

Health Consultation

Public Health Evaluation of Soil Sampling Data for Lagoon 3

SOMERS PLATING, INC.

SOMERS, TOLLAND COUNTY, CONNECTICUT

EPA FACILITY ID: CTN000103776

FEBRUARY 13, 2007

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 concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared By:

Connecticut Department of Public 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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**PUBLIC HEALTH EVALUATION OF SOIL
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The conclusions and recommendations in this health consultation are based on the data and information made available to the Connecticut Department of Public Health (CT DPH) and the Agency for Toxic Substances and Disease Registry (ATSDR). CT DPH and ATSDR will review additional information when received. The review of additional data could change the conclusions and recommendations listed in this document.

BACKGROUND AND STATEMENT OF ISSUE

Before remedial activities of Lagoon 3 of the Somers Plating site began in November 2005, the United States Environmental Protection Agency (U.S. EPA) consulted with the Connecticut Department of Public Health (CT DPH) about using a modified cleanup level for cadmium to remediate portions of Lagoon 3. The U.S. EPA requested that the CT DPH evaluate public health implications from exposure to contaminated soil and sediment in Lagoon 3, post remediation. In an earlier health consultation, CT DPH previously determined that exposures to cadmium in surface soils at the site represented a public health hazard to those who may have been exposed [ATSDR 1996]. This health consultation evaluates current site conditions in the area where the soil has been remediated to the alternative (modified) cleanup level for cadmium as well as the wetland area (which is part of Lagoon 3) where the soil has not been remediated.

The Somers Plating, Inc. site is located at 58-60 Springfield Road (Connecticut Route 83) in Somers, Tolland County, CT. The site is bordered to the east by a wooded area and a cornfield; to the south by a residential property; to the west by Springfield Road; and to the north by a cornfield, a portion of which extends into the site. There is an herb supplier/grower located immediately adjacent to the site. A map of the site can be found in Appendix A.

The site consists of approximately 3.62 acres of land with two unoccupied one-story buildings (Buildings A and B) in a mixed residential/commercial zone. It was formerly used as a metal working shop/plating facility, a gasoline service station, a school, and a daycare center. Two known former metal hydroxide sludge lagoons associated with the plating operation were located at the site (Lagoons 1 and 2) and are shown on the map in Appendix A.

An asphalt-paved parking area largely surrounds Building A and borders Building B on the western and northern sides. Three discrete areas of grass surrounded by pavement are located adjacent to the eastern and western sides of Building A and north of the Building B. The area of grass located north of Building B appears to be co-located with one of the metal hydroxide sludge lagoons. The eastern portion of the site ranges from wooded near the southern boundary, to partially clear in the central portion, to cornfield in the northern portion [Weston 2005].

A third lagoon named Lagoon 3 was reported by a local citizen and is buried in the wooded area at the northeast corner of the property. A large majority of Lagoon 3 is not within the Somers Plating, Inc. site property boundary. Lagoon 3 is actually made up of Lagoons 3 and 3A, but for the purpose of this health consultation, the lagoons will be

grouped together and referred to as Lagoon 3. Lagoon 3 is located in a separate area approximately 50 feet northeast of Lagoon 2. Lagoon 3 is made up of a grassy area and a wetland area. Seasonal creeks with intermittent flow are located near this lagoon. A small brook, Gillette Brook, is located approximately a quarter mile away from this lagoon. Tire marks from all terrain vehicle (ATV) use were noted by U.S. EPA personnel approximately 150 feet north of Lagoon 3 in the fall of 2005. However, the U. S. EPA noted during this site visit that physical evidence of trespassing or public access was not found at Lagoon 3.

The U.S. EPA conducted a cleanup of this site in 2005. They have remediated the soil in Lagoons 1 and 2 to meet the state cleanup standard for cadmium (34 parts per million or ppm), which is the primary contaminant for the site. The U.S. EPA remediated the grassy area of Lagoon 3 to an alternative (modified) cleanup level of 200 ppm which exceeds the state cleanup standards for cadmium. The EPA did not remediate the contaminated soil in the wetland area. The U.S. EPA completed remedial activities in December 2005 and returned in the Spring 2006 to perform restoration activities. Post excavation sampling was performed immediately after remediation activities in 2005.

