Introduction

The Agency for Toxic Substances and Disease Registry (ATSDR) in Atlanta, Georgia has evaluated environmental data from the LCP Chemicals Superfund Site in Brunswick, Georgia. The LCP Chemicals Superfund Site (LCP Chemicals Site) is located on Ross Road and occupies approximately 813 acres immediately northwest of the city of Brunswick. Tidal marshland covers more than 670 acres of the property. Former manufacturing operations at the LCP Chemicals Site are located on about 133 acres of dry land (upland), east of the marsh.

The current LCP Chemicals Site has been associated with industrial-related activities since at least 1919 (EPS 2007a). An oil refinery, a paint manufacturing company, a power plant, and a chlor-alkali plant have all operated at this site over the years. During various manufacturing activities by several companies, site soils in the dry-land portion of the site, groundwater beneath the site, and the tidal marsh adjacent to the site became contaminated with waste products from these operations (EPA 2011).

In September 2010, ATSDR released this public health assessment as a draft for public comment. The 2010 public health assessment focused on the evaluation of contaminants in soil in the 133 acres of dry-land area because this area is being redeveloped and could be used for either commercial or residential purposes. We received comments on the 2010 report, which are presented in Appendix F.

In addition, EPA collected environmental data since 2010, in part based on recommendations in the 2010 report. New data are available for soils, sediment, and pond water from the dry-land area and for sediment and seafood samples from a portion of the Altamaha Canal, just south of the site.

This final Public Health Assessment for the LCP Site presents the findings, conclusions, and recommendations that were part of the 2010 report as well as new findings, conclusions, and recommendations based on new environmental data.

ATSDR has conducted numerous activities at the site since it was added in 1996 to the National Priorities List of hazardous waste sites. These activities include the following:

- The 2010 public release of this public health assessment focused on the dry-land area. This public release made numerous recommendations to other agencies to collect additional environmental data, which now are part of this final release of the same report.
• A 2005 health consultation for the Arco neighborhood, which evaluated soil samples from the former Arco neighborhood adjacent to the LCP Site.
• A 1999 report about the consumption of seafood and wild game contaminated with mercury to evaluate self-reported symptoms and illnesses for persons who ate locally caught seafood. The report also assesses person’s exposure to mercury and provided information that was used to develop recommendations for a seafood consumption advisory.
• A series of health consultations from 1994 to 1996 that evaluated the risk of harmful effects from consuming locally caught seafood from the Turtle River System contaminated with hazardous waste from the LCP site. These evaluations were used to develop the initial fish consumption advisory.

Throughout ATSDR’s activities at the LCP site, we worked closely with federal, state, and local officials and most importantly with the community to assess the impact that the LCP site may have had on the residents of Brunswick and Glynn County. ATSDR has strived to serve the public by using the best science, take responsive public health actions, and provide trusted health information to prevent people from coming into contact with harmful toxic substances.
Overall Conclusion

ATSDR divided the 133 acres into half-acre grids to determine whether a grid would be a concern for future residential or commercial development. Some of these grids were found to contain harmful soil levels of mercury, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, lead, and dioxins should certain portions of the site be developed.

If the LCP Chemicals Site becomes residential, 66 half-acre grids have at least one chemical in soil that could harm the health of children and adults. If the site becomes commercial or industrial, 9 half-acre grids have at least one chemical in soil that could harm the health of workers (see figures below). Some uncertainty exists in this overall conclusion because uncertainty exists in the amount of chemical exposure that will occur after the site is developed and some dry-land areas were inadequately sampled.

Conclusions

Conclusions 15 were presented in the September 2010 release of this report for public comment. The basis for these conclusions is environmental soil samples collected by the U.S. Environmental Protection Agency (EPA) predominantly in the 1990s, although a few samples were collected in the early 2000s. These conclusions focus on soil contamination in the dry-land area of the LCP site. During the 1990s, EPA also removed much of the contaminated soils from the site.
If certain dry-land areas of the LCP Chemicals Site become residential, polychlorinated biphenyls (PCBs) in soil at 41 half-acre grids on the site could harm the health of children and adult.

