United States General Accounting Office

GAO

Report to the Chairman, Subcommittee on Transportation and Hazardous Materials, Committee on Energy and Commerce, House of Representatives

April 1990

NONHAZARDOUS WASTE

Environmental Safeguards for Industrial Facilities Need to Be Developed

GAO/RCED-90-92

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-235708

April 12, 1990

The Honorable Thomas A. Luken
Chairman, Subcommittee on Transportation
and Hazardous Materials
Committee on Energy and Commerce
House of Representatives

Dear Mr. Chairman:

As you requested, this report describes the Environmental Protection Agency's (EPA) information on the threats to groundwater posed by industrial nonhazardous waste facilities and evaluates EPA's progress for and plans in assessing and revising its 1979 general standards for these facilities. We also developed information, as requested, on the environmental controls certain states require for industrial facilities and what groundwater monitoring has revealed at these facilities in selected states.

As arranged with your office, unless you publicly announce its contents earlier, we will make no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to other appropriate congressional committees; the Administrator, Environmental Protection Agency; the Director, Office of Management and Budget; the state agencies included in our review; and other interested parties.

This report was prepared under the direction of Richard L. Hembra, Director, Environmental Protection Issues, who may be reached at (202) 275-6111 if you or your staff have any questions. Other major contributors are listed in appendix I.

Sincerely yours,

J. Dexter Peach
Assistant Comptroller General

Executive Summary

Purpose

Thousands of nonhazardous industrial facilities across the nation handle wastes that can seep into the soil and contaminate groundwater. Under the Resource Conservation and Recovery Act of 1976 (RCRA), the regulation of facilities that handle only nonhazardous waste is left to the states, although the Environmental Protection Agency (EPA) established some general standards for these facilities in 1979. The Congress, however, aware that groundwater contamination was occurring at nonhazardous waste facilities, directed EPA in 1984 to assess and revise its 1979 standards for these facilities by March 1988 to better prevent groundwater contamination.

Concerned about EPA's progress in assessing and revising the 1979 standards, the Chairman of the Subcommittee on Transportation and Hazardous Materials, House Committee on Energy and Commerce, asked GAO to determine, among other things, (1) the information EPA has on threats to groundwater contamination posed by nonhazardous industrial facilities and (2) EPA's progress and plans for assessing and revising its standards for these facilities.

Background

Nonhazardous wastes are not without risk to human health and the environment. Wastes handled in nonhazardous waste facilities include (1) small amounts of hazardous wastes that are exempted from EPA's hazardous waste regulations and (2) other types of nonhazardous waste, such as wastes that EPA is studying to identify and regulate as hazardous in the future.

Industrial waste is generated from factories, processing plants, and other manufacturing activities. This waste is diverse, ranging from brine in the food processing industry to dyes and pigments in the chemical industry. It also includes rubble from the construction or demolition of buildings and highways. Industrial facilities that handle these types of wastes include landfills and surface impoundments (i.e., pits, ponds, and lagoons storing liquid wastes).

EPA's 1979 standards do not require specific environmental controls, such as the monitoring of groundwater at industrial facilities to detect possible groundwater contamination. In 1984, the Congress directed EPA to assess whether the 1979 standards for all facilities were adequate or needed to be revised to protect against groundwater contamination. EPA was also specifically directed to revise its standards for those nonhazardous waste facilities that receive small amounts of hazardous wastes

and that are exempted from more stringent EPA hazardous waste regulations. The revised standards are to require, among other things, groundwater monitoring.

Results in Brief

EPA has strong indications that wastes containing dangerous chemicals may be seeping from some nonhazardous industrial facilities into the soil and groundwater, causing contamination and threatening human health and the environment. These indications are based largely on data EPA collected and analyzed between 1985 and 1987. EPA's data show that (1) some of these facilities handle small amounts of hazardous waste, such as arsenic, and (2) most facilities do not use environmental controls to prevent or detect groundwater contamination. In addition, EPA believes that some nonhazardous industrial facilities handle other wastes that are dangerous enough for EPA to plan to regulate them as hazardous in the near future.

Although required to revise the standards by March 1988, EPA has not done so, and it has made little progress in gathering the data that it believes are necessary to revise the standards. EPA's existing data, which indicate that these facilities pose environmental threats, are not sufficient to support a regulatory proposal to revise the existing standards, according to EPA. EPA says it will revise the 1979 standards as soon as it has adequate data. In the meantime, however, EPA does not have a strategy in place to guide its assessment and revision efforts. Without a strategy, it is not clear how and when EPA will revise its standards or whether it will assess and revise the standards for all industrial facilities or just those that handle small amounts of hazardous waste.

Principal Findings

EPA Data on Potential Threats

Between 1985 and 1987, EPA collected data on industrial facilities. On the basis of its initial data collection efforts, EPA estimates that about 20,700 landfills and surface impoundments handle most of the more than 7.6 billion tons of industrial nonhazardous waste generated annually. EPA also estimates that 2,200, or more than 10 percent, of the industrial facilities handle small amounts of hazardous wastes. The Congress specifically required EPA to revise its standards for nonhazardous waste

facilities disposing of small amounts of hazardous waste, such as arsenic, mercury, and strong acids, because it was particularly concerned about the health threats these wastes may cause.

EPA's data showed that many of these facilities do not have adequate safeguards to prevent and detect groundwater contamination. For example, only 18 percent of the industrial landfills, 9 percent of the surface impoundments, and 5 percent of the construction/demolition debris landfills have groundwater monitoring that would aid in detecting contamination. In addition, state officials reported to EPA that 25 percent of the approximately 2,200 industrial facilities monitoring groundwater were cited in 1984 for violating state standards to protect groundwater. Similarly, state officials told GAO that groundwater monitoring showed contamination at 32 of 112 facilities in 2 states.

In addition, EPA has indications that some industrial facilities may contaminate groundwater with wastes that may be regulated as hazardous in the future. For example, EPA has identified over 100 wastes in such industries as pesticides and dyes and pigments that it may want to regulate as hazardous waste.

Progress and Plans for Assessing Standards

EPA's stated objective is to revise the 1979 standards as soon as it has adequate data. However, since 1987, EPA has made little progress in gathering and assessing additional data, even though it generally knows what types of data it needs to collect, such as more specific information on the hazards posed by industrial waste and case studies of facilities that have caused environmental damage. In 1988, because of other higher priority work, EPA temporarily suspended work on a mail questionnaire that would have collected some of the data for the revision effort.

Moreover, the agency's plans for accomplishing this objective are not clear. EPA has not yet established milestones for when it will resume work on the suspended mail questionnaire that it describes as critical for its data collection efforts. EPA has also not established the specific tasks or identified the required resources necessary to assess and revise the standards. A strategy that sets out the specific tasks to be performed, milestones for the tasks, and the required resources would give greater focus to EPA's efforts by providing a systematic framework on what should be accomplished and by when.

Recommendation

To give more focus to fulfilling its statutory requirements to assess and revise the 1979 standards, GAO recommends that EPA develop a formal strategy to complete these efforts. This strategy should outline the objectives, specific tasks, milestones for completing the tasks, organizational responsibilities, and required resources necessary to carry out the strategy. In addition, the strategy should include an assessment of the standards for all industrial facilities, as required by statute.

Agency Comments

GAO discussed the factual information presented in this report with EPA and state officials who generally agreed with the facts, and their comments have been incorporated into the report where appropriate. As requested, however, GAO did not obtain official comments on the report.

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Abbreviations

EPA	Environmental Protection Agency
RCRA	Resource Conservation and Recovery Act

Introduction

Each year U.S. industrial facilities handle billions of tons of waste that is currently regulated as nonhazardous.[1] Much of this waste is placed in landfills and surface impoundments (pits, ponds, and lagoons) that can leak and contaminate the groundwater. If groundwater contamination occurs, cleanup can be difficult and expensive. As a result, prevention of contamination is the preferred approach to protecting this valuable resource, which supplies drinking water to approximately half the nation.

The Congress addressed the potential for groundwater contamination posed by industrial and other nonhazardous waste disposal facilities, such as municipal landfills, in the Resource Conservation and Recovery Act (RCRA) of 1976. Under RCRA, the Environmental Protection Agency (EPA) is required to develop minimum standards that all waste disposal facilities must meet to be considered environmentally safe. Once these standards have been developed, the states have primary responsibility for enforcing them and for providing additional environmental safeguards for these facilities, if necessary.

Although EPA developed minimum standards to address industrial and other nonhazardous waste disposal facilities in 1979, the Congress later became concerned that groundwater contamination was occurring at these facilities. As a result, the Congress, in 1984, required EPA to assess, by November 8, 1987, whether its 1979 standards could adequately protect against groundwater contamination and, at a minimum, required EPA to revise its standards for those facilities that handle small amounts of hazardous wastes by March 31, 1988. In response to these 1984 requirements, EPA published proposed regulations in August 1988 to revise its standards for municipal landfills and said it would address the need to revise the standards for industrial facilities in the future.

How Nonhazardous Waste Is Characterized

RCRA broadly defines solid waste to include solid, semi-solid (sludge), liquid, and gaseous waste (methane). It further classifies solid waste into two broad categories—hazardous and nonhazardous. EPA defines as hazardous those wastes that either (1) exhibit one of four characteristics (ignitability, corrosivity, reactivity, and toxicity[2]) or (2) are among the

[1]In this report, industrial facilities refer to landfills and surface impoundments that handle either industrial or construction/demolition debris wastes, unless otherwise noted.