Site Visit

CT DPH staff did a site visit on October 12, 2005, of the Somers Plating, Inc. site along with the U.S. EPA, Somers Health Department (SHD), and the site contractor. Representatives from CT DPH and the SHD discussed site related soil sampling and remediation issues with U.S. EPA and contractors and toured the site. The weather was rainy and cool. Contractors were excavating contaminated soil from Lagoons 1 and 2. CT DPH staff observed that much of the area near Lagoons 1 and 2 is unfenced, open, and easily accessible. However, access to Lagoon 3 is limited due to the surrounding woods and vegetation. CT DPH did not observe any evidence of trespassing of the property near Lagoon 3. There were some narrow dirt trails near the area, but none of the trails lead out onto Lagoon 3. A second site visit in April 2006 revealed that site conditions regarding access to the site and evidence of trespassers have not changed.

Demographics

The site is in the town of Somers, Tolland County, Connecticut whose population is 10,417 [US Census Bureau 2000]. The site occupies approximately 3.62 acres of land. The site is bordered by one residential property to the south. There are four residences directly across Springfield Road from the site. Total population in these homes is approximately 13. All of the four homes are connected to a municipal water supply. However, a recent discussion with the SHD has confirmed that there are a few private residential wells within the nearby area of the site.

Environmental Contamination and Health Comparison Values

In June and September 2005, U.S. EPA took 167 pre-excavation soil samples at various depths (0-6 inches to 3 feet below ground surface (bgs)) in Lagoon 3 for several contaminants including cadmium, total and hexavalent chromium¹, lead, zinc, and copper. Soil contamination was randomly distributed throughout Lagoon 3. Cadmium, trivalent chromium, zinc, and lead contamination in soil are generally co-located in the lagoon. The average concentrations of lead, trivalent chromium, copper, and zinc in surface and subsurface soil in both areas of Lagoon 3 (remediated grassy area and wetland area) were well below health protection remediation cleanup standards. Since volatile organic compounds (VOCs) were not found to be present in the onsite soil after repeated sampling in the past by the U.S. EPA, the soil was not analyzed during this sampling event for VOCs.

The remediation efforts were completed in November 2005. This included excavating sections of the grassy area of the Lagoon 3 that exceeded the previously described remediation cleanup standards and replacing them with clean fill. The U.S. EPA remediated at various depths (two to ten feet bgs, depending on how deep below the surface the contamination was present or if they reached water) of the grassland area of Lagoon 3 to an alternative (modified) cleanup level of 200 ppm which exceeds the state cleanup standards for cadmium.

This modified clean up level for cadmium exceeds the Connecticut Remediation Standard Regulations Direct Exposure Criteria (CT RSRs). However, CT RSRs are extremely protective and were developed to protect children and adults who have contact with soils on daily basis for many years (30 years).

The portion of Lagoon 3 that is a wetland area was not remediated. Because of this, cadmium levels in this area of the lagoon are higher than the remediated grassy area and were evaluated separately in the remainder of this health consultation.

1. Remediated Area

Thirty-seven post-excavation surface and subsurface samples were taken in November 2005 of the remediated area of Lagoon 3. The results of this post excavation surface soil sampling are included in Table 1. There were a few small portions within the remediated area of Lagoon 3 that were not excavated because their cadmium concentrations were below the modified cleanup level of 200 ppm or there was some other obstacle preventing the U.S. EPA from excavating the area. For these areas, pre-excavation concentrations were used to calculate the overall average concentration of cadmium in surface soil for the remediated area of Lagoon 3. These samples are also included in Table 1. The maximum cadmium level in surface soil in this area was 5470 ppm², about 160 times the CT RSR for cadmium in soil for residential exposures. The average surface

¹ Hexavalent chromium was not detected in these samples, therefore it is assumed that all of the total chromium found was trivalent chromium.

² This value was from a section of the remediated area where the U.S. EPA was unable to excavate.

soil concentration was 167 ppm, about 5 times the CT RSR. Less one third of the surface soil samples contained cadmium levels that exceeded the CT RSR.

Since some of the subsurface soil was excavated in the grassy remediated area of Lagoon 3, it was assumed that the cadmium concentrations in these areas were at the detection level. Using this assumption, average cadmium concentration in subsurface soil at depths less than or equal to 3 feet were calculated and were below the CT RSRs. Since soil samples deeper than 3 ft bgs were not sampled; it is unknown whether the soil at this depth is contaminated.

Table 1. Summary of Post Excavation Surface Samples Results from the Remediated Area of Lagoon 3 of the Somers Plating Site, November 2005.

