Coal Combustion By-Products and Low-Volume Wastes Comanagement Survey

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REPORT SUMMARY

This report presents the results of a survey of the U.S. utility industry, conducted by EPRI in order to assemble information on comanagement of high-volume coal combustion by-products with low-volume wastes.

Background

EPRI, in cooperation with the Utility Solid Waste Activities Group (USWAG) and individual utility companies, is completing in a multiyear research effort to generate information related to the comanagement of low-volume and high-volume combustion by-products. This research is providing technical input to a regulatory determination by the United States Environmental Protection Agency. As part of the research effort, EPRI conducted a broad survey of the utility industry.

Objectives

To obtain information regarding the types of low-volume wastes utilities currently comanage with high-volume by-products; to determine the general characteristics of the disposal facilities.

Approach

A four-page questionnaire was sent to all electric utilities with more than 100 megawatts of coal-fired generating capacity. The questionnaire requested general information on types of waste comanaged and on construction of the disposal facility. The survey was designed to generate a high response rate and create a representative sample of the industry. The questionnaire, therefore, requested primarily qualitative or descriptive information that was believed to be readily available, rather than quantitative data on the volumes or chemical characteristics of the various low-volume waste types. Several follow-up calls were made over a six-month period following the mailing to increase the response rate.

Results

The survey produced information on 259 actively operating utility disposal facilities, accounting for about three-quarters of the utility high-volume by-product generation. About half of the facilities responding to the survey are landfills, slightly less than half are impoundments, and a small number are minefills. Forty-two percent of the facilities are lined. Ninety percent are

permitted facilities, and 63 percent monitor groundwater. Trends over the last decade are: increased use of landfills rather than impoundments, increased use of compacted clay and synthetic liners, and increased groundwater monitoring.

Overall, 80 percent of the facilities comanage at least one low-volume waste with high-volume by-products. The most commonly comanaged wastes are coal mill rejects (55 percent of facilities), floor/yard drain wastewater (48 percent), demineralizer regenerant (44 percent), air heater/precipitator washwater (42 percent), and coal pile runoff (41 percent). Comanagement is more common at impoundments (90 percent) than landfills (70 percent). The median number of comanaged wastes at impoundments is eight, the median at landfills is two. Low-volume wastes are also commonly used in ash sluice water (39 percent of facilities that sluice ash) and flue gas desulfurization make-up water (63 percent of FGD facilities).

EPRI Perspective

The survey results show the prevalence of comanagement practice in the utility industry, and suggest that regulations governing comanagement have the potential to affect a large majority of coal-burning utilities. However, many of the comanaged wastes (e.g. boiler blowdown, cooling tower blowdown) contain little dissolved or suspended solids and are unlikely to impact the environmental performance of the high-volume by-product disposal facility. In addition, the current trend toward lined facilities with groundwater monitoring illustrates the controls that utilities are implementing to further minimize environmental risks.

The information gathered in this survey are being used in conjunction with detailed site-specific data generated by EPRI at 14 comanagement facilities. These studies included detailed descriptions of management practices, collection and analysis of low-volume waste samples, characterization of the solids composition and porewater chemistry of cores collected from the management units, description of geology and groundwater flow, and determination of groundwater quality. This information and data is providing technical input to the EPA for its regulatory determination governing utility comanagement practices.

Interest Categories
Land and Water Quality
Waste and Water Management
Environmental Compliance Planning

Keywords
Groundwater quality
High-volume by-products
Low-volume wastes
Comanagement
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ABSTRACT

A survey of utilities was performed to obtain information regarding the comanagement of low-volume wastes with high-volume combustion by-products in utility disposal sites. This information will be used to provide technical input for a regulatory determination by the U.S. Environmental Protection Agency on the comanagement practice.

The survey found that low-volume wastes are comanaged with high-volume combustion by-products at 80 percent of the 259 active disposal facilities responding to the survey. The most commonly comanaged low-volume wastes are coal mill rejects, floor/yard drain wastewater, demineralizer regenerant, airheater/precipitator washwater, and coal pile runoff. Comanagement is more common at impoundments than landfills. The median number of low-volume wastes comanaged at impoundments is eight, while the median at landfills is two. While unlined impoundments were typical 20 years ago, the current trend in utility disposal sites appears to be toward lined landfills with groundwater monitoring.

ACKNOWLEDGMENTS

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EXECUTIVE SUMMARY

The Electric Power Research Institute (EPRI), in cooperation with the Utility Solid Waste Activities Group (USWAG) and individual utility companies, is engaged in a multi-year research effort to generate information related to the comanagement of low-volume and high-volume combustion by-products. The findings from this research will provide technical inputs to a regulatory determination by the United States Environmental Protection Agency on remaining wastes and comanagement practice. As part of that research effort, EPRI conducted a broad survey of the utility industry. The primary objective was to obtain information regarding the types of low-volume wastes utilities currently comanage with high-volume by-products and the general characteristics of the disposal facilities. To ensure a good response, the survey was designed to solicit primarily qualitative and descriptive information that was readily accessible by utility personnel.

The survey was mailed in November 1994 to environmental managers of all utility power plants with at least 100 MW of coal-fired generating capacity. The mailing and subsequent telephone interviews produced information on 323 high-volume coal combustion by-products (CCB) management facilities serving 238 power plants located in 36 states. The power plants in the survey represent about two-thirds of the total coal-fired generation in the United States, generating more than 1 billion megawatt hours of electricity in 1995.

Management Facilities

Of the 323 facilities, 259 are actively operating utility disposal facilities. These facilities reported receiving approximately 70 million tons of high-volume by-products in 1995, about three-quarters of the utility total for that year. About half the facilities were landfills, slightly less than half were impoundments, and a small number were minefills. The trend over the last decade is toward increased use of landfills for disposal rather than ponds.

Size of the utility disposal facilities covered a broad range. Surface areas ranged from 3 acres to 3000 acres, with a median of 80 acres. Disposal capacities ranged from 0.05 million cubic yards to 82 million cubic yards, with a median of 3.5 million cubic yards. The disposal facilities in the survey have been in operation for less than 2 years to more than 60 years, with a median of 16 years of operation (through 1996). On average, ponds have been in operation slightly longer than landfills.

Forty-two percent of the active facilities are lined. The predominant liner material is compacted clay, accounting for about two-thirds of the lined facilities. Synthetic and composite liners account for about one-quarter of the lined facilities. Significantly more landfills are lined than ponds, 57 percent as compared to 28 percent. Twenty-two percent of the facilities reported having leachate collection systems. Three facilities reported having a double liner and leachate collection system.

Comanaged Wastes

Survey results clearly point to the prevalence of comanagement within the industry. Overall, 80 percent of the 259 active disposal facilities comanage at least one low-volume waste. Comanagement is more common at ponds (91 percent) than at landfills (70 percent) or minefills (75 percent). The higher rate for ponds reflects the variety of liquids, such as runoff, cooling tower blowdown, boiler blowdown, and demineralizer regenerant, that can be readily managed in an impoundment. For the same reason, ponds also comanage more types of wastes than landfills. Ponds typically comanage more than five low-volume wastes, with a median of eight waste types per facility. Landfills typically comanage two or three low-volume wastes, with a median of two waste types per facility.

The most commonly comanaged wastes are:

- coal mill rejects — 55 percent of the facilities
- floor/yard drain wastewater — 48 percent of the facilities
- demineralizer regenerant — 44 percent of the facilities
- air heater/precipitator wash — 42 percent of the facilities
- coal pile runoff — 41 percent of the facilities

Some comanagement also occurs during collection and transport of ash and flue gas desulfurization (FGD) by-products. About 39 percent of the facilities that sluice ash use a source of makeup water other than just river/lake water or recirculated pond water. For FGD facilities, 63 percent use a source of makeup water other than just river/lake water or recirculated pond water. The most commonly used sources are low-pressure service water, cooling water and cooling tower blowdown, and runoff.

Regulatory Controls

About 90 percent of the facilities surveyed operate under a permit issued by local, state, or federal regulatory agencies. State-issued permits are by far the most common. Groundwater monitoring is performed at nearly two-thirds of the active facilities. A similar percentage are subject to groundwater quality standards. Site-specific calculated limits and numerical limits (e.g., maximum contaminant levels) are the most common types of standards. Groundwater monitoring is more than twice as common at landfills than at ponds.

Residues from Coburning

Utilities were asked to specify whether the high-volume CCBs disposed at a facility were derived from coburning of other materials with coal. Of the 266 active facilities (including ash use facilities) responding to the survey, about one-third (94 facilities; 35 percent) reported receiving CCBs from plants that coburn at least one other material with coal. Used oil was by far the most common (28 percent of all facilities), followed by contaminated soils (8 percent), low-volume wastes (5 percent), and solid wastes (4 percent). Other materials include petroleum coke, wood products, and solvents.

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INTRODUCTION

The electric utility industry generates more than 100 million tons of fly ash, bottom ash, boiler slag, and flue-gas desulfurization (FGD) sludge each year from the combustion of coal (American Coal Ash Association, 1997). Collectively, these are referred to as "high-volume" coal combustion by-products (CCBs). Historically, about 25 percent of the high-volume by-products have been used for construction materials and other beneficial use applications, while most of the remaining 75 percent have been disposed of in landfills or impoundments. These landfills and impoundments can be owned and operated either by utilities or by others.

Utilities also generate several other wastes associated with fossil fuel combustion, as part of equipment maintenance, water purification, and materials storage and handling. Examples are boiler cleaning liquids, wastewater treatment sludges, water purification residues, boiler and cooling tower blowdown, coal pile runoff, and coal mill rejects. These wastes are commonly referred to as "low volume" wastes, although in some cases their liquid amounts may be substantial (greater than one million gallons per year per generating station.) Most utilities have historically comanaged some or all of these low-volume wastes with their high-volume by-products in land disposal facilities.

The Electric Power Research Institute (EPRI), in cooperation with the Utility Solid Waste Activities Group (USWAG) and individual utility companies, is completing a multi-year research effort to generate field-scale information and scientific results to evaluate environmental effects arising from comanagement of low-volume wastes and high-volume combustion by-products. The findings from this research will provide technical inputs to a regulatory determination by the United States Environmental Protection Agency (EPA) described below.

Regulatory Background

In 1980, U.S. Congressman Thomas Bevill of Alabama sponsored an amendment to the Resource Conservation and Recovery Act (RCRA) that temporarily excluded three broad types of waste from Subtitle C hazardous waste disposal regulations: fossil fuel combustion waste, certain mining wastes, and cement kiln dust (Public Law 96-482, 1980). The rationale for the exclusion was that the wastes were generated in large volumes, there was little existing information regarding their characteristics and environmental behavior, and the potential risks posed by the wastes were believed to be low based on the limited available data. The exclusion from hazardous waste regulations would remain in effect for the three so-called "Bevill wastes" until completion of a comprehensive study of the wastes by the EPA as defined in RCRA Section 8002, and a subsequent determination on whether hazardous waste regulation under subtitle C of RCRA is warranted.

In the case of fossil fuel combustion wastes, the exclusion referred to "fly ash waste, bottom ash waste, slag waste, and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels" (RCRA Sec. 3001 (b) (3) (A)). In 1981, Gary Dietrich, then the EPA Associate Deputy Assistant Administrator for Solid Waste, clarified the EPA's interpretation of the scope of the fossil fuel combustion waste exclusion in a letter to USWAG. The Dietrich letter stated that the exclusion applied to the following:

(a) fly ash, bottom ash, boiler slag and flue gas emission control wastes resulting from (1) the combustion solely of coal, oil, or natural gas; (2) the combustion of any mixture of these fossil fuels; or (3) the combustion of any mixtures of coal and other fuels, up to a 50 percent mixture of such other fuels; and

(b) wastes produced in conjunction with the combustion of fossil fuels, which are necessarily associated with the production of energy, and which traditionally have been, and which actually are, mixed with and codisposed or cotreated with fly ash, bottom ash, boiler slag, or flue gas emission control wastes from coal combustion.

In 1988, the EPA completed its study of coal combustion wastes from electric utilities and issued a Report to Congress finding that high-volume coal combustion by-products do not warrant regulation as hazardous waste under RCRA (U.S. EPA, 1988). When the EPA did not complete the required regulatory determination within six months, a lawsuit filed in 1991 by the Bull Run Coalition led EPA to sign a Consent Decree with a new schedule for completing the determination. The Consent Decree, formally entered on June 30, 1992, divided fossil fuel wastes into two categories with different schedules: high-volume wastes from combustion of coal by electric utilities, and "remaining wastes." Remaining wastes were defined as:

(a) fly ash, bottom ash, boiler slag, and flue gas emission control wastes from the combustion of coal by electric utility power plants when such wastes are mixed with, codisposed, cotreated, or otherwise comanaged with other wastes generated in conjunction with the combustion of coal or other fossil fuels; and

(b) any other wastes subject to Section 8002(n) of RCRA (except fly ash, bottom ash, boiler slag, and flue gas emission wastes from coal combustion by electric utilities).

Remaining wastes therefore include all wastes generated from the combustion of any mixture of coal and other fuels up to 50 percent mixtures of such other fuel, all combustion wastes when the primary fuel is a fossil fuel other than coal, and high-volume wastes from coal combustion when they are comanaged with other wastes generated in conjunction with the combustion of fossil fuels.

In accordance with the 1992 Consent Decree schedule, EPA published a final regulatory determination on high-volume coal combustion wastes in the Federal Register on Aug. 9, 1993. The determination stated that, "Based on all of the available information, EPA has concluded that regulation of the four large-volume coal-combustion wastes as hazardous waste under RCRA Subtitle C is unwarranted" (58 FR 42472). However, the determination was strictly limited to the management of one or more of the four high-volume coal-combustion wastes.

Objective

The primary objective of this survey was to obtain information regarding the types of low-volume wastes utilities currently comanage with high-volume by-products and the general characteristics of the disposal facilities.

Study Approach

An initial survey of about 27 disposal facilities operated by six utilities was performed in 1993 to gather preliminary information on utility waste management practices, and to determine what types of information were readily available. The results of this preliminary survey indicated that comanagement was prevalent, with almost 80 percent of the facilities comanaging at least one low-volume waste with high-volume CCBs. Information on the quantities of comanaged low-volume wastes was not readily available. The results of this initial survey were shared with EPA prior to the August 1993 Regulatory Determination.

A second survey was performed to obtain information from a larger number of utilities. A four-page questionnaire (see Appendix A) was sent to all electric utilities with more than 100 megawatts (MW) of coal-fired generating capacity. The questionnaire requested general information on types of waste comanaged and on construction of the disposal facility. The survey was designed to generate a high response rate and create a representative sample of the industry. The questionnaire, therefore, requested primarily qualitative or descriptive information that was believed to be readily available, rather than quantitative data on the volumes or chemical characteristics of the various low-volume waste types. Several follow-up calls were made over a six-month period following the mailing to increase the response rate.

Results from the second survey are summarized in this report. An electronic data file is also available from EPRI containing information provided by the respondents.

