ONONDAGA LAKE

Superfund Review

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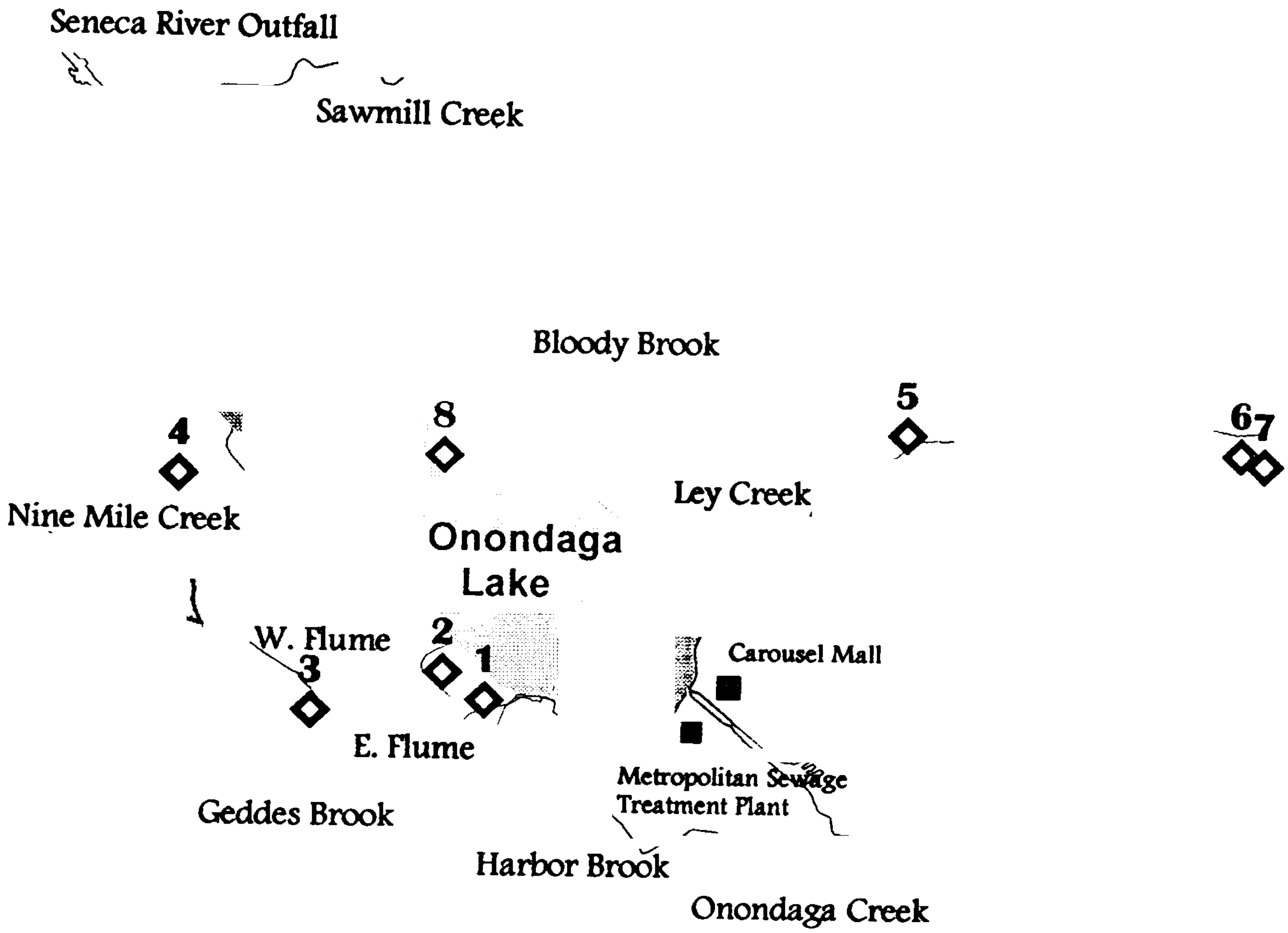
ASSESSING THE HEALTH RISKS

In December 1994, the Environmental Protection Agency (EPA) added Onondaga Lake to the National Priority List (NPL), a list of the most contaminated sites in the country to be managed under EPA's Superfund Program. Under a special cooperative agreement with EPA, the New York Department of Environmental Conservation (DEC) is responsible for overseeing remediation activities at the Onondaga Lake Superfund Site (OLSS), actually a complex of eight subsites within the lake's drainage basin (with more potentially to be added this year).

