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Office of Solid Waste and
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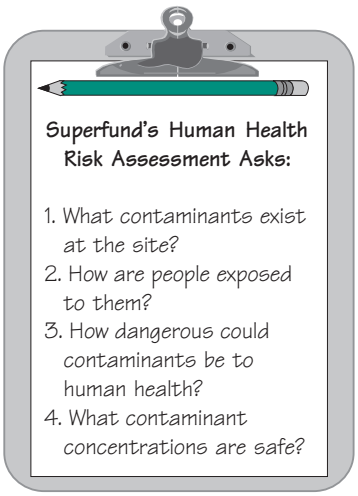
Superfund Today

FOCUS ON RISK ASSESSMENT

What is Risk Assessment?

Driving a car, eating a meal, or flying in an airplane—all of these ordinary activities pose some degree of risk to our health and well-being. Every day, people take a multitude of risks. Many have well-documented potential for harm. We think about our needs, and decide for ourselves which risks are worth taking.

It isn't as easy to make decisions about risks related to environmental pollution. How dangerous *is* that Superfund site nearby? Past land uses like wood treating, metal plating, dry cleaning, and waste disposal may have left hazardous chemicals in the soil at these sites. In many cases, contaminants have moved into the ground water, air, or surface water. People who then come into contact with these contaminated media face a certain degree of risk. But how much? We need expert help to answer the question of whether or not we are at risk.



The professionals who practice "risk assessment" provide that help. Superfund's risk assessors determine how threatening a hazardous waste site is to human health and the environment. They seek to determine a safe level for each potentially dangerous contaminant present—a level at which ill health effects are unlikely and the probability of cancer is very small. While risk assessors frequently analyze threats to the environment, the protection of human health is considered paramount.

The clipboard (left) shows the four main questions the risk assessment process answers. Each Superfund site is unique in terms of contaminants and their potential health effects. Therefore, EPA conducts risk assessments on a site-by-site basis. The risk assessment estimates the current and possible future risks *if no action were taken to clean up the site*. The goal is to *manage risks* to acceptable levels. Risk managers balance risk information against a variety of site factors to select the best cleanup strategies.

Living near a Superfund site doesn't automatically place a person at risk—that depends on the chemicals present and the ways people are exposed to them. Indeed, the risk from a Superfund site is often considerably less than many risks we take every day. Still, Americans want to be informed about these unfamiliar threats. The pages that follow describe how EPA measures human health risk at hazardous waste sites. ❑

This Issue...

- *Profiles Superfund's human health risk assessment process;*
- *Presents a case study in risk assessment;*
- *Discusses some cleanup approaches that reduce risk; and*
- *Provides resources you can tap for more information.*

Superfund's Risk Assessment Process for Human Health

A Superfund human health risk assessment estimates the "baseline risk." This is an estimate of the likelihood of health problems occurring if no cleanup action were taken at the site. To estimate the baseline risk at a Superfund site, EPA undertakes a four-step process:

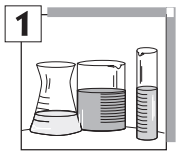
Step 1: Analyze Contamination

Step 2: Estimate Exposure

Step 3: Assess Potential Health Dangers

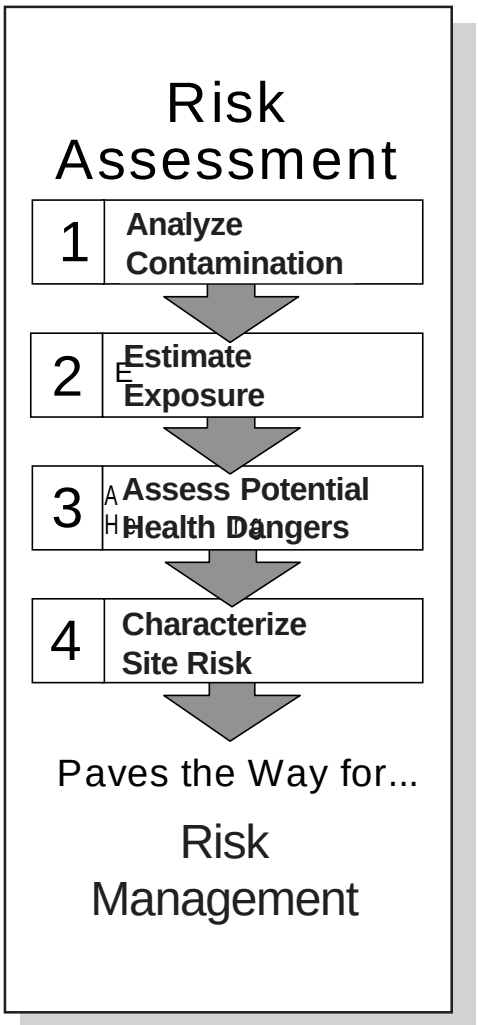
Step 4: Characterize Site Risk

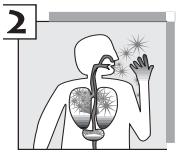
Over years of cleanup experience, risk assessors have refined scientific approaches, assumptions, and equations to support risk assessment decisions. These are documented in guidances that help them make informed, consistent decisions about potential health risks.



Analyze Contamination

Scientists collect samples of soil, air, water, sediment, plants, fish and/or animals at and around the site. They analyze these samples in laboratories. These analyses reveal the chemicals present and their levels. Risk assessors consult past scientific studies on the effects these chemicals have had on people. Where human studies are unavailable, risk assessors look at animal studies. They compare chemical levels at the site with those in the studies. This helps determine which site chemicals are most likely to pose the greatest threat to human health. The rest of the risk assessment study focuses on these chemical substances.



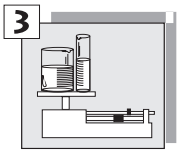


Estimate Exposure

EPA calculates ways people might be exposed to the chemicals identified in Step 1 and at what levels. Risk assessors also figure out how many years this exposure might reasonably be expected to occur. People may come into contact with chemicals in a variety of ways: breathing, touching, or consuming contaminated air, water, soil, or food. For each of these "pathways," EPA estimates quantities of a given chemical that could reach a person's lungs, digestive system, or skin. To do this, EPA's risk assessors ask such questions as:

- ✓ Do people live or work on or near the site? For how long?
- ✓ Do children play on or near the site? How frequently?
- ✓ Do people drink or shower with site-contaminated water? How frequently?
- ✓ Do people eat fish from, or swim in, site-contaminated lakes or streams? How often?

From this information, risk assessors calculate the "Reasonable Maximum Exposure" scenario, or RME for short. The RME portrays the highest level of human exposure that could reasonably be expected to occur from the chemicals identified in Step 1. Exposures are calculated for groups of people like children, site workers, and residents. They take into account how long, how often, and how many ways people could be exposed to site chemicals. The RME scenario also factors in the number of years exposure could occur if the site were not cleaned up. Both current and likely future uses for the site are considered. Step 2 helps ensure the selected cleanup remedy protects all people around a Superfund site, with a focus on the most vulnerable or sensitive populations.



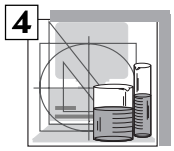
Assess Potential Health Dangers

While probable exposure to the community is being calculated, risk assessors determine the toxicity, or harmfulness, of each chemical identified in Step 1. Obviously, the type and intensity of potential health problems vary, depending on the chemicals and the amount of exposure. Risk assessors compare the results of animal (and, when available, human) studies on health effects to "doses" that could be encountered around a site. For example, a likely "dose" could come from consuming a certain amount of contaminants as a result of drinking polluted water every day for 30 years.

Risk assessors use two methods to evaluate the human health effects arising from exposure to Superfund site contaminants. One approach calculates the chance of *cancer* occurring as a result of exposure. The other compares what is known about the *non-cancer* health effects of chemicals to the concentration of those chemicals at the site.

The likelihood of any kind of cancer resulting from a Superfund site is expressed as a probability; for example, a "1 in 10,000 chance." In other words, for every 10,000 people that could be exposed, one extra cancer case *may* occur as a result of exposure to site contaminants. An extra cancer case means that one more person could get cancer than would normally be expected to from all other causes.