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LOW-VOLUME WASTES

Overview of Waste Types and Management Practices

Utilities manage several by-products and wastes associated with combustion of fossil fuels for generating electricity. These are generally grouped into two broad categories: high-volume combustion by-products and low-volume combustion wastes. High-volume combustion by-products are defined as fly ash, bottom ash, boiler slag, and FGD by-products. High-volume CCBs are largely the inorganic residues contained in the coal that do not combust and are either recovered from the exhaust air stream (fly ash and FGD by-products), or that accumulate in the boiler and are periodically removed (bottom ash and boiler slag).

Low-volume combustion wastes include all wastes generated ancillary to the combustion process and power generation that are not high-volume by-products. The term “low volume” is somewhat of a misnomer in that it includes liquid wastewaters that may be generated in relatively large amounts (millions of gallons per day). However, the quantity of solids in the wastewater is very small relative to the ash and FGD by-product solids with which they are comanaged. Included in the definition of low-volume wastes are any waters or solids that are comanaged in a management facility with high-volume by-products.

High-volume CCBs are typically managed in impoundments or landfills either on or near the power plant property. Low-volume wastes may be routed directly to impoundments, may be combined in an equalization or holding basin prior to the impoundment, or may be treated (individually or collectively) in a wastewater system prior to discharge to an impoundment. Landfills may receive solid low-volume wastes (e.g., mill rejects) directly, and may receive sludges dredged from equalization and wastewater treatment basins and from other plant sources where low-volume wastes are comanaged.

Previous EPRI reports have described the characteristics of several utility low-volume wastes and methods for managing the wastes (EPRI, 1985, 1987, 1992, 1993). The following sections present a brief description of some low-volume wastes included in this survey.

Low-Volume Waste Descriptions

Air Heater, Precipitator Washwaters

Air heaters are heat-exchanging devices that recover waste heat from the flue gas. Heat recovered from the hot air exiting the boiler is used to preheat the incoming combustion air, thereby increasing boiler efficiency (Stultz and Kitto, 1992). Fly ash entrained in the hot flue gases collects on the heat-exchange surfaces of the air heaters. The air heaters are cleaned with low- or high-pressure water spray at a frequency generally ranging from once per month to once per year, depending on operating conditions (EPRI, 1987). The need for cleaning may be dictated by a decline in unit performance. Due to possible condensation of sulfuric acid on the heat exchangers, a source of alkalinity, such as sodium hydroxide, is sometimes added to the cleaning spray for pH control. Air heaters often can be isolated so that cleaning can be performed while the unit is operating. The volume of air heater washwater at a coal-fired plant averages 14.5 gallons per day per megawatt (gpd/MW) (EPRI, 1987).

Similarly, the fireside (outside) of other heat exchanging surfaces such as precipitators, economizers, superheater tubes, and boiler water tubes may be washed on a periodic basis. These deposits are also removed with a water spray that sometimes includes sodium hydroxide to control pH. In some cases, hardened deposits must be removed mechanically. Fireside cleaning usually occurs infrequently during scheduled outages, generating an average flow of 2.9 gpd/MW (EPRI, 1987).

Air heater and fireside washwaters are sometimes referred to as metal cleaning wastes (as are boiler chemical cleaning wastes, described below). The washwaters may be routed to a settling basin, to a wastewater treatment pond, or directly to an ash pond. Neutralization and settling is the most common form of water treatment (EPRI, 1987). Air heater and fireside washwaters are often routed to ash ponds due to their similarity to ash sluice waters (EPRI, 1985).

Boiler Chemical Cleaning Waste

Scale build-up on the waterside (inside) of boiler tubes reduces boiler efficiency and can lead to tube failure due to restriction of water flow. To prevent excessive scale accumulation, the boiler tubes are cleaned on an infrequent basis using a chemical solution. The five most common types of boiler cleaning chemicals are inhibited hydrochloric acid, inhibited hydroxyacetic/formic acids, ammoniated ethylenediaminetetraacetic acid (EDTA), ammonium bromate, and ammoniated citric acid (EPRI, 1992). Inhibitors that prevent deposition of solubilized metals on clean tube surfaces include ammonium bifluoride, sodium nitrite, thiourea, Cutain, and Rodine (EPRI, 1987).

At coal-fired plants, boiler tubes are cleaned about once every two to five years generating an average of 125 gal/MW of wastewater per rinse (EPRI, 1992). A single cleaning may require one to four rinses, depending on the cleaning chemical used. The wastewater generated from boiler tube cleaning, referred to as boiler chemical cleaning waste (BCCW), can contain high concentrations of metals (iron, copper, trivalent chromium, nickel, and zinc), as well as the constituents contained in any solvents and corrosion inhibitors used (EPRI, 1992). Boiler chemical cleaning wastes are sometimes referred to as metal cleaning wastes.

Management of BCCWs may include one or more of the following: routing to ash ponds, pretreatment, on-site treatment in wastewater ponds or tanks, evaporation in a utility boiler, or contract disposal (EPRI, 1992). Pretreatment consists of in-line neutralization and mixing of rinses. Wastewater treatment may include neutralization, chemical precipitation, and filtration. Boiler evaporation consists of pumping the liquid wastes from a holding tank directly into the firebox through one or more atomizing nozzles. Contract disposal may include off-site treatment prior to final disposal of wastewater and/or sludge.

Boiler Blowdown

Boiler water is heated to produce steam in production of electricity. Most utility boilers condense and recirculate boiler water in a closed system. High-purity water is required for efficient steam production; a maximum dissolved solids concentration recommended for boilers operating above 2000 psi is 15 mg/L (EPRI, 1987). Dissolved and suspended solids in boiler water increase with continued circulation through the steam cycle, thereby decreasing efficiency of the boiler operation. To regulate boiler water chemistry, water is periodically removed from the system and replaced with purified water (Stultz and Kitto, 1992). The removed water is referred to as blowdown. Boiler blowdown is usually low in dissolved solids (~15 mg/L) and may contain chemical additives such as phosphate and hydrazine (N_2H_2) to control deposition and corrosion (EPRI, 1987). At some plants, boiler blowdown is performed continuously, at others the process is intermittent. The average quantity of boiler blowdown has been estimated at about 150 gpd/MW at coal-fired plants (EPRI, 1987).

Cooling Tower Blowdown/Sludge

Cooling water is used to cool and condense exhaust steam. Plants with closed-loop cooling systems use cooling towers or ponds to reject heat to the atmosphere and recover cooling water for recirculation. Plants that use once-through cooling systems discharge cooling water to a lake or river without recirculation. About half of utility boilers use closed-loop cooling (U.S. EPA, 1996).

Cooling tower blowdown is the water withdrawn from a closed-loop system in order to control the amount of impurities in the circulating water (Stultz and Kitto, 1992). Cooling tower blowdown contains relatively low levels of dissolved solids. The water may have chemicals added to prevent biofouling (growth of fungi, algae, and bacteria) in the cooling systems and to prevent corrosion in the condensers. The amount of wastewater generated depends on the quantity of water removed from the system. EPA estimated typical blowdown rates between 10,000 gpd/MW and 32,000 gpd/MW for closed-loop coal-fired plants, depending on the source of cooling water (U.S. EPA, 1996).

Solid materials collect in the base of the cooling tower and must be removed on an infrequent basis. This sludge is derived from airborne soil and dust, system debris, and suspended solids in the cooling water (EPRI, 1987). The sludge is removed for disposal about once every one to five years.

Noncontact Cooling Water

Noncontact cooling water refers to water used to cool steam or mechanical equipment via heat exchangers, without direct contact with the heat source. For purposes of this report, noncontact cooling water refers only to the low volumes of water used to cool mechanical equipment, such as pumps. This water is eventually discharged to plant floor drains or other collection points in the plant, and may then be comanaged in ash ponds. The much larger quantity of water used to cool steam in condensers (condenser cooling water) is not included in this wastestream. The portion of noncontact condenser cooling water that may be comanaged is discussed under Cooling Tower Blowdown.

Coal Pile Runoff

Coal pile runoff is an intermittent waste stream produced during periods of rainfall and snowmelt. The runoff is usually collected in a trench around the perimeter of the coal storage pile and initially routed to one or more sumps. It then may be pumped to a wastewater treatment basin or directly to an ash basin, or recycled for use as plant makeup water. The chemical character of coal pile runoff varies with the chemical characteristics of the coal. Eastern bituminous coals can produce acidic leachate, while runoff from subbituminous coal may be alkaline. The quantity of coal pile runoff depends on precipitation and coal pile configuration.

Coal Mill Rejects/Pyrites

Coal preparation prior to use in a pulverized coal boiler includes crushing and grinding. Rocks, metal fragments, minerals, and hard coal may be rejected from the mills. The mill rejects often contain pyrite, a hard iron sulfide (FeS_2) mineral. However, the pyrite content of mill rejects is highly variable, ranging from 6 percent to 86 percent (EPRI, 1987). The higher percentages are associated with eastern bituminous coals, the lower percentages with western subbituminous coal.

The quantity of mill rejects generated at a plant is a function of the coal source, coal preparation at the mine, and the utility mill type. Three plants burning eastern bituminous coal with sulfur contents ranging between 1.5 percent and 3.5 percent sulfur by weight generated between 750 tons and 1200 tons of rejects per 100 MW capacity annually (EPRI, 1987). In a more recent study of 16 plants, mill rejects were generated at rates ranging from 0.15 lbs/hr to 350 lbs/hr, with an average of 350 lbs/hr (EPRI, 1997). The plants in this study each burned 1.8 to 6.5 million tons of coal annually.

Demineralizer Regenerant and Resins

Fossil fuel power plants require large volumes of very pure water for steam production. Ion exchange beds are used to treat boiler makeup water and condensate, exchanging hydrogen or hydroxyl ions on the bed resins for a variety of ionic species in the water. The salts that accumulate on the exchange resins must be periodically removed to "regenerate" the beds for further use. Regeneration consists of passing an acidic or basic solution through the bed to remove the mineral salts and replenish the hydrogen and hydroxyl ions.

Several types of exchange resins are used, depending on source water quality and the specific ions requiring removal. Regeneration is usually performed with either sulfuric acid to remove cations or sodium hydroxide to remove anions, producing a low-pH or high-pH regenerant wastewater with dissolved solids between about 1,000 mg/L and 10,000 mg/L (EPRI, 1987). The beds may be regenerated as infrequently as once per week or as frequently as several times per day. Acidic and basic regenerant cycles may be performed in the same day. The average flow rate for demineralizer regenerant has been estimated as about 100 gpd/MW for a coal-fired plant (EPRI, 1987).

In some cases, the acidic and basic regenerant wastewaters are mixed in an equalization tank for self-neutralization. In others, the demineralizer regenerants are routed directly to a wastewater treatment pond or an ash pond. Spent resins also require disposal when regeneration is no longer effective.

Floor and Yard Drains and Sumps

Floor and yard drains are used to collect area drainage from the plant site. The collected drainage may be routed to sumps as an intermediate storage step prior to entering a wastewater treatment basin or an ash pond. Pump seals, tank leakage, wash water, equipment spray down, and other miscellaneous flows all contribute to floor and yard drain flows. Approximate flow rates have been estimated at about 30 gpd/MW (EPRI, 1987).

Low-Pressure Service Water

Low-pressure service water is general-purpose water at a power plant. Its uses include pump cooling water and equipment cleaning water. Depending on its use, it may be treated with inhibitors to prevent corrosion, biofouling, and scaling. Common corrosion inhibitors include phosphates, silicates, zinc, molybdate, and nitrite (Micheletti, 1995). Chlorine and bromine are used to control biofouling, and synthetic polymers may be used to control scaling. Low-pressure service water is usually collected in floor and yard drains after use.

Wastewater Treatment Sludge

Wastewater treatment sludge is generated in solids settling basins and wastewater treatment basins at power plants. The sludge quantity and composition will reflect characteristics of the influent sources. Influent sources may include coal pile runoff, boiler chemical cleaning rinses, air heater and fireside washwater, demineralizer regenerant, boiler blowdown, and floor and yard drain discharge (EPRI, 1987). Solids are removed from the treatment ponds about once every two years, depending on pond size and influent water quality (EPRI, 1993).

Because of their chemical characteristics, metal cleaning wastes (fireside washwaters and boiler chemical cleaning wastes) are often managed in ponds separately from the other low-volume wastes (EPRI, 1993). Primary constituents found in sludges from metal cleaning waste basins include iron, nickel, cadmium, sulfate, vanadium, and zinc. Sludges from low-volume waste ponds that do not contain metal cleaning wastes are typically low in metals (EPRI, 1993).

Water Treatment Sludge

Raw water may be treated with lime and clarified to reduce dissolved and suspended solids content prior to use in power plant systems (EPRI, 1987). The quantity of sludge produced depends on the amount and quality of the water that is treated. The composition of sludges produced from this treatment process reflects the suspended solids and dissolved solids in the source water, and the treatment additives.

Laboratory Waste

Laboratory wastes generally consist of dilute solutions generated daily during the chemical analysis of coal, soil, and water samples. The quantity of waste generated is very small, in the range of a few drums per year (EPRI, 1993). Typical solutions contain silica, phosphorous, hydrazine, and sodium, and they may be caustic or acidic.

Sanitary Waste

Sanitary wastes at power plants are similar to those produced at any industrial facility. Sanitary sewage flows at industrial facilities range from 8 gpd to 25 gpd per capita (EPRI, 1987).

Plant Site Runoff

Plant site runoff is an intermittent waste stream produced during periods of rainfall and snowmelt. It is the runoff that is not associated with the coal pile or any other specific land use. The runoff may be collected in sedimentation basins or routed directly to ash ponds. The quantity of runoff depends on precipitation and size of the plant.

Dredge Spoils

Dredge spoils are sediments that may be dredged from various surface water locations at a plant site, including rivers, lakes, and ponds. Generation of dredge spoils is intermittent and infrequent.

3

COMANAGEMENT SURVEY

Survey Approach and Definitions

An initial comanagement survey was performed by EPRI in 1993, prior to the final regulatory determination on high-volume coal combustion by-products, to estimate the percentage of the utility industry that might be impacted by the comanagement issue. The preliminary survey included six utilities and 27 disposal facilities. Two important results emerged from that effort. First, it was determined that comanagement was prevalent within the industry, occurring at almost 80 percent of the facilities contacted. Second, it was apparent that quantitative information on comanaged wastes was often either unavailable, or difficult for utilities to assemble.

To obtain more information for the EPA regulatory determination, EPRI undertook a second survey in 1994. The primary goal of this survey was to obtain basic information on comanagement practices from a large number of high-volume CCB disposal facilities. To ensure a good response, the survey was designed to solicit primarily qualitative and descriptive information about the types of wastes that are comanaged, and general features of the management facilities. The questionnaire was kept relatively short, and most questions were easily answered by utility personnel familiar with operation of the management facility. A copy of the questionnaire (Phase I - General Information Survey) is provided in Appendix A.

The survey was mailed in November 1994 to all utility power plants with at least 100 MW of coal-fired generating capacity, based on the 1994 Environmental Directory compiled for the Edison Electric Institute (EEI, 1994). The surveys were sent to a utility environmental manager or equivalent, and they were asked to complete a questionnaire for each active and recently closed disposal facility. Several follow-up calls were made to increase the overall response rate, particularly for utilities with a significant amount of coal-fired capacity, and to clarify ambiguous or unclear answers. Survey responses were collected until mid-1995.