If certain dry-land areas of the LCP Chemicals Site become commercial or industrial, PCBs in soil in six half-acre grids on the site pose a health risk for commercial and industrial workers.

Children and adults who come in contact with high PCBs in soil might experience harmful effects to the immune, dermal, nervous, developmental, and reproductive systems (ATSDR 2000). Specific health effects include:

- Small changes in immune function as evidenced by a weakened response to an antigenic challenge,
- Mild damage to fingernails and toenails,
- Inflamed oil-producing glands associated with the eyes
- Gum recession,
- Learning and performance problems,
- Problems with attention and impulse control,
- Fewer male births,
- Lower birth weight,
- Longer menstrual cycles in women,
- An increase in cardiovascular disease in women,
- An increase in deaths from Parkinson disease in women,
- An increase in deaths from dementia in women, and
- An increase in diabetes in women.

Children and especially preschool children, with their nervous systems still developing, may be a particularly susceptible group if they come in contact with high PCBs levels in soil in some areas.

Commercial and industrial workers also are at risk of harmful effects if they have contact with soil in six half-acre grids of the site with the highest PCB levels. Their estimated exposure to PCBs could cause the same health effects as listed previously.

Daily contact with PCBs in soil over many years poses a high cancer risk for children and adults should the site become residential. PCBs in soil pose a moderate cancer risk for workers if the site becomes commercial or industrial. Such exposure could put residents and workers at increased risk for several cancers, including cancers of the liver, thyroid, biliary tract, intestines and skin.
Some uncertainty exists when deciding if harmful effects might be expected because very little health information is available on the most common type of PCBs found in LCP soils. Therefore, ATSDR relied upon health information from other types of PCBs. Uncertainty also exists in estimating how much PCBs people will contact once the site is developed and from using results from soil samples that were collected 15 years ago. These soil samples may not represent current or future conditions at the site. In addition, some dry-land areas were insufficiently sampled.

Six half-acre grids on the site exceed the U.S. Environmental Protection Agency’s (EPA) 1994 clean-up level for PCBs of 25 parts per million (ppm) while 41 grids have average PCB concentrations greater than 1 ppm. In the text of this report, see Table 4 for a list of grids that are a concern because of residual PCB contamination and see Figure 34 for their location.

### Conclusion 2

**Mercury in Dry-Land Area**

If certain dry-land areas of the LCP Chemicals Site become residential, mercury in soil in 10 half-acre grids on the site could harm the health of children and the developing fetus if women are pregnant.

If certain dry-land areas of the LCP Chemicals Site become commercial or industrial, mercury in soil in four half-acre grids on the site could harm the health of the developing fetus if a female worker is pregnant. One of these half-acre grids also could harm the health of women who are not pregnant and the health of men.

### Basis for Decision (Conclusion 2)

For women who live in the 10 half-acre grids on the site with high mercury concentrations in soil, the estimated intake of mercury from soil approaches or exceeds levels that cause harmful neurological effects to the fetus during pregnancy. Children born to these women might experience neurological effects involving language, attention and memory, and to a lesser extent visual/spatial and motor functions. The estimated exposure levels in preschool children who live in these areas also approach or exceed levels that could harm their health. They are at risk of the same neurological effects.

Mercury in soil in four half-acre grids on the site also poses a risk for commercial and industrial workers if the site is developed. Pregnant workers who have contact with mercury in soil in these areas are at risk of exposing their developing fetus to mercury levels that might cause harmful effects after birth. Some children born to women exposed to these levels might experience neurological effects involving language, attention and memory, and to a lesser extent visual/spatial and motor functions.