[2]Under the toxicity characteristic, a waste is defined as hazardous if a sample of the waste contains a certain minimum concentration of at least one of eight metals and six organic chemicals. Below this minimum level, the waste is not controlled as a hazardous waste.

about 460 commercial products and production-process wastes EPA specifically lists as hazardous.

Nonhazardous wastes are those that either do not meet EPA's definition for hazardous waste or are exempted from hazardous waste regulation. Generally, nonhazardous wastes include industrial; construction/demolition debris; municipal; and four "large-volume wastes" excluded by law from control as hazardous waste, pending development of additional information to determine the level of control needed and the economic impact of regulating these wastes.[3] Nonhazardous wastes are not without risk to human health and the environment. For example, they include wastes that may

- contain small amounts of hazardous wastes, including small-quantity generator waste[4] (e.g., arsenic, lead, mercury, and strong acids) and household hazardous waste (e.g., common household products like cleansers, solvents, paints, and batteries);
- pose substantial human health and environmental threats and that EPA is studying to determine whether to regulate as hazardous;
- contain toxic chemicals in amounts that, while not considered high enough to warrant regulation as hazardous wastes, could pose some threat to human health and the environment; and
- contain chemicals, such as sodium, that are unlikely to be regulated as hazardous by EPA but that could adversely affect groundwater quality.

Industrial waste is generated from factories, processing plants, and other manufacturing activities. The types of waste vary from industry to industry as well as within an industry—from brine in the food processing industry to dyes and pigments in the chemical industry. As a result, the universe of industrial waste includes wastes with different chemical compositions and physical form. Industrial waste also includes construction/demolition debris waste—brush, stumps, or rubble from the construction or demolition of bridges, highways, or buildings.

[3]The four large-volume wastes are (1) drilling fluids and other wastes resulting from oil and gas production, (2) mining and ore-processing wastes, (3) by-products of fossil fuel combustion, and (4) cement kiln dust. EPA has conducted special studies on the first three types of large-volume wastes and is considering promulgating a separate set of standards for them.

[4]A small-quantity generator is classified by EPA as one that produces less than 100 kilograms of hazardous waste per month. This waste is exempted from more stringent EPA hazardous waste regulations.

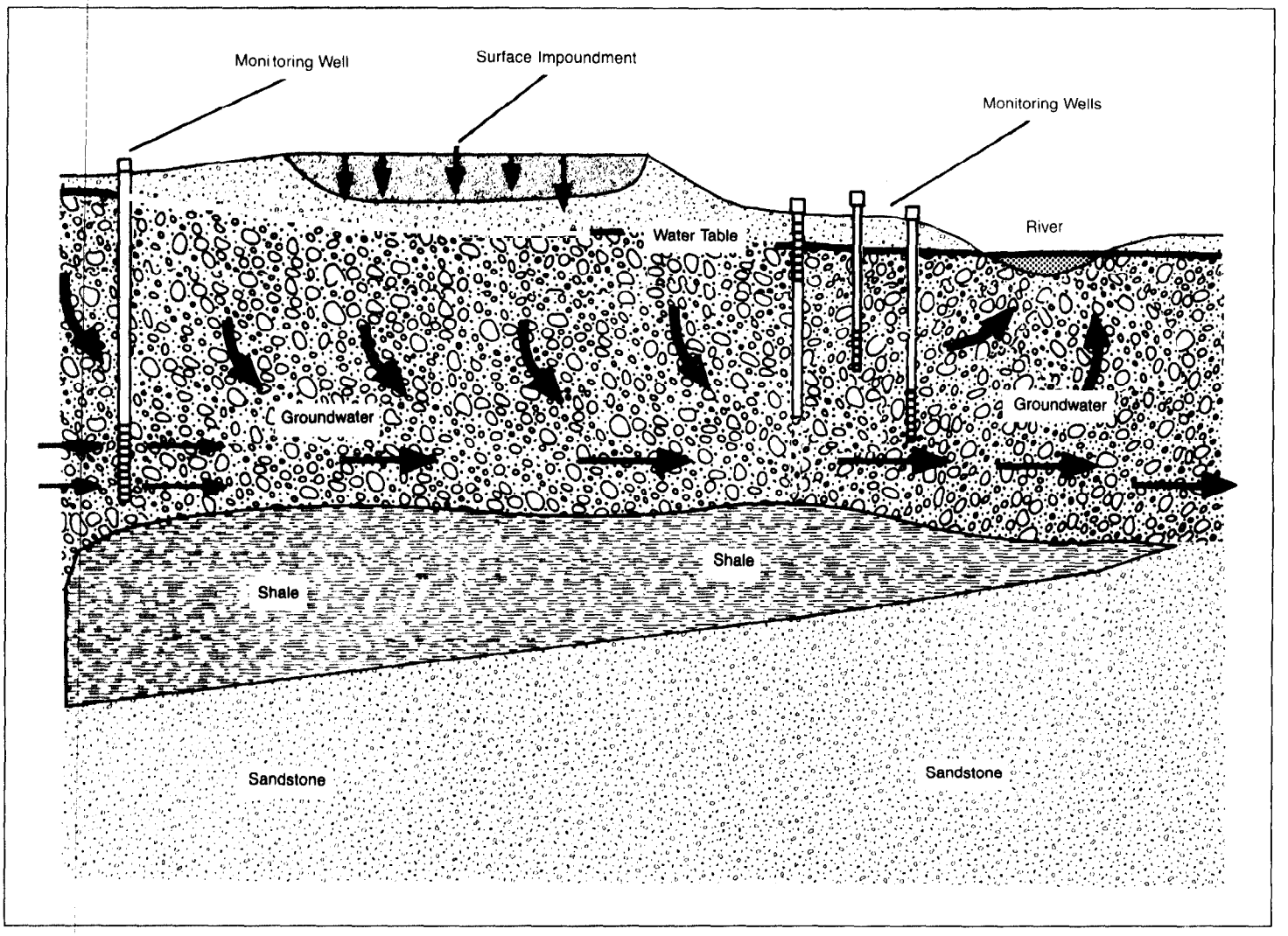
Industrial Facilities

Industrial and construction/demolition debris waste is generally disposed of in four types of waste management units—surface impoundments, landfills, land application units, and waste piles.[5] A surface impoundment is a depression in the earth or a diked area that holds liquid wastes for treatment, storage, or disposal. A landfill is an area of land or an excavation in the earth where wastes are permanently placed. A land application unit is an area of land where wastes, such as wastewater or sludge, are placed onto or mixed into the soil. A waste pile is a mass of waste generally placed on the ground for storage or treatment.

Waste management units can cause contamination, for example, when waste seeps from a surface impoundment into the soil or the waste is dissolved by water, such as rainfall, to form leachate. The leachate then migrates down into groundwater. (See fig. 1.1.)

[5]One or more waste management units can be located at a waste disposal facility because various methods may be used to treat, store, and dispose of different types of nonhazardous waste.

Figure 1.1: Groundwater Contamination From a Surface Impoundment



Resource Conservation and Recovery Act

In 1976, the Congress passed Subtitle D of RCRA to ensure the safe disposal of nonhazardous solid waste on land. Under Subtitle D, EPA's role is limited to (1) establishing voluntary guidelines for states' solid waste management plans and (2) developing minimum standards necessary to protect human health and the environment from nonhazardous waste facilities. In 1979, EPA promulgated regulations that set out voluntary guidelines for state solid waste plans and required general minimum standards for these facilities; it made minor modifications to the standards in 1981. The standards address surface water, groundwater, air,

endangered species, flood plains, land application, disease, and safety. They include general requirements, such as groundwater protection standards and a prohibition against the destruction of an endangered species habitat.

The states are primarily responsible for enforcing EPA's standards, which every nonhazardous waste disposal facility must meet, and implementing programs to regulate these facilities. Further, states may develop more stringent standards than those established by EPA. For example, states may require permits for these facilities to ensure they are designed and operated in an environmentally safe manner.[6]

1984 RCRA Amendments

In the early 1980s, the Congress became increasingly concerned about environmental problems, including groundwater contamination caused by industrial and other nonhazardous waste disposal facilities. The contamination of groundwater is a concern because the nation depends upon groundwater for a variety of uses. In addition to supplying about half of the nation's drinking water, groundwater provides about 40 percent of the water used for irrigation and about 6 percent of the water used in industry.

The Congress believed that without additional environmental protection nonhazardous waste disposal facilities might require costly cleanups with federal funds. It was concerned because (1) these facilities were recipients of unknown quantities of small-quantity generator and household hazardous wastes and (2) design, location, and monitoring standards for these facilities were either nonexistent or far less restrictive than those governing hazardous waste facilities. Consequently, in its 1984 RCRA amendments, the Congress required EPA to take two actions, among others, to address groundwater contamination from these facilities.

First, under section 4010 of RCRA, EPA was directed to study the adequacy of its 1979 standards to protect human health and the environment against groundwater contamination and to report the study's results to the Congress by November 8, 1987. In particular, EPA was to assess its standards in the areas of groundwater monitoring, prevention of contamination, and corrective action, or cleanup, of contamination that does occur.

[6]A permit is an authorization, license, or similar control document used to implement certain requirements, environmental in this case.

Second, EPA was required to revise its standards by March 31, 1988, for nonhazardous waste facilities receiving hazardous wastes from small-quantity generators or households, and, at a minimum, to (1) require groundwater monitoring to detect groundwater contamination early, (2) provide for corrective action of contamination as necessary, and (3) establish criteria for the acceptable location of these facilities. For example, EPA could require facilities to monitor groundwater by installing a system of wells around the landfill or surface impoundment to detect changes in groundwater quality. To illustrate, one well would be placed before the groundwater reaches the waste management unit, and others would be placed after the groundwater has flowed by the unit. Samples would then be taken periodically to determine whether the unit is leaking waste and has contaminated groundwater. In addition, if contamination does occur, corrective action requirements can better ensure that appropriate action, such as cleanup, can be chosen and implemented to remedy the problem.