For the purposes of this survey, the following definitions were provided:

> **Disposal facility:** A facility used for final disposition of high volume by-products. Does not include impoundments or other areas used to store ash prior to final disposal or utilization.
>
> **High-volume by-products:** Any of the following four wastes: fly ash, bottom ash, boiler slag, and flue gas desulfurization by-products.
>
> **Comanaged wastes:** Any waste that is not a high-volume by-product and is managed in the same disposal facility with one or more high-volume by-products.

The definition of disposal facility produced some ambiguity in the survey responses. At several power plants, comanagement actually occurs in an intermediate holding basin. For example, bottom ash may be sluiced to a settling basin that also receives the plant's low-volume wastes. Solids dredged from the settling basin, primarily composed of ash, are then dewatered and transported to a high-volume CCB landfill for disposal. Similarly, many utilities combine several predominantly liquid low-volume wastes, but not ash, in an equalization basin, and send only the dredged solids to the high-volume CCB landfill. In those cases, the landfill was considered the comanagement disposal facility, and any low-volume waste comanged in a settling or equalization basin was included as a waste comanged in the final disposal facility. The design and operation of settling or equalization basins were not considered in the survey.

In some cases, questionnaires were completed for facilities that are currently inactive but not officially closed. The facilities do not currently receive wastes, but may at some time in the future. Inactive facilities were treated as closed for purposes of this survey.

Survey Results

Survey Response

Questionnaires were mailed to managers representing 167 utilities (Appendix B). Completed questionnaires were returned by 91 utilities, producing information on 323 high-volume CCB management facilities serving 238 power plants located in 36 states (Figure 3-1). The power plants in the survey represent about two-thirds of the total coal-fired generation in the United States. They burned more than 500 million tons of coal in 1995 and generated more than 1 billion MWh of electricity. The survey results include information from the eight plants that had the most coal-fired generation in 1995, each producing more than 16 million MWh of electricity, as well as the smallest generator in 1995 at 648 MWh. Overall response was skewed toward the larger plants, which generate the largest quantities of CCBs. The median coal-fired generation for all U.S. plants in 1995 was 1.79 million MWh, while median generation among plants in the survey was 2.92 million MWh, based on data compiled by the Energy Information Administration (EIA, 1996).

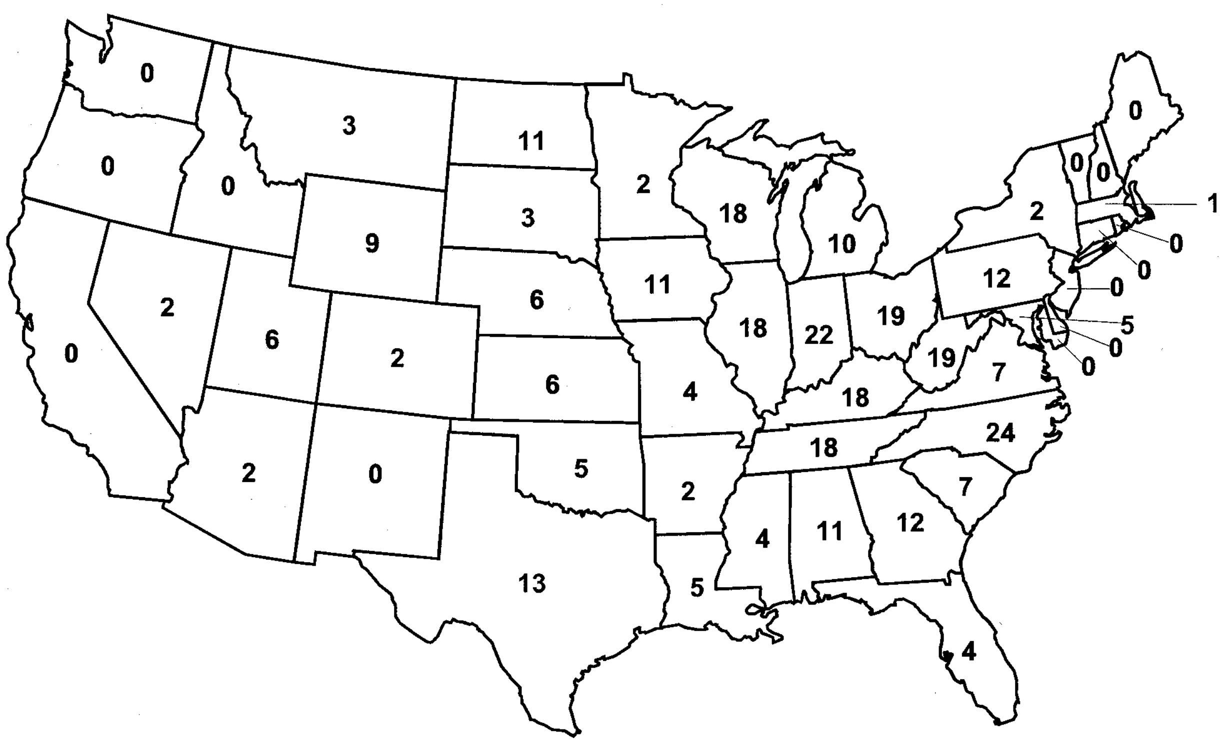


Figure 3-1
Geographic distribution of facilities responding to the comanagement survey

Management Facilities

Types of Facilities and CCB Quantities

Data were received for 323 management facilities serving 238 power plants. Of the 323 facilities, 259 are active disposal units. Responses for these 259 facilities were the basis for most of the data compilation in this report. Fifty-seven of the facilities are closed and were requested to supply only limited information on materials used to cover the site. Five facilities are small beneficial-use applications, and two facilities are independently owned sanitary landfills. These seven facilities were not included in the disposal site data compilations. Three facilities included among the 259 active disposal units are large structural fill sites that are classified as utilization operations rather than disposal facilities. For purposes of this survey, the responses for the large structural fills were grouped with active disposal units due to similarity in design and construction to landfills.

The facilities in the survey reported receiving approximately 70 million tons of high-volume CCBs annually, about three-quarters of the 92 million tons of high-volume CCBs generated in 1995 by the utility industry (ACAA, 1996). Fly ash accounted for 60 percent of the reported CCBs, FGD by-products accounted for 25 percent of the CCBs, and bottom ash and boiler slag made up the remaining 15 percent (Figures 3-2 and 3-3).

Of the 259 active disposal facilities in the survey, 51 percent were landfills, 46 percent were ponds, and 3 percent were minefills (Figure 3-4). This distribution is consistent with overall industry practices as reported in the utility Environmental Directory Database, which lists 53 percent landfills, 43 percent ponds, and 5 percent unknown for ash disposal operations (EEI, 1994). The consistency reinforces that the management facilities in the survey are representative of industry practices.

Although landfills comprise only about half of the disposal facilities, they receive about two-thirds of the total quantity of CCBs for disposal reported in the survey (Figure 3-5). Ponds receive about one-third of CCBs for disposal, while minefills account for less than 5 percent. The proportionately higher disposal at landfills reflects the trend toward increased use of landfills over ponds by utilities in recent years. This trend is evident in Figure 3-4. Disposal units opened prior to 1980 were predominantly ponds, outnumbering landfills by nearly 2:1. For disposal units opening since 1980 those figures have reversed, with landfills outnumbering ponds by more than 2:1.

Some of the plants included in the comanagement survey that use landfills for final disposal also use ponds for collection and temporary storage of high-volume CCBs. At these facilities, the comanagement of low-volume wastes with high-volume CCBs often occurs in the temporary storage ponds, with only the comanaged solids being carried over for final disposal in the landfill. Although information on interim collection and storage was not requested, about 22 percent of the landfills in the survey indicated sluicing at least one high-volume CCB prior to landfill disposal.

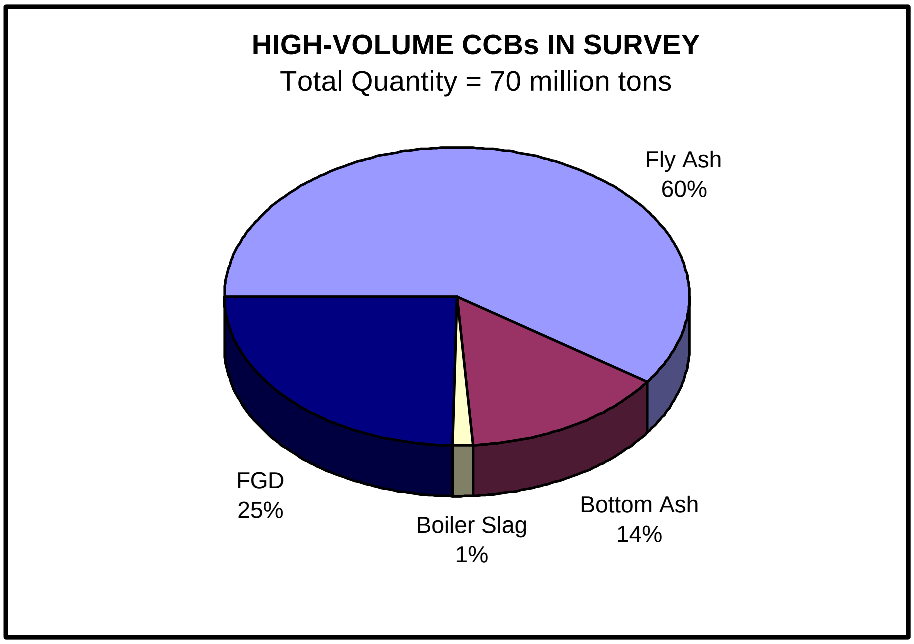


Figure 3-2
Annual quantities of high-volume CCBs represented in the comanagement survey