Contaminant	Sample Depth (feet)	Concentration Range (ppm [#])*	Number of Exceedances of Comparison Value/Number of Samples Taken	Comparison Value (ppm)/Average Concentration (ppm)	Comparison Value Source
Cadmium	0-6"	<15-5470	12/42	34/167	CT RSR [^]

* Assumes that the samples points that were not remediated are equal to the September 2005 Pre-excavation Sampling

[#] Parts per million

< = Less than

[^] Connecticut Remediation Standard Regulations Direct Exposure Criteria (CT RSRs). CT RSRs are soil standards that were developed to be protective of children and adults who have contact with soils on a daily basis for many years (30 years) in a residential setting.

In Table 1 and later in Table 2, CT DPH calculated average cadmium concentrations rather than 95% upper confidence limits (UCLs) because we had relatively large sample sizes. When the sample size is large, we can be reasonably confident that average concentrations provide a conservative estimate of the “true” average.

2. Wetland Area

As stated earlier, surface and subsurface samples were taken at various depth intervals (0-6 inches and 6-12 inches bgs) and various locations in the wetland area of Lagoon 3 in September 2005. The results of this sampling are shown in Table 2. As stated previously, the wetland area of Lagoon 3 was not remediated.

The average cadmium concentration in surface soil was 394 ppm, approximately 12 times greater than the CT RSR and twice the modified cleanup level of 200 ppm. The maximum cadmium concentration in surface soil was 2490 ppm, approximately 73 times the CT RSR. About 77% of the surface soil samples had cadmium levels above the CT RSR. The average current cadmium concentration in surface soil samples in the wetland area was more than twice as high as the average level seen in surface soil in the remediated grassy area of Lagoon 3.

Subsurface soil sampling was only performed for 6-12” bgs depth range. The average cadmium concentration in subsurface soil was 148 ppm, approximately 4 times greater than the CT RSR. The maximum cadmium concentration in subsurface soil was 542 ppm, approximately 73 times the CT RSR. About half of the subsurface soil samples had cadmium levels about the CT RSR.

Table 2. Summary of Surface and Subsurface Sample Results from the Wetland Area of Lagoon 3 of the Somers Plating Site, September 2005.

Contaminant	Sampling Date	Sample Depth (feet)	Concentration Range (ppm [#])	Number of Exceedances of Comparison Value/Number of Samples Taken	Comparison Value (ppm)/Average Concentration (ppm)	Comparison Value Source
Cadmium	09/05*	0-6”	<15-2490	49/64	34/394	CT RSR [^]
	09/05	6-12”	<22-542	7/16	34/148	

[#] parts per million

* A few sampling points were remediated in November 2005. If they have, then it is assumed that the cadmium concentration is at the detection level of <20ppm.

< = Less than

[^] Connecticut Remediation Standard Regulations Direct Exposure Criteria (CT RSRs). CT RSRs are soil standards that were developed to be protective of children and adults who have contact with soils on a daily basis for many years (30 years).

3. Onsite Groundwater

Past onsite groundwater sampling in 1998 by the property owner’s contractor indicated levels of cadmium above the state drinking water standard of 5 parts per billion (ppb). The U.S. EPA installed two monitoring wells by Lagoon 3 and took groundwater samples in the summer of 2006. The groundwater was analyzed for various contaminants, including VOCs and heavy metals. Both groundwater samples had elevated levels of cadmium. The maximum cadmium level found in the monitoring wells was 160 ppm, approximately 32 times the state drinking water standard.

DISCUSSION

Exposure Pathway Analysis

To evaluate potential exposures to cadmium in soil in the Somers Plating site, CT DPH evaluated the environmental data and considered how people might come into contact with contaminants in soil. The possible pathways of exposure are dermal, inhalation, and incidental ingestion. In other words, in order to be exposed to contaminants in soil in Lagoon 3 of the Somers Plating site, one must come into contact with the soil by touching the soil, breathing airborne soil particles, or eating soil adhered to fingers or food items.

