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Health Consultation

Woonasquatucket River and Centredale Manor

CENTREDALE MANOR

NORTH PROVIDENCE, PROVIDENCE COUNTY, RHODE ISLAND

CERCLIS NO. RID981203755

JUNE 7, 1999

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

Health Consultation: A Note of Explanation

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

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members.

This document has previously been released for a 30 day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The health consultation has now been reissued. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

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NORTH PROVIDENCE, PROVIDENCE COUNTY, RHODE ISLAND

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Prepared by:

Exposure Investigation and Consultation Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

Background and Site Description

The U. S. Environmental Protection Agency (EPA) - Region I asked the Agency for Toxic Substances and Disease Registry (ATSDR) to review environmental data for the Woonasquatucket River and determine if environmental contamination poses a public health hazard. In addition, the Public Employees for Environmental Responsibility (PEER) petitioned ATSDR to assess the public health impact of dioxin contamination in and along the river.

Woonasquatucket River begins in the hills near North Smithfield and empties into the Providence River in downtown Providence. Figure 1 depicts the course of the river through North Providence. Water quality in the river has been impacted by numerous point and non-point sources of pollution. The Smithfield wastewater treatment plant discharges into the river just above the Johnston town line. In the lower basin, storm water runoff, combined sewer overflows, and discharges from industries along the river contribute to chemical and bacteriological contamination of the river.

The portion of the Woonasquatucket River from Lonigan Dam to Waterplace Park is used for water recreational activities including canoeing, kayaking, and boating. In October 1996, the Rhode Island Department of Health (RI DOH) issued a fishing advisory for the Woonasquatucket River below the Smithfield-Johnston line. The advisory recommends a "catch and release" policy because of elevated levels of dioxin and other contaminants in the fish. In spite of the advisory, it is possible that some residents may still be eating fish from the river.

The Centredale Manor apartment building is located along the Woonasquatucket River, upstream of Allendale Dam. Centredale Manor is an eight-story building that was constructed in 1982. It is occupied by about 135 residents, many of whom are elderly and disabled. In the 1930s, a textile mill operated on the property now occupied by Centredale Manor. From the 1940s to the 1970s, Crown Chemical Company and Metro-Atlantic Chemical Company occupied the property. No information is available on the operations of Crown Chemical Company; Metro-Atlantic Chemical Company operated a barrel reclamation facility. In 1982, a contractor for the Rhode Island Department of Environmental Management (RI DEM) removed about 400 drums from the property. The remains of numerous rusted-out barrels are still visible in the wetlands area south of the manor property.

The Lee Romano Ballfield, the North Providence Boys and Girls Club, and the Early Years Learning Center are located along the Woonasquatucket River below Allendale Dam. At the ballfield, a batting cage, bullpen, and concessions stand are situated between the playing field and the river. The groundskeeper at the ballfield reported that after heavy rain storms, the field sometimes floods with surface water runoff from the surrounding land area.

Environmental Sampling Data

Fish

On May 13, 1996, EPA staff collected fish from two locations on the Woonasquatucket River. Sunfish were captured at Valley Street near Lonigan Dam, and American eels were captured at Smith Street in North Providence [1]. Three eels were composited and analyzed for metals, polychlorinated biphenyls (PCBs), organochlorine pesticides, and dioxins. Three sunfish composites, each consisting of 5 fish, were analyzed for the same chemicals. Fillets of the fish with the skin attached were analyzed separately from the offal. Chemical analyses of the fish indicated that the most significant contaminants in the fish were dioxins and PCBs [1].

There are 75 congeners of chlorinated dibenzodioxin (CDD) and 125 congeners of chlorinated dibenzofuran (CDF). 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD) is the most toxic chemical in the group. Some of the other CDDs and CDFs (i.e., those with the chlorine atoms in the 2,3,7,8 positions) have TCDD-like toxicity. Certain PCBs are also thought to have TCDD-like toxicity. In this report, "dioxin" will be used interchangeably with TCDD; dioxin-like compounds will be used as a generic term to refer to chemicals with TCDD-like toxicity.

