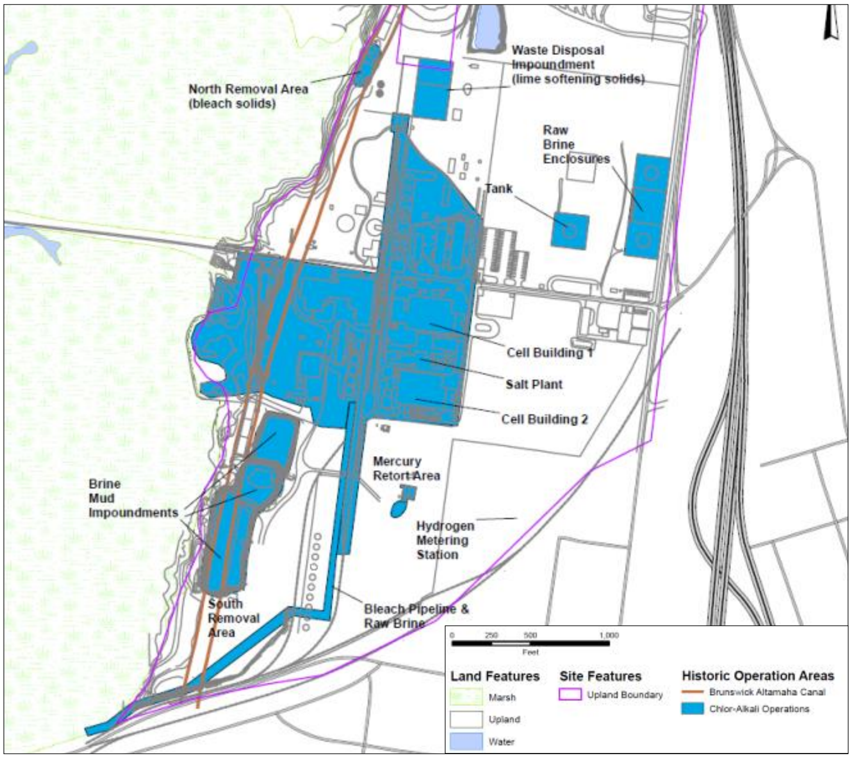
May 2020

Subsurface Contamination Defined at LCP Chemicals Superfund Site



Areas in blue show where chlor-alkali operations took place at the LCP Chemicals Site.

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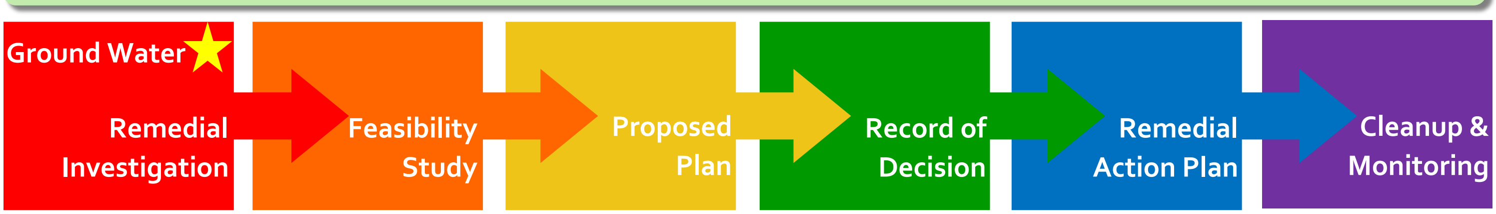
Site Background



The LCP site is located between the Turtle River and New Jesup Highway, just northwest of the Brunswick city limits. Honeywell owns the 813-acre property, which has a 100-year history of industrial activity, including oil refining and storage, a coal-fired power plant, and chemical and paint manufacturing plants. Those activities contaminated soil, ground water, and adjacent surface waters and marshlands until operations ceased in 1994. Honeywell and Georgia Power have cooperated with the U.S. Environmental Protection Agency (EPA) to study and clean up the site since then. Contaminants of concern include polychlorinated biphenyls (PCBs), mercury, lead, and cancer-causing polycyclic aromatic hydrocarbons (cPAHs).

Portions of the site were cleaned up in the mid-1990s. Approximately 130,000 cubic yards of contaminated soil and industrial wastes were removed from areas of the marsh and former operations areas, including the mercury cell buildings where sodium hydroxide (caustic), sodium hypochlorite (bleach), chlorine gas, and hydrogen gas were produced. Industrial buildings and facilities were demolished, including the above-ground portions of the cell buildings. A soil cover was placed over the cell buildings' concrete slabs to prevent exposure temporarily.