1. Surface Soil

As discussed earlier, Lagoon 3 is divided up into two areas: a wetland area that was not remediated and a remediated grassy area. Both areas are surrounded mostly by vegetation and woods, so access to the area is limited. Inhalation is not a complete pathway because of the presence of grass cover (which creates a very low potential for dry and dusty conditions) and wetlands. Completed dermal and ingestion exposures to surface soil in both areas are evaluated in detail in this health consultation. In addition, the site is abandoned and access is limited as described above, so we do not expect anyone to routinely use the property and be exposed to soil contamination on a regular basis. Therefore, in order to assess risks for adverse health effects, CT DPH used a trespasser exposure scenario. Trespasser assumptions will be described later in this document. This exposure scenario is realistic but conservative because the soil contamination is in an isolated and largely inaccessible area. As stated previously, in the past, there has been evidence of human trespassing near (but not on) Lagoon 3 (ATV tracks on a narrow trail that are in the wooded area around Lagoon 3). However, it is important to note that there is no easy access to the lagoon from any of the narrow trails. The public health implications of exposure from this pathway are discussed below.

2. Subsurface Soil in the Remediated and Wetland Areas

Soil at depth in both areas is not a complete pathway because most of the soil has been remediated or is a wetland area and unlikely to be frequented and because direct contact to deeper soils is difficult. Provided that digging or other activities that penetrate into deep soils do not occur, there will be no exposure to soils at depth for both areas of Lagoon 3. Therefore, exposure to contaminants in soil at depth is not evaluated further. If site conditions change, (ie., soils at depth were brought to the surface), this exposure pathway would have to be re-evaluated. This pathway will not be further discussed.

3. Onsite Shallow Groundwater

As mentioned previously, two onsite shallow groundwater wells were sampled for various contaminants involving heavy metals and VOCs in the spring of 2006. Although, elevated levels of cadmium are present in the shallow groundwater monitoring wells, no one is currently drinking the water on the site. Onsite shallow groundwater is not considered to be a present completed pathway and is not evaluated further. Past sampling in 1998 as noted in the Background and Statement of Issue section of this document also indicates that the site contamination had impacted the onsite shallow groundwater in previous years.

Onsite groundwater contamination could impact future offsite drinking water wells. As noted in the Demographics section of this document, a recent discussion with the SHD has confirmed that there are a few private residential wells nearby. However, samples for site-related contaminants taken in November 2000 of the nearest residential wells south of the site and northwest of the site indicate that the wells are not currently impacted by the site contamination. This pathway will not be further discussed.

Public Health Implications for Adults and Children

When determining the public health implications of exposure to hazardous contaminants, CT DPH considers how people might come into contact with contaminants and compares contaminant concentrations with health protective comparison values. When contaminant levels are below health-based comparison values, health impacts from exposure to those levels are unlikely. Contaminant levels exceeding comparison values do not indicate that health impacts are likely but instead warrant further evaluation. In this health consultation, CT DPH used Connecticut Remediation Standard Regulations direct contact residential soil standards (CT RSRs) [CT RSR 1996] as health protective screening values. As stated previously, these values are health-based levels developed to be protective of children and adults with frequent, long-term exposure to contaminants in soil. CT DPH only evaluated completed exposure pathways where surface soil contamination exceeded the CT RSRs.

In December 2005, the U.S. EPA excavated the soil in the grassy area of Lagoon 3 where the cadmium levels exceeded the modified cleanup level for cadmium and requested CT DPH's evaluation of public health implications from exposure to this modified cleanup level. This modified cleanup level exceeds the current CT RSR of 34 ppm. This section will evaluate public health implications from current cadmium levels in the remediated grassy area and the wetlands area that was not remediated.

Exposure to surface soil under these current conditions is a complete pathway for both areas of Lagoon 3 and is evaluated quantitatively in this health consultation. General toxicology information for cadmium is included in Appendix B.

It is important to note that CT RSRs were developed to be protective of young children and adults exposed to soil everyday over a long term, i.e., a residential backyard scenario. It is unlikely that such frequent and intense soil exposure would occur at Lagoon 3 because it is not a residential area, access is limited because of the vegetation and woods, and visitors are infrequent. In addition, during winter months, the ground would be frozen or snow-covered, and soil contact would be minimal. Lastly, access to this area is limited by the surrounding wetlands and wooded area. CT DPH evaluated health risks based on more realistic exposures to children and adults who may come into contact with surface soil in both areas of Lagoon 3 of the Somers Plating site.