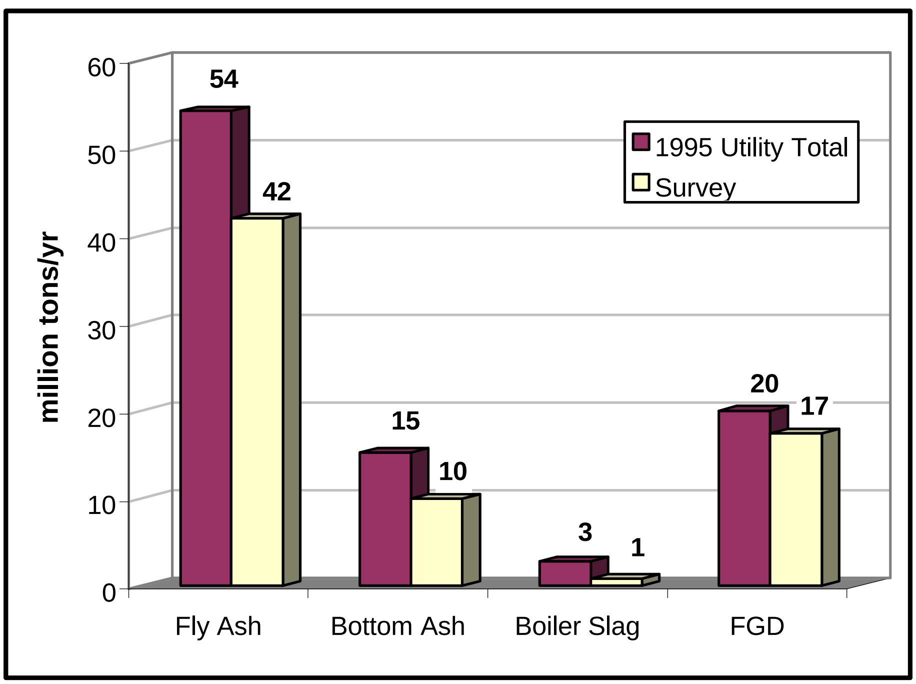


Figure 3-3
Annual disposal quantities by high-volume CCB type

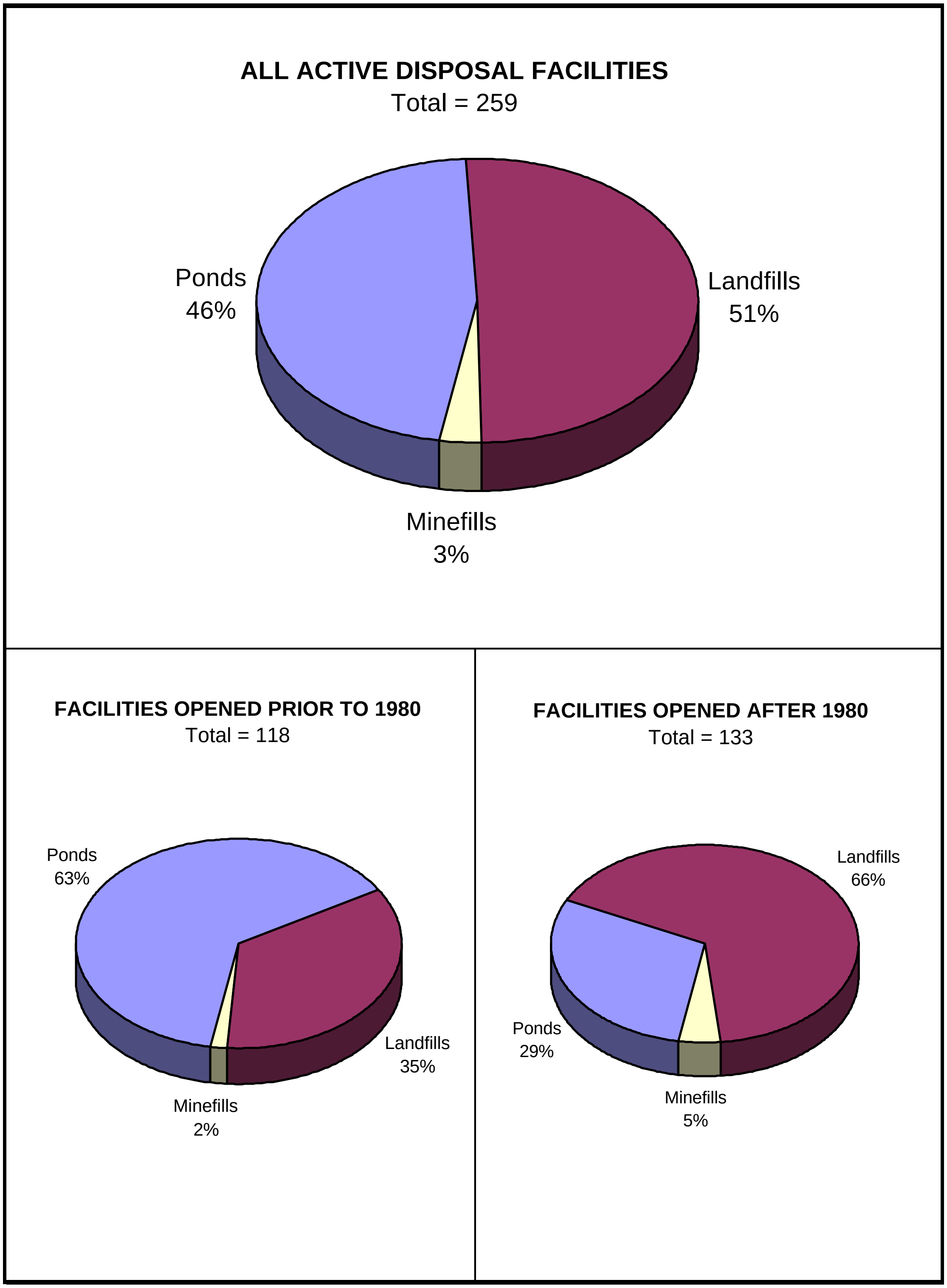


Figure 3-4
Types of CCB disposal facilities represented in the survey

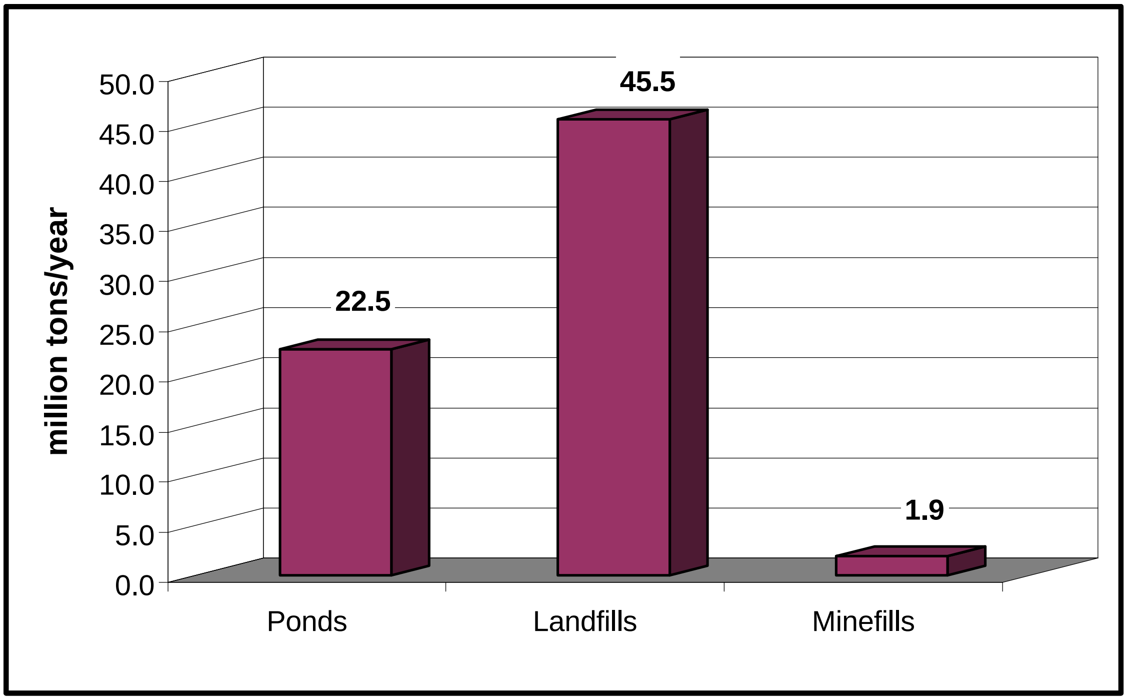


Figure 3-5
High-volume CCB disposal quantities by facility type

Size and Age of Disposal Facilities

Utility disposal facilities range from small to very large in surface area and disposal capacity. The median facility in the survey has a surface area of 80 acres and disposal capacity of 3.5 million cubic yards[1] (Table 3-1; Figure 3-6). Most facilities in the survey had disposal capacities between 0.1 million cubic yards and 8 million cubic yards, although units as small as 0.05 million cubic yards and as large as 82 million cubic yards were reported. Surface areas were typically between 10 acres and 125 acres, with maximum permitted areas in excess of 1000 acres.

Ponds are larger than landfills in surface area, but have slightly smaller median disposal capacity. Minefill sites are significantly larger in median area and capacity than ponds and landfills, however the sample population was relatively small. Total disposal capacity of active facilities reported in the survey was 1.6 billion cubic yards.

Ages of active disposal units in the survey ranged from newly opened to more than 40 years old (Table 3-1; Figure 3-7). The median age of ponds is 22 years, the median age

[1] Disposal capacity in the survey includes both used and available capacity.

of landfills is 15 years. This again reflects the trend toward more landfills and fewer impoundments. Anticipated closure dates for currently active facilities are variable. Median projected closure year was 2010, however 22 facilities were projected to operate until 2030 or beyond. Projected closure dates are highly dependent on several factors external to the disposal facility, such as power plant life and decisions regarding generation and dispatch of individual power plants. The projections are also sensitive to estimates for CCB utilization, which many utilities are optimistic will significantly increase over the next several years.

Table 3-1
Size, Capacity, Year Opened, and Anticipated Closure of Utility Disposal Facilities Responding to the Survey

	Number of Facilities Responding	Minimum	Median	Maximum
Size		--------------- acres ---------------		
Ponds	111	5	91	1500
Landfills	125	3	68	900
Minefills	8	9	128	3000
All Facilities	244	3	80	3000
Disposal Capacity		--------------- cubic yards ---------------		
Ponds	107	99,935	3,420,000	63,000,000
Landfills	111	60,000	3,700,000	82,000,000
Minefills	7	51,200	12,373,100	26,400,000
All Facilities	225	51,200	3,500,000	82,000,000
Year Opened		--------------- year ---------------		
Ponds	114	1949	1975	1994
Landfills	129	1950	1982	1995
Minefills	8	1930	1986	1993
All Facilities	251	1930	1980	1995
Anticipated Closure Year		--------------- year ---------------		
Ponds	87	1995	2013	>2045
Landfills	117	1993	2009	>2045
Minefills	4	1999	2015	2034
All Facilities	208	1993	2010	>2045

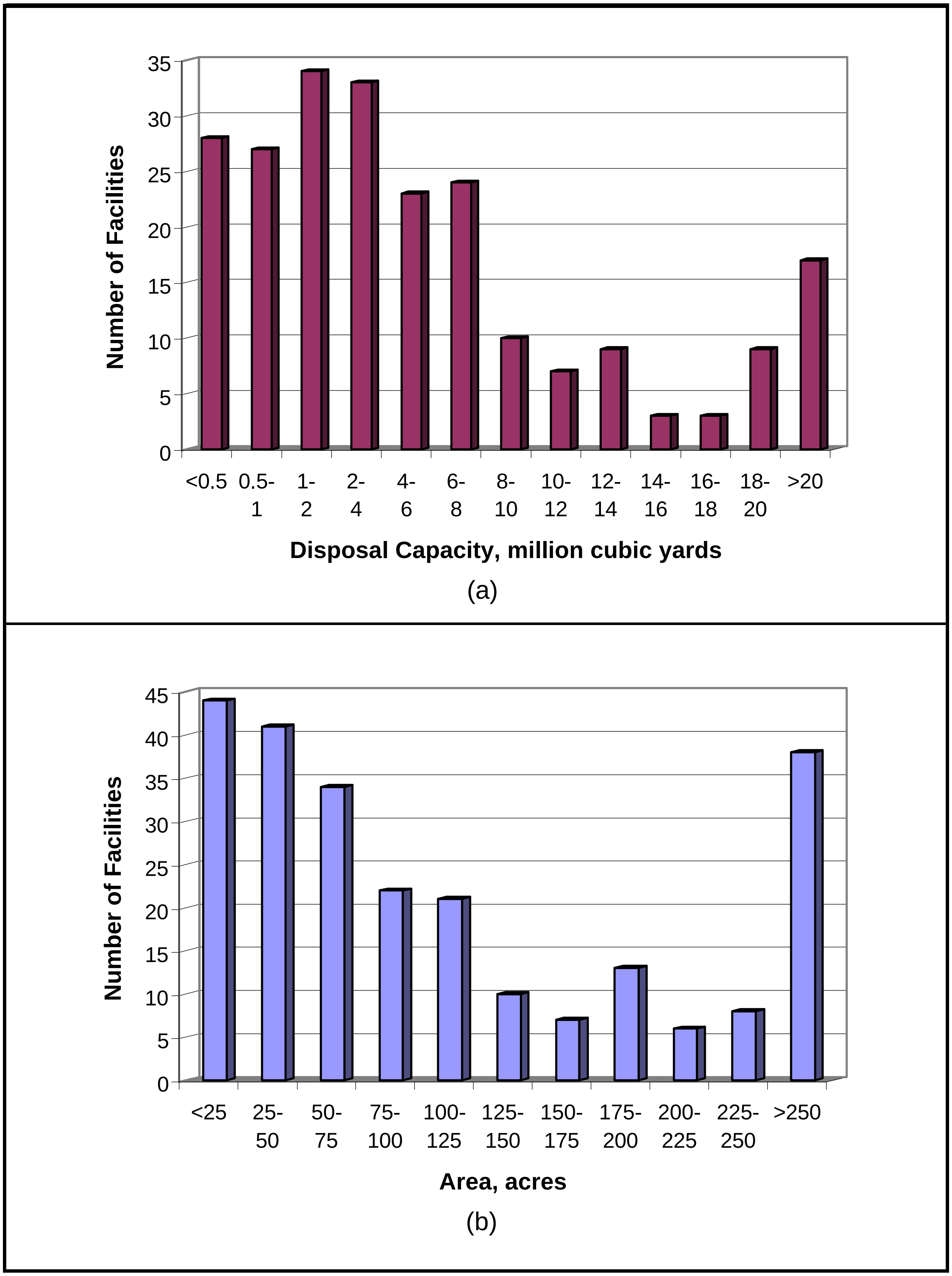


Figure 3-6
Disposal capacity (a) and area (b) of disposal facilities responding to the survey

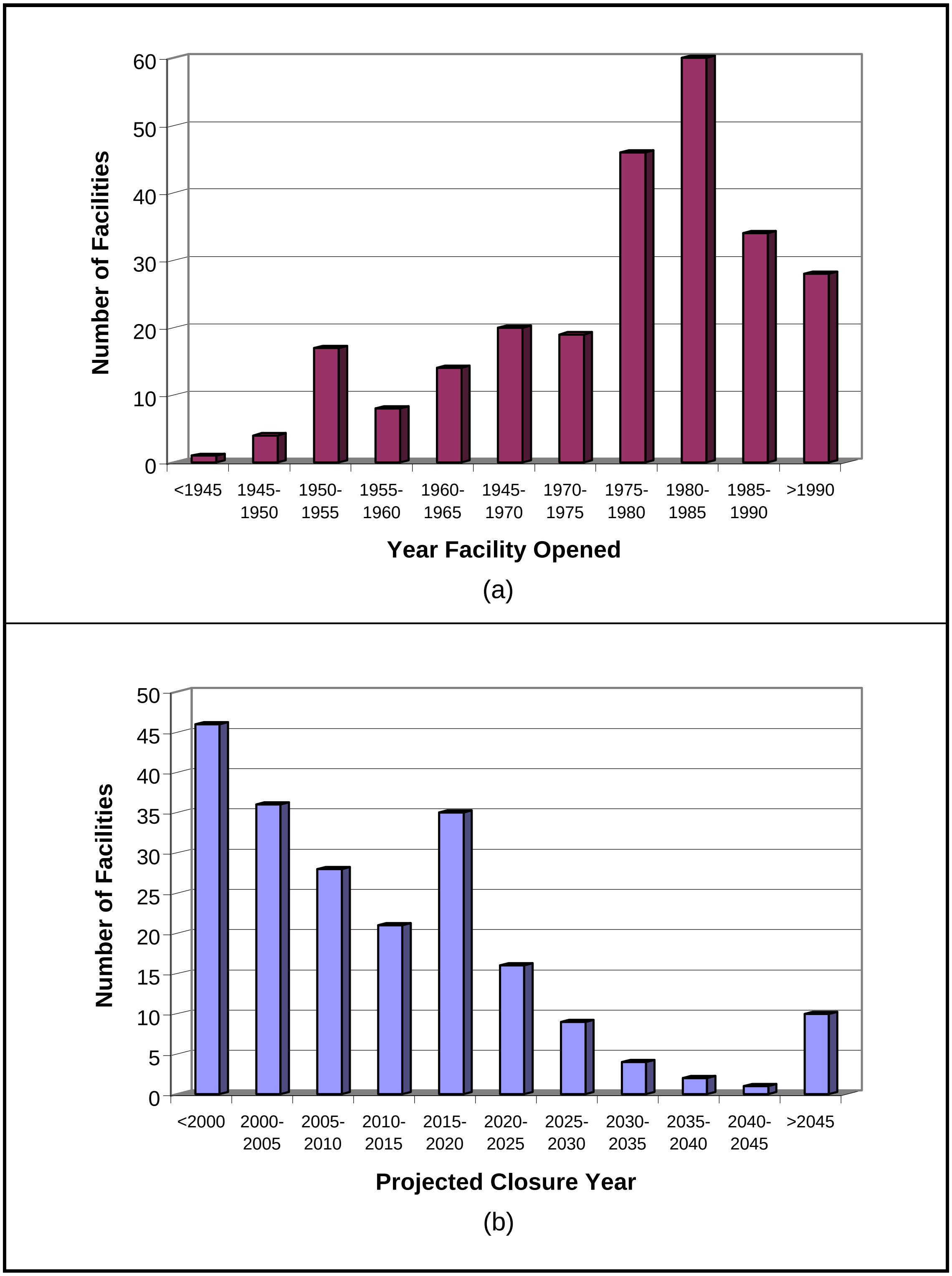


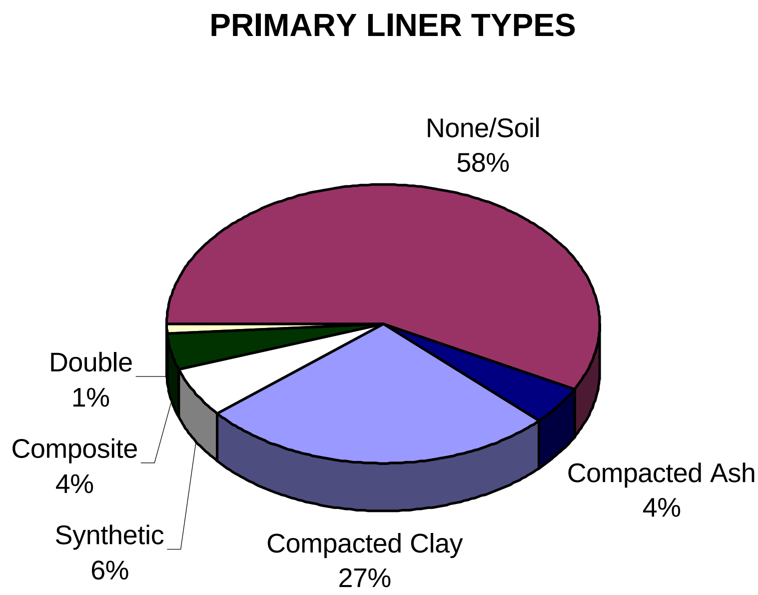
Figure 3-7
Year opened (a) and projected closure year (b) for disposal facilities responding to the survey

Liners

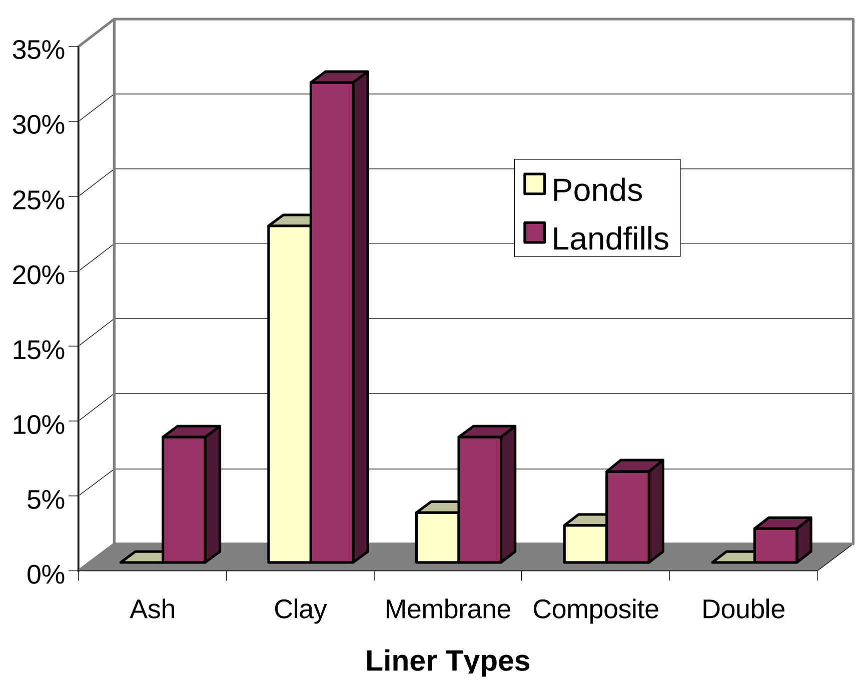
Forty-two percent of all respondents reported construction of an engineered bottom liner at active disposal facilities. For this analysis, the most recently constructed portions of the active disposal areas were considered. For example, a facility with an old unlined section and newer lined section was included among the lined facilities. Facilities that specified low-permeability natural soils (e.g., lakebed clay or bedrock) were included among the unlined facilities.