In February 2020, Honeywell released the Site Characterization Summary Report. The purpose of this report was two fold: 1) provide a comprehensive presentation of work performed since monitoring and study activities commenced over 20 years ago; and 2) provide a data summary of the current Site-wide groundwater contamination including a summary of work performed to investigate the cell building area. This Technical Assistance Report summarizes key findings identified by the Glynn Environmental Coalition's Technical Advisor, Frank Anastasi.

Industrial Activities and Resulting Contamination

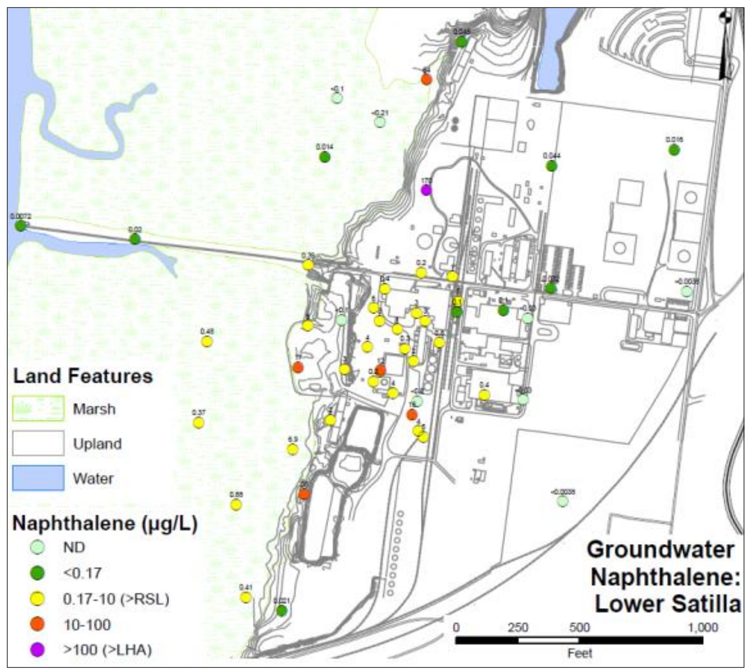
From 1944 to 1994, the chlor-alkali production facilities used a "mercury cell process" to make caustic, bleach, chlorine, and hydrogen by immersing graphite and mercury in salty solutions. From 1979 to 1994, hydrochloric acid was also made by reacting chlorine and hydrogen.

Mercury, which is liquid under ambient conditions, was lost to the environment during operations. Caustic solutions containing dissolved mercury, liquid sodium hydroxide, sodium chloride brine, and bleach spilled and leaked onto the ground. These chemicals contaminated the sediments and ground water surrounding the cell buildings. Leaks from impoundments where process wastes were stored also contributed contaminants to the groundwater. Production operations took place in various locations on site, as you can see in image on the front page of this report.

After these facilities were decommissioned in 1994, liquid mercury was removed from the process equipment, the cell buildings were demolished, and a soil cover was placed over the remaining concrete building foundations. The contaminated ground water around the cell buildings became known as the caustic brine pool. This ground water had an extremely high pH - the measure of how acidic or basic a solution is on a scale from 0, most acidic, to 14, most basic, and pure water is a neutral of 7. A pH of 14 was observed in some places and groundwater also contained large amounts of salts and dissolved solids. This dense and highly caustic ground water sunk through the surficial sandy sediments of the Satilla Formation (approx. 15 to 50 feet deep), dissolving significant amounts of silica and other naturally occurring minerals.

The caustic brine pool spread out laterally as it settled on top of the cemented sandstone layer that lies about 50 feet deep below the ground surface. This 10-foot thick sandstone layer marks the top of the Ebenezer Formation, a water-bearing sand layer about 40 feet thick lying beneath the cemented sandstone.

Contamination migrated through the sandstone into the water-bearing sand, known as the Upper Ebenezer Formation. In some locations, contaminants including dissolved mercury are present.



Example of ground water contamination: cPAH Naphthalene in lower portion of Satilla Formation. (Ref. Figure 5.6C from Site Characterization Summary Report)

Nature and Extent of Contamination

The cell buildings and site-wide ground water contamination at LCP have been studied since the 1990s. Hundreds of test pits, soil borings, monitoring wells were installed and sampled, and various test probes and sensing techniques were used to define natural geologic materials and the nature and extent of contamination.

From 2013 to 2019, carbon dioxide was injected into the affected portion of the saturated Satilla sediments through 257 wells to lower the pH (closer to a neutral pH of 7) and remove dissolved contaminants from the ground water. As a result, mercury and other dissolved metals precipitated out of the ground water and were deposited in the sediments. This reduces contaminants migrating with the ground water that might reach a receptor (for example, a human or a fish).

