technologies. The large amount of waste at the site poses a difficult problem for which some innovative cleanup technologies, including in situ techniques to avoid excavation, could have been considered and examined in treatability studies.

Why the State and the community chose capping, an impermanent and incomplete remedy, over incineration and groundwater treatment, which are permanent and complete, is not entirely clear. But avoidance of higher costs and pessimism about the safety of incineration seem to be the critical factors. Concerns about incineration can be addressed through effective communication of state-of-the-art incineration technology including effective pollution control technology. The concern about enormous cost for incineration could have been addressed through either the hot spot or search for alternative treatment strategies.

Actually, the groundwater contamination problem did not get enough attention, as capping cannot completely stop further contamination. (The ROD had a tacit acknowledgment of a carcinogenic risk factor of 1 in 100,000 for contaminant migration through groundwater seeps entering the Arkansas River. It is not certain that the cap alone, or even in combination with groundwater cleanup, would permanently reduce this to EPA's typical goal of limiting risk to 1 in 1 million.)

This site also illustrates a subtle and largely ignored issue in Superfund cleanups—cumulative risk. To what extent is a cleanup at one site planned relative to neighboring cleanup sites that can contribute environmental risk to the same population? Assessment of environmental risk at only one Superfund site seldom acknowledges human exposures from another site and, therefore, what seems for one site to be a safe level of contamination, exposure, and risk may not be so cumulatively. The Compass Industries site and the Sand Springs petrochemical Complex Superfund site face each other across the Arkansas River. The migration of contaminated groundwater into the river from ***both*** sites would increase the danger to the same downstream users.

Case Study 3
Conservation Chemical Company, Kansas City, Missouri, EPA Region 7

Capsule OTA findings.—A hydraulic containment system to pump and treat some contaminated groundwater and capping of the site were chosen over the alternative of excavating and treating contaminated soil and buried wastes, which was recommended in an EPA study and by the State. Water treatment cannot remove all the diverse contaminants at the site. No estimate was said to be possible for the duration of the cleanup.

Key ~atm:

- Entered Superfund system: 1/1/79
- Preliminary Assessment: 3/1/79
- Site Inspection: 3/1/79 - 11/1/80
- National Priorities List
  –proposed date: 4/1/85
  —final date: none
  —site rank: none
- RIFS start and completion: Complex history of studies by PRPs and EPA
- Public comment period before Record of Decision: 3/26/87 - 5/8/87
- Signing of ROD: 9/30/87
- Estimated complete remediation: none possible

Total time.—Unpredicted but probably a very long time–decades.

Brlaf description of site.–" The site is approximately 6 acres in size and is situated on the floodplain of the Missouri River near the confluence of the Missouri and Blue Rivers, on the river side of the levee. [The aquifer under the site] is used as a source of drinking water by both private residents and public water supply companies."

"Waste disposal operations began [in 1960] and continued until approximately 1980. CCC employed a variety of waste handling practices, including but not limited to solvent incineration, solvent resale, pickle liquor neutralization, cyanide complexation, chromic acid reduction, and ferric chloridelferric sulfate recovery. Residual materials from the various treatment processes were generally disposed of on site in the basins. Drums, bulk liquids, sludges, and solids were buried at the site. Some wastes, such as drummed cyanide wastes and arsenic and phosphorus containing wastes, were disposed of on site without treatment. . . . approximately 93,000 cubic yards of materials are buried on site. "

Major contamination/environmmtal threat.—There are 21 substances "substantially in excess of applicable criteria or standards for water quality. These include six metals, cyanide, four phenolic compounds, and 10 volatile organic compounds (VOCS)." Other substances "cause concern for aquatic life." Also, dioxin was detected at levels up to 29 parts per billion (ppb). (A level of 1 ppb has been EPA's guideline for soil cleanup.)

The greatest risk comes from the use of contaminated groundwater. Next is the risk from contaminated soils, which may be "transported by precipitation runoff into surface water bodies or the groundwater. Contaminated soils also present hazards from direct contact and wind dispersion of particulate."

T~he] groundwater is considered to be a current drinking water source since groundwater is used for drinking water within a two mile radius of the site."