Male and female workers who have prolonged contact with soil from the one half-acre grid with the highest remaining mercury contamination also are at
risk of harmful effects. Their estimated exposure level might result in damage to their neurological system, such as diminished sensitivity to pain, diminished touch, decreased fine motor performance, impaired vision, and impaired hearing.

Some uncertainty exists concerning the risk of harmful effects from mercury in soil. The chemical form of mercury in soil at the LCP Chemicals Site has not been well-established, although scientific studies from marsh sediment show that almost half the mercury is organic mercury. Therefore, ATSDR assumed that most of the mercury in soil at the LCP Chemicals Site was organic mercury. There’s some uncertainty about whether the organic mercury bound to soil would cause harmful effects. In addition, uncertainty exists in the mercury concentrations in surface soil following development of the site and uncertainty exists from using the results from soil samples that were collected 15 years ago. These soil samples may not represent current or future conditions at the site.

Ten half-acre grids exceed EPA’s 1994 clean-up level of 20 ppm mercury in soil. See Table 29 for a list of the 10 grids that are a concern because of residual mercury contamination and see Figure 37 for their location.

<table>
<thead>
<tr>
<th>Conclusion 3</th>
<th>Lead in Dry-land Area</th>
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<tbody>
<tr>
<td>If certain dry-land areas of the LCP Chemicals Site become residential, lead in soil in 28 half-acre grids on the site could harm the health of children.</td>
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<table>
<thead>
<tr>
<th>Basis for Decision (Conclusion 3)</th>
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<tr>
<td>If the site becomes residential, exposure to lead in soil at these 28 half-acre grids could increase children’s blood lead levels and result in the following harmful effects:</td>
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<tr>
<td>- Small decreases in IQ,</td>
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<tr>
<td>- An increase in attention deficit hyperactivity disorder,</td>
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<tr>
<td>- Reduced attention span,</td>
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<tr>
<td>- Lack of concentration,</td>
</tr>
<tr>
<td>- Decreased fine muscle skills,</td>
</tr>
<tr>
<td>- Withdrawn behavior,</td>
</tr>
<tr>
<td>- Decreased height,</td>
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<tr>
<td>- Small delays in puberty, and</td>
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<td>- Small changes in kidney function.</td>
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Some uncertainty exists in this conclusion because uncertainty exists in estimating children’s exposure to lead in soil if the site becomes residential. Uncertainty also exists from using the results of soil samples that were collected 15 years ago. These soil samples may not represent current or future conditions at the site.
See Table 31 for a list of the 28 half-acre grids that are a concern because of residual lead contamination and see Figure 40 for their location.

**Conclusion 4**

**PAH in Dry-land Area**

If certain dry-land areas of the LCP Chemicals Site become residential, polycyclic aromatic hydrocarbons (PAHs) in soil in six half-acre grids on the site could harm the health of children and adults.

If certain dry-land areas of the LCP Chemicals Site become commercial or industrial, PAHs in soil in two half-acre grids on the site could harm the health of workers.

**Basis for Decision (Conclusion 4)**

Daily contact with PAHs in residential soil over many years poses a moderate risk of certain cancers for children and adults. Similarly, workers also have a moderate risk of certain cancers should some areas become commercial or industrial. Such exposure could put residents and workers at increased risk for lung and skin cancers.

Some uncertainty exists in these conclusions because uncertainty exists in estimating how much PAHs people will contact once the site is developed. Uncertainty also exists from using the results from soil samples that were collected 15 years ago. These soil samples may not represent current or future conditions at the site.

See Table 35 for the list of half-acre grids that are a concern because of residual PAH contamination and see Figure 41 for their location.

**Conclusion 5**

**Mixtures of PCB, Mercury, and Lead in Dry-Land Area**

If certain dry-land areas of the LCP Chemicals Site become residential, contact with soil containing a mixture of PCBs, mercury, and lead (or a combination of these) could harm the health of children.

**Basis for Decision (Conclusion 5)**

Studies have shown that children exposed to low levels of PCBs, mercury, and lead showed impaired learning of a performance task, resulting in problems with attention and impulse control.