CT DPH assumed a trespasser scenario for both areas where contact with soil occurs 2 days per week, 9 months out of the year for 6 years. These assumptions were made because, as stated previously, the area appears to be used infrequently and there is little access to the Lagoon 3 area. Nine months was used instead of 12 because it is assumed that exposure would be limited in the winter months due to frozen ground and snow cover. Therefore, exposure assumptions to both areas of Lagoon 3 of the Somers Plating site represent a youth (age 13-18 years) trespasser exposure scenario. Given that there is evidence of ATV usage in the wooded area near Lagoon 3, CT DPH believes that this is a likely and realistic, but still a very conservative exposure scenario. Exposure to surface

soil under the current conditions from Lagoon 3 by an adult trespasser over the age of 18, for example, a hunter, would also be protected by the teenage trespasser scenario.

CT DPH did not calculate theoretical cancer risks because there is insufficient evidence to conclude that long-term exposure to cadmium from dermal or oral (ingestion) exposure has been shown to cause cancer in toxicology studies. There is, however, sufficient evidence from human and animal toxicological studies to conclude that long-term inhalation exposure to cadmium has been shown to cause cancer. However, inhalation exposure to cadmium from Lagoon 3 is not considered to be a complete pathway.

1. Remediated Area

CT DPH has used an average cadmium concentration of 167 ppm in soil and calculated an average daily dose of 0.00003 mg/kg/day using the assumptions described above (trespasser scenario). Because the dose from the site after cleanup is less than ATSDR's Minimum Risk Level (MRL) for chronic oral exposure of 0.0002 mg/kg/day³ and U. S. EPA's reference dose (RfD) which is 0.0005 mg/kg/day⁴, noncancer health effects from cadmium in soil in the remediated grassy area of Lagoon 3 of the Somers Plating site are unlikely. MRLs and RfDs are estimates of daily exposure to humans that are likely to be without harmful noncancer effects. Dose and risk calculations are provided in Appendix C. Although cleanup levels do not meet the CT RSRs, the risk of exposure to cadmium is unlikely to result in any adverse health effects under the given conditions and a trespasser exposure scenario. However, as stated previously, if site conditions change, i.e., if a business or home is built on or near the lagoon, then exposures and risks should be re-evaluated.

2. Wetlands Area

CT DPH has used an average concentration of 394 ppm in soil and calculated an average daily dose of 0.00007 mg/kg/day using the assumptions described above (trespasser scenario). Because the dose from the site is less than ATSDR's MRL for chronic oral exposure of 0.0002 mg/kg/day and U. S. EPA's RfD which is 0.0005 mg/kg/day, noncancer health effects from cadmium in soil in the wetlands area of Lagoon 3 of the Somers Plating site are unlikely. Although cleanup levels do not meet the CT RSRs, the risk of exposure to cadmium is unlikely to result in any adverse health effects under the given conditions and a trespasser exposure scenario. However, as stated previously, if site conditions change, (i.e., if a business or home is built on or near the lagoon), then exposures and risks should be re-evaluated.

³ ATSDR oral MRL for water. The oral MRL for food is 0.001 mg/kg/day [ATSDR 1999].

⁴ EPA oral RfD for water. The oral RfD for food is 0.001 mg/kg/day [IRIS 1994].

CONCLUSIONS

Before the U.S. EPA remediated the site, surface and subsurface soil in the grassy area of Lagoon 3 of the Somers Plating site was contaminated with elevated levels of cadmium, trivalent chromium, lead, and zinc. The wetlands area of Lagoon 3 was not remediated and remains contaminated. The U.S. EPA remediated the soil (0-2 ft) in the grassy area of the lagoon using a modified cleanup level for cadmium in December 2005. This alternate cleanup level exceeds the CT RSRs. This health consultation evaluates the current site conditions where post excavation sampling took place in the grassy area. It also evaluates current site conditions in the wetland area that was not remediated.

CT DPH evaluated exposure doses and public health implications from exposure to cadmium in surface soils from both areas of Lagoon 3 under current conditions using realistic but conservative exposure assumptions. CT DPH did not assess doses and risks from exposure to subsurface soils from the lagoon because it was not considered to be a complete exposure pathway. For both areas of Lagoon 3 of the Somers Plating site, CT DPH determined that under current conditions and assuming that the area is used regularly by teenage trespassers, adverse health effects from exposures to the surface soil are unlikely.

The U.S. EPA's alternative cleanup level of 200 ppm for cadmium is a health protective cleanup criterion given the current land use. In the remediated area of Lagoon 3, the U.S. EPA met its alternative cleanup goal (average cadmium concentrations are less than 200 ppm). It is important to emphasize that the 200 ppm cleanup level for cadmium is a site specific criterion developed by the U.S. EPA. The U.S. EPA did not perform a cleanup on the wetland area of Lagoon 3 even though cadmium concentrations in the wetland area are higher than the alternative cleanup. This area does not pose a public health risk, assuming a trespasser exposure scenario.