Non-cancer health effects can range from rashes, eye irritation, and breathing difficulties to organ damage, birth defects, and death. Risk assessors calculate a "hazard index" for non-cancer health effects. The key concept here is that a "threshold level" (measured usually as a hazard index of less than 1) exists below which non-cancer health effects are no longer predicted. Risk assessors determine the amount of a chemical that can cause a noticeable non-cancer health effect. Then they use these data to figure out how dangerous the site contaminants are.



Characterize Site Risk

In this step, EPA determines the most critical site risks and whether they are great enough to cause health problems for people at or near a Superfund site. The results of the three previous steps are combined, evaluated, and summarized. Risk assessors add up potential risks from the individual chemicals and pathways and calculate a total site risk. They also consider the amount of uncertainty in the risk estimates. Risk assessment results are then factored into decisions on how best to clean up the site during the *risk management* phase.

Risk Management Puts Risk Assessment to Work

Risk managers use the data on cancer risk and non-cancer health effects to decide how to handle site cleanup. They also consider several other factors not related to risk in arriving at final cleanup levels. These factors include state and federal regulations, costs, treatment techniques, technological feasibility, and community acceptance.

The goal is to assess risk and then manage it. Risk managers plan strategies to reduce or prevent risk by limiting or stopping exposure to contaminants. This does not always call for the removal of contaminants or the cleaning of soil, air, or water. Sometimes cleanup workers can simply put a cap over the site or build underground walls to keep chemicals from reaching people.

Regardless of the approach chosen, risk managers seek a solution that will make the site safe for both current and expected future uses. Until all cleanup is completed, cleanup workers continue to check the site. This ensures contaminant levels are dropping or remain in the safe range, and cleanup requirements are being met. ❑

Remember...

Risk assessment is not an exact science. Risk assessors use the best available data on what is occurring, or could occur, at the site, and apply their scientific judgment to calculate the likelihood of exposure to site chemicals. Results are probabilities, not certainties.

Children Are Often More Vulnerable to Site Chemicals

They can swallow dirt when they play

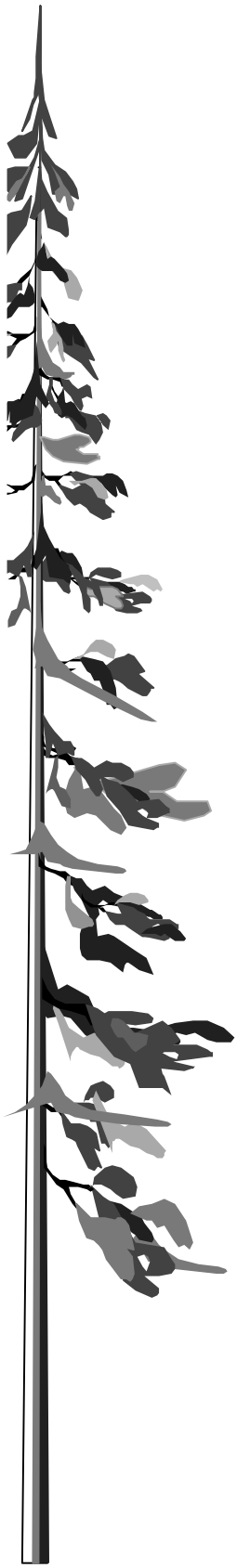
The same "dose" of a chemical has a greater effect on a smaller person due to lower body weight

