Unit 5: Hazardous Waste and Love Canal

Module: Environmental Justice and Freshwater Resources
UNIT GOALS

• Discuss Love Canal from a historical and environmental justice standpoint.
• Articulate the events that led to the passage of the Superfund Act.
• Demonstrate how geology and hydrology facilitated the flow of toxic materials at Love Canal.


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The history of Love Canal began in 1892 when William T. Love proposed digging a canal, roughly six miles long, to connect the upper and lower Niagara Rivers via an engineered waterfall and thus generate power. Love wished to build a carefully planned industrial city with convenient access to inexpensive water power and major markets. Because of economic woes, the project was not completed. Instead, Love left behind a partially dug section of the canal, sixty feet wide and three thousand feet long.

“Niagara Falls” c. 1870: Photo source (Creative Commons license): http://www.loc.gov/pictures/item/2006677459/ Rights Advisory: No known restrictions on publication; Library of Congress.


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• 1970s: Approximately 800 private homes and 240 low-income apartments were built around Love Canal.

• 1976: A study revealed toxic chemical residues in the air at a high percentage of homes at the canal’s southern end. Drums of chemicals were found just beneath or on the surface, and high levels of PCBs were in the storm sewer system.

• Love Canal Homeowners Association collected health data from families which showed clustering of diseases in neighborhoods.

• 1978: the New York State Department of Health (NYSDOH) found high levels of contaminants and recommended that the 99th Street school be closed, that pregnant women and children under age of two be evacuated, and that residents not eat out of their home gardens, and spend minimal time in their basements.

• 1980: President Jimmy Carter ordered evacuation of Love Canal.

To explain how Love Canal became so detrimental to the health of the local residents, one must look at the history of use, the geology of the area, and how waste products from Hooker Chemical, the City of Niagara and the US Army were discarded. The abandoned Love Canal was approximately 9,750 feet long (2.9 km) long, about 50 feet (15 m) wide and 10 to 40 feet (3 m to 12 m) deep. From the 1920s until 1953, the empty canal was used as a regular dumping location first for municipal refuse, then World War II military wastes, which included nuclear waste, and then chemical waste. The 21,000 tons of chemicals, including dioxin-tainted trichlorophenols, went as deep as 10 to 25 feet. By 1953, the dump was closed and covered with a relatively thin layer of soil.

“Barrel of PCBs” Image source: (Used by Courtesy: University Archives, State University of New York at Buffalo) http://digital.lib.buffalo.edu/cdm/singleitem/collection/LIB-003/id/114/rec/1

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The events at Love Canal were critical to the passage of the federal Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). The law allows the Environmental Protection Agency (EPA) to manage cleanup of contaminated sites.

- Companies have to pay for costs of cleanup.

Today, the waterway that gave the neighborhood its name is buried under a plastic liner, clay and topsoil in a fenced area declared permanently off-limits, and the 239 homes closest to the canal were demolished. After remediation, Love Canal was declared "habitable." Since then, a public corporation took ownership of abandoned properties in Love Canal, fixed up the homes and resold them. The community is now known as Black Creek Village.


“Aerial view of abandoned homes adjacent Love Canal site showing toxic waste rising to surface of the ground” c. 1980: Image source: (Used by Courtesy: University Archives, State University of New York at Buffalo) http://digital.lib.buffalo.edu/cdm/singleitem/collection/LIB-003/id/129/rec/1

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However, catastrophic medical problems persisted for families whose homes were not among the 239 that were demolished. One reason the events at Love Canal are so significant in the history of environmental justice is that the episode represents the beginning of community members taking the initiative to make their own scientific observations and to trust their homegrown knowledge.

“Abandoned Love Canal home with discarded household items and sign in front reading 'House for sale cheap’” c 1979: Image source: (Used by Courtesy: University Archives, State University of New York at Buffalo) http://digital.lib.buffalo.edu/cdm/singleitem/collection/LIB-003/id/100/rec/1

“Demonstrators carrying signs at the rally against resettlement of the Love Canal area”: April 1, 1990: Image source: (Used by Courtesy: University Archives, State University of New York at Buffalo) http://digital.lib.buffalo.edu/cdm/singleitem/collection/LIB-003/id/507/rec/1


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Love Canal today is a 70-acre, fenced-off site with a leachate collection system at the center of the site. Water collected in the leachate system is run through a series of carbon filters and treated and re-used.

For more information about the Love Canal history, visit the EPA Region 2 website: http://www.epa.gov/region02/mediacenter/podcast.html and listen to the podcast “History of Love Canal and the Superfund Program” (12:32 mins)


Photo by Sean_Marshall, accessed via Flicker [“Empty streets next to the Love Canal dump site” Oct 8, 2005: Photo source (Creative Commons license): http://www.flickr.com/photos/7119320@N05/3777347466/ ]
Click on this link (http://d32ogoqmya1dw8.cloudfront.net/files/integrate/teaching_materials/freshwater/love_canal_google_earth.v2.kmz) to open a KML file in Google Earth. You will fly to Niagara Falls, New York, and see the map above. The file, called “Love Canal – 1978 to 1980.kml” can be found in the Temporary Places section in Google Earth.

