assessment is real since I used to work at the site eight hours a day. The pesticide's smell was perceived by the workers. The public health assessment answered the health concerns and the document is beneficial. Appreciate the interest of the PR Project in the community and the information. However, the conclusions on the public health assessment are not completely clear.

   Response: Thanks for your comment. The Puerto Rico Cooperative Agreement Project presented four conclusions in this document since they are related to different media (surface soil at the site, drinking water, air and surface soil adjacent to the site).

   ATSDR has established five conclusion categories. These five categories are:
   - Category 1 Urgent public health hazard
   - Category 2 Public health hazard
   - Category 3 Indeterminate public health hazard
   - Category 4 No apparent public health hazard
   - Category 5 No public health hazard

The conclusions on this public health assessment were determined based on the results of the exposure and health effects evaluations. The degree of public health hazard at the site was characterized based on the following factors:

- The existence of past, current or potential future exposures to site-specific contaminants or physical or safety hazards.
- The susceptibility of the potentially exposed population.
- The likelihood of exposures resulting in adverse health effects.

Based on the available information, a statement was made about the health hazards associated with the site for each media.

If you have any other question regarding the conclusions of this public health assessment, please contact:

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Puerto Rico Cooperative Agreement Project
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Also, a summary in Spanish of the information in this Appendix is available and a Spanish fact Sheet on ATSDR conclusions categories and its definitions.

2. Comment: The public health assessment's conclusions are not clear. It is not clear if the site still represents a health hazard. Suggestions:

    - A more exhaustive sampling to determine the contaminants and the levels that could pose a health threat.

    - The PR Land Authority completes the removal of any physical hazard.

    - Keep signs of warning and the restriction of the access to the site.

    - Keep the vegetation to cover the surface soil as a measure to control the erosion and lixiviation.

    Response: Thanks for your comment. In terms of the health risk that the site represents at the present, it is important to remember that the facility is inactive since February 2003, so nobody should be exposed to the contaminants on the site. Even if the site is contaminated, if there are no exposures there are no health risks neither. The degree of contamination at and around the site is still to be evaluated as is recommended in this document.

    The Puerto Rico Cooperative Agreement Project agrees with your recommendations.

3. Comment: After reading the document, there is no comment.

    Response: Thanks.

CERTIFICATION

This Pesticide Warehouse III Public Health Assessment was prepared by the Arizona Department of Health Services 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.

for Team Leader, CAT, SPAB, DHAC, ATSDR