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From: Environmental Health Scientist, HSS, RPB, DHAC

Subject: Health Consultation: Frontera Creek Site, National Priorities List (NPL) Site, Humacao, Puerto Rico

To: Arthur Block, Region II
Through: Director, DHAC
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BACKGROUND AND STATEMENT OF ISSUES

The U.S. Environmental Protection Agency (EPA) Region II requested that the Agency for Toxic Substances and Disease Registry (ATSDR) evaluate the health implications of mercury and lindane levels at the Frontera Creek Site in Humacao, Puerto Rico, as found in the Final Remedial Investigation (RI) Report.

Industrial development of the Frontera Creek area began in 1970. Environmental concerns about the site first surfaced in 1977, with reports of an alleged connection between the deaths of 30 cows and the creek. An investigation by the Puerto Rico Environmental Quality Board (EQB) concluded that lindane discharged into Frontera Creek by one of the area industries could be the cause of the deaths. This study also identified elevated levels of mercury in another industry's effluent and in Frontera Creek surface water and sediment. The discharges of lindane were stopped and subsequent investigations by EQB and EPA focused on mercury contamination. All discharges of waste water into Frontera Creek from area industries ceased in 1979, when all facilities were connected to the sanitary sewer.

The opening of Ciudad Cristiana in 1979, marked the only residential development near the Frontera Creek area industries. In February 1985, EQB sampled soil from 5 Ciudad Cristiana homes for mercury finding levels above 1,000 ppb in all 5 homes. This discovery led the Puerto Rico Department of Health (PRDH) to survey urine from Ciudad Cristiana residents for mercury. Of the 795 residents tested, 21 had levels of mercury above 40 micrograms/liter (mcg/l). However, only
three of these were considered high enough by PRDH to be termed a health concern (i.e., above 150 mcg/l). Additional soil sampling by EQB in March 1985 found that 16 of 47 homes had levels above 1,000 ppb with a high of 12,975 ppb. In March 1985, the residents of Ciudad Cristiana were relocated based on the PRDH's evaluation of EQB's soil sampling and the blood and urine results. However, subsequent sampling of residential soils by EPA did not confirm the presence of elevated mercury levels. A review of the various soil sampling data, dated July 30, 1985, was done by ATSDR and the Centers for Disease Control (CDC). They concluded that the mercury levels did not present a threat to public health. In December 1985, those soil samples from EQB's original surveys with the highest reported mercury levels, were split and analyzed by EPA and EQB. Both agencies' laboratories found that mercury levels were not elevated and were within what are considered "background" levels.

One of the industries at the Frontera Creek site agreed to perform a RI in 1986. Their study focused on a wide range of contaminants including mercury and lindane.

This health consultation will evaluate the health implications, if any, of the mercury and lindane levels identified in the RI.

SITE VISIT

As part of the health assessment being done of the Frontera Creek NPL site, a site visit was made on May 20-23, 1991. Dr. John Crellin and Ms. Rosalyn Lee (ATSDR) met with Messrs. Jose Font (EPA) and Richardo Mayoral (PRDH), and Dr. Theresa Diaz (CDC). (Dr. Diaz is the Epidemic Intelligence Service [EIS] Officer for Puerto Rico and is the acting State Epidemiologist.) A search was also made of EPA's files on Frontera Creek.

On the site tour, it was observed that the Technicon facility was fenced and entry was restricted. The areas of Technicon contaminated with mercury was covered with grass or asphalt and marked with a warning tape.

During the site visit, it was revealed that the former residents of Ciudad Cristiana are still expressing concern about health effects possibly related to the site. These will be addressed during the health assessment.
CONTAMINANTS

SAMPLING PLAN

The field sampling program for the RI included the collection and analysis of over 1,000 samples of soil, sediment, surface water, groundwater, potable water, biota, and air. All samples were analyzed for mercury and 20 percent were checked for other hazardous substances list parameters including lindane. Background samples from locations in the area were collected for each media. These background locations were selected to be as similar to the site as possible. The laboratory quality control/quality assurance protocol prescribed by EPA Region II was followed including the collection of replicate samples.