HRS scores .—groundwater 51.02; surface water 9,45; air 0.00; total 29.99.

Removal actions.–None indicated in ROD; SCAP indicated over $2 million spent on removal, starting in 1985.

Cleanup remedy selected.—This remedial cleanup is the third selected for the site. The first cleanup, done by the original owner, was discovered in 1985 to have failed. The State had approved a closure "which called for the addition of absorbents and cementing materials to the waste in the uppermost 5 feet of each basin. Waste acids, predominantly pickle liquor, and fly ash were mixed with the upper layer of waste materials in the basins. Tests conducted in 1985 indicated that the desired pozzolonic cement-like properties have not formed. Also there are indications that this material has deteriorated and will continue to deteriorate. "

The 1987 ROD indicated a previous ROD in mid-1985 that adopted a circumferential containment approach with interior pumping. But its implementation was stopped in 1986 when geotechnical investigations found that the depth to bedrock ranged so high (to 160 feet) that "the construction of a circumferential impermeable barrier could be more difficult than originally believed, " (Neither SCAP or EPA's master list of all RODS indicates an earlier ROD for this site.)

Many cleanup alternatives for the Conservation Chemical site have been examined, and most have been eliminated. Because the enactment of SARA came after the initial studies, EPA performed two more studies in 1987. However, the current ROD evaluated only three main cleanup alternatives in what is a well-structured and well-presented analysis: 1) the 1985 remedy, 2) onsite containment of contaminants by onsite pumping and groundwater treatment, and 3) excavation followed by soil treatment.

The 1987 ROD chose a remedy that includes: 1) the use of a permeable cap to allow water intrusion to assist groundwater cleanup; 2) a withdrawal well system to achieve an inward groundwater gradient; 3) a groundwater treatment system based on several unit operations, including "at a minimum, such treatment processes as metals precipitation (utilizing both hydroxide and sulfide precipitation), filtration, biological treatment, and carbon absorption"; and 4) offsite groundwater monitoring. Some descriptions of the chosen remedy from the ROD on the selected remedy are:

- " . . . relies on hydraulic, rather than structural, containment to prevent migration of contaminants from the site. "
- "Although designed primarily for containing the on-site contaminants, [it] would also clean up a portion of the off site contamination. "
- "while the treatment technologies that will be employed provide high levels of treatment, they do not remove 100 percent of the contaminants. "
- "This cleanup process could take a substantial time period. "

- “There is no methodology available to estimate the length of time required for cleanup.”
- “This cleanup would include the discharge of acceptable levels of contaminants remaining in the groundwater after treatment to surface waters and the need to dispose of solid wastes resulting from the groundwater treatment processes.”
- “.0. because an active pumping system relies upon the use of currently available technology, which can be constructed in the shortest time frame, this alternative would provide expeditious implementation of the remedial action with substantial certainty as to its effectiveness in protecting public health and the environment.”
- “. . . may prove to be the least costly remedy that would meet the environmental goals and requirements of CERCLA.”

Satisfaction **of SARA statutory requirements:**

1) Selection of permanent cleanup.—The ROD said the selected remedy “is cost-effective, consistent with a permanent remedy [and] applies permanent solutions and alternative treatment technologies to the maximum extent practicable.” On the issue of permanency: “Contaminants present at the site will be contained at the site, thereby eliminating further uncontrolled releases into the environment.” Also: “Treatment of hazardous substances to reduce their volume, toxicity and mobility by treating the extracted groundwater is the principal element of [the selected remedy] . . . the uncertainties of [the soil treatment alternative’s] technical feasibility at this site raise substantial question as to its practicability. Extensive research would be necessary prior to its implementation to resolve this question. For these reasons, [the selected remedy] offers treatment to the maximum extent practicable.”

The selected groundwater treatment part of the remedy, however, does not involve destruction technology to a large extent. Most of the unit processes are separation technologies. The result is the generation of hazardous sludges requiring management and the discharge of contaminants to the air. Moreover, no attempt was made to estimate the duration of the groundwater cleanup. Such estimates have been made at other Superfund sites. If there is insufficient data to make such an estimate, then there is a remarkable degree of uncertainty about the functioning of the groundwater pump and treat approach.