While it has been known for years that the lake and areas around it are heavily contaminated with dozens of toxic substances, it was EPA's determination that this contamination poses a significant risk to human health that earned it NPL status. The Agency for Toxic Substances and Disease Registry (ATSDR), a branch of the U.S. Department of Health and Human Services, has since classified the OLSS as a *public health hazard* because of the potential of contaminant exposure to the public.

What risks are associated with contamination at the Onondaga Lake Superfund Site? In this issue of *Onondaga Lake Superfund Review*, we will (a) provide an overview of how risk assessments are carried out, and (b) examine the known risks to human health associated with contamination at the OLSS.



ONONDAGA LAKE SUPERFUND SUBSITES
(Chemical Contamination)

Subsite	Toxic Contaminants
1. Willis Avenue	chlorinated dioxins, chlorinated furans, chlorobenzenes
2. Semet Tar Beds	aromatic hydrocarbons & substituted aromatic hydrocarbons, alkanes & substituted alkanes, polyaromatic hydrocarbons, ketones, benzene, toluene, xylene isomers, phenols, cresols, carbon disulfide, napthalene
3. Bridge Street Facility	mercury, mercury waste, PCBs
4. Maestri No 2	barium, mill scale, corrosive and ignitable wastes
5. Salina Town Landfill	PCBs, solvents
6. General Motors, Fisher Guide	PCBs, solvents, heavy metals
7. Ley Creek Dredgings	PCBs
8. Onondaga Lake Sediments	mercury, alkali wastes, antimony, manganese, cadmium, copper, nickel, zinc, lead, PCBs, benzene, chlorobenzenes, polyaromatic hydrocarbons

Dealing With Risk

Risk, the probability that something harmful will occur, is a pervasive feature of everyday life. Simple choices are laden with risk. In general, we address such risks as whether to drive fast when we are late for an appointment in a two-step process:

First, we evaluate the potential consequences of our choices, then determine the likelihood these will occur. The faster we drive, the greater our risk of having a serious accident. Second, we decide whether the risks are worth taking: either we accept a heightened risk of an accident occurring from speeding or we decide it is preferable to be late.

The risks associated with toxic waste sites are dealt with through a similar, yet more complicated, process. First, scientific data are used to formulate a *risk assessment*, in which risks are quantified, usually as a probability (e.g. one in one million). Then *risk management* balances various considerations (political, financial, etc.) to choose how to reduce the risk.

It is important to differentiate between a *chemical hazard* and *site risk*. A chemical hazard is an inherent characteristic of a chemical compound (e.g. toxicity, flammability, reactivity, etc.). A site risk, on the other hand, exists only when there is a possibility that hazardous chemicals could cause harm to humans and/or the environment. Thus, the presence of hazardous chemicals does not necessarily constitute a site risk.

Although risk assessments are ostensibly objective, as they deal only with scientific data, they depend on professional judgements, which renders them rather subjective. Risk management is more overtly subjective. The assessment results must be considered alongside technological, financial and political considerations.

Risk Assessment: Uncertain Science

More often than not, not all the data needed for an accurate calculation of risks is available. Sites contaminated with even fewer hazardous chemicals than are found at the OLSS are seldom characterized sufficiently to account for all the chemicals present. In addition, because little is known about the synergistic effects[1] of most chemicals, this factor is not accounted for in most risk assessments. Finally, much of what is known about the toxic effects of many chemicals is the result of testing on laboratory animals. Ethical considerations aside, this method has one severe limitation: the results it yields are not necessarily applicable to humans. Simply because exposure to a chemical gives rats cancer does not mean that cancer (and not some other disorder, for example) will necessarily develop in humans. By the same token, simply because a chemical does not cause cancer in rats, we can not conclude with 100% certainty that it will not cause cancer in humans.

Unfortunately, fully characterizing a site (i.e. eliminating these uncertainties) would be prohibitively expensive and time consuming; it is unlikely that any money would be left over for remediation. These considerations must be balanced if risks are to be limited effectively.

Qualitative vs. Quantitative Risk Assessments

Risk assessments are either Qualitative or Quantitative. A Qualitative Assessment determines whether hazardous chemicals present at the site can move off-site and cause harm to the public or the environment.

Qualitative Risk Assessment Information (Minimum Data)

- Local climatic conditions
- Seasonal fluctuations in groundwater levels
- Distribution of the contaminant(s)
- Current and projected uses of the site
- Local human and wildlife population densities
- Use of groundwater in area
- Location of nearby surface water bodies (e.g. lakes, rivers)
- Volume of major hazardous contaminants
- Toxicity of the contaminant(s)

[1] Two or more chemicals may work together to produce stronger effects than the same chemicals acting individually.