When evaluating the risk from exposure to a mixture of dioxin-like chemicals, risk assessors often convert the toxicity of individual congeners to TCDD toxicity equivalents (TEQs) using Toxicity Equivalent Factors (TEFs). The toxicity of the mixture is then assumed to be equal to the sum of the individual components. In this health consultation, contaminant levels will be expressed as TCDD TEQs whenever possible.

The EPA - Region VII laboratory analyzed the sunfish and eel composite samples for dioxin congeners, and the National Health and Environmental Effects Research Laboratory (NHEERL) conducted confirmatory analyses on the same fish extracts. NHEERL reported the TCDD content of the sunfish composite to be 63.1 parts per trillion (ppt) and 91.7 ppt for the eel composite [2]. The contribution of other dioxin congeners to the TCDD TEQs was minor [1].

Sediment/Soil

On October 23-24, 1997, EPA personnel collected sediment samples from seven dams along the Woonasquatucket River below Route 44 [3]. The sampling crew collected the samples from the top four inches of sediment near the center of the channel. The samples were analyzed for metals, polyaromatic hydrocarbons (PAHs), PCBs, pesticides, and dioxin-like compounds. The analytical results indicated that sediment samples were contaminated with PAHs (total PAHs of 18.4 ppm - 67.3 ppm) and PCBs (0.21 - 1.42 ppm). In addition, elevated concentrations of TCDD (0.21 - 8.2 ppb) and other dioxin-like compounds were detected in the sediment. The concentrations of TCDD were highest in sediment from the Allendale Dam (7.35 ppb) and the Lymansville Dam (8.20 ppb). The addition of dioxin TEQs for other dioxin-like compounds increased these values only slightly: Allendale Dam (7.39 ppb) and Lymansville Dam (8.24 ppb).

Sediment samples also contained 1,2,4,5,7,8-hexachloroxanthene (HCX) at concentrations ranging from 1.6 ppb (Esmond Dam) to 182 ppb (Lymansville Dam). This compound is a by product in the production of hexachlorophene. In sediment sample, the concentration of HCX was about 20 times higher than the concentration of TCDD.

In September of 1998, EPA staff collected 39 sediment and 6 soil samples from the Woonasquatucket River and other areas adjacent to the river. The sediment samples were collected along the edge of the river in about 6 inches of water. Soil samples were collected at depths ranging from 0 to 16 inches to 30 to 42 inches. Nine of the sediment samples contained dioxin TEQs in excess of 1 ppb. Four of five soil samples collected from Centredale Manor contained dioxin TEQs at concentrations ranging from 3.0 to 6.3 ppb. A sediment sample from a drainage swale east of Centredale Manor contained 15.8 ppb dioxin TEQs. Two sediment samples were collected from the Woonasquatucket River adjacent to the Lee Romano baseball field. One sediment sample contained 0.02 ppb dioxin TEQs, and the other contained 8.0 ppb dioxin TEQs.

On January 15, 1999, EPA staff collected 16 surface soil samples (0-3 inches) from the Centredale Manor, Lee Romano Baseball Field, North Providence Boys and Girls Club, and Early Years Learning Center. On January 27, 1999, EPA personnel collected 5 additional surface soil samples from the area between the ballfield and the Woonasquatucket River.

The concentrations of dioxin TEQs in 5 surface soil samples from the ballfield ranged from 0.00006 to 0.008 ppb. In 5 surface soil samples collected between the ballfield and the river, the dioxin TEQs ranged from 0.000 to 0.0018 ppb.

Three surface soil samples collected around the North Providence Boys and Girls Club contained 0.0003 to 0.007 ppb of dioxin TEQs. A soil sample collected on club property 10 feet from the river contained 0.291 ppb dioxin TEQs.

Six surface soil samples from Centredale Manor contained from 0.006 to 5.5 ppb of dioxin TEQs. Two soil samples contained dioxin TEQs in excess of 1 ppb. These samples were collected outside the guard rail along the Centredale Manor parking lot and 1.5 feet (5.5 ppb) and 3.0 feet (2.5 ppb) from the river bank.

Drinking water wells

The EPA and the RI DOH recently tested water from two drinking water wells (Yacht Club Bottling Company and Pied Piper Nursery) near the Centredale Manor for dioxin contamination. No dioxin contamination was detected in water from either well. ATSDR also reviewed test results for other organic and inorganic contaminants in water from the wells. These tests were conducted for compliance with Safe Drinking Water Act regulations. No violations of drinking water standards were reported.