Point out the Niagara River to the south and a creek to the north of the landfill, formed natural boundaries for the area affected by the migrating chemicals.

If you click the check box off and on (temporarily removing from view the 1978 aerial photograph) you can see where the 99th Street Elementary School once was as well as the houses before demolition. You can also use the transparency slider bar, if you choose. Point out the houses that were there in the aerial photo and that are no longer there. Click on the seven red diamond-shaped icons to view photos taken in 1978 to 1980.

To show what the Love Canal area looks like now, turn on the photos under Layers → Photos → Panoramio. Click on several of the small photo icons in and around Love Canal. Another option for showing what Love Canal looks like today is to use Google Street View in Google Earth (found on the right side of the map window). Move along the streets that surround the Love Canal landfill: Colvin Blvd to the north; 100th Street to the west; Frontier
Hazardous Waste and Love Canal: Part 2

**Question:**
Why didn’t the chemicals and other hazardous materials simply flow downward and deeper into the ground?


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Below is a simplified cross section of Love Canal.
- Note the relative thicknesses of materials and locations of home basement.
- Note contrasting geology:
  - Sandy silt near surface allows material to flow from dump into homes.
  - Clays farther down provide barrier to flow laterally and vertically.
  - Note the permeability values given.

* Permeability: $> 10^{-6}$ cm/s
* Permeability: $10^{-4}$ to $10^{-3}$ cm/s

The schematic geologic cross section was modified by author Meg Stewart from: “Neighborhood change at Love Canal: contamination, evacuation and resettlement” T. Fletcher, 2002 http://www.sciencedirect.com/science/article/pii/S0264837702000455
The contaminants from Love Canal flowed away from the dump through groundwater. The permeability of the top-most layer (sandy silt) was higher than that of the next layer down, which is clay.

http://techalive.mtu.edu/meec/module06/Permeability.htm

Gravel image modified from Jason Hollinger photo from Flickr.com: https://www.flickr.com/photos/7147684@N03/3184558307
This schematic drawing shows the hydrologic process of contaminant flow (labeled Leachate) emanating from the Love Canal dump site toward a home approximately 150 meters away. Water as precipitation and infiltration becomes groundwater in an unconfined aquifer and expedites the flow of chemical contaminants in the substrate. The red leachate arrows are drawn proportionally to show that the topsoil layer has a faster flow rate (permeability) than the underlying hard clay layer. Although this schematic is drawn showing one direction of water and contaminant flow, left to right or west to east, the Love Canal leachate flowed in the opposite direction, east to west, as well. This area of Niagara Falls is relatively flat and the hard clay/sandy silt top layer interface has only minor slope.

This figure does not show the schematic for containment of the toxic waste dump site, including barrier drains to prevent groundwater flow and reinstalled clay cap covering a much larger surface area than the original width of the canal. The most toxic area (16 acres (65,000 m²)) was reburied with a thick plastic liner, clay and dirt. An 8-foot-high barbed wire fence was constructed around this area.

A leachate treatment system is in use to collect the Love Canal leachate in the subsurface and pump it into a holding tank at the treatment facility and then through a clarifier. The sludge separated in the clarifier is transferred to storage tanks and the remaining liquid is pumped through activated carbon filters.

Image created by author: Meg Stewart
Students know the distance from the source of the hazardous waste at Love Canal to the nearest affected homes from the 1978 aerial photo (measured in Google Earth on Slide 8) and the permeability (as a rate in cm/sec on Slide 10) of the sandy silt topsoil layer, so they then calculate the length of time it took for toxins to reach the nearest home. Recall: 1 cm/sec = 864 m/day

http://digital.lib.buffalo.edu/cdm/singleitem/collection/LIB-003/id/25/rec/1

“Abandoned home at Love Canal, Ring 1” May 1982, Image source: (Used by Courtesy: University Archives, State University of New York at Buffalo)
http://digital.lib.buffalo.edu/cdm/singleitem/collection/LIB-003/id/397/rec/1

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Although at the time, community generated data were dismissed as “useless data generated by housewives,” the history at Love Canal has inspired others. Films such as A Civil Action and Erin Brockovich dramatize events of contamination and subsequent litigation in Woburn, Massachusetts, and Hinkley, California, respectively. In Woburn, groundwater contaminated with high levels of trichloroethylene (TCE) and in Hinkley, groundwater contaminated with hexavalent chromium, were deemed responsible for cancer and other illnesses endured by people in communities nearby the facilities that leaked these substances.

Recommend these movies to the students.

“A Civil Action” Book cover source: http://serc.carleton.edu/woburn/index.html
“Erin Brockovich” Photo source (Creative Commons license): http://www.flickr.com/photos/evarinaldiphotography/6850072448/