EPA's Report to the Congress

In response to its statutory requirements, EPA reported to the Congress in October 1988 on the adequacy of its standards. EPA concluded that the 1979 standards were not adequate for municipal landfills and in August 1988 proposed regulations to revise the standards for the nation's approximately 6,500 operating municipal landfills. The proposed municipal landfill standards are more specific than the 1979 standards and cover requirements in a number of new areas, such as liners, groundwater monitoring, and corrective action. EPA plans to issue final standards in April 1990. The agency decided to separately address the need to revise its standards for industrial facilities.

Objectives, Scope, and Methodology

The Chairman, Subcommittee on Transportation and Hazardous Materials, House Committee on Energy and Commerce, requested that we review federal and state regulation of industrial facilities. This request was prompted by EPA's decision to revise its standards for municipal landfills first and to address the need to revise its standards for industrial facilities in the future.

As agreed, we addressed the following questions:

- What information does EPA have on the threats to groundwater contamination posed by industrial facilities?
- What are EPA's plans for and progress in assessing and revising its 1979 standards for these facilities?

- What are some of the environmental controls that certain states require for these facilities?
- What has groundwater monitoring at these facilities revealed in selected states that require groundwater monitoring?

We conducted our review at EPA headquarters and in eight states. We also spoke with state associations for waste disposal, such as the Association of State and Territorial Solid Waste Management Officials.[7] We limited our work to landfills and surface impoundments, in part because the 1984 statutory requirements specifically mention landfills and surface impoundments. In addition, land application units use environmental controls that are substantially different from landfills and surface impoundments, and very little information on waste piles is available from EPA.

To determine what information EPA has on the threats posed by these facilities, we reviewed the studies EPA completed in response to the 1984 statutory requirements. EPA's data collection efforts included Summary of Data on Industrial Non-Hazardous Waste Disposal Practices (Dec. 1985), Census of State and Territorial Subtitle D Nonhazardous Waste Programs (Oct. 1986), Screening Survey of Industrial Subtitle D Establishments (Dec. 1987), and Report to the Congress: Solid Waste Disposal in the United States (vols. I and II, Oct. 1988). We also discussed the studies' findings with responsible officials in EPA's Office of Solid Waste. We met with officials in the Office of Solid Waste, Characterization and Assessment Division, regarding EPA's hazardous waste identification program and reviewed the agency's documents on industrial wastes that it has studied and may identify as hazardous in the future. In addition, we reviewed the program's study on the risk associated with industrial nonhazardous waste that contain concentrations of toxic chemicals in amounts below threshold levels for being regulated as hazardous waste. To determine what other information EPA may have on the threats posed by industrial facilities, we contacted officials in and obtained pertinent documents from EPA's Offices of Ground-Water Protection, Drinking Water, Research and Development, and Toxic Substances. The results of this work are discussed in chapter 2.

To determine EPA's plans for and progress in assessing and revising its 1979 standards for industrial facilities, we interviewed EPA officials in

[7]The association is a nonprofit national organization of the directors of state solid and hazardous waste management programs and their staffs.

the Office of Solid Waste, Waste Management Division, who are responsible for assessing and revising the standards for these facilities. In addition, we examined EPA's preliminary planning document and its regulatory proposal to obtain information on industrial facilities. Further, we reviewed EPA reports prepared pursuant to the Federal Manager's Financial Integrity Act.[8] The results of this work are discussed in chapter 2.

To determine some of the environmental controls that states have for industrial facilities, we conducted telephone interviews to obtain information from selected state solid waste and water officials. As agreed with the requester, we restricted our telephone interviews to industrial landfills and surface impoundments, which are more of an environmental concern because of the large volume of waste they handle, and did not address construction/demolition debris landfills. State officials in Alabama, Ohio, Pennsylvania, Tennessee, Texas, and Washington were interviewed. We selected these states on the basis of geographic distribution and the number of waste management units in each state. According to EPA's information, these six states had 35 percent of the industrial landfills and surface impoundments nationwide. Since industrial states usually have large numbers of these units, our sample contains states from the more industrialized regions of the country.

The telephone interviews focused on permits, liners, and groundwater monitoring because of the requester's interest in these controls. Also, these controls are included in EPA's proposed revisions of its standards for municipal landfills, and the EPA official responsible for assessing the standards for industrial facilities agreed that these were also major environmental controls for these facilities. In addition, we asked about (1) inspections of industrial facilities, (2) state officials' concern about the potential for industrial facilities to adversely affect the groundwater, (3) the number of groundwater contamination cases caused by industrial facilities in the past 2 years, and (4) whether EPA assistance was needed for state programs.

We did not independently verify information obtained from our telephone interviews, nor did we assess whether the states' requirements adequately protect groundwater from contamination by industrial facilities. In our interviews, state officials in some instances did not believe that a particular question applied to their states or did not have data

[8]The act requires agencies to report "material weaknesses" in programs' internal controls to the President and the Congress.

readily available to provide an answer. We conducted follow-up calls with state officials to obtain additional information so that we could elaborate on specific aspects of a state's requirements or an official's opinion. The results of this work are discussed in chapter 3.

To obtain information on the results of groundwater monitoring in selected states, we conducted work in California and New Jersey because these two states have required groundwater monitoring at industrial facilities since the mid-1980s, and, therefore, had groundwater monitoring data available to review. In California, we performed our work in two regions of the State Water Resources Control Board—the Sacramento Office of the Central Valley Region and the Los Angeles Region. We chose these two regions because, according to state records, they had the largest number of such facilities. We conducted our review at the regional level because no statewide records were maintained on groundwater monitoring data. In New Jersey, our work covered facilities across the entire state because the state's records were centrally located.

After officials in these two states provided us with the names of facilities, we contacted state personnel responsible for overseeing groundwater monitoring requirements, asking them to identify (1) facilities with one or more active industrial landfills, surface impoundments, and construction/demolition debris landfills; (2) facilities with groundwater monitoring; (3) facilities where such monitoring had revealed wastes in the groundwater at levels that exceeded the states' standards; (4) the known or suspected source of contamination; and (5) the actual or potential threat to groundwater posed by each facility. The results of this work are discussed in chapter 4.

We discussed the factual information presented in the report with responsible EPA and state officials, who generally agreed with the facts, and their comments have been incorporated where appropriate. However, as requested, we did not obtain official agency comments. We conducted our review between August 1988 and January 1990 in accordance with generally accepted government auditing standards.

EPA Needs to Better Address the Environmental Threats Posed by Industrial Facilities

In the 1984 RCRA amendments, the Congress directed EPA to assess and revise its 1979 standards for industrial facilities by March 31, 1988. However, as of January 1990, EPA had not done so because it does not believe that it has sufficient data to support a regulatory proposal to revise the existing standards. However, EPA does have strong indications that some industrial facilities contaminate groundwater, thereby potentially threatening human health and the environment. These indications, which are based largely on data EPA collected between 1985 and 1987, include information about the types and volume of wastes these facilities handle and the facilities' limited use of environmental controls to prevent and detect groundwater contamination. Until EPA assesses and revises the standards, the government cannot be assured that it has taken the steps necessary to adequately protect human health and the environment against groundwater contamination from industrial facilities.

Although EPA plans to revise these standards as soon as it has adequate data, it has made little progress since 1987 in collecting these data. Further, it is not clear how and when EPA plans to revise these standards because the agency has not yet developed a strategy that lays out the objectives, tasks to be performed, milestones, organizational responsibilities, and resources necessary to complete the tasks. A strategy containing these elements would give greater focus to the agency's efforts by providing a systematic framework and timing for expected results.

EPA's Data Suggest That Industrial Facilities Pose Threats

EPA's data strongly suggest that some industrial facilities may contaminate groundwater and thus threaten human health and the environment. EPA collected some of these data between 1985 and 1987. These data were developed, in part, to fulfill EPA's statutory requirements to assess and revise its existing standards for industrial facilities. From these efforts, EPA found that (1) the number of industrial facilities, about 20,700, is large; (2) some facilities handle hazardous wastes from small-quantity generators; and (3) few facilities have in place environmental controls that protect against groundwater contamination.

EPA's waste identification program also has data that indicates the threats posed by industrial facilities.[1] This program's studies of industrial nonhazardous wastes indicate that some industrial landfills and surface impoundments handle wastes that may later be identified and

[1]This program identifies and evaluates industrial wastes to determine whether they should be controlled as hazardous waste.

regulated as hazardous waste. These wastes may threaten human health and the environment through groundwater contamination. In addition, data from this program indicate that industrial facilities pose environmental and human health threats even when they handle wastes that contain toxic chemicals in concentrations below the level EPA regulates as hazardous.

EPA's Data Collection Efforts

EPA gathered general information on industrial facilities through three studies conducted between 1985 and 1987. In 1985, EPA completed a literature study that collected and analyzed information from such sources as published and unpublished reports on the characteristics and volume of wastes generated annually by industries that EPA had identified as, among other things, generating the largest amounts of nonhazardous wastes. EPA also surveyed 56 states and territories[2] in 1985 and 1986 to obtain, among other things, information on the number, environmental controls, and environmental impact of industrial facilities. And finally, because of gaps in the states survey, in 1987, EPA completed a telephone survey of about 18,000 firms in 17 industries (which EPA had determined cover 99 percent of the industrial facilities) in order to obtain 1985 information about the number of on-site disposal facilities and quantities of wastes disposed of in them.