Case Study

Risk Assessment in Action: Joseph Forest Products, Wallowa County, Oregon

A Picture of Progress

- A fire in 1974 at the Joseph Forest Products site destroyed the facility and caused thousands of gallons of wood treatment solutions and waste to be washed into the soil.
- In 1984, the company removed some waste material in response to a violation notice from the Oregon Department of Environmental Quality. The company was unable to continue further cleanup efforts after filing for bankruptcy and ceasing wood treatment operations.
- EPA testing in 1985 revealed elevated levels of contaminants, primarily arsenic and chromium, in the soil at the site. In addition, contamination was found in some ground water and surface water samples.
- Initial investigations showed that City of Enterprise water supply springs, located in the path of the contaminated water moving from the site, were threatened by site contamination. EPA responded by excavating over 1,000 tons of highly contaminated soil and installing a security fence around a treatment building to prevent access.
- These actions ensured the safety of the City water supply and ground water while EPA conducted a risk assessment and looked into a long-term cleanup plan for the site.
- During the site cleanup, City officials visited the site and assisted EPA with sampling activities. EPA also updated City officials on site progress during City Council meetings and with periodic fact sheets.



The Risk Assessment

The cleanup efforts begun by Joseph Forest Products and the soil removal conducted by EPA reduced the immediate threat posed by the site. EPA then conducted a site risk assessment to decide whether additional measures were needed to protect the public from the long-term risks of contamination. Like most risk assessments, the one conducted at Joseph Forest Products estimated "baseline risk," the potential risk of health problems if no additional cleanup actions were taken at the site. The focus of the risk assessment was to determine cleanup levels appropriate for the likely future use of the site (in this case, residential). The risk assessment followed the four steps described on page 2 and page 3.

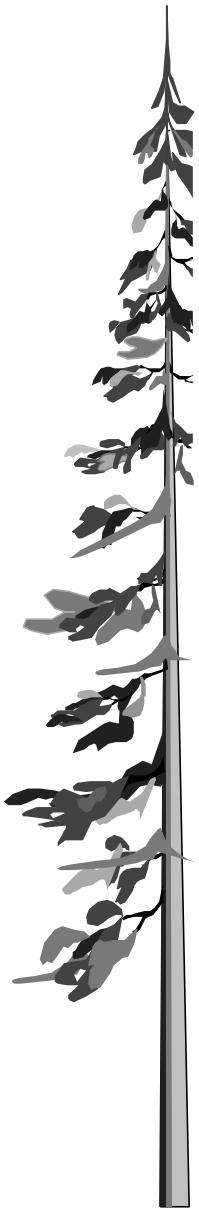
Step 1: Analyze Contamination

Samples taken of the soil, ground water, and surface water revealed that the main contaminants were arsenic and chromium. These chemicals were used in wood treatment processes conducted at the site. The most contaminated areas were on or around the treatment building.

Step 2: Estimate Exposure

EPA identified Reasonable Maximum Exposure (RME) scenarios and estimated human exposures to contaminants identified in Step 1. These scenarios describe the probable situation if the site remained contaminated with no cleanup technologies in place, and include both the current and future uses of the site.

Since residential areas are located directly across the street from the site, both the "current use" and "future use" RME scenarios were residential. In this case, it was assumed that children living near the site could ingest or be exposed to contaminated soil.



Step 3: Assess Potential Health Dangers

Arsenic and chromium are known to cause non-cancer health effects. Exposure to arsenic can have an effect on people's nervous systems, usually beginning with numbness, blurred vision, and muscle tenderness. The primary non-cancer health effect from chromium exposure is kidney damage. Long-term exposure to both chemicals also can ultimately cause extra cancer cases among the population. As mentioned earlier, an extra cancer case means that one more person could get cancer than would normally be expected from all other causes.

Step 4: Calculate Site Risk

Overall, EPA's investigation at Joseph Forest Products found that the high risk of non-cancer health effects and the increased chance of cancer from swallowing or coming into direct contact with contaminated soils were the main threats to human health if the soils remained untreated.

EPA's risk assessment showed that additional cancer risk and non-cancer health effects were *probable* if the site was not cleaned up. Calculations were based on the likely amount of time various people would spend at the site, their activity there, and the amount of contact they would have with contaminated resources.

The risk assessment calculated that without long-term site cleanup, future child residents would face a 4 in 1,000 chance of developing an extra cancer case—primarily from swallowing or coming into direct contact with arsenic-contaminated soils over a lifetime. In addition to the risk posed by contaminated soils, the potential contamination of ground water and surface water threatened City water supplies. The risk assessment also calculated a hazard index of 82 for potential non-cancer health effects from the contaminated soils around the treatment building.