Three grids have elevated levels of PCBs, lead, and mercury; eight grids have elevated levels of PCB and lead; and, five grids have elevated levels of PCBs and mercury. See Figure 42 for the location of these grids.
Conclusions 6-12 are based on new environmental samples collected by EPA after 2010. Many of these samples were collected in response to recommendations from ATSDR in the December 2010 public release version of this report. The new environmental samples consist of soil samples from the dry-land area with a focus on the former drive-in theater and the pond in the northwest corner of the site. EPA also collected sediment and seafood samples from the Altamaha Canal just south of the LCP Site.

**Conclusion 6**

**Dioxin in Dry-land Area**

In 2011, EPA collected soil samples from eight, dry-land areas and measured dioxin levels. These dry-land area varied in size and thus consisted of varying numbers of half-acre plots. One sampling area consisting of 30 half-acre plots contained dioxins in soil that could harm the health of children and adults should this area become residential.

**Basis for Decision (Conclusion 6)**

Daily contact with dioxins in soil in this one area over many years poses a high risk of cancer for children and adults. Human studies have shown that dioxin can cause liver cancer and might be associated with cancers of the lung, colon, prostrate, breast, blood, and lymphatic system. Rodent studies have confirmed that dioxin can cause cancer at multiple sites, including the liver, lung, mouth, and thyroid.

In addition, preschool male children who have daily contact with these soils could be at risk of reproductive effects once they reach adulthood. As adults, they might experience problems with (1) decreased number of sperm, (2) decreased number of motile sperm, and (3) fewer male offspring.

The location of this 30 half-acre area contaminated with dioxin is shown in Figure 43 and is labeled as sampling area 8.

**Conclusion 7**

**Former Theater**

In 2010, EPA collected soil samples from the former theater area in the northeast section of the site. Glynn County plans to build a detention center in this area so ATSDR evaluated the risk for adult workers and inmates who might come in contact with chemicals in soil. Mercury, lead, and PCBs in soil from the former drive-in theater area is not expected to harm people’s health.

**Basis for Decision (Conclusion 7)**

The mercury and lead levels in soil in the former theater area were either below ATSDR’s screening levels or the levels were at or near background levels in soils. Therefore, harmful effects from mercury and lead in soil are not likely.
The exposure of prison inmates and adult workers to PCBs in soil would be at levels far below ATSDR’s health guideline for PCBs. Therefore, PCBs in soil are not likely to cause harmful, non-cancerous effects. The risk of cancer from daily exposure to PCBs in soil is insignificant.

**Conclusion 8**  
**On-site Pond**  
In 2010, EPA collected surface water and sediment samples from the on-site pond in the northwest corner of the dry-land area. The levels of PCBs, mercury, PAHs, and lead in surface water and sediment from the on-site pond are not expected to harm people’s health.

**Basis for Decision**  
**(Conclusion 8)**  
Levels of PCBs, mercury, PAHs and lead in the on-site pond were either below ATSDR’s comparison values or at background levels. In addition, the pond does not serve as a source of drinking water nor does the pond support fish.

**Conclusion 9**  
**Sampling Sufficiency for Dry-land Area**  
Some dry-land areas do not have adequate sampling data; therefore, it is difficult to draw conclusions about whether these unsampled soils could harm people’s health. Most of the insufficiently sampled areas are in the southeastern portion of the site (including the cell building area) and in the western dry-land area closest to the marsh. For other areas that have been sufficiently sampled, we are able to draw conclusions about potential health impacts.

**Basis for Decision**  
**(Conclusion 9)**  
One reason for the limited sampling in some areas is that EPA decided that some environmental data were unusable because of data quality issues. In addition, some areas were not sampled because LCP Chemicals did not perform industrial activities on certain portions of the site. However, numerous industries occupied the site before LCP’s chlor-alkali facility, and those industries could have disposed of waste throughout the property.