Number and Type of Facilities

From its states and telephone surveys, EPA estimates that 20,700 industrial facilities (2,800 industrial landfills, 15,300 surface impoundments, and 2,600 construction/demolition debris landfills) are scattered across the nation. EPA also estimates that the 15,300 surface impoundments handle more than 95 percent of the industrial nonhazardous waste that is produced. The large number of these facilities is cause for concern because of the likelihood for groundwater contamination from known discharges of pollutants, according to officials in EPA's Office of Ground-Water Protection.

Volume and Type of Wastes

More than 7.6 billion tons of industrial nonhazardous wastes are generated annually, according to EPA's 1987 telephone survey estimates. Also, EPA found that industrial nonhazardous wastes are diverse, ranging from wastes that are potentially hazardous to potentially benign. These

[2]In addition to all 50 states and the District of Columbia, EPA's survey included the Commonwealth of Puerto Rico, the U.S. Virgin Islands, Guam, American Samoa, and the Commonwealth of Northern Mariana.

wastes originate from such different sources as the food processing, paper and pulp, and chemical industries. Table 2.1 shows the 17 industries that produce 99 percent of all industrial nonhazardous waste. Within each industry, a wide range of types of wastes exists—wastewaters, sludges, and solid wastes—that may contain heavy metals or organic chemicals. Approximately 31 million tons of construction/demolition debris wastes are generated annually, according to EPA's estimate, which is based on 1970 data.

Table 2.1: Seventeen Industries That Produce 99 Percent of All Industrial Waste

Waste in 1,000 tons

Industry	Volume of waste[a]
Pulp and paper	2,251,700
Primary iron and steel	1,300,541
Electric power generation	1,092,277
Inorganic chemicals	919,725
Stone, clay, glass, and concrete	621,974
Food and kindred products	373,517
Textile manufacturing	253,780
Plastics and resins manufacturing	180,510
Petroleum refining	168,632
Fertilizer and agricultural chemicals	165,623
Primary nonferrous metals	67,070
Selected chemicals and allied products	62,987
Organic chemicals	58,864
Water treatment	58,846
Rubber and misc. products	24,198
Transportation equipment	12,669
Leather and leather products	3,234
Total	**7,616,149**

[a]Volume of waste disposed of in 1985, according to EPA's latest available data, which EPA uses to estimate the annual volume.

Source: EPA.

From its states survey, EPA also estimates that 2,200, or more than 10 percent, of the nation's estimated 20,700 industrial facilities handle hazardous waste from small-quantity generators. However, EPA cannot determine from this information which facilities handle this waste because it obtained only general information on the number of facilities from the states and not specific information by facility. However, EPA's literature study indicated that seven industries may dispose of small-quantity generator hazardous wastes in industrial facilities. These

industries are (1) fabricated metals, (2) electrical machinery and electrical components, (3) transportation equipment, (4) petroleum refining, (5) other types of machinery, (6) organic chemicals, and (7) inorganic chemicals.

Environmental Controls and Impacts

In its 1985 states survey, EPA found that industrial facilities in 1984 made only sporadic and limited use of environmental controls to minimize groundwater contamination.[3] For example, most industrial landfills, surface impoundments, and construction/demolition debris landfills did not have design and monitoring controls, such as liners and groundwater monitoring, to prevent and detect leakage of wastes. About 22 percent, or 3,600, of the surface impoundments had liners, and only about 5 percent, or 800, had synthetic liners, which, according to EPA, are impermeable and better at preventing liquid wastes from leaking out of surface impoundments than are natural liners. Similarly, few industrial landfills and construction/demolition debris landfills had liners—about 13 percent and 5 percent, respectively. Also, EPA found that few industrial facilities had groundwater monitoring that could detect waste seepage—about 9 percent (1,400) of the surface impoundments, 18 percent (650) of the industrial landfills, and 5 percent (140) of the construction/demolition debris landfills.

In addition, EPA believes that surface impoundments are more likely to leak wastes into the soil and groundwater than landfills because they handle liquid wastes while landfills do not. Liquid wastes create a strong downward pressure that can push wastes into the soil, and liquid wastes can move easily into groundwater.

From its states survey, EPA found that wastes from industrial facilities may be leaking into groundwater. The states reported to EPA that, of the approximately 2,200 facilities with groundwater monitoring in 1984, about 550, or 25 percent, of them were cited for violations of states' groundwater standards.[4] Similarly, state officials told us groundwater monitoring revealed contamination at 32 of 112 industrial facilities in 2 states. (For further details, see chap. 4.)

[3]These facilities may use a variety of major environmental controls to detect and prevent contamination. Besides liners and groundwater monitoring, they may use such controls as (1) systems to collect, treat, and remove leachate (leachate collection systems); (2) berms and ditches to control leachate and stormwater from flowing in and out (run-on/run-off controls); and (3) a cover to seal the fill material or area once a landfill or surface impoundment is no longer being used.

[4]Because violations can vary in terms of meaning and severity, EPA notes that violations themselves are not always indicative of severe environmental impacts.

Some Wastes Being Disposed of at Industrial Facilities May Later Be Regulated as Hazardous

Through its waste identification program, EPA has learned that some industrial facilities handle wastes that are currently regulated as nonhazardous but that may be identified as hazardous in the future. If wastes are reclassified as hazardous, the facilities handling them would be regulated as hazardous waste facilities, which are subject to more stringent EPA regulations. Because EPA does not know if it has identified 90 percent or 10 percent of the hazardous waste that may need to be regulated, an increased amount of waste now being regulated as nonhazardous may be regulated as hazardous in the future, according to EPA's Deputy Director for the waste identification program. Further, EPA has found that industrial facilities may threaten the environment and human health even when they handle wastes with concentrations of toxic chemicals below its regulatory levels for being defined as a hazardous waste. This situation happens because EPA generally regulates wastes as hazardous when a high degree of certainty exists that the wastes are dangerous enough to be regulated as hazardous.

EPA has identified some industrial nonhazardous wastes that it believes it may need to regulate as hazardous either by its toxicity characteristic test or through the listing of specific wastes. In 1986, EPA proposed a revision to the toxicity characteristic that could add 38 organic chemicals, and it expects this proposal to be final by spring 1990. With this revision, EPA believes that hundreds of industrial nonhazardous facilities handling these wastes may come under hazardous waste regulations. Further, EPA expects to propose 15 additional chemicals to its toxicity characteristic by the end of 1990 and then to review additional chemicals for possible inclusion, according to the Characteristics Branch Chief of the Office of Solid Waste.

EPA has also identified over 100 production-process wastes that may warrant listing as hazardous, but because the agency is addressing other higher priority efforts with its resources, it has not yet proposed listing them. EPA does not know when a determination will be made to list these wastes or whether all these wastes should be listed as hazardous, according to waste identification officials. These wastes are from the pesticide, organic chemicals, dyes and pigments, and plastics and resins industries. As a result, facilities that handle these wastes will continue to be regulated as nonhazardous waste facilities for the foreseeable future.

EPA has also learned that some industrial nonhazardous wastes may threaten the environment and human health even though they contain toxic chemicals in amounts that fall below EPA's proposed regulatory

threshold, or concentration, levels for being identified as hazardous waste. A 1988 EPA screening study indicates that, under worst-case conditions, almost all of the 271 wastes in 12 industries studied can pose a range of risks to human health and the environment. For 11 wastes with 4 chemicals not to be included under EPA's revised toxicity characteristic, the cancer risk was greater than 1 cancer per 100 people when the waste was ingested through contaminated groundwater—which is thousands of times greater than the cancer risk posed by some hazardous wastes.[5] For all the wastes studied, resource damage—such as groundwater contamination—appeared to be the greatest concern, followed by cancer and then non-cancer human health risks.

Because this was an initial study to locate areas of risk for more detailed analysis, it incorporated many "worst-case" assumptions. For example, it assumed that contaminated groundwater was ingested from a drinking-water well that was located at the immediate edge of a landfill. Under more realistic assumptions, these facilities and wastes would be expected to show less risk. The extent of risk might or might not be significant, according to the official in charge of the study. As of January 1990, EPA had no plans to replicate this study using more realistic assumptions to better identify the risks associated with these facilities until it has collected more data on these facilities.

EPA Does Not Have a Strategy to Complete Its Statutory Requirements

EPA's stated objective is to revise its standards for industrial facilities as soon as it has adequate data available to support a rulemaking. However, since its initial data collection efforts between 1985 and 1987, EPA has made little progress in gathering the necessary data to assess and revise its 1979 standards, even though it acknowledges that this effort will take years to complete. Further, the agency has not yet developed a strategy that sets out a concrete plan of action specifying the tasks, milestones, and necessary resources to complete this effort.

[5]In general, EPA's policy is to use as acceptable cancer risk levels between 1 cancer per 100,000 people to 1 per 1 million depending on, among other factors, whether technology is available to detect the chemical at lower levels.

EPA Has Made Little Progress in Collecting More Data to Support a Rulemaking

Although EPA's data suggest that industrial facilities pose environmental threats, EPA believes these data are insufficient to draw conclusions about the threats posed and to support a regulatory proposal revising its 1979 standards for them. EPA believes that its data are insufficient because it will need to collect more accurate and facility-specific information before it can go forward with a rulemaking.