ATSDR has a categorization scheme whereby the level of public health hazard at a site is assigned to one of five conclusion categories (Appendix D). CT DPH has concluded that presently, there is No Apparent Public Health Hazard from exposure to the surface soil contaminated with cadmium in both areas of Lagoon 3 area provided that the use of this area does not change.

RECOMMENDATIONS

1. CT DPH recommends that if current site use changes such that there is greater potential for exposure to soil than what was evaluated in this health consultation, the site should be re-evaluated by the U.S. EPA and/or the SHD as appropriate.
2. CT DPH recommends that the CT DEP or SHD should evaluate the need for additional onsite groundwater monitoring on the Somers Plating Site. The U.S. EPA should continue to work with the SHD, CT DEP, and CT DPH to evaluate data if any becomes available. If the onsite groundwater remains contaminated above drinking water standards, then the CT DPH recommends that no drinking

water wells be installed in an area where the well could be impacted by site-related contamination.

3. CT DPH recommends that the SHD place appropriate institutional controls that will inform a new buyer of the existing contamination on the site.

PUBLIC HEALTH PLAN

Actions Taken

1. CT DPH has provided assistance to the U.S. EPA in responding to health questions relating to the cleanup level for cadmium in the grassy area of Lagoon 3 of the Somers Plating site.

Actions Planned

1. CT DPH will make this health consultation available to the U.S. EPA, SHD, CT DEP, and interested community members.
2. CT DPH will continue to work with the U.S. EPA to respond to health questions and concerns regarding cleanup of hazardous contaminants at the Somers Plating site.
3. CT DPH will review any additional data for this site and update this health consultation, if necessary.
4. CT DPH will work with SHD to place an appropriate institutional control for the Somers Plating Site.

REFERENCES

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CERTIFICATION

The Health Consultation for the Evaluation of Soil Data for Lagoon 3 of Somers Plating Site in Somers, Connecticut was prepared by the Connecticut Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodology and procedures existing at the time the health consultation was initiated. Editorial review was completed by the ATSDR Cooperative Agreement Partner.

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

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Appendix A
Maps of the Somers Plating Site

Appendix B
ATSDR Cadmium Fact Sheet

Appendix C
Risk Calculations

Lagoon 3, Somers Plating, Somers, Connecticut

A. Noncancer risks, trespasser, aged 13-18 years, Wetland Area

1a. Ingestion Dose-Cadmium

In this calculation, we are estimating the average daily dose of cadmium a trespasser, aged 13-18 years, would receive from via oral ingestion of soil.

$$\begin{aligned} \text{ADD}_i &= \text{I}_a * [\text{Soil}] * \text{EF} * \text{ED} * \text{C1} * \text{C2} * 1 / \text{BW}_t * 1 / \text{AT}_{nc} \\ \text{ADD}_i &= 50 \text{ mg/d} * 394.22 \text{ mg/kg} * 78.6 \text{ d/yr} * 6 \text{ yr} * 10^{-6} \text{ kg/mg} * \text{y} / 365 \text{d} * 1 / 60 \text{kg} * 1 / 6 \text{ yr} \\ &= \mathbf{7.07 \text{ E-5 mg/kg/day}} \end{aligned}$$

2a. Dermal Dose-Cadmium

In this calculation, we are estimating the average daily dose of cadmium a trespasser, age 13-18 years, would receive from dermal exposure to soil.

$$\begin{aligned} \text{ADD}_d &= [\text{Soil}] * \text{AF} * \text{ABS}_d * \text{SA} * \text{EF} * \text{ED} * \text{F} * \text{C1} * \text{C2} * 1 / \text{BW}_t * 1 / \text{AT}_{nc} \\ \text{ADD}_d &= 394.22 \text{ mg/kg} * 0.04 \text{ mg/cm}^2 / \text{-ev} * 0.001 * 9697 \text{ cm}^2 * 78.6 \text{ d/y} * 6 \text{ yr} * 1 \text{ ev/d} * 10^{-6} \\ &\text{kg/mg} * \text{y} / 365 \text{d} * 1 / 60 \text{kg} * 1 / 6 \text{ yr} \\ &= \mathbf{5.49 \text{ E-7 mg/kg/day}} \end{aligned}$$