The predominant liner material at utility sites is compacted clay, accounting for about two-thirds of the lined facilities (Figure 3-8a). Synthetic and composite liners account for about one-quarter of the lined facilities. A significantly higher percentage of landfills are lined than ponds, 57 percent as compared to 28 percent. This again reflects the more recent construction of landfill units, as well as the ability to more readily change design features of sub-units within a landfill. Landfills had higher percentages of all liner types than impoundments (Figure 3-8b).

Trends in liner use are further illustrated in Figure 3-9. Of 83 currently active facilities constructed prior to passage of RCRA in 1976, less than one-fifth are lined. Of 106 facilities constructed between 1976 and 1985, half are lined. Of 62 facilities constructed since 1986, more than two-thirds are lined. These numbers may slightly under-represent the percentage of new units that are lined, since some pre-1985 landfills shown as lined may be lined only in their newly constructed phases. Compacted clay continues to be the predominant liner material in new construction, although the use of synthetic and composite liners has also increased. Fifty-eight facilities (22 percent) reported having a leachate collection system. The numbers for landfills are most meaningful, since lined ponds essentially "collect" leachate at the pond outfall. Fifty-four landfills (41 percent) reported having a leachate collection system.



(a)



(b)

Figure 3-8
Liners in the most recently constructed disposal areas of all active disposal facilities (a), and by facility type (b)

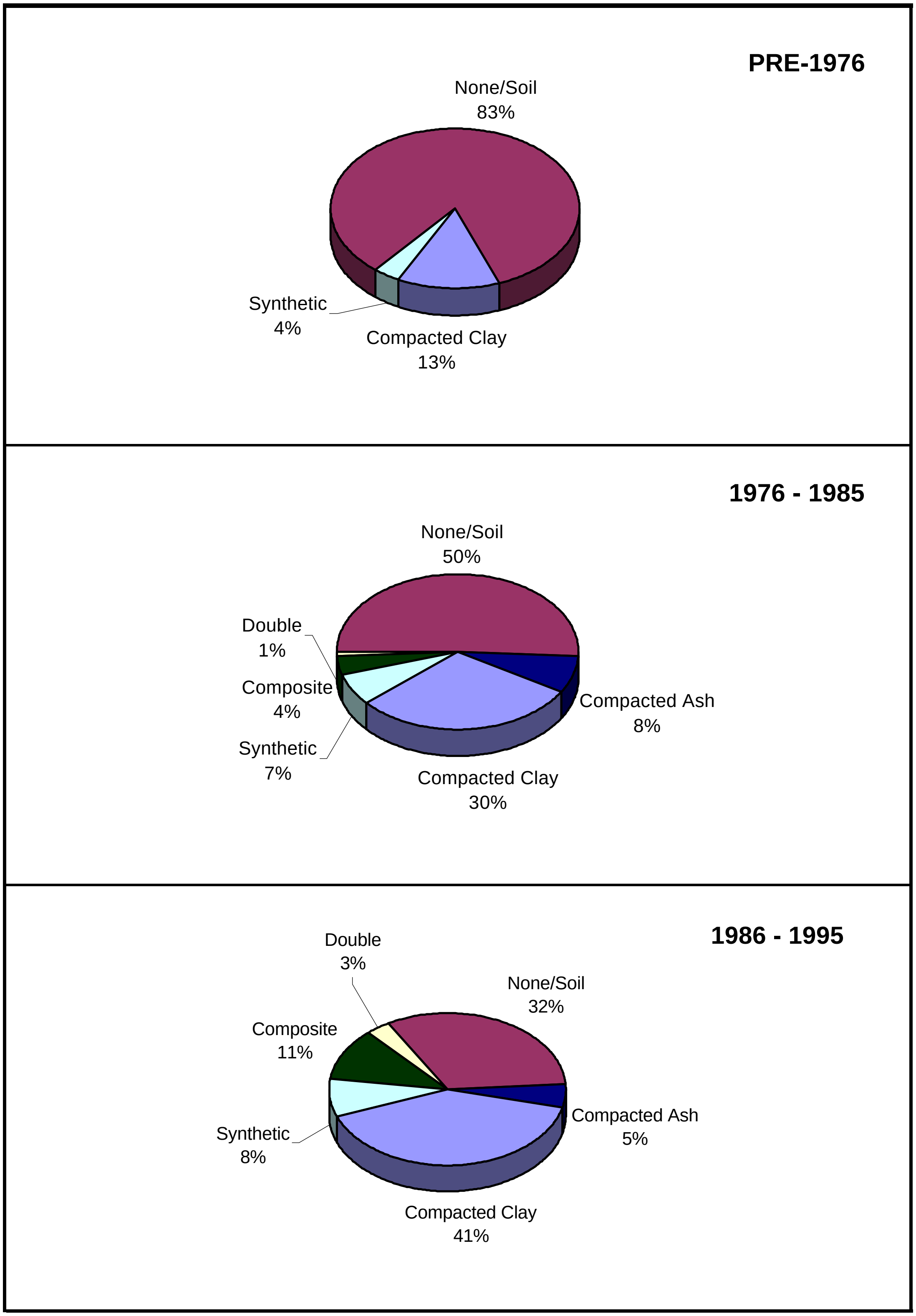


Figure 3-9
Trend in liners used at utility disposal facilities

Covers

Information on cover materials for closed sites and closed portions of active sites was also requested in the survey. A total of 206 facilities responded—53 closed facilities and 153 active facilities. Figure 3-10 shows the primary capping materials used at 204 of the sites.

About one-fourth of the sites indicated either no cover, compacted or uncompacted ash, or direct vegetation on ash. Forty-three percent reported primary capping materials that included topsoil, compacted or uncompacted native soils, or sand. Thirty percent indicated a compacted clay cap, and 2 percent indicated a synthetic cap. Responses for some of the active facilities may include interim covers prior to final closure. Two facilities reported "other" covers. In one case, a new landfill was built on top of a closed unit. In the second case, a coal storage pile was located on top of the disposal unit.

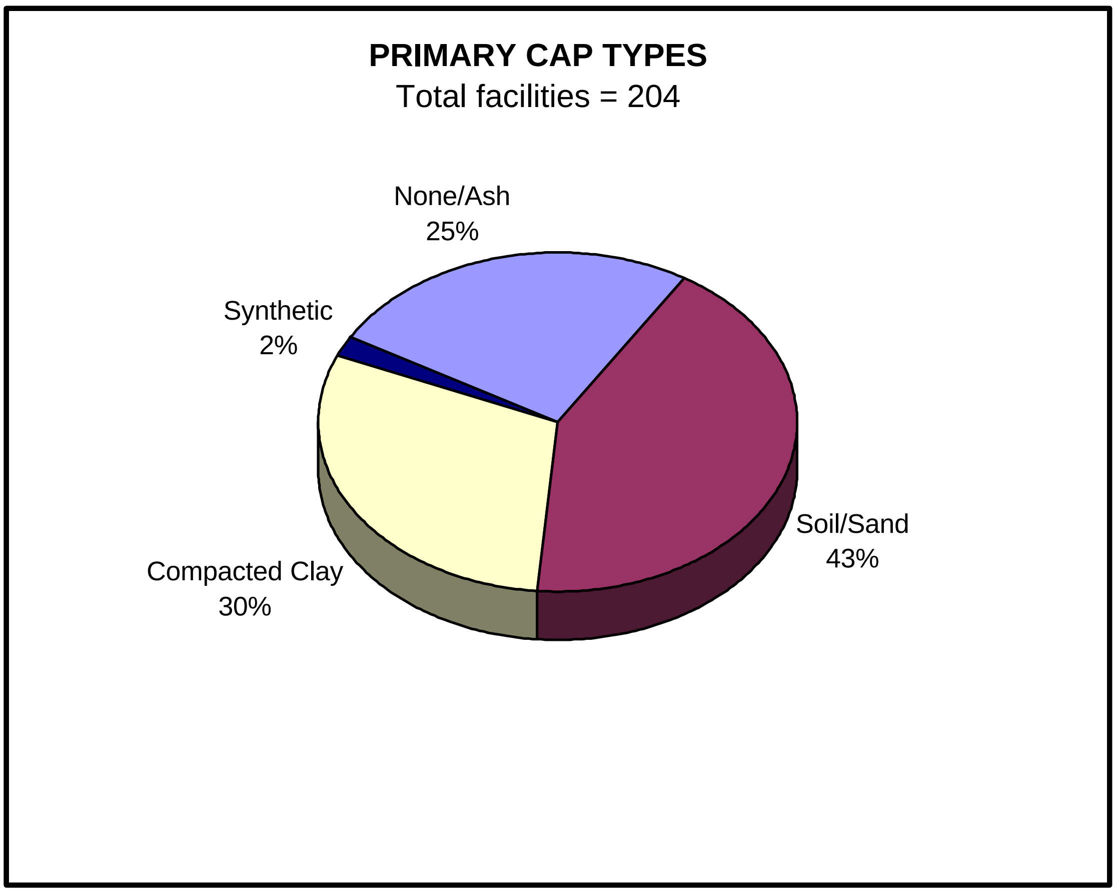


Figure 3-10
Primary capping materials used in covers at utility disposal facilities

Comanaged Wastes

Types of Comanaged Wastes

Survey information was requested on the types of low-volume wastes comanaged with high-volume CCBs at the disposal facilities. The survey listed 20 low-volume wastes, and provided space for other wastes not listed (Appendix A, Question 4). To the extent possible, "other" wastes were grouped with like wastes to facilitate analysis. Responses were not distinguished by the mode of comanagement, for example, whether the wastes were initially comingled in an interim storage facility or directly in the disposal facility.

Survey results clearly indicate the prevalence of comanagement within the industry (Table 3-2). Overall, 80 percent of the 259 active disposal facilities comanage at least one low-volume waste. Comanagement is more common at ponds (91 percent) than at landfills (70 percent) or minefills (75 percent). The higher rate for ponds reflects the variety of liquids, such as runoff, cooling tower blowdown, boiler blowdown, and demineralizer regenerant, that can be readily managed in an impoundment.

Table 3-2
Summary of Comanagement Practices by Facility Type

	Ponds	Landfills	Minefills	Total
Facilities in Survey	120	131	8	259
Facilities that Comanage[1] (%)	91%	70%	75%	80%

[1] One or more low-volume wastes

Figure 3-11 graphically illustrates percentages of facilities that comanage 16 wastes accepted in at least 10 percent of the disposal units. The most commonly comanaged wastes are coal mill rejects, with a positive response from more than half of the 259 active disposal facilities in the survey. Floor and yard drain discharge, demineralizer wastes, air heater ash, and coal pile runoff were the next most common, all comanaged in more than 40 percent of the facilities surveyed.

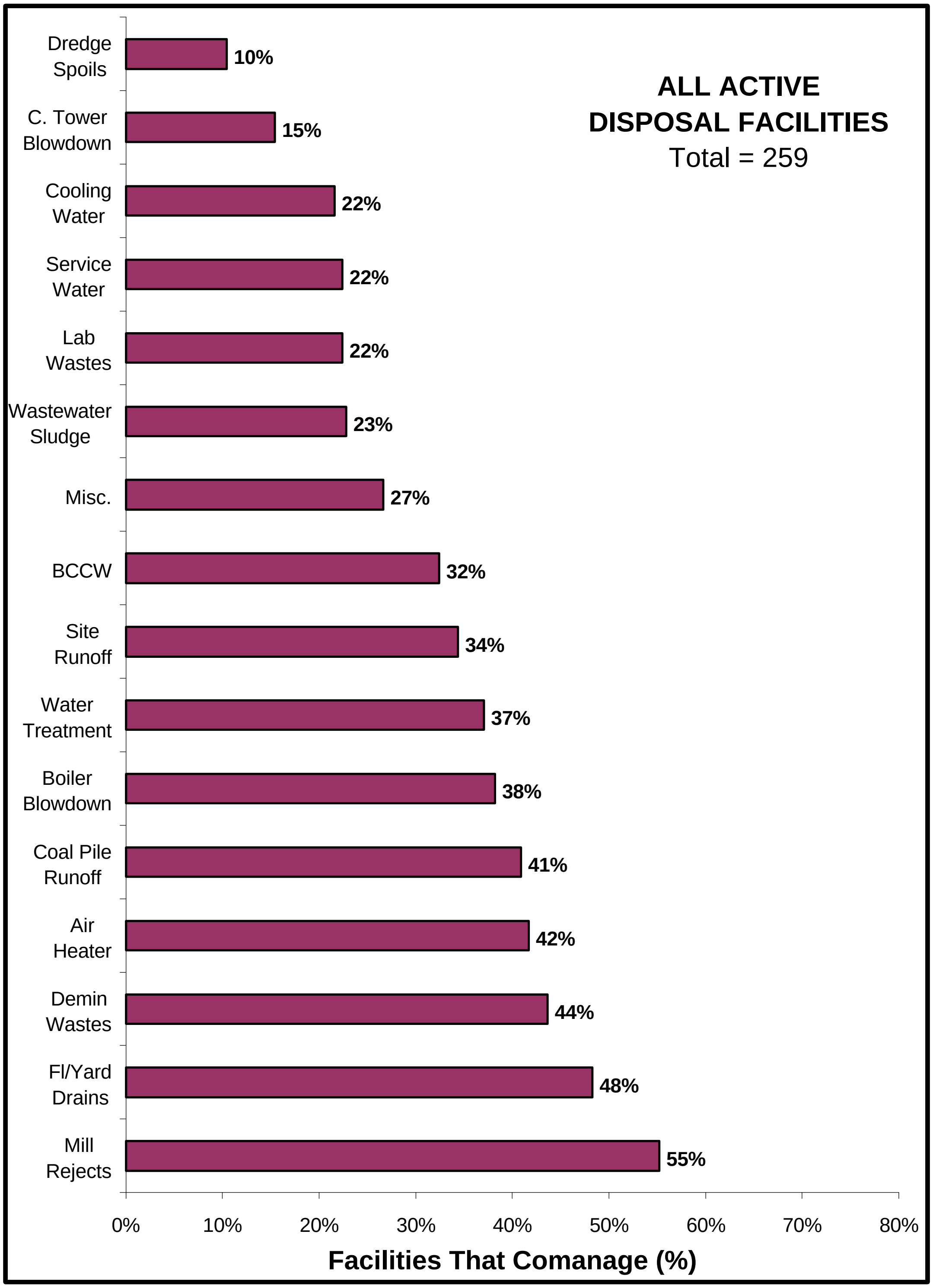


Figure 3-11
Low-volume wastes comanaged in high-volume CCB disposal facilities of all types

The differing practices at ponds and landfills are illustrated in Figure 3-12. For all wastes shown except coal mill rejects, wastewater sludge, and dredge spoils, the percentage of comanaging facilities is two to three times higher for ponds than landfills. Eight different wastes are comanaged at more than 50 percent of the ponds in the survey; none of the wastes are comanaged at more than 50 percent of the landfills and only coal mill rejects are comanaged at more than 25 percent of the landfills surveyed. Wastewater treatment sludge is the only waste in Figure 3-12 that is comanaged in a higher percentage of landfills than ponds. The prevalence of comanagement at ponds compared to landfills again reflects the nature of low-volume waste liquids that are readily managed in impoundments.