EPA says that it needs more data on (1) the hazards posed by industrial nonhazardous wastes; (2) the design, operation and location of industrial facilities; (3) groundwater monitoring; and (4) the facilities' environmental impact (e.g., case studies of facilities that have caused environmental damage). Types of data that EPA has not yet collected for industrial facilities include case studies, leachate characteristics, and the number of industrial facilities identified as requiring cleanup under the federal Superfund program.[6]

Since it completed its initial data collection efforts in 1987, EPA has made little progress in gathering the data it says it needs. In March 1987, EPA began work to develop a mail questionnaire that would have collected some of the more detailed information that Waste Management Division officials say is needed to support a rulemaking, such as first-time data on facilities in many industries. However, EPA suspended work on this effort in June 1988, before mailing out the questionnaire, to devote its resources instead to ongoing data collection efforts on hazardous waste facilities. As of January 1990, EPA officials responsible for developing the questionnaire did not know when work on the questionnaire will be resumed.

As of January 1990, the agency's only current effort to collect data is an August 1988 proposed rule to require owner/operators of industrial facilities to submit basic information that would identify the number and location of these facilities.[7] The proposal also calls for owner/operators to provide information, such as the number of households within 1 mile of the facility, that would give EPA an indication of the extent of risk the facilities pose to human health and the environment. The final rule is expected to be published in April 1990, and Waste Management Division officials estimate that they will have these data collected and analyzed by the fall of 1991. EPA's Waste Management Division officials say the agency intends to use the data to identify samples of facilities

[6]Superfund is a federal program that cleans up contamination at inactive or abandoned hazardous waste sites.

[7]This proposal is part of EPA's rulemaking to revise its standards for municipal landfills.

for future data collection efforts. However, they are not sure what these additional data collection efforts will be or when they will be conducted.

A Strategy Would Assist EPA in Fulfilling Its Requirements

From its experience in revising its standards for municipal landfills, EPA generally knows what type of data and steps are necessary to complete its revision efforts. However, the agency has not yet developed a strategy, or detailed plan, that provides a systematic framework to proceed with its efforts. Without such a strategy, it is unclear how and when EPA will meet its stated objective.

Developing a strategy—the first key step of any major undertaking—is important because it gives focus to agency efforts and serves as a benchmark for measuring agency performance. If coordinated within the agency, it informs staff of their organizational responsibilities. If communicated outside the agency, it provides a sense of agency direction, priorities, and timing for expected results. It also provides the Congress with a sense of what can be achieved with the level of resources committed and a way to hold EPA accountable for achieving its stated objectives.

In a 1988 report, we identified key elements that EPA needed to incorporate into the management of its hazardous waste program.[8] They included establishing a strategy, or planning document, that lays out the (1) objectives, (2) specific tasks to be completed, (3) milestones for completing the tasks, (4) organizational responsibilities, and (5) necessary resources to carry out the strategy. As with its hazardous waste program, some of these key elements are missing or incomplete in EPA's current plans to assess and revise its standards for industrial facilities.

First, while EPA's overall objective is to revise the standards, this objective does not specifically address, and the agency has not decided, whether its assessment and revision effort will include all or some industrial facilities. At a minimum, EPA will assess and revise its standards, as required, for those facilities that receive small-quantity generator and household hazardous waste, according to the Acting Chief of the Waste Management Division. However, the 1984 amendments require EPA to assess the adequacy of its 1979 standards for all industrial facilities and, at a minimum, to revise the standards for those facilities handling small-quantity generator and household hazardous waste.

[8]Hazardous Waste: New Approach Needed to Manage the Resource Conservation and Recovery Act (GAO/RCED-88-115, July 19, 1988).

Therefore, it is unclear whether EPA is going to meet its statutory requirement to assess its standards for all facilities.

Second, EPA has not yet established the specific tasks necessary to accomplish its objective. But, the agency has begun work identifying potential tasks that it says could eventually lead to the development of a detailed work plan for its assessment and revision effort. These potential tasks are contained in a November 1989 draft report from the Waste Management Division entitled Status Report: Industrial Subtitle D Waste Program. The draft does little beyond listing the agency's previously mentioned data collection efforts, such as the suspended mail questionnaire, and other potential data collection efforts, such as obtaining background reports on those industries targeted in the toxicity characteristic study. As a result, it falls short of detailing the tasks necessary to achieve the agency's stated objective.

Third, the agency has not set milestones for when it will develop a detailed strategy or complete this effort. EPA officials estimate that, once begun, this effort will take 6 years—3 years to collect and analyze the necessary data and 3 years for a rulemaking process. However, EPA officials based this estimate on the agency's past experience in revising the standards for municipal landfills and other rulemaking efforts, rather than a systematic assessment of the time required to complete the specific tasks necessary for this effort. Consequently, the agency will not be able to comply with its statutory requirements to assess and revise its standards until 1996 at the earliest, or more than 8 years after the statutory deadlines have passed. In addition, the agency has not established interim milestones for completing such tasks as the suspended mail questionnaire, which the draft status report refers to as critical for gathering adequate and accurate data on industrial facilities.

Fourth, the agency has not yet identified organizational responsibilities for completing the revision effort. In addition, the draft status report identifies potential responsibilities for several offices, but it does not include other EPA offices that should have a role—e.g., the Characterization and Assessment Division, which handles the waste identification program.

Last, EPA has not yet identified the resources that will be necessary to carry out its efforts. It has not yet determined the amount of staff years or funds it will need to collect and analyze additional data or to complete its rulemaking activities. Without the identification of the necessary resources, it is difficult for EPA and the Congress to adjust funding

levels or make other changes in their priorities to achieve the assessment and revision.

Conclusions

EPA's information from its data collection efforts on industrial facilities and its ongoing program to identify hazardous wastes, taken together, suggests that these facilities can contaminate groundwater and thus threaten human health and the environment. However, EPA does not believe that it now has sufficient information to support a regulatory proposal to revise its standards for these facilities. To meet its statutory requirements, EPA says it needs to collect more data in order to further study the adequacy of its standards for all industrial facilities.

EPA's stated objective is to revise the standards for industrial facilities when it has adequate data to support a rulemaking. However, EPA has not said whether it will assess and revise the standards for some or all facilities. To meet its statutory requirements, EPA must assess the standards for all facilities and, at a minimum, revise the standards for those facilities handling small amounts of hazardous waste. Almost 2 years past its statutory deadline, EPA has collected no additional data, and it has not developed a strategy for achieving its objective. It also has not set milestones for when it will develop such a strategy or complete its revision efforts. A strategy that comprises key elements (such as its objectives, specific tasks, milestones, organizational responsibilities, and necessary resources) would assist EPA in managing this effort by focusing the agency's efforts. It would also serve to communicate the agency's plans and needs to the public and the Congress. Thus, if the agency's plans and time frames are unacceptable, the Congress would have the opportunity to adjust funding levels or make other changes. In the absence of a strategy, it is not clear how and when the agency will achieve its stated objective. Further, until EPA assesses and revises the standards, the government can not be assured that it has taken the steps necessary to adequately protect human health and the environment against groundwater contamination from industrial facilities.

Recommendation

To give more focus to its statutory requirements to assess and revise the standards, we recommend that the Administrator, EPA, develop a formal strategy to fulfill these requirements. This strategy should establish the objectives, specific tasks to be completed, milestones for completing the tasks, organizational responsibilities for carrying out the tasks, and required resources to carry out the strategy. In addition, the strategy

should include an assessment of the standards for all industrial facilities, as required by the statute.

State Requirements for Environmental Controls Vary

To obtain information on some of the environmental controls that certain states require for industrial facilities, we conducted telephone interviews with six states.[1] The states contacted (Alabama, Ohio, Pennsylvania, Tennessee, Texas, and Washington) varied in their requirements for permits, liners, and groundwater monitoring. All six states require permits for some industrial landfills and surface impoundments. However, the states differed on whether they require liners and groundwater monitoring for all or some permitted facilities, and they generally differed in their reasons for their approaches.

Five states categorically exempt certain facilities from permit requirements as well as all other environmental controls. Most states also do not review these unpermitted facilities to determine whether they pose a risk to the environment and need environmental controls to protect against groundwater contamination. Because they could handle harmful wastes but are not required to have controls, unpermitted facilities may threaten groundwater, according to an official in EPA's Waste Management Division.

Officials in the six states uniformly said they were concerned that industrial landfills and surface impoundments would contaminate groundwater. Moreover, five of the six states had experienced one or more cases of groundwater contamination from these facilities. All six states also require inspections for permitted facilities, but most were not able to conduct all required inspections for 1988 because of a lack of resources. Nine of the 11 state officials interviewed believe EPA could assist them in their programs for industrial facilities by providing more technical assistance and specific minimum technical standards.

States Permit Some but Not All Industrial Facilities

According to our telephone interviews, all six states require permits for some industrial facilities, although a variety of exemptions to permit requirements exist. As shown in table 3.1, the estimated number of permitted surface impoundments ranges from 90 facilities with 1 or more surface impoundments in Tennessee to 1,347 individual surface impoundments in Ohio. The estimated number of permitted landfills ranges from 7 facilities with 1 or more landfills in Texas to 109 individual landfills in Pennsylvania.

[1] In this chapter, industrial facilities refer only to landfills and surface impoundments that handle industrial nonhazardous waste.

Table 3.1: Estimates of Permitted Surface Impoundments and Landfills by State

State	Permitted surface impoundments	Permitted landfills
Alabama	600	79
Ohio	1,347[a]	20[b]
Pennsylvania	288[b]	109
Tennessee	90[b]	57
Texas	700[b]	7[b]
Washington	[c]	45
Total	**3,025**	**317**

[a]The state's most recent estimate is based on 1980 data.

[b]Represents the number of facilities with one or more landfills or surface impoundments. As a result, the estimate represents the minimum number of landfills or surface impoundments in the state.

[c]No estimate available because local health departments issue permits and the state has no centralized data.