Approximately half of the grids are considered sufficiently sampled for making a health conclusion for the chemicals PCBs, mercury, and lead. That means that half of the grids require additional sampling in order to be sure that those areas are not contaminated.

See Figures 22 through 25 for the dry-land areas considered to have adequate sampling data.

**Conclusion 10**  
**Altamaha Canal**  
In 2011, EPA collected sediment samples from a portion of the Altamaha Canal that exists south of the LCP Site. ATSDR evaluated the risk of harmful effects from exposure to PCBs, mercury, PAHs, and dioxins in sediment.
along the Altamaha Canal. Adults and children who visit or play along the canal would not be exposed to contaminants in sediment at levels that could cause harmful, non-cancerous effects. It is unlikely that contact with these chemicals in sediment could cause cancer.

**Basis for Decision (Conclusion 10)**

These chemicals are not a health concern in Altamaha Canal sediment because:

- The concentration of lead in sediment from the canal is at or near background lead levels in soils and is unlikely to cause harmful health effects from direct contact,
- The concentration of mercury is below ATSDR’s comparison value; therefore, mercury in sediment is unlikely to cause harmful health effects from direct contact,
- The estimated exposure to dioxins and PCBs for adults and children who visit or play along the canal is well below ATSDR’s and EPA’s health guidelines. Therefore, harmful non-cancerous effects are not likely. The estimated exposure to PCBs, PAHs, and dioxins for adults and children who visit or play along the canal results in insignificant cancer risks.

**Conclusion 11**

**Mercury in Seafood from Altamaha Canal**

In 2011, EPA collected fish and shellfish samples from the canal. ATSDR estimated exposure to mercury from eating various fish and shellfish from the Altamaha Canal and reached the following conclusions about adults and children with typical and high fish consumption:

- Mercury levels in mullet and shrimp from the Altamaha Canal is not expected to harm people’s health.
- Mercury levels in blue crab, red drum, and sea trout is not expected to harm the health of typical fish consumers but could harm the health of high fish consumers.

**Basis for Decision (Conclusion 11)**

Depending upon age and race, high fish consumers eat about 2 to 7 ounces of fish and shellfish daily. Typical fish consumers eat about a half to 2 ounces of fish daily. These daily fish consumption rates do not necessarily mean that people eat fish every day. Their fish consumption averages out to the rates previously described. For example, someone with a daily fish consumption rate of 2 ounces might eat one 14 ounce fish meal a week or two 7 ounces fish meals a week. This frequency and amount of fish consumption averages out to two ounces of fish eaten daily.
Typical and high fish consumers of mullet and shrimp from the Altamaha Canal have estimated exposures to mercury that are well below levels that cause harmful effects. Typical fish consumers of blue crab, red drum, and sea trout from the Altamaha Canal have estimated exposures to mercury that are well below levels that cause harmful effects.

High fish consumers of blue crab, red drum, and sea trout from the Altamaha Canal have estimated exposures to mercury that approach levels that can cause harmful effects in young children and in children born to pregnant women who are high consumers. These children might experience neurological effects involving language, attention and memory, and to a lesser extent visual/spatial and motor functions.

Some uncertainty exists in the conclusions for sea trout and red drum because only one fish of each species was collected from the Altamaha Canal.

Fish and shellfish from the Altamaha Canal were also found to contain PCBs. ATSDR estimated exposure to PCBs from eating various fish and shellfish from the Altamaha Canal and reached the following conclusions about adults and children with typical and high fish consumption:

- PCB levels in red drum, blue crab, and shrimp is not expected to cause harmful, non-cancerous effects.
- PCB levels in sea trout is not expected to harm the health of typical fish consumers, but could harm the health of high fish consumers.
- PCB levels in mullet could harm the health of typical and high fish consumers.