Discussion

Most people in the U. S. are exposed to low levels of dioxin on a daily basis through their diet. Foods most likely to contain dioxin include meat, fish, and dairy products. The only confirmed health effects of dioxin exposure in humans are a skin condition termed "chloracne" and transient mild hepatotoxicity, which have been observed primarily in individuals with high level occupational exposures [4]. In a recent study, an increased incidence of cancer was observed in workers with dioxin exposures that were two to three orders of magnitude higher than the general public [5]. Other non-cancer health effects such as peripheral neuropathy, birth defects, and reproductive effects have been associated with exposure to dioxin in some studies, but a causal relationship remains unconfirmed. However, due to uncertainty regarding the health impact of low level dioxin exposures, it is considered prudent public health policy to identify possible sources of excess exposure and minimize further exposure when possible.

A complete review of the health effects of dioxin is beyond the scope of this consultation. Additional information can be found in ATSDR's Toxicological Profile for dioxins or in various published literature reviews [6,7]. The relative significance of dioxin test results for each of the sampled media are discussed below.

Fish

ATSDR staff heard anecdotal reports that some Asian and Hispanic residents of the area rely on fish caught in Rhode Island waterways as a subsistence food source. The types of fish consumed and the waterways fished have not been characterized, but it is possible that fish from the Woonasquatucket River have been eaten. Although the RI DOH issued a fishing advisory for the river and signs have been posted, some residents may still be eating fish from the river.

In 1996, elevated concentrations of dioxin were detected in sunfish (63.1 ppt) and eels (91.7 ppt) collected from the Woonasquatucket River. The sunfish were collected from the lower portion of the Woonasquatucket in Providence where sediment dioxin concentrations were less than those further upstream. If fish had been collected from the Allendale Dam or Lymansville Dam areas, where sediment dioxin concentrations were highest, the dioxin concentrations could have been even higher.

As a reference for comparison, in a national EPA survey, the average dioxin TEQ concentration in fish collected from areas known to be free of sources of pollution, was 0.59 ppt [8]. However, the EPA noted that, "These 'background' concentrations may not be representative of what many individuals consume [8]." In urban areas and areas with known point or non-point sources of pollution, average dioxin TEQ concentrations in fish were 11 ppt. Therefore, the dioxin concentrations in fish from the Woonasquatucket were well above the national average, even for polluted urban areas.

The Food and Drug Administration (FDA) does not have an Action Level for dioxin in fish. However, the FDA did issue an advisory for the consumption of fish from the Great Lakes [9]. The FDA recommended that fish containing dioxin residues in excess of 50 ppt should not be eaten. The FDA further advised that the consumption of fish containing 25 to 50 ppt of dioxin should be limited to one to two meals a month. The FDA placed no restrictions on the consumption of fish containing less than 25 ppt of dioxin.

The dioxin concentrations in fish from the Woonasquatucket River (63.1 and 91.7 ppt) exceeded the FDA advisory levels. The FDA levels were derived for sport fishermen, not subsistence fish eaters. Therefore, individuals who eat large quantities of fish from the Woonasquatucket River would be at even greater risk. In addition, fish from the Woonasquatucket River contain other contaminants that could contribute to the total risk. Therefore, ATSDR recommends that fish from the Woonasquatucket River should not be eaten because of the elevated levels of dioxin and other chemical contaminants.

Sediment

In October 1997, EPA personnel collected sediment samples from behind the seven dams along the lower Woonasquatucket River. The concentrations of dioxin were greatest in sediment from behind the Allendale Dam (7.4 ppb) and Lymansville Dam (8.2 ppb); dioxin concentrations were less than 1 ppb in sediment from the other five dams. Since the samples were collected from the center of the channel, it is likely that human contact with these sediments would be minimal.

In September 1998, EPA collected additional sediment samples from along the edge of the Woonasquatucket River. These samples, which were collected in about 6 inches of water, contained dioxin concentrations ranging from 0.0 to 10.1 ppb. Since these samples were collected along the edge of the river, it is possible that children who wade into the river could come into contact with the contaminated sediments. In particular, it was reported that children occasionally wade into the river next to the Lee Romano ballfield.