The Quantitative Assessment takes the analysis further and evaluates the risk of any of the exposure pathways (routes to exposure) being completed. A complete exposure pathway can be said to exist when the following four conditions are present:

a) There is a source of hazardous material.
b) There is a way of transporting it to people and the environment (a pathway).
c) There is a place where humans, animals and plants come in contact with the contaminant (point of exposure).
d) There is a way that people and ecological receptors can absorb the material into their bodies.

Quantitative Risk Assessment Information

Contaminant Characterization: Define the nature of the chemical releases from the site (what kind of releases are occurring).
Quantification of Release Rate: Identify the rate of transport of the hazardous material from the site (how much of the contaminant is getting out into the environment).
Estimation of Exposure and Uptake Rate: Study specific populations of people and ecological receptors (e.g., wildlife, specific plants, etc.) exposed to the contaminant, and identify the rate at which these materials are entering the receptor's bodies (what/who is getting exposed and how much is getting into their bodies).
Toxicological Evaluation: Compare known toxicological effects rates with acceptable exposure rates to determine if something should be done at the site to reduce the risks.
Risk Determination: Determine the level of risk as a probability.

The goal of the risk assessment is to evaluate the characteristics of the contamination relative to human and environmental health and to determine the extent of remediation necessary. Remediation refers to steps taken to reduce risks to acceptable levels, such as removal or isolation of the contamination. Acceptable levels are usually established for the most sensitive portion of the population. For example, children are generally more sensitive than adults.

Risk assessments consist of four basic steps:

(1) **Hazard Identification** looks at the types of contamination at the site and determines if the chemicals involved are hazardous to human health and the environment.

(2) An **Exposure Assessment** addresses the question: *"How much of the hazardous chemical are people and the environment (animals and plants) exposed to?"* A single contaminant may have many pathways.

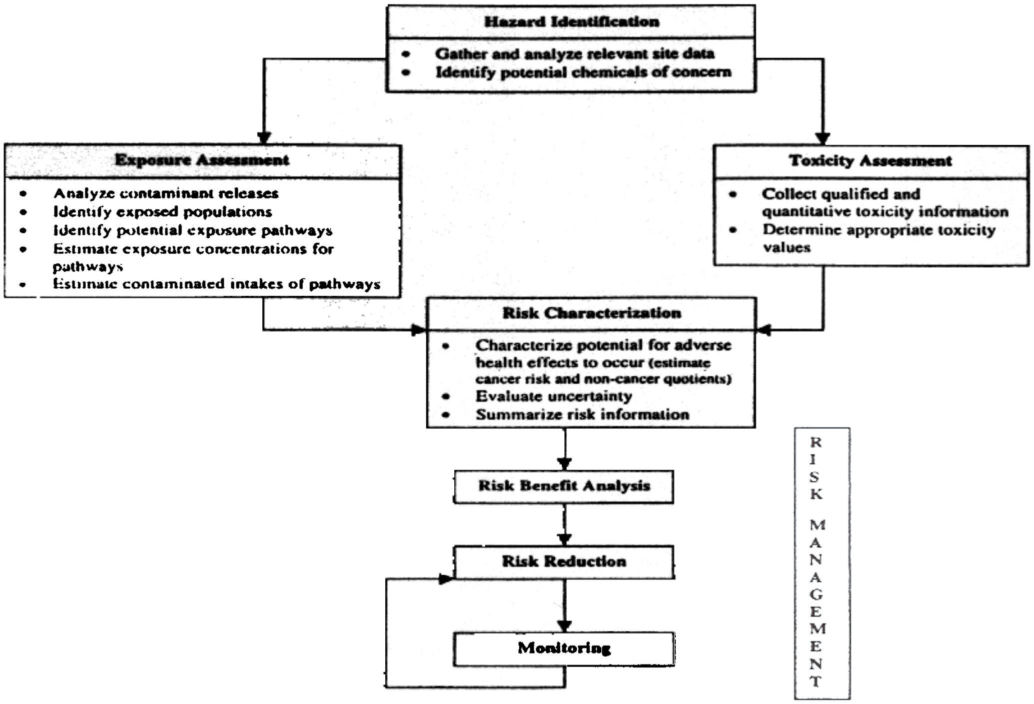
(3) A **Toxicity Assessment** addresses the question: *"What adverse human health effects or environmental effects are potentially caused by the hazardous chemicals?"* The toxicity assessment considers the potential for contaminants to cause adverse effects and they include an evaluation of the likelihood and/or severity of the effects. This part of the risk assessment consists of four basic steps:

a) Gather information about the toxicity of contaminants to be evaluated
b) Identify exposure periods for toxic effects
c) Determine the toxicity values for cancer and non-cancer contaminants
d) Determine both cancer and non-cancer toxic effects

This step in the risk assessment process consists primarily of searching the scientific literature for toxicological characteristics of the chemicals in question.