As implied by these percentages, the number of comanaged wastes in an individual facility is also significantly greater for ponds than landfills (Figure 3-13). Ponds typically comanage more than five low-volume wastes, with a median of eight low-volume wastes per facility. Landfills typically comanage two or three low-volume wastes, with a median of two waste types per facility.

Quantities of Comanaged Wastes

As previously discussed, disposal quantities for low-volume wastes are not readily available. Utilities were asked in the survey to estimate the total annual quantities of solids and liquids comanaged at each facility. Estimates were received from 163 of the 208 facilities that comanage wastes (78 percent). The results are summarized in Table 3-3.

Table 3-3
Summary of Low-Volume Comanaged Waste Quantities

	Ponds	Landfills	Minefills	Total
Facilities that Comanage[1]	111	91	6	208
Liquids				
Number of facilities	88	20	1	109
Quantity (million gal/year)	136,556	12,229	150	148,935
Solids				
Number of facilities	49	45	5	99
Quantity (million yds^3/year)	1.55	2.28	0.04	3.87

[1] One or more low-volume wastes

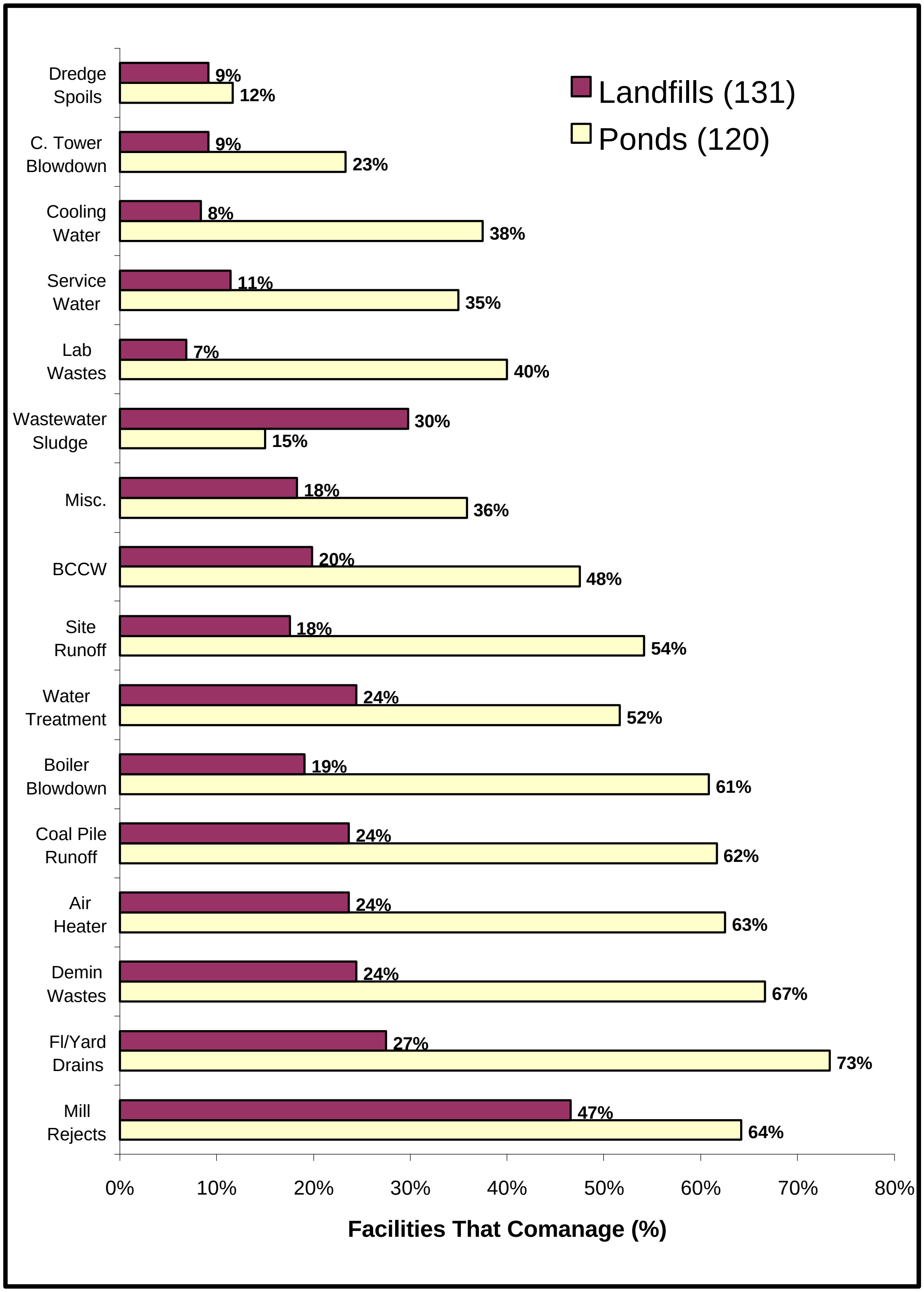


Figure 3-12
Low-volume wastes comanaged in high-volume CCB ponds and landfills

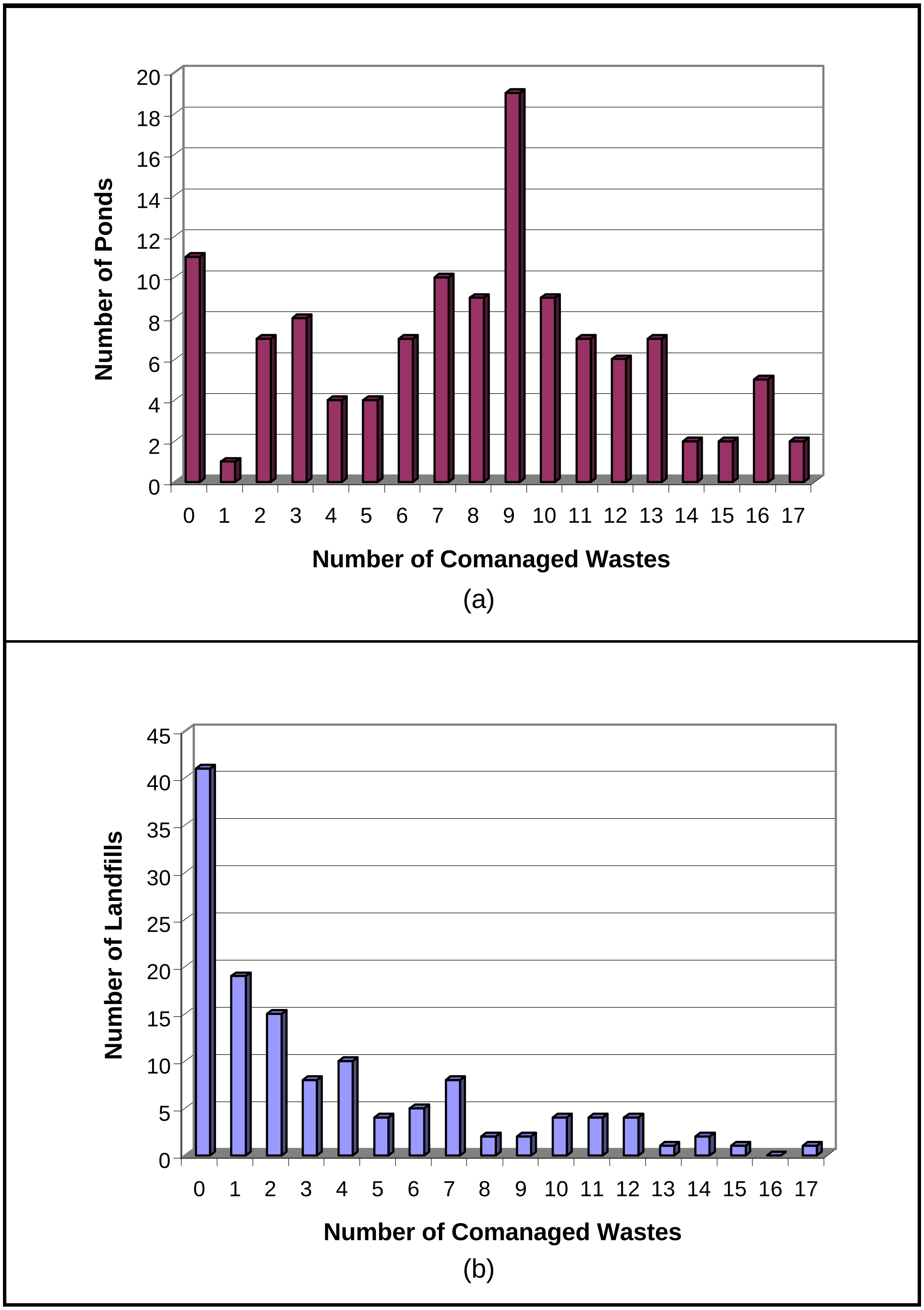


Figure 3-13
Number of low-volume wastes comanaged with high-volume wastes at individual ponds (a) and landfills (b)

The total liquid amount reported as comanaged was 149 billion gallons per year. Most of the liquids (91 percent) are comanaged at ponds. The average amount comanaged in ponds is 4.3 million gallons per day per facility. The average amounts for landfills and mines are 1.7 million gallons per day per facility and 0.4 million gallons per day per facility, respectively[2]. In most cases, the comanaged liquids likely contain at most only a few percent solids, and many large volume liquids contain much less than 1 percent solids (e.g., boiler and cooling tower blowdown). Assuming these liquids contain an average range from 0.1 percent solids to 1.0 percent solids, the total solids contribution from all of the reported liquid wastes is 0.7 million cubic yards to 7.4 million cubic yards annually for the facilities responding to the survey.

The total solids quantity reported as comanaged was 3.87 million cubic yards per year. More than half of this total was reported for landfills. The average rates of comanaged solids disposal for reporting facilities are 0.03 million cubic yards per facility per year for ponds, 0.05 million cubic yards per facility per year for landfills, and 0.008 million cubic yards per facility per year for minefills.

Based on these estimates, the range of total quantity of solids disposed of at the reporting facilities is 4.6 million cubic yards per year to 11.3 million cubic yards per year. Since 22 percent of the facilities that reported comanaging wastes did not report quantities, the total quantity may be 22 percent higher, or about 5.9 million cubic yards to 14.5 million cubic yards. This represents 9 percent to 23 percent of the 63 million cubic yards of high-volume CCBs reported by the facilities responding to the survey.

Ash Transport and FGD Makeup Water

Some comingling of low- and high-volume CCBs also occurs during the collection and transport process. Figure 3-14 shows the sources of make-up water for facilities that sluice ash or have wet FGD systems, and the percentages of facilities that use those sources. For example, 15 percent of facilities that sluice ash use cooling tower blowdown in the transport water.

The two most common sources of makeup water for sluicing and FGD systems are rivers/lakes and recirculated pond water. Neither of these sources suggest comanagement in themselves. Overall, 39 percent of the facilities that sluice ash use a source of makeup water other than just rivers/lakes or pond recirculation. Similarly, 63 percent of FGD facilities use a source of makeup water other than just rivers/lakes or pond recirculation. With the exception of low-pressure service water, no other individual sources were used at more than 25 percent of the facilities in the survey.

[2] The liquids reported as comanaged at landfills may reflect liquids comanaged in ponds prior to removal of solids and disposal in the landfills.