Site Cleanup and Risk Management

Clearly, the risk assessment pointed out the necessity of further cleanup actions to protect Enterprise residents and restore the safety of the Joseph Forest Products site. All cleanup actions have been completed at the Joseph Forest Products site and cleanup goals have been met. EPA will continue to monitor the ground water to ensure cleanup levels are maintained. Cleanup actions have included:

- ✓ Removing and decontaminating the process equipment from the wood preservative treatment building, demolishing the building, and excavating the soil beneath the building.
- ✓ Removing additional contaminated soil to an approved hazardous waste facility.
- ✓ Removing two underground petroleum tanks.
- ✓ Sampling soil, ground water, and surface water to confirm that cleanup levels were achieved.
- ✓ Limiting use of the immediate area surrounding the treatment building with deed restrictions.

The Rest of the Story: Superfund Cleanups

EPA uses the results of a risk assessment to help decide whether any long-term cleanup is needed at a Superfund site. If the answer is "yes," the risk assessment also guides decisions on which remedy would be best suited to the site and the surrounding community. EPA seeks the community's opinions on the cleanup approaches, and all cleanup options are thoroughly investigated before any decision is made.

The many cleanup technologies in use at Superfund sites are organized into two main categories: treatment and containment.

Treatment technologies use engineering approaches to reduce the volume, toxicity, or mobility of the contaminants.

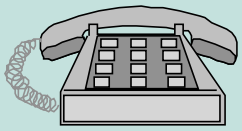
Common ***treatment*** technologies include destroying wastes by burning them at high temperatures while controlling the fumes; allowing wastes to evaporate into an air stream that is then treated and released; and injecting soils with micro-organisms that digest contaminants and result in less harmful materials.

Containment approaches build barriers that isolate contamination and keep it from coming into contact with people and the environment.

Common ***containment*** technologies include constructing a protective barrier, or cap, over the contaminated area; excavating the waste materials and disposing of them in a securely designed landfill; and building an underground barrier that blocks, diverts, or captures contaminated ground water.

In many cases, a combination of treatment and containment is the best solution. Engineers design the long-term cleanup approach, and as cleanup work progresses, the risk from hazardous waste contamination declines. If wastes are left at a site, EPA re-examines the site every five years after cleanup to make sure it is still safe. ❑

For More Information…



...on EPA's risk assessment process, or about a Superfund site in your neighborhood, please contact the toll-free Superfund/RCRA Hotline at 1-800-424-9346 or the Community Involvement Coordinator in the EPA regional office for your state; their numbers are listed below. Your local EPA office can tell you where you can go to review files on every Superfund site in your area. This information may include the results of a risk assessment. Often, EPA conducts community meetings to keep people who live near a site informed about site activities.

Region 1 *CT, ME, MA, NH, RI, VT* (617) 565-3425
John F. Kennedy Federal Bldg., Rm. RPS-74, Boston, MA 02203

Region 2 *NJ, NY, Puerto Rico, Virgin Islands*
(212) 637-3671
290 Broadway, New York, NY 10007

Region 3 *DE, DC, MD, PA, VA, WV* (215) 566-3245
841 Chestnut St., Philadelphia, PA 19107

Region 4 *AL, FL, GA, KY, MS, NC, SC, TN*
Waste Management Division, Atlanta Federal Center, 61 Forsyth Street, Atlanta, GA 30303
AL, FL, GA, MS (800) 435-9234
KY, NC, SC, TN (800) 435-9233
For emergency responses: (800) 564-7577

Region 5 *IL, IN, MI, MN, OH, WI* (312) 886-6685
Metcalfe Federal Bldg. 19th Floor, 77 West Jackson Blvd., Chicago, IL 60604

Region 6 *AR, LA, NM, OK, TX* (214) 665-6617
Tower & Fountain Place, 1445 Ross Ave. 12th Floor, Dallas, TX 75202

Region 7 *IA, KS, MO, NE* (913) 551-7003 or (800) 223-0425
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