A total of 147 surface and 83 subsurface soil samples were collected in Ciudad Cristiana. Seventy-five of the surface soil samples were from randomly selected lots and the rest were from lots requested by EPA, EQB, and a Citizens Advisory Board. Included in this last group were samples from the lots identified in the February and March 1985 surveys done by EQB as having the highest levels of mercury. There was a 100 percent split of surface soil samples from Ciudad Cristiana between the responsible party's contractor (Dynamac) and the contractor for EPA (NUS). In addition, there was a 25 percent split of surface soil samples between Dynamac and the contractor for EQB (IT Corporation).
Samples of groundwater were taken from 12 monitoring wells in Ciudad Cristiana, and 3 from the industrial sites. Two samples were obtained from the potable water system that runs through Ciudad Cristiana. Fourteen samples of surface water were collected from Frontera Creek, four from Frontera lagoon, and one from the Technicon ditch.

The selection of the biota to be sampled was made through site visits, bird censuses, and bank surveys of fishermen. Different levels of the food chain were sampled along with domestic cattle and coconuts. The major biota sampled were the common gallinule (a game bird), cattle egret, tilapia (an omnivorous food fish), tarpon (a top predator fish), shrimp, and crabs. Sample collection was done from the habitats nearest the site where the specific species resided.

Mercury concentrations in air were determined by using a low flow pump to pass air through a mercury dosimeter. The dosimeter was then analyzed with a Jerome Instrument Mercury Analyzer. This semiquantitative method was employed because there is no specific EPA method for mercury in air. Samples were taken both from Ciudad Cristiana and the industrial facilities.

RESULTS

Elevated levels of mercury were found at one of the industrial sites and that portion of Frontera Creek immediately adjacent to it. Levels of mercury from all other locations and media were within what was determined to be background for the area and/or below applicable federal or state regulatory levels.

Lindane concentrations were elevated only in soil from one industrial facility. Levels from all other locations and media were near or below the detection limit.

SOIL SAMPLES

In Ciudad Cristiana, 63/147 (40 percent) of the surface soil samples were below the method detection limit of 80 parts per billion (ppb), 78/147 (53 percent) between 80 to 200 ppb, 4/147 (3 percent) between 200 to 300 ppb, and 1/147 (0.7 percent) above 300 ppb. The highest level was 836 ppb. The average concentration for these samples was 91 ppb. The 32 background surface soil samples ranged from below the detection limit to 150 ppb with an average mercury level of 57 ppb.

Mercury levels in five of the 71 samples of subsurface soils from Ciudad Cristiana were above the method detect level of 80 ppb with a high of 236 ppb and an average of 23 ppb. In
contrast, 3 of the 32 background samples were above the method detect level with a high of 109 ppb and an average of 37 ppb.

A total of 173 soil samples were taken from 13 industrial facilities. Only 3 sites had mercury levels above 1,000 ppb. Technicon, the responsible party, had 17/33 samples above 1,000 ppb with 5 above 10,000 ppb and a high of 535,000 ppb. Of the other two sites with levels above 1,000 ppb, one had 5/33 samples above and the other 1/16. Only the Technicon site was considered to have mercury levels above background.

Lindane was detected in 1/8, 0/11, and 3/52 of the samples of surface and subsurface soils from Ciudad Cristiana, and of soils from the industrial sites. The level of lindane in the Ciudad Cristiana soil sample was 10 ppb. All three of the samples from the industrial sites, which were above the detection limit, were from the Reedco facility. The average lindane level from this site was 882 ppb with a high of 2,600 ppb. Concentrations of lindane in all of the soil samples from background locations were below the detection limit.

WATER

Sampling of ground-water, potable water, and surface water found no levels of mercury of health concern. Three of 12 groundwater monitoring wells had detectable levels of mercury ranging from 0.14 to 0.33 ppb. No mercury was found in two samples of potable water. Detectable levels of mercury were found in 3/22 surface water samples with a high of 0.86 ppb. EPA's maximum contaminant level for mercury in drinking water is 2 ppb. The Puerto Rico Water Quality Criteria for mercury in surface water is 1 ppb.

Lindane was not detected in 2 potable and 22 surface water samples. Mercury was the only analyte evaluated in groundwater.