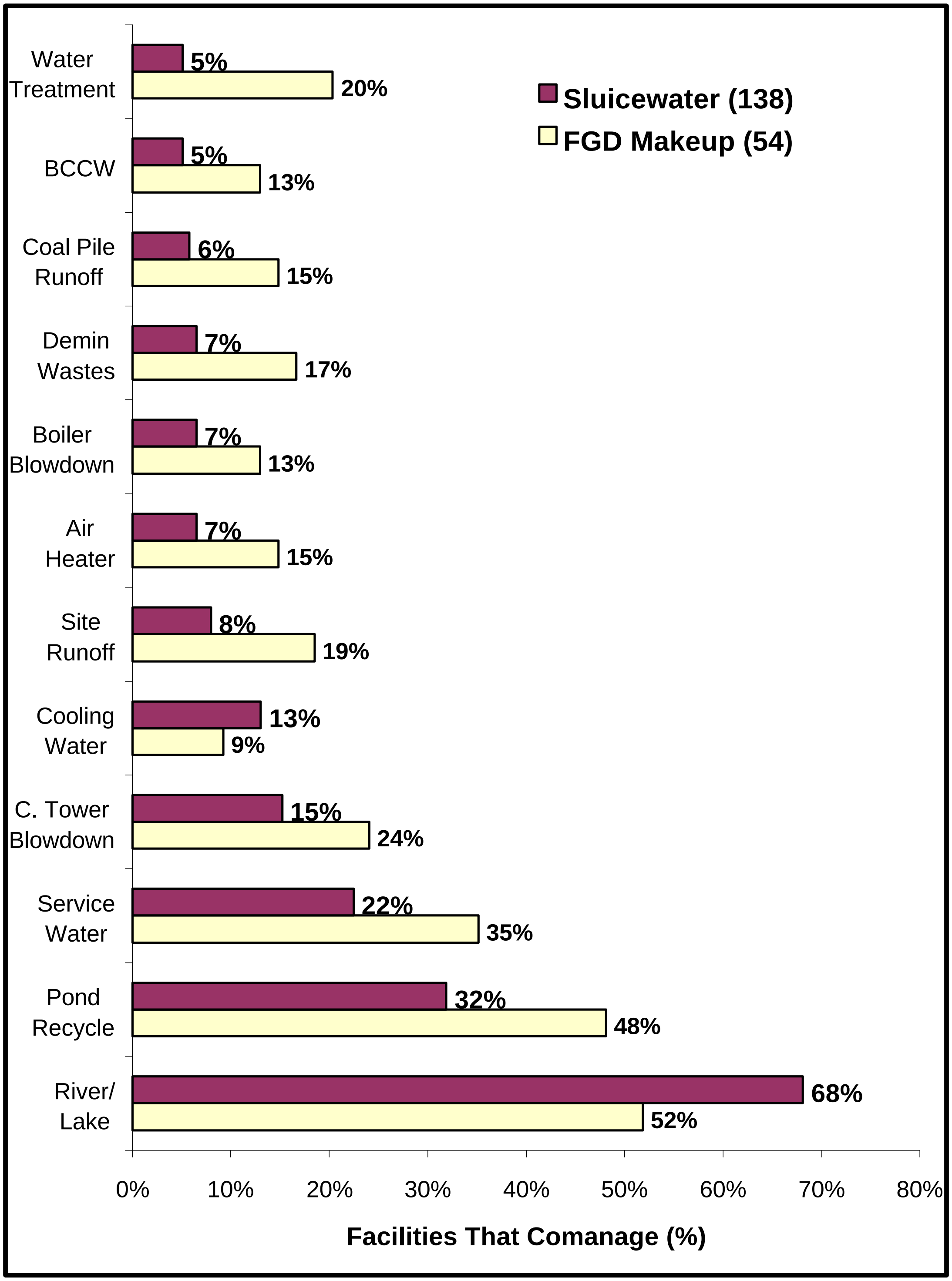


Figure 3-14
Waters and wastewaters used in ash transport and FGD makeup water. Value is expressed as percentage of disposal facilities in the survey that sluice ash (138) or employ FGD controls (54)

Changes in Comanagement Practices

Utilities were asked to list comanaged wastes that they permanently stopped sending to the disposal facilities within the three years prior to the survey. Twenty-three facilities responded to this question. Eleven listed boiler chemical cleaning wastes, four listed demineralizer wastes, two listed coal pile runoff, and one listed all liquid wastes. Other wastes listed for one facility each were coal mill rejects, asbestos, treatment plant sludge, boiler blowdown, cooling water, contaminated soils, site runoff, fly ash sluice water, miscellaneous plant wastes, and oil ash.

Regulatory Controls

A large majority of facilities surveyed (90 percent) operate under a local, state, or federal permit or license (Figure 3-15). State regulation is by far the most common, applying to more than 80 percent of all ponds and landfills. Less than 10 percent of ponds and landfills have local or federal permits.

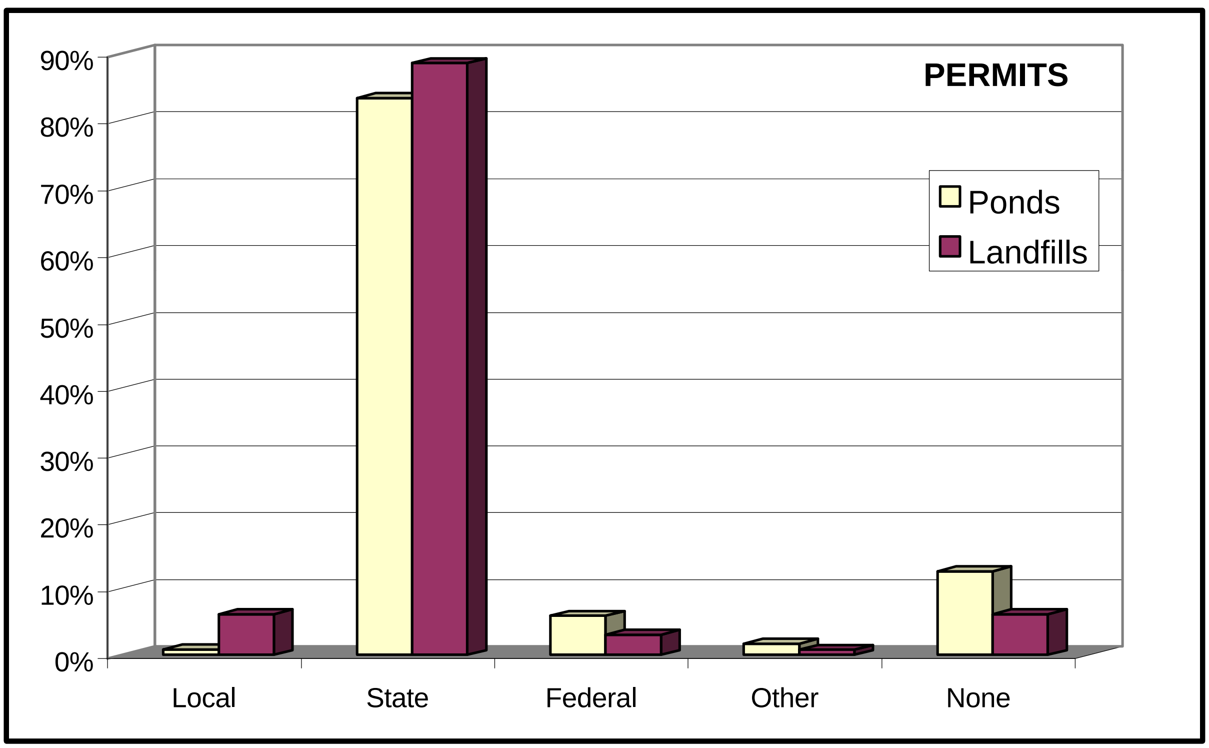


Figure 3-15
Percentage of active disposal facilities in the survey with permits or licenses

Groundwater standards apply at 62 percent of the facilities in the survey (Figure 3-16). The most common types of standard are site-specific statistical limits, applying to 41 percent of the facilities surveyed. These standards are typically tied to background concentrations, and include anti-degradation standards. Numerical limits, such as federal maximum contaminant levels (MCLs) or state-listed groundwater quality standards, are employed at 31 percent of the facilities. About 2 percent of the facilities were subject to narrative standards. Some facilities are subject to more than one type of regulatory limit.

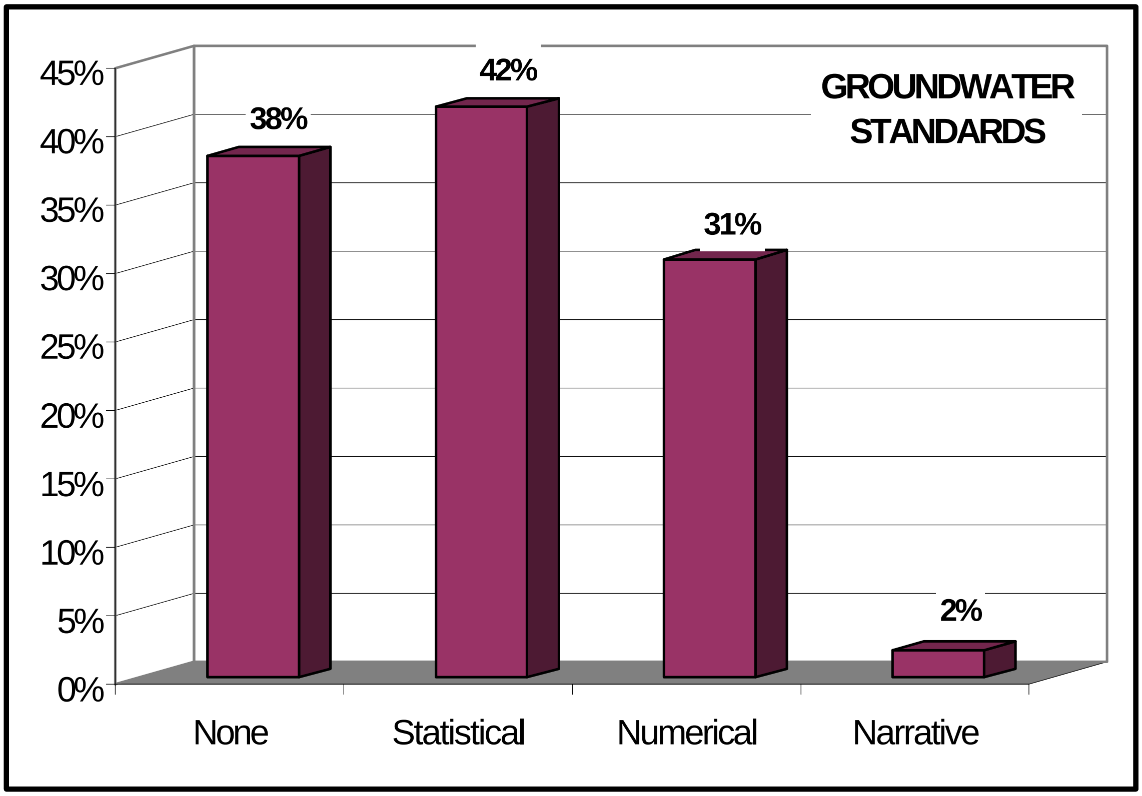


Figure 3-16
Percentage of disposal facilities in the survey subject to groundwater standards

Groundwater monitoring has become more common at utility disposal facilities as states implement solid waste disposal regulations and groundwater quality standards. Currently, 63 percent of all active disposal facilities monitor groundwater. It is most common at landfills, 84 percent of which responded yes to groundwater monitoring in the survey (Figure 3-17). Sixty-three percent of minefills and 39 percent of ponds indicated groundwater monitoring. As with liners, there is a trend toward increased groundwater monitoring at newer facilities. When only those facilities that opened since 1980 are considered, 79 percent indicate they currently monitor groundwater.

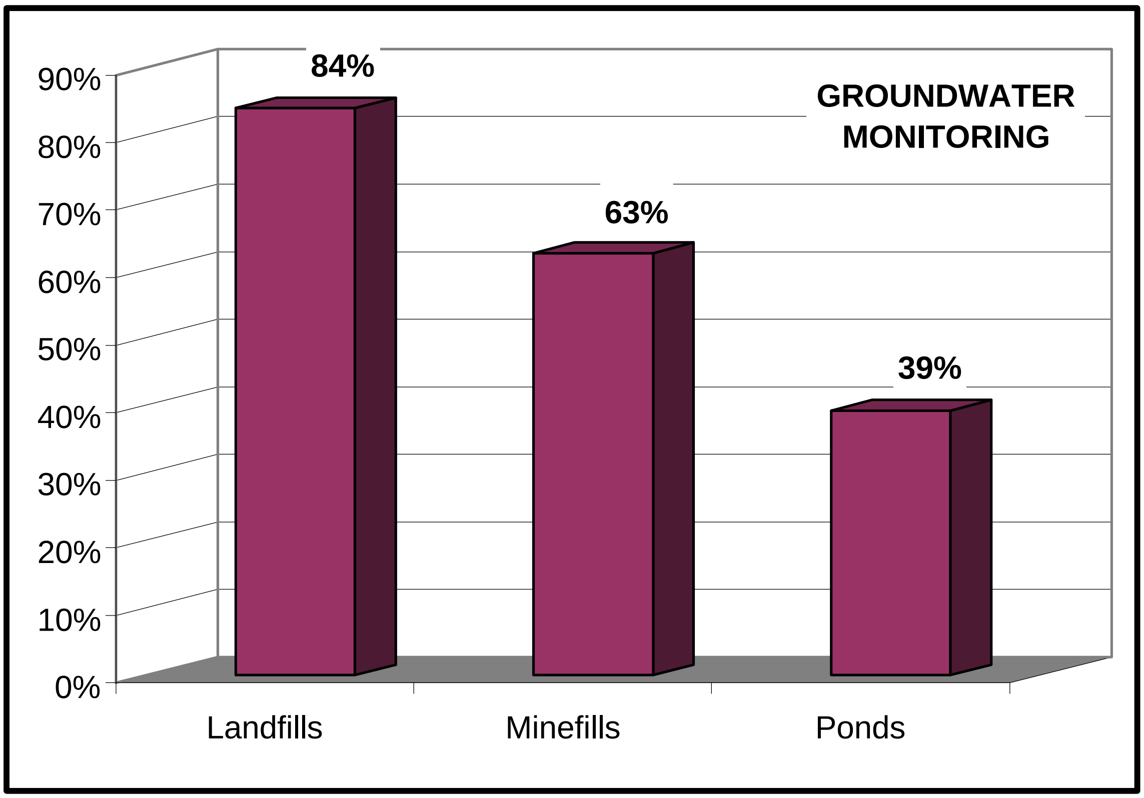


Figure 3-17
Percentage of disposal facilities in the survey that monitor groundwater

Residues From Coburning

Utilities were asked to specify whether the high-volume CCBs disposed at a facility were derived from coburning of other materials with coal. Of the 266 active facilities in the survey (including ash use facilities), about one-third (94 facilities; 35 percent) reported receiving CCBs from plants that coburn at least one other material with coal (Figure 3-18). Used oil was by far the most common (28 percent of all facilities in the survey), followed by contaminated soils (8 percent), low-volume wastes (5 percent), and solid wastes (4 percent). Other materials include petroleum coke, wood products, and solvents.

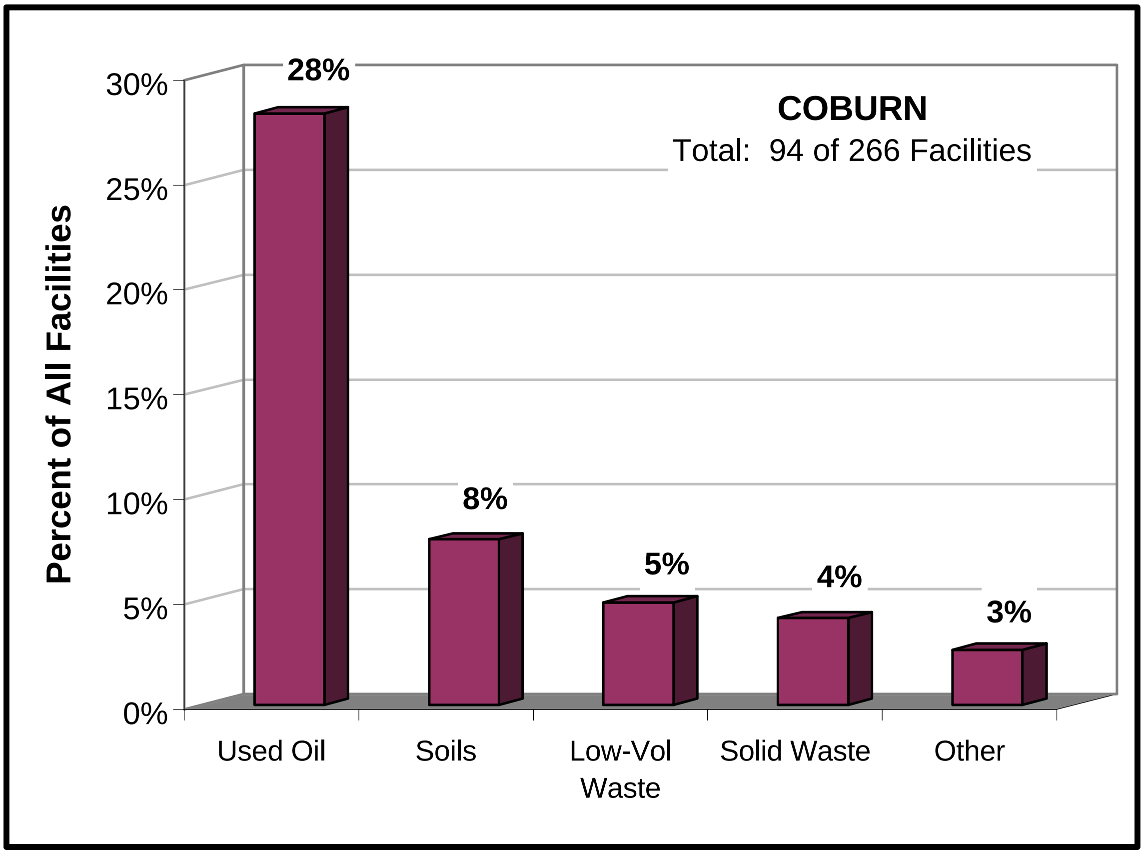


Figure 3-18
Disposal and beneficial reuse facilities that receive by-products from coburning

4

REFERENCES

American Coal Ash Association (ACAA). *1996 Coal Combustion Product (CCP) Production and Use.* ACAA, Alexandria, VA, 1996.