3a. Noncancer Hazard Index

$$\text{HI} = (\text{ADD}_i + \text{ADD}_d) / \text{MRL}$$

$$\text{HI} = (7.07 \text{ E-5 mg/kg/day} + 5.49 \text{ E-7 mg/kg/day}) / (0.0002 \text{ mg/kg/day})$$

$$\text{HI} = 0.36$$

A Hazard Index of 1 means that the estimated dose is equal to the safe dose. A Hazard Index less than 1 indicated that the estimated dose is below the safe dose and noncancer health effects are unlikely. A Hazard Index (HI) greater than 1 indicates that the estimated dose is above the safe dose and noncancer health impacts cannot be ruled out. In this case, the HI for cadmium is below 1. This indicates that noncancer health impacts from cadmium are unlikely.

B. Noncancer risks, trespasser, aged 13-18 years, Remediated Lagoon 3 Area

1a. Ingestion Dose-Cadmium

In this calculation, we are estimating the average daily dose of cadmium a trespasser, aged 13-18 years, would receive from via oral ingestion of soil.

$$\begin{aligned} \text{ADD}_i &= \text{I}_a * [\text{Soil}] * \text{EF} * \text{ED} * \text{C1} * \text{C2} * 1 / \text{BW}_t * 1 / \text{AT}_{nc} \\ \text{ADD}_i &= 50 \text{ mg/d} * 166.86 \text{ mg/kg} * 78.6 \text{ d/yr} * 6 \text{ yr} * 10^{-6} \text{ kg/mg} * \text{y} / 365 \text{d} * 1 / 60 \text{kg} * 1 / 6 \text{ yr} \\ &= \mathbf{2.99 \text{ E-5 mg/kg/day}} \end{aligned}$$

2a. Dermal Dose-Cadmium

In this calculation, we are estimating the average daily dose of cadmium a trespasser, age 13-18 years, would receive from dermal exposure to soil.

$$\begin{aligned} \text{ADD}_d &= [\text{Soil}] * \text{AF} * \text{ABS}_d * \text{SA} * \text{EF} * \text{ED} * \text{F} * \text{C1} * \text{C2} * 1 / \text{BW}_t * 1 / \text{AT}_{nc} \\ \text{ADD}_d &= 166.86 \text{ mg/kg} * 0.04 \text{ mg/cm}^2 / \text{-ev} * 0.001 * 9697 \text{ cm}^2 * 78.6 \text{ d/y} * 6 \text{ yr} * 1 \text{ ev/d} * 10^{-6} \\ &\text{kg/mg} * \text{y} / 365 \text{ d} * 1 / 60 \text{ kg} * 1 / 6 \text{ yr} \\ &= \mathbf{2.32E-7 \text{ mg/kg/day}} \end{aligned}$$

3a. Noncancer Hazard Index

$$\text{HI} = (\text{ADD}_i + \text{ADD}_d) / \text{MRL}$$

$$\text{HI} = (2.99\text{E-}5 \text{ mg/kg/day} + 2.32\text{E-}7 \text{ mg/kg/day}) / (0.0002 \text{ mg/kg/day})$$

$$\text{HI} = 0.15$$

A Hazard Index of 1 means that the estimated dose is equal to the safe dose. A Hazard Index less than 1 indicated that the estimated dose is below the safe dose and noncancer health effects are unlikely. A Hazard Index (HI) greater than 1 indicates that the estimated dose is above the safe dose and noncancer health impacts cannot be ruled out. In this case, the HI for cadmium is below 1. This indicates that noncancer health impacts from cadmium are unlikely.

WHERE:

ABS_d	= Soil dermal absorption fraction Cadmium: 0.001 [EPA 2004]
ADD_d	= average daily dose from dermal contact
ADD_i	= average daily dose from ingestion
AF	= recommended skin-soil adherence factor for residential teenage child; (moist conditions) 0.04 mg/cm ² -ev [EPA 2004]
AT_{nc}	= averaging time for noncancer risk; 6 years
BW_t	= teenager, 50 th percentile body weight [EPA 1997]; 60kg
C1	= conversion factor; 10 ⁻⁶ kg/mg
C2	= conversion factor; 1 year/365 days
ED	= exposure duration; 6 years for a teenager
EF	= exposure frequency; 78.6 days/year (2 days/wk, 9 months/year)
F	= event frequency, 1 event/day (1ev/day)
HI	= Hazard Index
IR_a	= soil ingestion rate for an adult; 50 mg/day [EPA 1997]*
MRL	= ATSDR minimal risk level (MRL); Cadmium: 0.0002 mg/kg/day
SA	= Skin surface area, 50 th percentile teenage trespasser: legs, feet, hands, and arms; 9697 cm ² [EPA 1997]
[Soil]	= Soil concentration, Current Conditions; Cadmium: 166.86 mg/kg (Remediated Area), 394.22 mg/kg (Wetland Area)