SEDIMENT

One hundred ninety-five of the 247 sediment samples, analyzed for mercury, were above the method detection limit of 80 ppb. Sediment samples from a ditch on the Technicon site had average concentrations of 6,786 and 7,205 ppb. However, samples from Frontera Creek and other locations averaged below 500 ppb. There was a sample with 2,900 ppb just downstream from the Technicon ditch.

Lindane was not detected in any of 39 sediment samples analyzed for this chemical.
BIOTA

Mercury levels from the biota samples were not above the U.S. Food and Drug Administration (FDA) action level for mercury. Only 3 of the 22 bird samples had levels above the method detection limit with a high of 132 ppb. Six of 34 tilapia had levels above the detection limit. However, all 6 of these were fish from Frontera Creek with concentrations ranging from 64 to 460 ppb. Seventeen of 29 tarpon had mercury levels above the detection limit with a high value of 244 ppb. However, the fish from the background areas had somewhat higher levels than those from Frontera Creek. Mercury levels in the crab or shrimp samples were below the detection limit. The FDA action level for mercury in fish and shellfish is 1,000 ppb.

Lindane was not detected in any of the biota samples.

AIR

The average levels of mercury in air from the Technicon site were 2.2 and 0.25 micrograms/m$^3$ (ug/m$^3$) and from Ciudad Cristiana 0.08 and 0.05 ug/m$^3$. Concentrations at the background locations averaged 0.04 ug/m$^3$. The EPA has established 1 ug/m$^3$ of mercury as the National Emission Standard for Hazardous Air Pollutants (NESHAPS) level.

Lindane was not detected in any of the air samples.

DISCUSSION

Except for the Technicon site, the mercury levels in the Frontera Creek and Ciudad Cristiana soils and sediments are no greater than two times the background concentrations found in the area near the site. They are also within the background range identified in a study of Puerto Rican soils done by the U.S. Geological Survey (USGS)$^2$. In addition, these levels are well within the range of values (10 - 3,400 ppb) reported by USGS for the United States (USGS Professional Paper 1270 - 1984).

The hazard presented by mercury on the Technicon site is largely dependent on the form of mercury. When ingested, the organic forms of mercury are generally more toxic than inorganic salts, which are in turn more toxic than elemental mercury. If all of the mercury were in the most toxic form, this site would represent a health hazard. A specific determination of the hazard represented by the mercury contamination can not be made because concentrations were measured as total mercury, not as the individual forms.
Other factors possibly affecting the hazard due to mercury at Technicon are the observed coverage of the contaminated areas by vegetation or pavement, and the restriction of access to workers only.

Concentrations of mercury in water, fish, and shellfish are below established regulatory levels. One air sample, taken from the Technicon site, was above the regulatory standard.

Except for three samples taken at the Reedco site, lindane is near or below detection limits. The concentrations of lindane found at Reedco do not represent a health hazard. However, the hazard represented by lindane at the Reedco site can not be fully evaluated due to the small number of samples taken (5).

CONCLUSIONS

The levels of mercury and lindane reported in this RI do not represent a health threat except for the mercury found on the Technicon site and, possibly, the lindane concentrations at the Reedco site. The levels found at Technicon may be a hazard to anyone ingesting these soils or sediments from this site on a long-term basis.

Except for the recommendations below, no additional actions due to mercury or lindane are necessary to protect public health, beyond appropriate protective measures by those individuals remediating the site.

RECOMMENDATIONS

ATSDR recommends that:

1. the extent and level of lindane contamination at the Reedco site be determined, and

2. any workers involved in the remediation of the Technicon Facility should wear the appropriate protective gear.

In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, the Frontera Creek NPL Site has been evaluated for appropriate follow-up with respect to health activities. Available environmental and clinical data indicate that the residents of Ciudad Cristana, which is part of the Frontera Creek Site, may have been exposed to mercury and lindane. However, this exposure is unlikely to represent a threat to health. Because of this conclusion, this site is not being considered for
follow-up health activities at this time. However, if data become available suggesting that human exposure did occur or is occurring, ATSDR will reevaluate this site for any additional indicated follow-up.

The above-mentioned reevaluation will be part of the health assessment currently being conducted on this site.

cc: Maureen Y. Lichtveld, M.D.