Five of the six states exempt one or more categories of surface impoundments or landfills from permit requirements and do not require any environmental controls at unpermitted facilities. The five states present a complicated array of permit exemptions for surface impoundments and landfills. Of the six states, only one—Pennsylvania—requires permits for all industrial units. All states but Texas and Washington permit all landfills. For surface impoundments, however, there is no clear pattern to the type of facility permitted—a facility exempted in one state may be permitted in another. The following discussion outlines each state's exemptions from permit requirements and reasons for them, as explained by state officials:

- Alabama. Exempts surface impoundments unless they (1) are associated with waste treatment plants[2] that discharge treated wastewater to surface water and (2) were established after the state instituted a permit requirement. The permit requirement was established sometime prior to 1979. Rather than permitting each impoundment at a treatment plant, Alabama issues the permit to the plant, and approves all impoundments associated with the plant as part of the permit requirements. Alabama is considering the development of a separate program to permit all surface impoundments. This would ensure that all new impoundments are built

[2]A waste treatment plant treats liquid wastes and then generally discharges the wastewaters to surface water, spreads them on land, or recycles them for use in the waste treatment process. The Clean Water Act requires every waste treatment plant discharging wastewater into a river or stream to obtain a permit that limits the amounts and types of pollutants that may be discharged.

with controls commensurate with their potential to contaminate groundwater.

- Ohio. Exempts surface impoundments in operation before the state established a permit requirement in 1976. The state does not have the resources to regulate these older facilities.
- Tennessee. Exempts surface impoundments unless they are associated with wastewater treatment plants that do not discharge treated wastewater to surface water. Like Alabama, Tennessee issues permits to plants rather than to individual surface impoundments. Such treatment plants include those that spread wastewater on land or recycle water for use in the waste treatment process. These plants require permits because they are more likely to receive dangerous waste and pose a threat to groundwater or surface water than plants discharging treated wastewater to surface water. The latter must meet federal permit requirements.
- Texas. Exempts all on-site landfills as well as on-site surface impoundments that are not part of a wastewater treatment plant. On-site refers to any unit owned by the waste generator that is within 50 miles of the waste-generating site. This exemption, which is written into state legislation, probably occurred because the state lacked resources to permit all facilities. Off-site facilities are permitted because they receive many types of waste and thus are considered more likely to receive dangerous wastes that require more controls. On-site facilities generally receive one waste, and because the industry both produces and disposes of the waste and must notify the state of its plans for waste disposal units, the state is assured that the industry is knowledgeable about proper disposal methods.
- Washington. Exempts landfills and surface impoundments handling less than 1,200 tons over the expected life of the unit because of limited resources. These small units are less likely to cause environmental damage if they should leak than are larger units, which are permitted.

Of the five states with permit exemptions, only Texas monitors unpermitted facilities. Among other things, Texas requires owners or operators to submit construction plans for new landfills or surface impoundments. The state has the authority to suggest, but not require, appropriate controls. Texas also requires annual state inspections of unpermitted facilities. However, less than half of these inspections were completed in 1988 because of resource constraints.

The unpermitted facilities in the five states could pose environmental and human health threats for a variety of reasons, according to the EPA

official responsible for assessing and revising the standards for industrial facilities. For example, the small surface impoundments or landfills exempted from permit requirements in Washington could contain exempted hazardous or other toxic wastes, such as acids from batteries, that could damage groundwater. As a result, this official told us the five states with permit exemptions should review all exempted industrial facilities for their potential environmental impact, such as groundwater contamination, and require controls commensurate with the potential risk rather than categorically exempting facilities from having permits and controls.

Requirements for Liners and Groundwater Monitoring Vary by State

We also asked state officials about the requirements for two environmental controls, liners and groundwater monitoring, used at permitted industrial facilities to prevent and detect groundwater contamination. All six states said they required these controls for some permitted facilities but differed as to whether these requirements were applicable for all facilities or only on a site-specific basis. However, although some states require liners or groundwater monitoring for all permitted facilities, not all facilities in these states have these controls in place because the states have not fully implemented their requirements or have exempted older facilities from meeting their requirements.

Liner Requirements

Liners are placed beneath and around surface impoundments and landfills to prevent wastes from leaking into the soil and contaminating groundwater. They are constructed of compacted soil, clay, or synthetic material, all of which are relatively impermeable. Facilities can also have double liners to provide additional protection against leakage.

The need for a liner, and the type of liner material required, can depend upon a variety of factors, such as the location of a facility and the type of waste that will be handled in it. For example, at a sensitive location—over an important aquifer—a liner may be required to prevent wastes from contaminating groundwater. For surface impoundments, which generally handle liquid wastes, EPA recommends synthetic liners because they are more impermeable than clay or compacted soil, thereby providing more protection against leakage.

Table 3.2 summarizes the results of our survey. As shown in the table, the percent of permitted surface impoundments with liners ranges from 11 percent in Tennessee to 83 percent in Alabama for the five states with available data. For permitted landfills, the range is from 5 percent

in Tennessee to 57 percent in Texas for the four states with available data.

Table 3.2: Estimated Number and Percent of Surface Impoundments and Permitted Landfills With Liners by State

	Surface impoundments			Landfills		
State	Liner required	Number	Percent	Liner required	Number	Percent
Alabama	all[a]	500	83	site-specific	7	9
Ohio	all[a]	674	50	all	[b]	[b]
Pennsylvania	site-specific	109	38[c]	site-specific	11	10
Tennessee	site-specific	10	11	site-specific	3	5
Texas	site-specific	350	50	certain categories	4	57
Washington	all	[b]	[b]	all	[b]	[b]

[a]The liner requirement applies to all units that were built after the requirement was established. As a result, less than 100 percent of all permitted units have liners.

[b]The state was implementing this control at all units at the time of our telephone interviews. As a result, the number of permitted units with liners is not available.

[c]Estimate based on 1980 data.

Along with the wide range in the estimates of lined units, the six states vary in their requirements for liners at permitted facilities, and state officials gave different reasons for their approaches. For those states requiring liners at all permitted surface impoundments, landfills, or both, officials contended that all permitted industrial facilities need some type of liner to protect against leakage. For example, an Ohio groundwater official explained that states often do not know all the chemicals in permitted industrial surface impoundments because the wastewater is usually tested for only a limited number. In addition, there is no federal requirement that states periodically determine whether the chemical composition of the wastes going into the surface impoundments has changed over time. Ohio has found chemicals in wastewaters—sulfates, phosphates, and ammonia—that would not show up in standard wastewater tests. Because such wastes can affect groundwater, Ohio has required liners for all new permitted surface impoundments since 1987 but does not have the resources to extend the requirement to older facilities. Using a different approach, Texas requires certain classes of permitted landfills—those with wastes that break down rapidly in the environment or those that are more hazardous—to have liners because it believes these wastes present more potential harm to the environment and should have more stringent controls, according to a state solid waste official. In contrast, the other states generally said that their decision to require a liner on a site-specific basis depended on the type of waste being disposed of or the suitability of the

facility's location. For example, a surface impoundment located far from groundwater with harmless waste, such as water used only for cooling machinery in an industrial process, would not require a liner, according to a Pennsylvania official.

States also vary in the type of material they require for liners. They generally determine the liner material required—compacted soil, clay, or synthetic—according to the type of waste the permitted surface impoundment or landfill handles or the suitability of its location. However, Alabama, Washington, Ohio, and Texas require composite liners—that is, a single liner with both a clay and synthetic layer—for some permitted industrial facilities. Alabama requires composite liners for some landfills and Washington for some surface impoundments and landfills, according to the type of waste and location of the unit. Ohio requires these liners at all permitted landfills because it considers a composite liner to be more effective than a single liner of either material, according to a state solid waste official. Texas requires a composite liner for a certain class of permitted landfills—ones handling wastes the state defines as more hazardous.

Groundwater Monitoring Requirements

Because surface impoundments and landfills with or without liners and other controls can leak wastes, groundwater monitoring is used at industrial surface impoundments and landfills to detect such leakage into the groundwater and to determine the extent and severity of any contamination.

The six states' requirements for groundwater monitoring are summarized in table 3.3. For states with available data, the percentage of units with groundwater monitoring ranged from 5 percent in Alabama to 50 percent in Ohio and Pennsylvania for surface impoundments and from 16 percent in Alabama to 90 percent in Pennsylvania for landfills.

Table 3.3: Estimated Number and Percent of Surface Impoundments and Permitted Landfills With Groundwater Monitoring by State

	Surface impoundments			Landfills		
State	Monitoring required	Number	Percent	Monitoring required	Number	Percent
Alabama	site-specific	30	5	site-specific	13	16
Ohio	certain categories	674	50	all	10	50[a]
Pennsylvania	site-specific	144	50	all[b]	98	90
Tennessee	site-specific	11	12	site-specific	33	58
Texas	site-specific	140	20	certain categories	2	29
Washington	all[a]	[a]	[a]	all	[a]	[a]

[a]The state was implementing this control at all units at the time of our telephone interviews. As a result, the percent of units with groundwater monitoring was less than 100, or data were not available.

[b]The groundwater monitoring requirement applies to all units that were built after the requirement was established. As a result, less than 100 percent of all permitted units have groundwater monitoring.