Edison Electric Institute (EEI). *Environmental Directory Data Base*. September 1994.

Energy Information Administration (EIA). *1995 Monthly Electric Power Plant Data*.

EPRI. *Characterization of Utility Low-Volume Wastes*, Report No. CS-3737, May 1985.

EPRI. *Manual for Management of Low-Volume Wastes From Fossil-Fuel-Fired Power Plants*, Report No. CS-5281, July 1987.

EPRI. *Boiler Chemical Cleaning Waste Management Manual*, Report No. TR-101095, August 1992.

EPRI. *Options for Handling Noncombustion Wastes (Second Edition)*, Report No. TR103010, December 1993.

EPRI. *Characteristics and Management of Mill Rejects at Electric Power Plants*, Draft Report No. TR108994, August 1997.

Micheletti, W.C. "Comprehensive Treatment Meets Service Water System Challenge," Power Engineering, October 1995, pp 29-30.

Stultz, S.C. and J.B. Kitto (eds.). *Steam: Its Generation and Use (40th Edition)*, The Babcock and Wilcox Co., Baberton, Ohio, 1992.

U.S. EPA. *Report to Congress: Wastes from the Combustion of Coal by Electric Utility Power Plants*, EPA Report No. EPA/530-SW-88-002, February 1988.

U.S. EPA. *Preliminary Data Summary for the Steam Electric Point Source Category,* Office of Water, Engineering and Analysis Division, April 1996.

A

SURVEY QUESTIONNAIRE

COAL COMBUSTION WASTE CO-MANAGEMENT

Phase I - General Information Survey

The Electric Power Research Institute (EPRI) and the Utility Solid Waste Activities Group (USWAG) are sponsoring this survey of utilities with coal-fired generating stations to gather critical data on the co-management of high-volume combustion wastes with other utility wastes. The survey results will be used as supporting data for the Environmental Protection Agency's determination on the regulatory status under RCRA's Bevill Amendment of co-managed wastes generated at electric utility stations. This determination is scheduled to be issued in 1998.

The surveying will be done in two phases. In this first phase, general information on high-volume waste co-management practices is being collected from a wide range of utilities. In Phase II, more detailed information will be collected from selected utilities.

INSTRUCTIONS

Please read and respond to all questions, unless otherwise specified. Many questions require a check mark (✓) to be placed next to the answer that best fits your response. Other questions require a brief written response in the space provided.

Definitions

Disposal facility - A facility used for final disposition of high-volume wastes. Does not include impoundments or other areas used to store ash prior to final disposal or utilization.

High-volume wastes - Any of the following four wastes: fly ash, bottom ash, boiler slag, and flue gas desulfurization (FGD) byproducts.

Co-managed wastes - Any waste that is not a high-volume waste and is managed in the same disposal facility with one or more high-volume wastes.

Please return the completed questionnaire as soon as possible, but no later than November 30, 1994. Fax or mail the completed form to:

Ken Ladwig
Science & Technology Management, Inc.
2511 North 124th Street
Brookfield, Wisconsin 53005-8208
Fax: 414/785-5950

A postage-paid return envelope is provided for your convenience.
Questions? Call Ken Ladwig at 414/785-5940.

Utility Name: ____

Disposal Facility Name:____

Disposal Facility Location (County, State):____

Disposal Facility Status: ( ) Active ( ) Closed ➔ Go to Question 19

WASTE TYPES AND VOLUMES

1. Which power plant(s) send their coal combustion wastes to this facility? Include unit numbers if not all the units from a power plant send their combustion waste to the facility.

____

____

2. What is the approximate annual volume of each high-volume combustion waste disposed at the facility, in cubic yards per year?

Fly ash .... ____________ cubic yards/year
Bottom ash .... ____________ cubic yards/year
Boiler slag .... ____________ cubic yards/year
FGD byproducts .... ____________ cubic yards/year

3. Are any of the combustion wastes disposed at the facility derived from the following technologies? (Check all that apply)

( ) Fluidized bed combustors
( ) Co-combustion of used oil with coal
( ) Co-combustion of contaminated soils or remediation wastes with coal
( ) Co-combustion of solid wastes with coal (e.g., paper, tires)
( ) Other______________________________________

4. Have any of the following wastes been co-managed with the high-volume combustion wastes at this facility? (Check all that apply)

( ) Demineralizer regenerant
( ) Boiler chemical cleaning wastes
( ) Coal pile runoff
( ) Other site runoff
( ) Boiler blowdown
( ) Coal mill rejects/pyrites
( ) Cooling tower blowdown
( ) Low pressure service water
( ) Non-contact cooling water
( ) Wastewater treatment sludge
( ) Contaminated soils
( ) Dredge soils
( ) Floor drains, sumps, etc.
( ) Air heater, precipitator washes
( ) Intake screen backwash
( ) Laboratory wastes
( ) Asbestos
( ) Miscellaneous plant wastes
( ) Water treatment wastes
( ) Municipal wastes
( ) Other_________________
( ) Other_________________
( ) Other_________________
( ) None

5. What is the approximate annual volume of <u>co-managed wastes</u> currently managed at the facility?

Solid wastes .... ____________ cubic yards/year
Liquid wastes .... ____________ million gallons/year

6. List any <u>co-managed wastes</u> that you have permanently stopped sending to this facility within the last three years.

____

7. If the disposal facility receives FGD byproducts, which of the following are used for makeup of FGD water? (Check all that apply)

( ) Recirculated pond water
( ) Air heater, precipitator washes
( ) Boiler chemical cleaning wastes
( ) Boiler blowdown
( ) Cooling tower blowdown
( ) Non-contact cooling water
( ) Water treatment discharge
( ) Demineralizer regenerant
( ) Coal pile runoff
( ) Miscellaneous plant runoff/water
( ) Low pressure service water
( ) River/lake water
( ) Other__________________
( ) Other__________________
( ) Other__________________
( ) No make-up water used

8. If ash is sluiced to the facility, which of the following are used for makeup of sluice water? (Check all that apply)

( ) Recirculated pond water
( ) Air heater, precipitator washes
( ) Boiler chemical cleaning wastes
( ) Boiler blowdown
( ) Cooling tower blowdown
( ) Non-contact cooling water
( ) Water treatment discharge
( ) Demineralizer regenerant
( ) Coal pile runoff
( ) Miscellaneous plant runoff/water
( ) Low pressure service water
( ) River/lake water
( ) Other__________________
( ) Other__________________
( ) Other__________________

FACILITY DESIGN AND OPERATION

9. What type of facility is this?

( ) Impoundment
( ) Landfill
( ) Minefill
( ) Other __________________

10. What is the total disposal capacity of the facility? ______________**cubic yards**

11. What year did this facility open? ______________

12. What year do you anticipate it will be closed? ______________

13. What is the area of the facility? ______________ **acres**

14. What type of liner does the site have? (Select one)

( ) None/natural soils
( ) Compacted ash
( ) Compacted clay
( ) Geosynthetic membrane
( ) Composite clay/membrane
( ) Double liner

15. Does the site have a leachate collection system? ( ) Yes ( ) No

REGULATORY PERMITS AND STANDARDS

16. Which of the following have issued a permit or license for this site?

( ) Local municipality
( ) Federal agency
( ) State agency
( ) No permit required
( ) Other_______________

17. Which of the following groundwater performance standards apply to this site?

( ) Nondegradation
( ) Numerical water quality standards
( ) Site-specific calculated limits
( ) None
( ) Other________________

18. Do you currently monitor groundwater at the facility? ( ) Yes ( ) No

FACILITY CLOSURE

19. What type of cap exists on closed portions of the site? (Check all that apply)

( ) None
( ) Uncompacted soil
( ) Compacted clay
( ) Geosynthetic membrane
( ) Composite clay/membrane
( ) Other_______________

20. For closed impoundments, how was ponded water removed prior to site closure?

____
____

IMPORTANT! Please provide the following information.
Name ____
Title ____
Phone Number ____

Thank you for taking the time to complete this form. EPRI greatly appreciates your participation in this study.

In the near future, a selected sample of participants in this study will have the opportunity to participate in a follow-up survey designed to collect more detailed information relative to co-management practices. Would you be interested in participating in the second phase of this research?( ) Yes ( ) No

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UTILITIES RECEIVING COMANAGEMENT

SURVEY FORM

AEP Generating Co.
Alabama Electric Cooperative, Inc.
Alabama Power Co.
Ames Municipal Electric System
Appalachian Power Co.
Arizona Electric Power Cooperative
Arizona Public Service Co.
Arkansas Electric Cooperative
Arkansas Power & Light Co.
Associated Electric Cooperative
Atlantic City Electric Co.
Austin Electric Department
Baltimore Gas & Electric Co.
Basin Electric Power Cooperative
Big Rivers Electric Corp.
Black Hills Power & Light Co.
Brazos Electric Power Cooperative
Buckeye Power Co.
Cajun Electric Power Cooperative
Carolina Power & Light Co.
Central Hudson Gas & Electric Corp.
Central Illinois Light Co.
Central Illinois Public Service Co.
Central Iowa Power Cooperative
Central Louisiana Electric Co., Inc
Central Power & Light Co.
Cincinnati Gas & Electric Co.
Cleveland Electric Illuminating Co.
Cleveland Public Power
Colorado Springs Dept. of Utilities
Columbus Southern Power Co.
Consumers Power Co.
Commonwealth Edison Co.
Cooperative Power Association
Corn Belt Power Coop.
Dairyland Power Cooperative
Dayton Power & Light Co.
Delmarva Power & Light Co.
Deseret Generation & Transmission
Detroit Edison Co.
Duke Power Co.
Duquesne Light Co.
East Kentucky Power Cooperative
Electric Energy, Inc.
Florida Power & Light Co.
Florida Power Corp.
Fremont Department of Utilities
Gainesville Regional Utilities
Georgia Power Co.
Grand Island Electric Dept.
Grand River Dam Authority
Gulf Power Co.
Gulf States Utilities Co.
Holyoke Water Power Co.
Hoosier Energy REC
Houston Lighting & Power Co.
Illinois Power Co.
Independence Power & Light Dept.
Indiana Michigan Power Co.
Indiana-Kentucky Electric Corp.
Indianapolis Power & Light Co.
Intermountain Power Agency

Interstate Power Co.
Iowa Electric Light & Power Co.
Iowa Southern Utilities Co.
Iowa-Illinois Gas & Electric Co.
Jacksonville Electric Authority
Jersey Central Power & Light
Kamo Electric Cooperative
Kansas City Board of Public Utilities
Kansas City Power & Light Co.
Kansas Gas & Electric Co.
Kansas Power & Light Co.
Kentucky Power Co.
Kentucky Utilities Co.
Lakeland Electric & Water Utilities
Lansing Board of Water & Light
Lincoln Electric System
Los Angeles Dept. of Water & Power
Louisville Gas & Electric Co.
Lower Colorado River Authority
Madison Gas & Electric Co.
Metropolitan Edison Co.
Midwest Power
Minnesota Power & Light Co.
Minnkota Power Cooperative, Inc.
Mississippi Power & Light
Mississippi Power Co.
Monongahela Power Co.
Montana Power Co.
Montana-Dakota Utilities Co.
Montaup Electric Co.
Municipal Electric Authority-Georgia
Muscatine Power & Water
Nebraska Public Power District
Nevada Power Co.
New England Power Co.
New York State Electric & Gas Corp.
Niagara Mohawk Power Corp.
Northern Indiana Public Service Co.
Northern States Power Co.
Oglethorpe Power Corp.
Ohio Edison Co.
Ohio Power Co.
Ohio Valley Electric Corp.
Oklahoma Gas & Electric Co.
Omaha Public Power District
Orange & Rockland Utilities, Inc.
Orlando Utilities Commission
Otter Tail Power Co.
Owensboro Municipal Utilities
Pacific Power & Light Co.
Pennsylvania Electric Co.
Pennsylvania Power & Light Co.
Philadelphia Electric Co.
Plains Electric G&T Cooperative
Platte River Power Authority
Portland General Electric Co.
Potomac Edison Co.
Potomac Electric Power Co.
PSI Energy, Inc.
Public Service Co. of Colorado
Public Service Co. of New Hampshire
Public Service Co. of Oklahoma
Public Service Electric & Gas Co.
Puget Sound Power & Light
Rochester Gas & Electric Corp.
Salt River Project
San Antonio City Public Service Board
San Miguel Electric Cooperative
Savannah Electric & Power Co.
Seminole Electric Cooperative
Sierra Pacific Power Co.
Sikeston Board of Municipal Utilities
South Carolina Electric & Gas Co.
South Carolina Public Service
South Mississippi Electric Power Assn.
South Texas Electric Coop.
Southern California Edison Co.
Southern Electric Generating Co.

Southern Illinois Power Cooperative
Southern Indiana Gas & Electric Co.
Southwestern Electric Power Co.
Southwestern Public Service Co.
Springfield City Utilities
Springfield City Water, Light & Power
Sunflower Electric Power Corp.
Tampa Electric Co.
Tennessee Valley Authority
Texas Municipal Power Agency
Texas Utilities Electric Co.
Texas-New Mexico Power Co.
Toledo Edison Co.
Tri-State Generating & Transmission Association
Tucson Electric Power Co.
Union Electric Co.
United Illuminating Co.
United Power Association
Virginia Electric & Power Co.
Washington Water Power Co.
West Penn Power Co.
West Texas Utilities Co.
Western Farmers Electric Cooperative
Wisconsin Electric Power Co.
Wisconsin Power & Light Co.
Wisconsin Public Service Corp.