ATSDR has not established a level of concern for dioxin in sediment. However, for dioxin contamination in residential soil, ATSDR has recommended an Action Level of 1 ppb dioxin TEQs. It is assumed that soil in a residential yard is readily accessible and that children would come into contact with the contaminated soil on a frequent and long-term basis. The principal route of exposure for children who come into contact with contaminated soil is ingestion of soil, with lesser exposures from dermal absorption and inhalation of contaminated dusts.

For children who wade in the Woonasquatucket River, the most likely route of exposure is dermal contact with contaminated sediments. Such exposures could occur occasionally, especially during the summer. However, it is unlikely that a child would contact contaminated sediment every day, as could occur for soil in a child's yard. Moreover, even if dermal contact with contaminated sediments occurred, only small quantities of dioxin would be absorbed, as is discussed below.

In experimental studies, dioxin-contaminated soil was applied to bare skin on the backs of laboratory rats. After 4 hours, 0.6 % of the dioxin was absorbed, and after 24 hours, 1% of the dioxin was absorbed [10]. Absorption through human skin would be even less, since rat skin is more permeable than human skin to lipid-soluble chemicals such as dioxin. Furthermore, dried sediment on the skin could fall off or be washed off, so it is unlikely that contaminated sediment would remain on the skin for 24 hours. In addition, the areas of the body most likely to contact the sediment are the hands and feet. The skin on the hands and feet is much thicker than on other parts of the body, which would substantially decrease dermal absorption. Because of these considerations, ATSDR concludes that occasional contact with dioxin-contaminated river sediment would not pose a public health hazard.

Sediment from the Woonasquatucket River was also contaminated with PCBs, PAHs, and other chemicals. However, an earlier analysis by EPA demonstrated that dioxin contamination in sediment poses the greatest relative health risk [11]. In the 1997 sediment sampling, it was reported that elevated concentrations of hexachloroxanthine (HCX) co-occurred with dioxin. On average, the concentration of HCX in sediment was 20-times greater than that of dioxin. However, the toxicity of HCX is much less than the toxicity of dioxin [12]. In an *in vitro* test, HCX was a million-fold less potent than dioxin; in an animal test, the virtually safe dose for HCX was 25,000-fold higher than dioxin. Therefore, TCDD is the contaminant in sediment that dominates the risk assessment.

In some areas, sediment from the river may have washed up during flooding onto people's yards and recreational areas. If this occurs, the exposure scenario for sediment deposited on dry land would be much different than for sediment in water. Sediment deposited on dry land should be assessed as soil contamination as is discussed below.

Although occasional contact with river sediment does not pose a significant health hazard, human contact with the river could pose other risks besides those related to chemical contamination. Monitoring conducted by the Narragansett Bay Commission documented the presence of elevated fecal coliformcounts in the Woonasquatucket River [13]. In general, fecal coliform counts were higher at a downstream station (Atwells Avenue) as compared to an upstream station (Manton Avenue). Discharges from combined sewer overflows after periods of heavy rain are a suspected source of microbiological contamination of the river. People who swim or wade in the river could be at risk for exposure to infectious bacteria or viruses.

Soil

Centredale Manor

Sediment collected from the Woonasquatucket River upstream of Centredale Manor did not contain significant levels of dioxin. However, sediment collected from behind Allendale Dam and Lymansville Dam, which are downstream of the manor, contained elevated concentrations of dioxin. In addition, soil samples collected from the area south of the manor contained elevated concentrations of dioxin. These results suggest that previous operations on manor property were a source of dioxin contamination.

ATSDR established an Action Level of 1 ppb for dioxin in residential soil. ATSDR defines an Action Level as a concentration of a chemical at which consideration of action to interdict or prevent exposure occurs. The EPA has also set 1 ppb dioxin TEQs as a starting point for setting cleanup levels at hazardous waste sites involving residential exposure to surface soils.

Four of five surface soil samples collected from the area south of Centredale Manor contained dioxin concentrations above 1 ppb. The maximum soil dioxin TEQ concentration of 6.3 ppb was collected next to a rusted-out drum, which suggests that the dioxin may have been a contaminant in the drum's contents.