As is the case with liners, the table shows the states also vary in their requirements for groundwater monitoring. The Washington State official responsible for all facilities and the Ohio and Pennsylvania officials responsible for landfills require groundwater monitoring at all permitted landfills and surface impoundments for the same reason that state officials require liners at all units—because all can cause groundwater contamination. Ohio, with a different strategy, requires groundwater monitoring for all surface impoundments except those with a double liner. This approach offers the facility owner/operator an incentive to use and maintain double liners, which provide more protection than single ones, and avoid the more costly groundwater monitoring requirement, according to an Ohio groundwater official. Double-lined surface impoundments must install a system between the liners to detect leaks, and if the top liner leaks and remains unrepaired, the state requires the facility to install groundwater monitoring, according to this official. In contrast, states using a site-specific approach generally required groundwater monitoring depending on the type of waste and location of the facility. In Tennessee, regarding landfills permitted prior to about July 1988, state officials weighed the cost of groundwater monitoring against the risk of not installing this control, according to the state's Director of the Solid Waste Management Division. Therefore, groundwater monitoring was not required if the waste was considered to be relatively harmless to the environment. However, the state has found that landfills sometimes receive more harmful wastes than the owner/operator anticipated at the time of permitting. As a result, the state has required groundwater monitoring at the majority of landfills permitted after July 1988.

Concern About Potential Groundwater Contamination

All officials interviewed said they were concerned about groundwater contamination at industrial facilities for one of the following reasons: (1) the state is responsible for protecting groundwater quality, (2) some industrial facilities have caused groundwater contamination in the past, and (3) some unpermitted facilities do not have proper controls.

According to estimates from officials in 5 of the 6 states, 76 cases of groundwater contamination were caused or suspected to have been caused by industrial nonhazardous surface impoundments and landfills in 1987 and 1988.[3] These state officials generally defined groundwater contamination as any amount of chemical in the groundwater above levels that would naturally occur. As shown in table 3.4, the estimated number of groundwater contamination cases at surface impoundments ranged from none in Tennessee to 17 in Texas. For landfills, estimates ranged from none in Alabama to 17 in Texas.

Table 3.4: Estimated Number of Groundwater Contamination Cases in 1987 and 1988 by State

State	Surface impoundments	Landfills	Total
Alabama	10	0	**10**
Ohio	12	10	**22**
Pennsylvania	[a]	[a]	[a]
Tennessee	0	1	**1**
Texas	17	17	**34**
Washington	[a]	[a]	[a]
Total	**39**	**28**	**67**

[a]The state did not have this information readily available.

In addition to the six states we contacted by telephone, we also gathered detailed information on what groundwater monitoring has revealed in California and New Jersey. These results are presented in chapter 4.

Inspections Required but Not All Conducted

The six states contacted use inspections to determine whether facilities are meeting permit requirements. Four states (Alabama, Pennsylvania, Texas, and Washington) require state inspections for both surface impoundments and landfills, while two require state inspections for either permitted surface impoundments or landfills. In Ohio, local health agencies are generally responsible for inspecting landfills. Tennessee has no inspection requirement for surface impoundments, but officials did

[3]Pennsylvania did not have information on the number of surface impoundments with contamination, and Washington had no information on the number of cases for surface impoundments or landfills.

inspect about half of these facilities in 1988 on a discretionary basis. Of the states requiring inspections for landfills, four said they require state inspections once a year or more, and one (Washington) had no fixed schedule but inspects landfills on a discretionary basis. For surface impoundments, Texas requires annual inspections for all permitted surface impoundments while three states (Alabama, Ohio, and Pennsylvania) generally require annual inspections for surface impoundments associated with a major wastewater treatment facility and inspections for others every 3 years. As with landfills, Washington requires inspections for surface impoundments but had no fixed schedule for conducting them, according to a state water official.

In general, the states lacked the resources to complete all required inspections in 1988, according to state officials. Alabama and Pennsylvania officials said they completed all or almost all required inspections for both landfills and surface impoundments in 1988. Officials in Ohio and Texas told us they conducted all or almost all of the required inspections for surface impoundments, whereas Washington conducted very few. For landfills, Tennessee conducted half or more than half of the required inspections while Texas and Washington conducted fewer than half. Ohio did not have inspection data available for landfills.

Some state officials also said that they used permit renewal as an oversight mechanism at industrial facilities. For surface impoundments, officials in three states (Ohio, Tennessee, and Texas) said they renewed permits for surface impoundments every 5 years, while Washington renewed permits annually. For landfills, Alabama and Washington renew permits every 5 years, according to state officials.

Assistance From EPA

Nine of the 11 state officials interviewed said they would like EPA's assistance in their programs for these facilities. Officials in Alabama, Ohio, and Pennsylvania said that EPA needs to set standards for industrial facilities, such as design requirements, either (1) to preclude shipment of wastes from states with stringent regulations to those with few or (2) to ensure that groundwater is adequately protected throughout the country. In addition, the Assistant Chief of the Ohio Groundwater Division said that minimum federal standards for industrial facilities, similar to EPA's proposed municipal standards, would give states a mandate to move forward in regulating industrial facilities. Without such a mandate, states will focus on other environmental areas, such as surface water, where federal mandates already exist, according to this official.

In addition, officials in Alabama, Ohio, Pennsylvania, and Texas said that EPA should provide technical assistance or information to the states. Generally, these state officials felt that EPA should be a repository of information on the proper controls to use at facilities and should share this information with the states. Some of these officials said that individual states do not have programs in place to research the latest environmental control technology or determine what controls work best in different geographical regions of the country. EPA officials said that EPA has the authority to provide this assistance under RCRA, but it has provided very little since 1980 because of lack of funding. Finally, officials in Alabama, Tennessee, Texas, and Washington said they would like federal funding for state programs. Pennsylvania and Ohio officials also noted that federal funding would be needed if EPA requires further controls that states must enforce for industrial facilities.

Groundwater Monitoring at Industrial Facilities in Two States Reveals Contamination

Groundwater monitoring can provide early information about the leakage of wastes from landfills and surface impoundments into the groundwater. As a result, it enables actions to be taken to minimize the extent and impact of such contamination. In California and New Jersey, groundwater monitoring identified for state officials those industrial facilities that they believe require closer attention and warrant further study to determine the extent and source of contamination and the need for cleanup. The results of groundwater monitoring in California and New Jersey show that some of these facilities are a source of groundwater contamination and confirm EPA's finding that these facilities may contaminate groundwater and threaten the environment.

Groundwater Monitoring in California and New Jersey

In 1984, California adopted regulations that required groundwater monitoring at industrial facilities. California established these requirements because early detection allows action to minimize effects on water quality. In addition, officials with the State Water Resources Control Board said that the cost of preventing contamination with groundwater monitoring is less expensive than the cost of cleaning up contaminated groundwater.[1] Groundwater monitoring is required while the facility is operating and after it closes, unless all wastes, waste residues, and contaminated materials are removed and decontaminated at closure. To require groundwater monitoring, one of the nine regional boards of the State's Water Resources Control Board issues or revises facility owner/operators' waste discharge requirement, which is similar to a permit. Regional boards review waste discharge requirements periodically and may revise them following a review.

In February 1989, we provided a data collection form to technical staff in two California regional board areas. Using readily available information, they identified a total of 88 active industrial facilities and told us that 38, or 43 percent, of these facilities were monitoring groundwater. According to regional board officials, some facilities were not monitoring groundwater because the regional boards do not have the resources to issue or revise each facility's waste discharge requirements to impose groundwater monitoring requirements.

In New Jersey, groundwater monitoring is required at all industrial facilities through a groundwater discharge permit, which the state

[1]There is no universal definition of contamination. Throughout this chapter, we use New Jersey's definition of groundwater contamination—groundwater with waste constituents at levels above the state's standards or prescribed limits.

began issuing in the early 1980s. New Jersey requires groundwater monitoring at these facilities to identify problems early in order to take necessary corrective measures in a timely manner, according to the state's assistant director in charge of groundwater quality. Groundwater monitoring is required while a facility is operating and for a period of time after it is closed. The permits are issued and renewed for a set period of time, not to exceed 5 years.

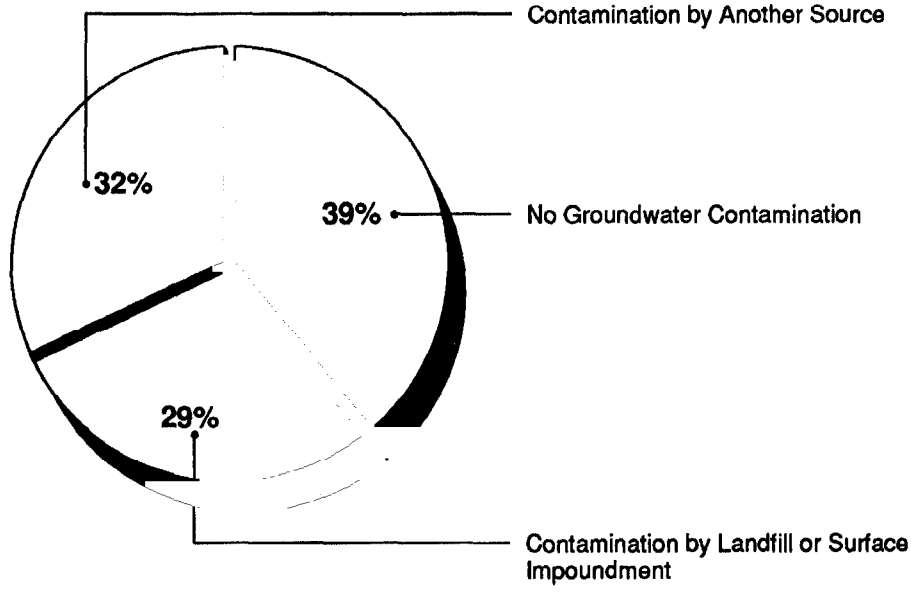
Although New Jersey requires groundwater monitoring for these facilities, not all the industrial facilities identified in our review had been required to conduct groundwater monitoring when we administered our data collection form in the state in March 1989. On the basis of readily available information, state officials reported that 74, or 86 percent, of the total 86 active industrial facilities identified were monitoring groundwater. Facilities that were not doing so, officials said, had not yet been issued a permit requiring monitoring because of resource constraints, or were not in compliance with their permit requirements.