The important feature of the selected remedy is that it does not directly deal with the contaminated soil and buried wastes on site. Drawing water through the site, or flushing, is not likely to remove all contaminants. Depending on soil conditions and what chemicals are present, some contaminants are difficult to remove by flushing. It is difficult to conceive of water drawn through the site’s hazardous materials being able to dissolve or otherwise remove all the diverse contaminants at the Conservation Chemical site. And what will happen when the pumping is stopped? Indeed, the ROD did not claim complete removal of the site’s contamination.

The ineffectiveness of flushing was shown at tests at the Volk Field Air Force site in Wisconsin. EPA laboratory research on the use of surfactants to remove organic contaminants from soil had been successful. However, the field study found that in situ soil washing with aqueous surfactants “was not measurably effective,” (U.S. Environmental Protection Agency, “Project Summary—Field Studies of In Situ Soil Washing,” February 1988.)

The selected remedy leaves a very large amount of untreated hazardous material on the site. The ROD said that protection against the risk posed by contaminated soil will be addressed first by the permeable cap on the site during the pump and treat stage and second by the placement of a RCRA cap upon completion of the groundwater cleanup. Limiting site access is also offered as a means of minimizing risk. Regarding the dioxin contamination: “Since all the [dioxin] containing samples were obtained from sludge and surface soil samples, the waste containment strategy and surface cap will minimize possible contact with TCDD. ”

A major issue for the Conservation Chemical site is the rejection of the alternative of excavation followed by soil treatment, which an

EPA contractor recommended in a special study for Superfund's enforcement program (Jacobs Engineering, "Analysis of Alternative Remedial Action For The Conservation Chemical Co. Site, Kansas City, MO," March 1987.). The study concluded: "The only treatment method which would meet the environmental protection goal (of permanent removal or detoxification of contaminants), and therefore the only method likely to gain public acceptance, is excavation followed by soil treatment. Therefore, we recommend that excavation followed by soil treatment be considered as an alternative treatment technology, under the requirements of SARA, for implementation at the CCC site." Admittedly, the study dealt with soil treatment or washing in general terms. Moreover, even this treatment is a separation technology which would, like the selected groundwater treatment, produce concentrated residues which would have to be managed. Overall, the study was an excellent analysis of cleanup alternatives and carefully considered the pros and cons of a number of options including in situ bioreclamation, in situ soil flushing, and excavation followed by landfilling. The ROD included the recommended alternative but consistently evaluated it more negatively than the selected remedy. Some relevant ROD comments supporting rejection of soil treatment are:

- On reliability: "while [it] could be implemented, extensive testing and studies would be necessary to verify this prior to implementation. "
- On implementability: "[it] applies a new technology and, as a result, there are substantial uncertainties associated with implementation of this alternative which may take considerable time to resolve before this alternative could be implemented"
- On technical effectiveness: "There are still unresolved uncertainties associated with the technical effectiveness of [soil treatment]."
- On environmental concerns: The ROD noted that there would be short-term impacts because of excavation which could be minimized but not eliminated. "The option also involves the discharge of low levels of contaminants and the generation of treatment plant sludges requiring disposal."
- On safety: "The potential safety risks for [it] appear to be greater."
- On public acceptance: "the alternatives are generally equivalent based on anticipated public acceptance." (Avery different statement than one in the Jacobs Engineering report.)
- On cost: The ROD's estimated cost of the selected remedy is $21 million and for soil treatment $24 million. "While there are a number of uncertainties for each alternative . . . [they are] the greatest for [soil treatment]."
- On operation and maintenance: "[Soil treatment], if feasible, should require a'substantially shorter period of operation and maintenance than [the others]."

Z) Accurate assessment of land disposal and containment alternatives.—Although there is a groundwater treatment component to the selected remedy, the cleanup rests on containment of the hazardous materials that are the source of the groundwater contamination. There was no significant analysis of the long-term uncertainties and possible failures of the containment and capping aspects of the cleanup. Considering the proximity of the site to both surface and groundwater, this lack of analysis is a major shortcoming of the selected remedy.