ATSDR staff inspected the area around the manor on January 27, 1999. The area south of the manor was covered with heavy brush and briars, and it appeared to be subject to flooding. ATSDR staff observed beverage bottles and cans, bicycle parts, and the ruins of a tree house in the area. This evidence indicates that children and other neighborhood residents have accessed the area.

The risks incurred by children who played in or walked through the contaminated areas would be influenced by several factors: (1) how often the child played in the area, (2) how many years the child played in the area, and (3) the age of the child. Although the thick bushes, briars, and marshy nature of the land would discourage trespassing, it appears that children and others have occasionally entered and played in the area. However, during such events, it is likely that direct contact with contaminated soil would be limited by the heavy cover of leaves and vegetation on the soil. In addition, because of the physical conditions in the area, it is likely that only older children (i.e., older than 6 years old) have entered the area. This consideration is significant, because soil ingestion is greatest in infants and young children who engage in frequent hand-to-mouth activity. Soil ingestion decreases in older children who are less likely to put their fingers or soiled objects in their mouths.

Another important factor in assessing dioxin exposure is the distribution of contamination in the area that is accessed. If the contamination originated from buried or leaking drums, then dioxin contamination may be present as "hot spots," rather than being uniformly distributed. This would affect estimates of exposure, since long-term exposures would be expected to correlate with the average concentration of dioxin in the accessed area, rather than the maximum concentration. Additional soil sampling being conducted by EPA should provide information on the distribution of dioxin contamination.

ATSDR concludes that contact with contaminated areas, if limited to occasional visits by older children, would not pose a health hazard. However, if the use of the property changes, or if frequent, prolonged contact occurs, then exposures of health concern could result. Since future activities or the use of the land cannot be predicted, it would be prudent public health policy to implement actions to remediate or prevent further contact with contaminated areas. In addition, appropriate actions to prevent further off-site migration of the contamination are warranted.

A wetlands area lies directly east of Centredale Manor. One of three sediment samples collected from this area contained an elevated dioxin TEQ concentration (15.8 ppb). Because the area is heavily vegetated and the sample was collected in a wetland area, it is likely that human contact with contaminated sediment in this area has been infrequent. Nevertheless, additional characterization of this area is needed to determine if the observed dioxin contamination is an isolated hot spot, or whether contamination is more widespread.

In the January 15, 1999 sampling, two soil samples collected west of the Centredale parking lot fence and along the banks of the river contained elevated dioxin levels (2.5 ppb and 5.5 ppb). It is unlikely that elderly residents of Centredale Manor have accessed this heavily vegetated area, nor is it an attractive play area for children. Because previous contact with this area has likely been infrequent, such contact would not pose a public health hazard. However, as with other contaminated areas around the manor, further characterization of contamination in this area is warranted to assist in determining appropriate remedial actions.

Lee Romano Ballfield and North Providence Boys and Girls Club

The concentrations of dioxin TEQs detected in a surface soil sample from the ballfield or in the area of the concessions stand, bullpen, batting cage, or bleachers ranged from 0.0001 to 0.008 ppb. These concentrations of dioxin are within the range of background soil levels in the United States [3]. The dioxin concentrations in soil from the ballfield were several orders of magnitude below ATSDR's Action Level of 1 ppb dioxin in surface soil. The Action Level is protective of public health in residential and recreational areas. Therefore, soil dioxin levels on and near the ballfield do not pose a public health hazard. Similarly, the soil dioxin levels near the North Providence Boys and Girls Club are less than 1 ppb and do not pose a public health hazard.

Drinking water wells

Dioxin is very insoluble in water and it binds tightly to organic matter in soil. In one study, only 1.5% of the dioxin applied to the soil surface leached to a depth of 1 inch after 15 months [14]. Therefore, it is very unlikely that dioxin contamination in surface soil would leach into the groundwater aquifer. The well at the Yacht Club Bottling Company is 170 feet deep and is drilled in bedrock. These factors would provide a physical barrier to the infiltration of surface contamination into the aquifer. In addition, water at the plant is treated through an activated carbon cartridge, which would remove most organic contaminants.

No dioxin was detected in water from the drinking water wells at the Yacht Club Bottling Company and the Pied Piper Nursery. Furthermore, water from these wells is in compliance with all drinking water regulations.

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