In both states, the facility owner/operator must periodically submit reports on the results of samples taken from the groundwater monitoring wells. California regional technical staff and New Jersey state geologists review these reports to determine if groundwater standards have been exceeded and, if so, to what extent. While the reports may show that levels or standards have been exceeded, the significance and nature of this contamination varies and thus warrants different responses, according to the Assistant Director, Ground Water Quality Management Element, New Jersey Department of Environmental Protection. Therefore, in some cases the states continue to review the periodic reports, and in other cases they may require the owner/operator either to study the extent and source of contamination or to clean up contamination. For example, if a facility is believed to be contaminating groundwater that is already of poor quality and the groundwater has no current or potential use, the state may continue to review a facility's groundwater monitoring reports if the contaminants are not considered to be significant. However, if a facility is identified as a potential source of contamination for drinking water, the states may require the owner/operator to study the extent and source of contamination and, if necessary, to take corrective action.

Groundwater Monitoring Reveals Contamination

Of the 112 facilities with groundwater monitoring, state officials reported that data indicated contamination at 68, or 61 percent, of these facilities. At 32—or 29 percent of the 112—facilities, the known or suspected source of the contamination was an industrial landfill, surface impoundment, or construction/demolition debris landfill. At the other 36 facilities (32 percent) with contamination, either another source on or near the facility—such as a hazardous waste management unit, underground storage tank, or adjacent facility was the known or suspected source of contamination—or the source of contamination was not known, according to state officials. (See fig. 4.1.) At the 32 facilities where a nonhazardous waste landfill or surface impoundment was the known or suspected source, the state was taking or planning to take a variety of actions, ranging from continuing to review groundwater monitoring reports to requiring cleanup. In addition, 18 of the 32 facilities were believed to pose a moderate to great threat to groundwater, according to state officials. The results of groundwater monitoring at industrial facilities and the officials' belief that many of these facilities pose a moderate to great threat to groundwater confirms EPA's finding, discussed in chapter 2, that there are indications that these facilities do pose environmental threats.

Figure 4.1: Results of Groundwater Monitoring at 112 Industrial Facilities in California and New Jersey



State Actions to Address Threats of Groundwater Contamination

At the 32 facilities where a nonhazardous waste landfill or surface impoundment was the known or suspected source of the contaminated groundwater, the states were (1) implementing corrective action, (2) planning to implement corrective action, (3) studying or planning to study the source or extent of such contamination, or (4) continuing to review the facility's groundwater monitoring reports, according to state officials. These 32 facilities (11 in California and 21 in New Jersey) were handling diverse types of wastes from the processing and manufacturing of food, chemicals, rubber, paper, paint, metals, and construction/demolition debris. Of these 32 facilities, 20 involved surface impoundments, 4 industrial landfills, 3 demolition debris landfills, and 5 facilities with both an industrial or construction/demolition debris landfill and surface impoundments.

As shown in table 4.1, 18 of the 32 facilities, or over half, were believed to pose a moderate to great threat to groundwater. In making these judgments, we asked state and regional board officials to consider the volume and type of waste, the facility's design and operating controls, and hydrogeological conditions. In addition, some officials also considered the actual or potential use for the groundwater. For example, three of the five facilities considered to pose a great threat to groundwater had either affected groundwater or potentially threatened groundwater used for drinking or agricultural purposes.

Table 4.1: The Level of Threat to Groundwater From Contamination by Landfills or Surface Impoundments in California and New Jersey

Level of threat	California	New Jersey	Total
Little to no	2	0	**2**
Some	2	10	**12**
Moderate	4	9	**13**
Great	3	2	**5**
Very great	0	0	**0**
Total	**11**	**21**	**32**

At 15 of the 32 facilities, the states were in the process of requiring either further study of the contamination or corrective action. Of these 15 facilities, 13 involved surface impoundments and 2 involved construction/demolition debris landfills. Their level of threat to groundwater ranged from little to no threat to great. State officials reported they were taking actions at these facilities for several reasons: (1) the contamination had impaired or threatened groundwater uses and (2) results showed that standards had been exceeded to the extent that the facility posed a moderate or great threat to groundwater. For example,

at a California paper manufacturer, the regional board was working with the facility, considered to pose a moderate threat, to lower the level of total dissolved solids[2] leaking from an unlined surface impoundment located on sandy soil, according to the responsible regional engineer. At a New Jersey facility considered to pose some threat, the state informed the facility owner/operator in May 1989 that the construction/demolition debris landfill may be contaminating groundwater and directed the owner/operator to study the cause and extent of contamination. In the previous 2 years, groundwater monitoring reports had repeatedly shown that standards for the amounts of hazardous and nonhazardous wastes in the groundwater were being exceeded. The standards for arsenic and lead, hazardous waste constituents, were being exceeded between 2 to 4 times, while the standards for nonhazardous waste constituents (such as sulfate, iron, sodium, ammonia, and total dissolved solids) were being exceeded in some cases by hundreds of times.

At the other 17 facilities, the states were continuing to review groundwater monitoring reports to identify any significant changes or trends that would warrant further action. Fourteen of these facilities were in New Jersey and 3 were in California. Of the 17 facilities, 7 involved surface impoundments, 4 industrial landfills, 1 construction/demolition debris landfill, and 5 facilities with both a surface impoundment and an industrial or construction/demolition debris landfill. Their level of threat to groundwater ranged from little to no threat to a moderate threat. Officials said they were continuing to monitor these facilities because the monitoring reports were inconclusive as to whether a problem existed at the facility.

Nonhazardous Wastes Can Contaminate Groundwater and Impair Its Uses

At three facilities with contaminated groundwater, state officials told us that wastes, such as sodium and chlorides, which are unlikely to be regulated as hazardous, had not only degraded groundwater quality but had also impaired or threatened groundwater uses. At two facilities considered to pose a great threat to groundwater, nonhazardous wastes had rendered groundwater unusable for drinking by adversely affecting its taste or for agricultural purposes by reducing the productivity of lands irrigated with the water. Nonhazardous waste from a third facility threatens groundwater flowing in the direction of a nearby residential subdivision that depends upon groundwater as a drinking water source.

[2]Total dissolved solids are the solid waste particles that have dissolved in water and are usually associated with the palatability of water, according to an EPA drinking water official.

At the first facility, New Jersey officials strongly suspect unlined surface impoundments at an inorganic chemical plant as the source of contaminated groundwater that has affected two nearby drinking water wells. State officials suspect the facility because it is the only industry in an otherwise rural area. The contamination was initially identified through samples taken from the facility's groundwater monitoring wells. These samples revealed excess levels of nonhazardous waste constituents (sodium, chloride, sulfate, and total dissolved solids). Later, the state learned that the contamination had probably migrated off-site and affected at least two nearby wells. For one of the affected wells, the facility owner/operator is voluntarily purifying water for this property owner whose well, which is across the street from the facility, was found to have similar contaminants. In early 1989, the state learned that a new drinking water well drilled approximately 1/2-mile from the facility showed similar contamination. The state is requiring the company to further investigate the facility's contamination, and using the results of this study, the state will decide what cleanup action will be required. In addition, the state is planning to require that liners made of material with very low permeability be placed underneath the facility's unlined surface impoundments.

At the second facility, nonhazardous wastes (chlorides and total dissolved solids) from two unlined surface impoundments at a California meat processing plant have contaminated shallow groundwater that supplies many private drinking water wells and irrigation wells. These unlined surface impoundments cover 8.2 acres and are located in sandy soil. The contamination was first identified in February 1986 through a nearby homeowner's complaint about the deteriorating taste of well water. At that time, the facility was not required to monitor groundwater. A subsequent state investigation revealed that the facility was not in compliance with its operating license. For instance, these surface impoundments received brine wastes in an amount 2-1/2 times the amount authorized.

As of January 1990, the contamination has affected 10 nearby drinking water wells, which the regional board required the facility to replace, and farther away, the contamination is threatening the water supply of a mobile home park where 300 people live. In addition, three agricultural irrigation wells have been contaminated. As a result, the productivity of an apple orchard and a vineyard may have been diminished. Two of the three wells have been closed and replaced with deeper wells. The regional board is still determining if the third irrigation well should also be replaced. The company's comptroller estimates that the cost of

replacing these 13 wells is $125,000. While a long-term remedial action is being determined, interim measures to clean up the contaminated groundwater are underway. The facility is blending polluted and unpolluted groundwater and discharging it into surface water. For a long-term disposal alternative, the facility is planning to change its waste disposal method and inject wastewater and polluted groundwater into deep wells located below the groundwater that is used as a drinking water source. The company's controller estimates the total cost of cleanup and the new injection disposal system will be about $2.5 million.

At the third facility, groundwater had been contaminated by two unlined surface impoundments holding ammonia-nitrogen, nitrate nitrogen, sulfate, and total dissolved solids. This contamination was identified through samples taken from the facility's groundwater monitoring wells. As of April 1989, the contaminated groundwater was not known to have affected any groundwater uses, but the responsible state geologist said the facility's contamination posed a great threat because the groundwater flows in the direction of a residential subdivision located about 1/2-mile from the facility. This subdivision relies upon groundwater as a source for drinking water. The state plans to require some type of cleanup at the facility after a study of the contamination is completed.

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