(4) The final step, **Risk Characterization,** addresses the question: *"At the exposures estimated in the Exposure Assessment, is there a potential for adverse health or ecological effects to occur, and if so what kind and to what extent"?*

The risk characterization step forms a bridge between the risk assessment and the risk management steps and therefore is a key step in the ultimate decision for remediation.



Risk Management

Risk management addresses the question: *"What can (and should) we do about these risks?"* This process integrates political, social, economic, and engineering considerations with risk-related information in order to select the appropriate response to a health or environmental hazard.

Several general approaches are used in managing risks at Superfund sites.

In-situ containment (isolate the contamination in place surrounding the contaminant with a barrier).

2. *Removal* (remove the contamination and dispose of it in a licensed facility).
3. *Treatment* (treat the contamination right where it is to eliminate the hazardous characteristics).
4. *Natural attenuation* (let the contamination degrade naturally so that risks are reduced to acceptable levels).
5 *Institutional Controls* (limit public access to the contaminated site by surrounding it with a fence).

Risks at the Onondaga Lake Superfund Site

Risk assessments are currently underway or will soon be conducted as part of Remedial Investigation studies at all the subsites. While all types of contamination must be taken into account in efforts to restore the lake, a full accounting and discussion of all the contaminants at the OLSS (see page 2) is beyond the scope of this newsletter. Therefore the following discussion will be limited to four major contaminants at the OLSS: mercury, PCBs, benzene and chlorobenzenes.

Mercury

Distribution: Low concentrations of mercury have been found in the water of the lake, while high concentrations have been found in the sediments and fish in the lake, the West Flume, and lower portions of Geddes Brook and Ninemile Creek. This contamination is primarily the result historical releases. However, recent studies indicate that mercury continues to reach the lake from some of the tributaries, the Onondaga County Metropolitan Sewage Treatment Plant, and from the atmosphere.

Effects: In nature, particularly in aquatic ecosystems, bacteria can convert some forms of mercury to methyl mercury, a highly toxic compound that bioaccumulates. Ingestion of methyl mercury can cause permanent damage to the brain and kidneys. Exposure to methyl mercury during pregnancy can cause brain damage in the developing fetus.

Bioaccumulation

Individual cells selectively absorb and store a variety of substances through the process of bioaccumulation. While this process allows them to accumulate nutrients and essential minerals, it can cause them to absorb and store harmful substances (including methyl mercury and PCBs). As a result, toxic materials that may be dilute in the surrounding environment can reach dangerous levels in the cells and tissues of individual organisms. As predators consume more and more contaminated prey, they absorb contamination, which in turn becomes increasingly concentrated in their cells and tissues. Thus, small fish that feed on contaminated plankton (microscopic aquatic organisms) may eventually exhibit contaminant concentrations hundreds of times greater than that found in the plankton itself.

Concentrations of mercury in some Onondaga Lake fish greatly exceed the FDA limit of 1 ppm for seafood caught for commercial use.[2] For example, mercury levels in smallmouth bass have been measured at almost 8 ppm.

Polychlorinated Biphenyls (PCBs)

Distribution: PCBs have been found in Onondaga Lake water and sediments in Ley Creek and Onondaga Lake, as well as in soils and groundwater at the General Motors and the Salina Town Landfill subsites. PCBs are also currently legally discharged into the lake from various locations, such as the Carousel Mall.

[2] Contaminant concentrations are measured in ppm (parts per million) or ppb (parts per billion). Thus, a soil sample with a mercury concentration of 155 ppm consists of 155 parts mercury for every 1,000,000 parts of soil.

Effects: Exposure to this family of synthetic chemicals can cause skin and lung irritations, altered immune response, and liver damage. PCB exposure during pregnancy is associated with low birth weight and diminished learning ability. PCBs, which bioaccumulate, are considered a probable human carcinogen[3] and have been identified as a potential hormone disrupter (i.e. may interfere with reproductive functions). The FDA requires fish for sale to the public to contain less than 3 ppm PCBs. PCBs have been found at concentrations of 4.7 ppm in fish from Onondaga Lake.

Benzene

Distribution: Benzene has been found in Onondaga Lake water and sediments and in groundwater and soils near the Semet Tar Beds and Willis Avenue subsites.