* EPA (1997) recommends using a soil ingestion rate of 50 mg/day for a child/adult over 6 years old. The U.S. EPA states that these values represent best estimates of average soil

ingestion rates. U.S. EPA programs have used 200 mg/day and 100 mg/day as conservative estimates of average soil intake rates. CT DPH opted to use the best estimate average value of 50 mg/day rather than the more conservative estimates for the sake of consistency.

Appendix D. ATSDR Interim Public Health Categories

Category/Definition	Criteria	ASTDR Actions
<p>1. Urgent Public Health Hazard</p> <p>This category is used for sites where short-term exposures (< 1 year) to hazardous substances or conditions could result in adverse health effects that require rapid intervention.</p> <p>This determination represents a professional judgment based on critical data which ATSDR has judged sufficient to support a decision.</p> <p>This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.</p>	<p>Evaluation of available relevant information indicates that the site-specific conditions or likely exposures have had, or are likely to have in the future, an adverse impact on human health that requires immediate action or intervention. Such site-specific conditions or exposures may include the presence of serious physical or safety hazards.</p>	<p>ATSDR will expeditiously issue a health advisory that includes strong recommendations to immediately stop or reduce exposure to mitigate the health risks posed by the site.</p>
<p>2. Public Health Hazard</p> <p>This category is used for sites that pose a public health hazard due to the existence of long-term exposures (> 1 year) to hazardous substance or conditions that could result in adverse health effects.</p> <p>This determination represents a professional judgment based on critical data which ATSDR has judged sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.</p>	<p>Evaluation of available relevant information suggests that, under site-specific conditions of exposure, long-term exposures to site-specific contaminants (including radionuclides) have had, are having, or are likely to have in the future, an adverse impact on human health that requires one or more public health interventions. Such site-specific exposures may include the presence of serious physical or safety hazards.</p>	<p>ATSDR will make recommendations to stop or reduce exposure in a timely manner to mitigate the health risks posed by the site.</p>

Category/Definition	Criteria	ASTDR Actions
<p>3. Indeterminate Public Health Hazard</p> <p>This category is used for sites in which “critical” data are insufficient with regard to extent of exposure and/or toxicologic properties at estimated exposure levels.</p> <p>This determination represents a professional judgment that critical data are missing and ATSDR has judged the data are insufficient to support a decision. This does not necessarily imply all data are incomplete; but that some additional data are required to support a decision.</p>	<p>This category is used for sites in which “critical” data are insufficient with regard to extent of exposure and/or toxicologic properties at estimated exposure levels. The health assessor must determine, using professional judgement, the “criticality” of such data and the likelihood that the data can be obtained and will be obtained in a timely manner. Where some data are available, even limited data, the health assessor is encouraged to the extent possible, to select other hazard categories and to support their decision with clear narrative that explains the limits of the data and the rationale for the decision.</p>	<p>ATSDR will make recommendations in the public health assessment to identify the data or information needed to adequately assess the public health risks posed by the site.</p>
<p>4. No Apparent Public Health Hazard</p> <p>This category is used for sites where human exposure to contaminated media may be occurring, may have occurred in the past, and/or may occur in the future, but the exposure is not expected to cause any adverse health effects.</p> <p>This determination represents a professional judgment based on critical data which ATSDR considers sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.</p>	<p>Evaluation of available relevant information indicates that, under site-specific conditions of exposure, exposures to site-specific contaminants in the past, present, or future are not likely to result in any adverse impact on human health.</p>	<p>Recommendations made to reduce exposure are not needed to reduce risk but may be considered prudent public health practice.</p>
<p>5. No Public Health Hazard</p> <p>This category is used for sites that, because of the absence of exposure, do NOT pose a public health hazard.</p>	<p>Sufficient evidence indicates that no human exposures to contaminated media may have occurred, no exposures are currently occurring, and exposures are not likely to occur in the future.</p>	<p>ATSDR may make no recommendations or may recommend community health education.</p>