In the FS for the French Limited site in Texas, use of a slurry wall and cap to contain hazardous waste was described as a "temporary solution" for which the "volume and toxicity would not be affected . . . [and] . . . the potential would always exist for failure of either the cap or the slurry wall allowing for the movement of unstabilized wastes contained onsite. "

RIFS contractor.—Information on the complex RIFS history is missing, However, the SCAP notes that on 5/21/87 there was an EPA takeover of the RIFS, but the takeover came after the RIFS reports were completed.

State **concurrence.—** The front of the ROD said: "The State of Missouri has been consulted on the selected remedy." In the responsiveness summary at the end of the ROD, reference was made to a written comment by the Director, Division of Environmental Quality, Missouri

Department of Natural Resources: "The Missouri Department of Natural Resources recommends the alternative incorporating excavation of the wastes and soil washing with downgradient groundwater pumping and treatment be utilized for the remedial action at the CCC site. The commentor stated that this recommendation is consistent with the final recommendation contained in an EPA contractor's report on alternative remedial action technologies at the CCC site." The ROD contained a copy of an internal EPA memo stating that EPA headquarters and the Department of Justice support the selected remedy.

Cominunity acceptance.—The ROD said that there was a "low level of community concern. No major public concerns have been received at this time." One comment noted in the responsiveness summary is from the Coalition for the Environment, Kansas City. The questions touched upon the length of time for the groundwater cleanup.

Special comments.—The ROD says: "Total risk from all carcinogens should be between one in ten thousand to one in ten million. " This is a very broad range which could mean that actual risks associated with cleanup goals might be 100 times as great as the 1 in 1 million 1evel used most frequently by EPA.

The site's HRS groundwater score seems low in the context of the information in the ROD on what contaminants are present and the use of the aquifer for drinking water.

General conclusions.–Contrary to what the ROD concludes, the selected remedy does not offer a permanent remedy which effectively reduces the toxicity of the site's contaminants. Contaminant volume would decrease somewhat through groundwater treatment, because groundwater moving through the site would flush some contaminants from the soil. Groundwater treatment, for the most part, removes some unknown amount of contaminants which maybe landfilled somewhere else or may be discharged into the air.

Although the soil excavation and treatment alternative is not a true destruction approach, it is more consistent with the intent of SARA, **as** the EPA contractor report also concluded. The cleanup selected for the Seymour Recycling site in Indiana sets a better example because it includes two components to treat site contaminants in addition to the pump and treat component for the groundwater.

The rejection of the soil excavation and treatment alternative seems to be based on uncertainty about its effectiveness. This uncertainty exists because no treatability study was conducted as part of the RIFS. But this uncertainty must be balanced against the uncertainties of the selected pump and treat remedy: How long will water be pumped and treated? What contaminants in what amounts will be removed and what will remain on site? How protective is the capon the site? What is the ability of the hydraulic containment system to prevent contaminants from moving off site in the groundwater? Also, although the pump and treat can be started sooner, the ROD acknowledged that the soil treatment remedy could be completed in a much shorter time.

Many uncertainties weaken the claim that the selected remedy is cost-effective. Even if a treatability study for soil treatment was successful, the selected remedy—with its comparable uncertainties—would not offer the same overall level of long-term environmental protection. Therefore, regardless of cost, it would not be cost-effective.

The rejected soil treatment alternative ($24 million) was estimated to cost about the same as the selected remedy ($21 million). However, because soil treatment was only discussed in general terms, its cost is highly uncertain, especially when compared to the selected remedy which uses off-the-shelf equipment, The estimated cost of the soil treatment alternative was probably underestimated. Indeed, for a similar cleanup at the Chemical Control site the cost of soil treatment was about the same as for Conservation Chemical, even though the amount of material treated at Chemical Control (some 20,000 cubic yards) was a small fraction of that at Conservation Chemical (the ROD indicated about 100,000 cubic yards).

EPA's contractor report on alternative remedial action at Conservation Chemical used a