The results of the fish and shellfish sampling from the Altamaha Canal support the current fish advisory for the Turtle River system issued by the Georgia Department of Natural Resources (GDNR). The Altamaha Canal is tidally connected to the lower Turtle River through several waterways and GDNR has fish and shellfish consumption advice specifically for the lower Turtle River. See Table 46 for more information about the state’s fish and shellfish consumption recommendations for the lower Turtle River.

The basis for this decision are:

- Typical and high fish consumers of red drum, blue crab, and shrimp have estimated exposures to PCBs that are well below levels that can cause harmful, non-cancerous effects. Typical fish consumers of sea trout have estimated exposures to PCBs are well below levels that can cause harmful, non-cancerous effects.
• High fish consumers of sea trout and typical and high fish consumers of mullet have estimated exposure to PCBs that approach levels that can cause harmful, non-cancerous effects.

High consumers of sea trout and typical and high consumers of mullet might experience the following harmful effects to the immune, dermal, nervous, developmental, and reproductive systems. Specific health effects include:

• Small changes in immune function as evidenced by a weakened response to an antigenic challenge,
• Mild damage to fingernails and toenails,
• Inflamed oil-producing glands associated with the eyes
• Gum recession,
• Learning and performance problems,
• Problems with attention and impulse control,
• Fewer male births,
• Lower birth weight,
• Longer menstrual cycles in women,
• An increase in cardiovascular disease in women,
• An increase in deaths from Parkinson disease in women,
• An increase in deaths from dementia in women, and
• An increase in diabetes in women (ATSDR 2000).

Children and especially preschool children, with their nervous systems still developing, may be a particularly susceptible group.

Children and adults who frequently eat mullet from the Altamaha Canal for many years also have a high increased risk for several cancers, including cancers of the liver, thyroid, biliary tract, intestines and skin.

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**Next Steps**

ATSDR recommends

1. Restricting some LCP Chemicals Site areas from residential development unless further steps are taken to prevent contact with PCB, mercury, lead, PAH, and dioxin contamination that remains in soil on the property.

2. Restricting some LCP Chemicals Site areas from commercial or industrial use unless further steps are taken to prevent contact with PCB, mercury, and PAH contamination that remains in soil on the property.

3. Additional soil sampling in and around the former cell building’s footprint because of residual soil contamination if future plans include development of this area.
4. Additional sampling in areas where sampling data are limited. In general, the western portion of the site has been sampled more than the eastern portion. Particular attention should be given to the former cell building area should the land use change and to future enclosed structures built above the caustic brine pool area.

5. Continued monitoring of fish and shellfish in the Turtle River and in the marsh near the LCP Chemicals Site. The Georgia DNR continues to monitor seafood in the area and to maintain the fishing advisory for the Turtle River System.

6. Continuation of the GDNR’s fish advisory for the Turtle River System. The major components of this advisory are provided in Tables 43-46 of this health assessment. GDNR’s recommendations for the lower Turtle River (see Table 46) apply for fish obtained from the Altamaha Canal.

The 2013 GDNR fish advisories for rivers, lakes, and estuaries in Georgia, including the Turtle River system, can be found at this website: http://www.gaepd.org/Documents/fish_guide.html. To view their brochure, click on “Guidelines for Eating Fish from Georgia’s Waters, 2013”.

In addition, GDNR has a brochure, ‘A woman’s guide for eating fish and seafood from coastal Georgia’. This brochure is available at http://health.state.ga.us/pdfs/environmental/chemhazard/fish%20consumption/wfcg_coastal.pdf.

For More Information

ATSDR’s Public Health Assessment for the LCP Chemicals Superfund Site is available at this internet address: http://www.atsdr.cdc.gov/sites/lcp/.

For more information about ATSDR’s work at the LCP Chemicals Superfund Site, you should contact ATSDR at 1-800-CDC-INFO (1-800-232-4636) and ask to be transferred to Dr. David Mellard or you can dial Dr. Mellard direct at 770-488-0727.