Effects: Benzene causes cancer in humans, particularly in the blood-forming organs (leukemia). Benzene is also associated with other blood-related disorders, such as anemia and excessive bleeding, and diminished immune response.

Chlorobenzenes

Distribution: Chlorobenzenes have been found in Onondaga Lake water and sediments, as well as in groundwater and soils near the Semet Tar Beds and the Willis Avenue subsite. The most prevalent form of chlorobenzene at the OLSS is 1,4-dichlorobenzene.

Effects: Breathing and touching 1,4-dichlorobenzene are associated with lung and skin irritations. This compound is considered a possible human carcinogen.

[3] PCBs have been shown to cause cancer in laboratory animals, but no such link has been conclusively established in humans.

What Does All This Mean To Me?

The goal at all Superfund sites is to reduce the risk to the public and the environment. However, because of the Onondaga Lake Superfund Site's complex nature, this process will take many years. Current schedules for remediating individual subsites extend as far as 2008. In addition, 10-12 more potential subsites are currently being evaluated. If any of these is added to the site, the overall schedule could extend even further into the future.

The principal exposure pathway for contamination at the Onondaga Lake Superfund Site (identified thus far) is consumption of contaminated fish. Therefore, eating fish from the lake puts you at significant risk. Don't panic if you have recently eaten fish from the lake—just don't eat any more. Women of childbearing age, infants, and children are particularly vulnerable and should take special care.

Although the FDA sets standards for various chemicals in commercially sold fish, sportfish are not regulated. However, in recognition of the high contaminant levels in Onondaga Lake fish, the State of New York has issued an advisory stating that **fish caught in Onondaga Lake should not be eaten.** This advisory does not include the Seneca River (even though fish from the lake have been caught in the river as far as Baldwinsville and Fulton) because it is not part of the Superfund site. Therefore, common sense would also tell us to avoid eating fish from those areas of the Seneca River as well.

Benzene (a known human carcinogen) and 1,4-dichlorobenzene (a possible human carcinogen) are both found in large quantities at the OLSS. Although the public is not in immediate danger from exposure to these chemicals, their continued isolation is not assured. Any movement of these contaminants from their present locations could result in increased risks to the public and the environment.

Risk assessment is an art rather than a science. While scientifically generated data is clearly subject to various interpretations, stakeholders, with different (and often conflicting) agendas, are bound to come into disagreement, largely because they have different perspectives of risk. For example, while a Potentially Responsible Party (PRP)[4] may view its own risk in monetary terms (and seek to minimize its costs), a local resident will see risk in terms of potential health problems for him/herself and his/her family. The most effective way you can ensure that your risks are minimized is to actively participate in the Superfund process.

Where Can I Find More Information?

Additional information about the Onondaga Lake Superfund Site can be obtained at three local repositories. Their collections include cleanup plans, scientific studies of the subsites, and reports on contamination in the lake.

Atlantic States Legal Foundation
658 West Onondaga Street
Syracuse NY 13204
(315) 475-1170
Hours: M-F 8:00 a.m. - 6:00 p.m.
Please call first.

Onondaga County Central Library
Fifth Floor, The Galleries
447 South Salina Street
Syracuse NY 13204
(315) 435-1900
Hours: M, Th, F, and Sat 9:00 a.m. - 4:50 p.m.
Tu and Wed 9:00 a.m. - 8:20 p.m.

NYSDEC Region 7 Office
615 Erie Boulevard West, 2nd Floor
Syracuse NY 13204
(315) 426-7400
Hours: M-F 8:30 a.m. - 4:45 p.m.

If you would like to receive any of the newsletters in this series, or if you have any questions about the contents of this newsletter, please contact Atlantic States Legal Foundation by phone (475-1170) or e-mail (aslf@igc.apc.org).

[4] Companies or individuals who may be held responsible for contamination at Superfund sites may, in turn, be legally liable for the costs of remediation. These entities have a strong interest in minimizing the potential risks arising from this contamination and ensuring that the required remediation represents the cheapest option.

SUPPORT ATLANTIC STATES' EFFORTS TO PROMOTE A SAFER, CLEANER ENVIRONMENT FOR EVERYONE

Atlantic States Legal Foundation was established in 1982 to provide legal, technical, and organizational assistance on environmental issues to non-governmental organizations and others. ASLF's work in Central New York includes three program areas: (1) the *Oswego River Basin Program*, which includes a variety of initiatives on Onondaga Lake, the Finger Lakes, and the Seneca, Oneida, and Oswego Rivers; (2) *Community Education*, including Onondaga Creek restoration and workshops on environmental health issues; and (3) *Environmental Justice* for all citizens adversely affected by environmental degradation.

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