In 2018-2019, deep soil borings to the base of the Satilla Formation were sampled to define the extent of liquid mercury. Ground water sampling refined the extent of the caustic brine pool in the Satilla Formation, and demonstrated the effectiveness of the carbon dioxide injections to restore ground water to a neutral pH and reduce levels of dissolved mercury and other contaminants. Some associated contaminants were found in the underlying Upper Ebenezer Formation, but not in the deeper Lower Ebenezer Formation.

Residual Ground Water Contamination Summary

- Elevated levels of benzene, chlorobenzene, and dichloromethane were found. They are present mainly in the Satilla Formation, and extend west of the site beneath the marsh as far as the Turtle River. They were also found at lower concentrations, below the cemented sandstone layer, in the Upper Ebenezer Formation.
- Polycyclic Aromatic Hydrocarbons (PAHs) are present in the Satilla Formation, with higher concentrations near known petroleum sources and at depths of between 4 and 16 feet below ground. This is indicative of the historical petroleum releases at the site as much as 70 years ago. The most common PAHs at elevated levels are benzo(a)anthracene, naphthalene, and 1-methylnaphthalene. They were found west of the site, beneath the marsh and at one location as far west as the Turtle River.
- Metals are present in the Satilla ground water across more areas of the Site than other contaminants. They occur mainly in the middle and lower Satilla sands. Some of the metals are naturally occurring, but mercury, lead, and perhaps others were released from industrial operations. Most of the other metals are found in trace quantities and are naturally occurring in coastal Georgia. The seven metals of most significance are arsenic, beryllium, chromium, lead, mercury, selenium, and vanadium. They were found west of the site, beneath the marsh and as far west as the Turtle River.
- Sodium and pH are indicators of the caustic brine pool. Elevated pH levels in the Satilla sands were found west/southwest of the cell buildings. Beneath the cemented sandstone layer, in the Upper Surficial Aquifer, high pH was found near the southwest corner of the caustic brine pool (carbon dioxide injections did not reduce pH levels beneath the cemented sandstone layer). Sodium concentrations in the Satilla sands have declined since the 1990s, due to dilution by groundwater flow and recharge. In the deeper Upper Surficial Aquifer, elevated sodium levels are generally found with elevated pH.

Liquid Mercury at the Cell Buildings

Honeywell reported that the extent of liquid mercury is now defined to the base of the Satilla Formation. Physical subsidence (sinking) of the cell building slabs, due to dissolution of the quartz sand by the caustic solution releases, helped mercury sink through the

Locations of liquid mercury in soil based on visual observations. (Ref. Figure 6.1 from Site Characterization Summary Report)

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subsurface. Ground vibration during pile driving to support the foundations also promoted downward transport of liquid mercury. Mercury should not have migrated through the cemented sandstone layer that lies beneath the Satilla sands. Test borings did not penetrate into the sandstone out of precaution to not promote potential mercury migration through it.

Mercury that had been present in spaces beneath and between the slabs was recovered when the buildings were decommissioned. Residual mercury remains present at depth mainly to the south and east of Building No. 1. Small discrete droplets or beads of mercury were observed in many soil cores, and they were found only in sands. In the subsidence area, discrete droplets were observed up to 50 feet below ground. The beads of mercury were very small, ranging up to 2 millimeters in size. Some mercury bead "stringers" were observed; they are described as small localized deposits of beads ranging from less than 1 to 3 inches thick, in circular to elliptical shapes, with widths up to 3 or 4 times their height. The stringers were found typically resting upon clay layers.

What's Next?

EPA and Honeywell expect to meet soon to discuss the Characterization Report. EPA informed GEC in an April telephone conference that they will require limited additional ground water sampling to ensure there is a complete and up-to-date picture of the ground water contamination across the entire site. This is expected to be completed in the second or third quarter of 2020.

Once additional data is collected, the data and findings will be incorporated into a Remedial Investigation and Risk Assessment Report which is expected to be completed sometime in 2021. The Feasibility Study then will evaluate potential remedial actions to address the liquid mercury and dissolved ground water contamination across the site. The Glynn Environmental Coalition and our Technical Advisor will continue to monitor as progress is made.

Additional details of the historical site investigations, removal actions, and risk assessments conducted for the LCP site, can be found at **semspub.epa.gov/work/04/11120293.pdf**.

For key figures from the Site Characterization Report, visit **glynnenvironmental.org/lcp-chemical-superfund-site**.